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Remedial Investigation / Baseline Risk Assessment for the Lower Three Runs Integrator Operable Unit (U)

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SAVANNAH RIVER SITE • AIKEN, SOUTH CAROLINA

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EXECUTIVE SUMMARY

This Remedial Investigation/Baseline Risk Assessment (RI/BRA) has been developed for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) located at the Savannah River Site (SRS) in South Carolina (Figure ES-1). The SRS encompasses 803 square kilometers (km^2 [310 square miles {mi^2}]) of South Carolina coastal plain along the Savannah River in Aiken, Barnwell, and Allendale counties. The LTR IOU is one of six IOUs that correspond to the respective watersheds associated with the stream systems located on the SRS (Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs), and the Savannah River that establishes the northwestern boundary of the SRS. The SRS IOUs are defined as surface water bodies (e.g., stream, lakes, and ponds) and associated wetlands/floodplains, including surface water, sediment/soil (sediment and floodplain/wetland soils), and related biota. The LTR IOU is listed as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Unit in Appendix C, Resource Conservation and Recovery Act/CERCLA Units, of the SRS Federal Facility Agreement (FFA).

The LTR watershed is located in the southeastern portion of SRS. LTR is a large blackwater stream that originates in the northeast portion of SRS and follows a southerly direction for approximately (~) 40 kilometers (km [24.5 miles {mi}]), discharging into the Savannah River. The LTR watershed drains about 460 km^2 (180 mi^2) and includes two main industrial SRS operable units (OUs): P-Area Operable Unit (PAOU) including P-Reactor, and R-Area Operable Unit (RAOU) including R-Reactor. For administrative purposes, the LTR IOU is delineated into Upper, Middle, and Lower subunits. The Upper subunit is located upgradient of the PAR Pond Dam, while the Middle and Lower subunits are located below the PAR Pond Dam in an area referred to as the "tail portion" of the LTR IOU. The remedial action for the Middle and Lower subunits was previously addressed and documented in the *Explanation of Significant Differences (ESD) for the Revision 0 Interim Action Record of Decision Remedial Alternative Selection: PAR Pond Unit (U); Lower Three Runs Integrator Operable Unit Tail Portion Middle and Lower Subunit*s (Savannah River Nuclear Solution [SRNS] 2012a).

The Upper subunit is the subject of this RI/BRA. This document presents a summary of data collected for development of the RI/BRA, describes the nature and extent of the contaminants in affected media, provides an evaluation of the potential risk to human health and ecological receptors, and identifies remedial action objectives (RAOs) and remedial goal options (RGOs).

SRS IOU Program Phases

The SRS IOU program is implemented in three phases to support a final CERCLA Record of Decision (ROD) for the IOU. Phase I of the IOU program (i.e., RI Work Plan) consists of an assessment of existing data to determine if early actions are necessary and to define additional data needs. Phase II of the IOU program consists of ongoing sampling and assessment of the IOU and refinement of the conceptual site model (CSM). The status of the IOU during Phase II is documented through submittal of Periodic Reports. Four Periodic Reports were submitted for the LTR IOU. Phase II concludes when the OU investigations that may impact the specific IOU are complete. At that time, the entire IOU is addressed holistically in Phase III through an assessment of all available data, development of the RI/BRA, completion of the RI/Feasibility Study (FS) process through the ROD, and remedial actions, if warranted. The LTR IOU is the first SRS IOU to transition to Phase III of the IOU program.

Background

In 1953, R-Reactor began operations, followed by P-Reactor in 1954. Both P- and R-Reactors received cooling water from the Savannah River via the river water distribution system. Prior to construction of the PAR Pond canal system, thermal reactor effluent from R-Reactor was discharged directly into Joyce Branch (R-Area Old Discharge Canal), a tributary of LTR. P-Reactor initially discharged to Steel Creek. In 1958, PAR Pond was created by constructing an earthen dam across the widened LTR stream corridor, and the pre-cooler ponds/canal system was constructed. In 1963, P-Reactor began discharging into the LTR system via PAR Pond, which was built to augment the cooling water available to both P- and R-Reactors. Effluent from R-Reactor was routed through the R-Area Discharge Canal to pre-cooler ponds Pond A and Pond B, ultimately discharging into the North Arm of PAR Pond. This effluent pathway was used for R-Reactor from 1961 until the reactor was shut down in 1964. P-Reactor discharges flowed to

Pond 2, Ponds 4 and 5, and into PAR Pond via Pond C. Effluent discharges from P-Reactor ceased in 1987.

Liquid releases to the PAR Pond canal system included process leaks, reactor disassembly basin purges, thermal discharges, and makeup cooling water that contained low levels of metals and radionuclides, primarily cesium-137 (Cs-137), but also cobalt-60 (Co-60) and plutonium isotopes in much smaller quantities. In 1991, the water level in PAR Pond was reduced to allow for dam repair, exposing Cs-137 contaminated sediments at the pond's edge. In 1995, the Department of Energy (USDOE) issued an Interim ROD (IROD) that selected refilling PAR Pond and maintaining the water level at a minimum of 59.4 meters (m [195-feet {ft}]) as an interim action to cover and shield the contaminated sediments (WSRC 1995). The IROD recognized that subsequent remedial actions would likely need to be performed for other components of the watershed and stream, including the series of pre-cooler ponds and canals.

Remedial Investigation

The initial RI Work Plan for the LTR IOU (WSRC 2002) documented the compilation of existing data for the LTR IOU (including sediment, sediment/soil, surface water, and biota [fish]) from various sampling and monitoring efforts conducted by various data stewards. The data are maintained in the LTR IOU database. The Work Plan and subsequent Periodic Reports (1, 2, 3, and 4) provided data that contributed to the IOU database and documented the status of the IOU through ongoing evaluation of human health and ecological risk and refinement of the CSM.

Although the LTR IOU database contained a vast amount of historical data, an extensive characterization of the LTR IOU (i.e., canals, ponds, and stream/floodplains) sediment/soil, surface water, and fish was undertaken in 2009/2010 to supplement the historical information in support of RI/BRA development. The 2009/2010 characterization was completed per the approved *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2010a). The characterization identified Cs-137 as the principal contaminant throughout the LTR system. For the Middle and Lower subunits (tail portion), the characterization identified areas that resulted in an unacceptable cancer risk (1E-04 or greater) to the adolescent trespasser, who was identified as the most likely human receptor for the tail portion. Following a Time

Critical Removal Action in 2012 involving excavation of Cs-137 contaminated soil/sediments in the tail portion, land use controls to install additional fencing and signage near the major road crossing and utility easements along the tail portion was selected as the remedial action for the Middle and Lower subunits (SRNS 2012a). The remedial decision for the Middle and Lower subunits will be documented in the final ROD for the LTR IOU.

As discussed in more detail in Chapter 1, RI/FS investigations are complete and final cleanup actions have been implemented for potential sources of contamination to the LTR IOU (as identified in the FFA). P-Area and R-Area are the two major industrial areas associated with the LTR IOU. Final RODs were issued for the PAOU and the RAOU in 2010 and 2011, respectively. In 2016, it was determined that additional data were needed to address data gaps in surface water and sediment in PAR Pond. The additional characterization of PAR Pond sediment and surface water was completed per the *Addendum to the Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2016a).

In support of RI/BRA development, the LTR IOU Core Team, consisting of representatives from the United States Environmental Protection Agency, South Carolina Department of Health and Environmental Control, and the USDOE – Savannah River, agreed to a strategy to segregate the LTR IOU into nine exposure areas (EAs). EAs represent geographically distinct locations within the Upper subunit of the LTR IOU, each of which contains environmental media to which a receptor may be exposed. This approach allows for remedial decisions to be made on a smaller scale within the larger LTR IOU area. The EAs are the following:

- EA 1: Pond A and the R-Reactor Area Discharge Canal,
- EA 2: Canal from Pond A to Pond B,
- EA 3: Pond B and the emergency release canal connecting Pond B to Pond C,
- EA 4: Canal from Pond B to the North Arm of PAR Pond,
- EA 5: Joyce Branch (Old R-Area Discharge Canal),
- EA 6: PAR Pond,

- EA 7: Pond 2 and the canal from P-Area to Pond 4,
- EA 8: Ponds 4 and 5 and the canal to Pond C, and
- EA 9: Pond C.

The data used to develop the RI/BRA consist of historical data from the LTR IOU database, data collected during the 2009/2010 characterization efforts, and data from the 2016 PAR Pond characterization. Data packages were developed for each EA and included an assessment of the historical and supplemental data for usability in the RI/BRA. A pedigree level (high, medium, or low) was assigned to each EA dataset based on review of available quality assessment/quality control related documentation, data summary reports, or publications indicating adequate peer review. The Core Team reached agreement that only high- and medium-level data are appropriate to use in the final dataset for the RI/BRA.

The Core Team agreed that an "onsite worker" was the most likely human receptor for the Upper subunit. The onsite worker is based on an SRS researcher scenario and is also protective of the adolescent trespasser previously evaluated for the Middle and Lower subunits of the LTR IOU. Because it is known that some contaminants could bio-accumulate in fish, and fish are a mobile media, the evaluation of human exposure also includes a recreational fisherman scenario.

Nature and Extent

Previous characterization efforts have revealed Cs-137 is the principal contaminant in the LTR system. Other radionuclides (i.e., Co-60) are also present to a lesser extent. In fish tissue, Cs-137 and mercury were identified as the primary contaminants. All detected constituents are summarized in Appendix A by media.

Risk Assessment

The data for each EA were used to evaluate the risk to human receptors (principally the onsite worker), potential ecological threats, and whether principal threat source material (PTSM) is present. Table ES-1 summarizes the results of these evaluations and identifies the refined constituents of concern (RCOCs) for each subunit that requires remedial action consideration. The Human Health Risk Assessment is presented in Appendix B of this document. Human health

RCOCs were identified in the sediment/soil medium (Cs-137, Co-60), and for the fish medium (Cs-137 and mercury); no RCOCs were identified for the surface water medium. From an ecological perspective, the data associated with each EA are quantitatively evaluated in the ecological risk assessment in Appendix C. No ecological RCOCs were identified for either the sediment/soil or surface water medium.

The characterization and risk evaluations for each EA confirm that contamination in the LTR IOU system is relatively homogeneous.

- Cs-137 was identified as an RCOC for the onsite worker in sediment/soil media in all nine EAs.
- Co-60 was identified as an RCOC for the onsite worker in sediment/soil media in EA 1, EA 5, EA 6, EA 7, and EA 9.
- Cs-137 and mercury were identified as RCOCs for fish tissue in all nine EAs (based on biota [fish] data from EA 3, EA 6, EA 8, and EA 9).

No PTSM RCOCs are identified for any EA within the LTR IOU. However, EA 1, EA 3, and EA 5 had specific locations where Cs-137 levels were above the PTSM threshold. These locations with higher Cs-137 activity concentrations will be re-evaluated in the FS phase of the project to ensure that a full range of alternatives is considered in the remedy selection process.

Remedial Action Objectives

RAOs are media-specific or site-specific objectives for protection of human health and the environment. RAOs usually specify the RCOCs for the potential receptors, media of concern, and exposure pathways. RAOs developed for the LTR IOU RI/BRA are discussed in more detail in Chapter 4 and summarized below:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceed the 1E-06 risk threshold or background levels, and
- Protect the recreational fisherman from exposure to contaminated fish.

Remedial Goal Options

RGOs serve to provide a range of cleanup goals for each RCOC and are typically identified along with the RAO statements. Following public comment and approval of the Proposed Plan, the RGOs for the selected remedy are documented as final cleanup goals or remedial goals in the ROD. For the LTR IOU RI/BRA, human health RGOs were developed for the onsite worker (sediment/soil media) and the recreational fisherman (fish tissue media). The risk-based RGOs correspond to a risk of 1E-06 for carcinogens (i.e., Cs-137 and Co-60) and a hazard quotient of 1 for noncarcinogens (i.e., mercury). The most likely RGOs presented are the starting point for developing remedial alternatives. The RGOs are discussed in more detail in Chapter 4 and summarized below in Table ES-2.

Media requiring remediation will be monitored to determine when the remedial action is complete (i.e., that the RG has been attained).

Implementation Schedule

The key deliverables and submittal dates for the LTR IOU project are shown below.

Deliverable	Submittal Date
Submit Rev.0 RI/BRA	July 3, 2017
Submit Rev.0 Feasibility Study	April 5, 2018
Submit Rev. 0 Proposed Plan	November 30, 2018
Submit Rev. 0 Record of Decision	July 22, 2019
Issuance of the Record of Decision	March 31, 2020
Remedial Action Start	May 27, 2021

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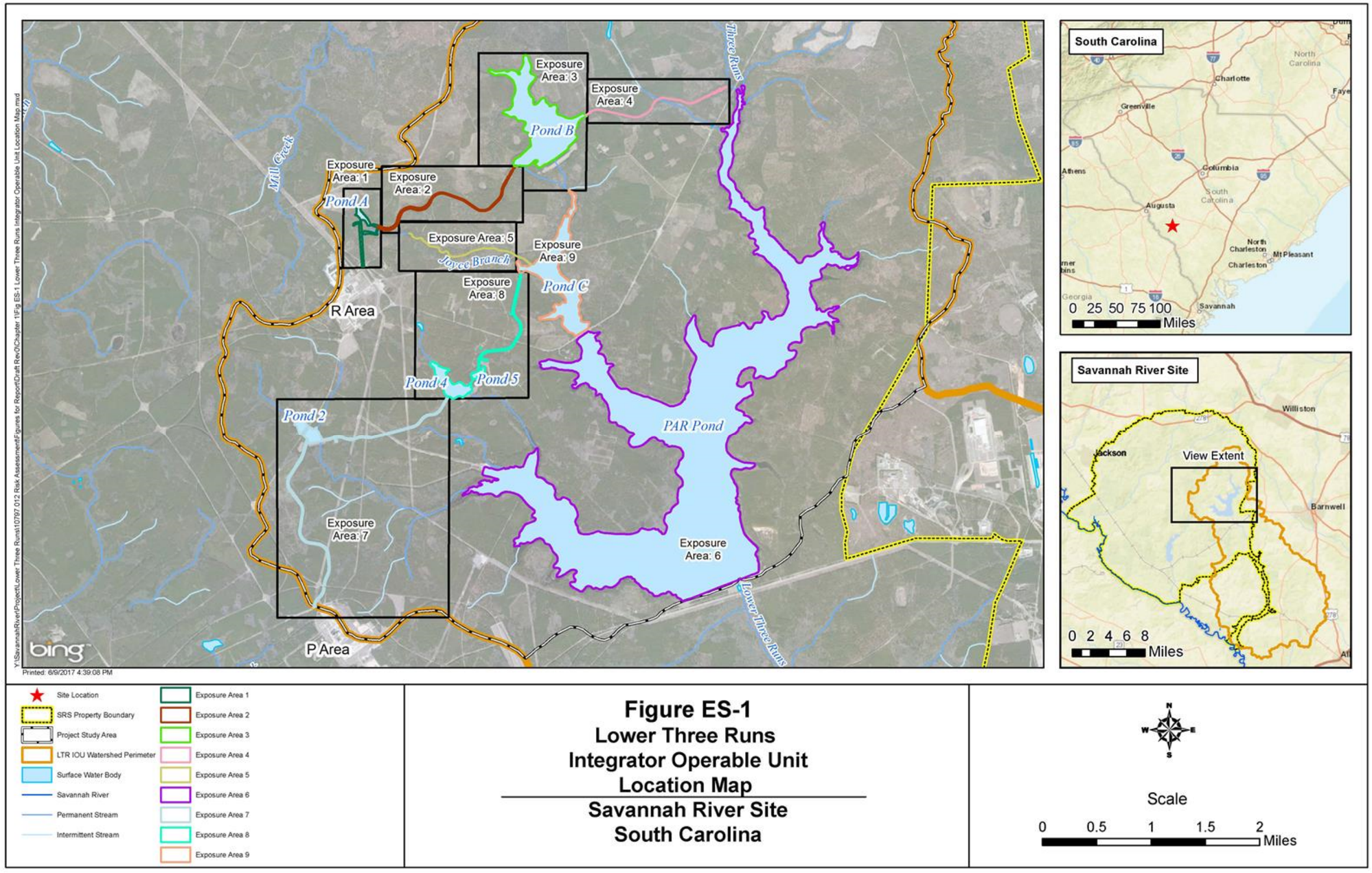


Figure ES-1. Lower Three Runs Integrator Operable Unit Location Map

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Table ES-1. LTR IOU Risk Summary

Upper Exposure Area	Human Health Onsite Worker RCOCs	Human Health Recreational Fisherman RCOCs
1. Pond A – Including R Discharge Canal	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 8.2E-04 (Decayed = 6.4E-04) Co-60 = 1.7E-06 (Decayed: 3.8E-07) Total Cumulative Risk (TCR) = 8.2E-04 (Decayed = 6.4E-04)	Fish Tissue Not sampled: Assume Cs-137 and mercury (from EAs 3, 6, 8, 9)
2. Canal from Pond A to Pond B	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 2.7E-04 Decayed = 2.3E-04	Fish Tissue Not sampled: Assume Cs-137 and mercury (from EAs 3, 6, 8, 9)
3. Pond B	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 5.5E-04 (Decayed = 3.3E-04)	Fish Tissue Cs-137(+D) Mercury
4. Canal from Pond B to North Arm of PAR Pond	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 1.0E-04 (Decayed = 8.8E-05)	Fish Tissue Not sampled: Assume Cs-137 and mercury (from EAs 3, 6, 8, 9)
5. Joyce Branch (Old Discharge Canal)	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 1.3E-03 (Decayed = 9.4E-04) Co-60 = 9.1E-06 (Decayed = 1.7E-06) TCR = 1.3E-03 (Decayed = 9.4E-04)	Fish Tissue Not sampled: Assume Cs-137 and mercury (from EAs 3, 6, 8, 9)
6. PAR Pond	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 4.9E-05 (Decayed = 2.9E-05) Co-60 = 1.2E-06 (Decayed: 7.2E-08) TCR = 5.0E-05 (Decayed = 2.9E-05)	Fish Tissue Cs-137(+D) Mercury
7. Canal from P-Area to Ponds 4 and 5 – Including Pond 2	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 7.7E-04 (Decayed= 4.5E-04) Co-60 = 9.6E-06 (Decayed: 1.0E-06) TCR = 7.8E-04 (Decayed = 4.5E-04)	Fish Tissue Not sampled: Assume Cs-137 and mercury (from EAs 3, 6, 8, 9)
8. Ponds 4 and 5 – Including Canal from Ponds 4 and 5 to Pond C	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 2.8E-04 (Decayed = 1.9E-04)	Fish Tissue Cs-137(+D) Mercury
9. Pond C	Sediment /Soil (0 to 1 ft) Cs-137(+D) = 1.2E-04 (Decayed = 6.7E-05) Co-60 = 1.4E-06 (Decayed = 9.6E-08) TCR = 1.2E-04 (Decayed = 6.7E-05)	Fish Tissue Cs-137(+D) Mercury

Table ES-2. Risk-Based RGOs for the Onsite Worker

Media	RCOC	Units	Onsite Worker	Recreational Fisherman	SRS BKGRD 95th %tile	2X SRS BKGRD 95th %tile	SRS BKGRD Max	IOU BKGRD Max	Most Likely RGO
Sediment/ Soil	Cesium-137 (+D) Cobalt-60	pCi/g pCi/g	0.18 *0.0832*	NA NA	0.34 NA	*0.68* NA	3.3 NA	0.623 0.011	0.68 0.0832
Fish Tissue	Cesium-137 (+D) Mercury	pCi/g mg/kg	NA NA	*0.0544* *0.154*	NA NA	NA NA	NA NA	0.488 0.24	0.0544 0.154

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LIST OF ABBREVIATIONS AND ACRONYMS

~	approximately
>	greater than
≥	greater than or equal to
<	less than
ac	acre
ARAR	applicable, relevant and appropriate requirement
ATC	Atmospheric Technologies Center
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BCF	bioconcentration factor
BRA	Baseline Risk Assessment
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSM	Conceptual Site Model
DMS	data management system
EA	Exposure Area
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESD	Explanation of Significant Difference
ESV	ecological screening value
°F	degrees Fahrenheit
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
ft^3	cubic feet
GIS	Geographical Information System
ha	hectare
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IOU	Integrator Operable Unit
IROD	Interim Record of Decision
km	kilometer
km^2	square kilometers
LTR	Lower Three Runs
LUC	land use control

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued)*

m	meter
m^2	square meters
m^3	cubic meters
MCL	maximum contaminant level
mi	mile
mi^2	square miles
mph	miles per hour
mps	meters per second
msl	mean sea level
ND	not detected
NPDES	National Pollutant Discharge Elimination System
NRIE	Natural Resource Injury Evaluation
OPA	Oil Pollution Act
OU	operable unit
PAOU	P-Area Operable Unit
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PP	Proposed Plan
PRG	Preliminary Remediation Goal
PTSM	Principal Threat Source Material
QA/QC	quality assurance/quality control
RAO	remedial action objective
RAOU	R-Area Operable Unit
RCOC	refined constituent of concern
RCOPC	refined constituent of potential concern
RCRA	Resource Conservation and Recovery Act
RCW	red-cockaded woodpecker
RG	remedial goal
RGO	remedial goal option
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSER	Removal Site Evaluation Report
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SCDNR	South Carolina Department of Natural Resources
SCDHEC	South Carolina Department of Health and Environmental Control
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
SRTC	Savannah River Technology Center
SVOA	semi-volatile organic analyte
SVOC	semi-volatile organic compound

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

TAL	target analyte list
TBC	to be considered
TCL	target compound list
TCR	total cumulative risk
TES	Threatened, Endangered and Sensitive (species)
TL	threshold level
TOC	total organic carbon
UCL	upper confidence limit
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USFS-SR	USDA Forest Service – Savannah River
USGS	United States Geological Survey
VOA	volatile organic analyte
VOC	volatile organic compound
WMA	Wildlife Management Area
WSRC	Washington Savannah River Company (post October 2005)
WSRC	Westinghouse Savannah River Company (before October 2005)
XRF	x-ray fluorescence
yd^2	square yards
yd^3	cubic yards

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1.0 INTRODUCTION

This Remedial Investigation/Baseline Risk Assessment (RI/BRA) has been prepared for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) located at the Savannah River Site (SRS – the "Site") in South Carolina (Figure ES-1 in the Executive Summary). The primary goal of the LTR IOU RI/BRA is to provide sufficient information to support a Proposed Plan (PP) and a Record of Decision (ROD) for selection of a final remedy for the LTR IOU. The requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) constitute the applicable regulatory framework for this document. The format and content of this document have been developed to accommodate the IOU process in accordance with decisions made by Core Team (i.e., representatives from the United States Environmental Protection Agency [USEPA], South Carolina Department of Health and Environmental Control [SCDHEC], and the United States Department of Energy [USDOE] – Savannah River).

1.1 Purpose and Organization of Report

SRS manages and monitors six IOUs that correspond to the surface water bodies (e.g., streams and lakes) and associated wetlands, including surface water, sediment/soil, and related biota associated with the major watersheds on the site. The IOUs include the Savannah River and Floodplain Swamp, Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. The term "Integrator Operable Unit" is used to indicate that these surface water bodies and associated wetlands could receive contamination from multiple potential sources, including Resource Conservation and Recovery Act (RCRA)/CERCLA operable units (OUs), Site Evaluation Areas, National Pollutant Discharge Elimination System (NPDES) outfalls, and operational facilities. SRS manages and monitors the IOUs because they represent a possible pathway for the release of contamination from SRS activities to off-SRS receptors and the environment.

The primary objectives of the SRS IOU program are to:

- Assess risk to potential human and ecological receptors from IOU contamination exposure;
- Evaluate the impact of inactive and active waste units and operating facilities on the IOU;

- Determine if IOU early actions, including reprioritization of operable unit (OU) implementation schedules, are necessary;
- Propose and implement early actions as required; and
- Complete the Remedial Investigation/Feasibility Study (RI/FS) process by defining the nature and extent of contamination, remedial action objectives (RAOs), and final remedial actions if necessary.

The SRS IOU program is implemented in three phases to support a final CERCLA ROD for the IOU (Figure 1-1). Phase I of the IOU program consists of an assessment of all existing data to determine if early actions are necessary and to define additional data needs. Phase II of the IOU program consists of ongoing sampling and assessment of the IOU and refinement of the conceptual site model (CSM), continuing in parallel with the OU investigations within the watershed. The status of the IOU during Phase II is documented through submittal of periodic reports to the USEPA and SCDHEC for review and approval. Information in these periodic reports includes new media data, wildlife surveys, OU sampling as it impacts the IOU, newly identified OUs, early actions status and evaluation, a refined CSM, data needs evaluation, and benchmark evaluation to assess contaminant threat to human health and ecological receptors. If additional data are needed, a final Sampling and Analysis Plan (SAP) will be proposed in the final periodic report. Phase II concludes when the OU investigations that may impact the specific IOU are complete. At that time, the entire IOU is addressed holistically in Phase III for final cleanup decision making. Phase III includes an assessment of all available data, development of the RI/BRA, completion of the RI/FS process through the ROD, and remedial actions, if warranted.

The LTR IOU is the first SRS IOU to transition to Phase III of the IOU program. This RI/BRA Report has been developed to support final remedial action determinations for the LTR IOU. It includes a summary of data collected to characterize LTR IOU conditions, describes the nature and extent of the contaminants in affected media, provides an evaluation of the potential risk to human health and ecological receptors, and identifies remedial goal options (RGOs).

Supporting information includes data tables (Appendix A), human health risk assessment (HHRA) (Appendix B), ecological risk assessment (Appendix C), principal threat source material (PTSM)

evaluation (Appendix D), RGO calculations (Appendix E), and Natural Resource Injury Evaluation (NRIE) Checklist (Appendix F). Appendices A through F support the conclusions presented in the RI/BRA.

1.2 SRS Background

In 1950, the U.S. Government required property to build a nuclear facility in South Carolina to produce the basic materials used in the fabrication of nuclear weapons. At that time, the upland areas of the LTR IOU predominantly supported an agrarian community with sufficient stream corridors to provide needed water resources. In 1951, SRS was closed to the public. The U.S. Department of Agriculture Forest Service began a reforestation program converting agricultural land to forests, and the University of Georgia, University of South Carolina, and the Philadelphia Academy of Sciences began ecological baseline studies. The University of Georgia would eventually establish the Savannah River Ecology Laboratory that is present at the SRS today. SRS comprises an area of approximately (~) 803 square kilometers (km^2, 310 square miles [mi^2]. The Site is located in Aiken, Barnwell, and Allendale counties, ~32-kilometers (km [20-miles {mi}]) south of Aiken, South Carolina (Figure ES-1).

USDOE owns SRS, and Savannah River Nuclear Solutions, LLC (SRNS) provides management and operating services. Since its creation in 1951, SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. SRS has also provided nuclear materials for the space program and for medical, industrial, and research efforts. Chemical and radioactive wastes are byproducts of the nuclear material production processes. Hazardous substances, as defined by CERCLA, and hazardous waste, as defined by RCRA (40 Code of Federal Regulations [CFR] 261.20), are present in the environment at SRS.

On December 21, 1989, SRS was placed on the CERCLA National Priorities List. In accordance with Section 120 of CERCLA, USDOE has entered into a Federal Facility Agreement (FFA) with SCDHEC and USEPA to coordinate cleanup activities at SRS under one comprehensive strategy that fulfills RCRA and CERCLA assessment, investigation, and response action requirements. The LTR IOU is listed as a CERCLA unit in Appendix C of the FFA (1993).

1.3 Description of LTR IOU

The LTR watershed is located in the southeastern portion of SRS. The LTR stream is a large blackwater stream that originates in the northeast portion of SRS and follows a southerly direction for ~40 km (24.5 mi). LTR is one of the five major streams on SRS that flow into the Savannah River. LTR has an annual average discharge of 1.8 cubic meters (m^3)/sec (64 cubic feet [ft^3]/sec). The LTR watershed drains ~460 km^2 (180 mi^2) and includes two main industrial SRS OUs: P-Area Operable Unit (PAOU), including P-Reactor (105-P), and R-Area Operable Unit (RAOU), including R-Reactor (105-R).

The LTR IOU includes a broad range of habitats and a large number of plant and animal species, including numerous threatened, endangered, and sensitive (TES) species. Chapter 2 provides a detailed discussion of the biota in the LTR IOU.

The LTR IOU is defined by the surface water bodies and associated wetlands located in the LTR watershed. For administrative purposes, the LTR IOU is further delineated into the Upper subunit located above the PAR Pond dam, and the Middle and Lower subunits located below the dam. The Upper subunit is the subject of this RI/BRA.

1.3.1 LTR IOU Upper Subunit (above PAR Pond Dam)

The Upper subunit, located above the PAR Pond dam, contains a 1,068-hectare (2,640-acre) mainstream impoundment (PAR Pond) along with several smaller ponds (pre-cooler ponds) and canal systems, including P-Area Discharge Canal and the Old R-Area Discharge Canal (Joyce Branch) (Figure 1-2). PAR Pond was created in 1958 to address the cooling water requirements of both P- and R- Reactors. A 1951 aerial photograph of LTR IOU Upper subunit prior to SRS industrial activity is depicted on Figure 1-3.

R-Reactor began operations in 1953, and was followed by P-Reactor in 1954. Both received cooling water from the Savannah River via the river water distribution system. Prior to construction of the PAR Pond canal system, R-Reactor discharged reactor effluent, known as "thermal discharges," directly into Joyce Branch. P-Reactor discharged reactor effluent directly into Steel Creek. In 1958, PAR Pond was created by constructing an earthen dam across the LTR creek, and the pre-cooler ponds and canal system were constructed. The three main arms of the

reservoir follow the uppermost portion of LTR and its tributaries. Effluent from R-Reactor was routed to the R Canal and pre-cooler Pond B to the north arm of PAR Pond (Figure 1-4). This effluent pathway was used for R-Reactor discharge from 1961 until the reactor was shut down in 1964. Since the shutdown of R-Reactor, R Canal and Pond B have remained essentially undisturbed.

PAR Pond also served as a heat exchange/cooling reservoir for P-Reactor until 1988. Heated water was released through a series of man-made canals and smaller impoundments into the pre-cooler Pond C and released into an area known as the "hot arm" of PAR Pond. Effluent discharges from P-Reactor ceased in 1987. As with the R Canal system, since the shutdown of P-Reactor, the associated canal system and pre-cooler ponds have remained essentially undisturbed.

Liquid releases before and after the construction of PAR Pond and the pre-cooler and canal system included process leaks, reactor disassembly basin purges, and thermal discharges that contained tritium, metallic contaminants, and other radiological contaminants. Radiological contaminants, primarily cesium-137 (Cs-137), present in the pre-cooler ponds and PAR Pond were sorbed onto the sediments. Extensive characterization from 2006 through 2014 of LTR IOU soils, floodplain sediment, surface water, and biota (primarily fish tissue) confirmed that contamination is present in PAR Pond and the canal system that could result in a risk to human and ecological receptors.

The section of LTR above the north arm of PAR Pond is hydrologically upgradient of PAR Pond (Figure 1-4), and there is no process history in this portion of the watershed that would indicate a potential for release of contaminants to the environment.

1.3.2 LTR IOU Middle and Lower Subunits (below PAR Pond Dam)

From the PAR Pond dam, LTR flows ~30 km (19 mi), braiding through bottomland/floodplain forests before it enters the Savannah River. The Upper and Middle subunits of the LTR IOU are well within SRS property. The Middle subunit begins below the PAR Pond dam. The Lower subunit begins further downstream where the southern SRS boundary begins to follow the LTR stream corridor (Figure 1-5). Approximately 8.0-km (5 mi) downstream from the PAR Pond dam, beginning at the Patterson Mill Road crossing, the SRS boundary narrows providing a limited buffer of the USDOE property for the LTR stream and associated floodplain. This area is referred

to as the "tail portion" of the LTR IOU. The Lower subunit includes the tail portion of the LTR IOU. The DOE-owned tail portion consists of an ~0.20- to 0.40-km (0.125- to 0.25-mi) wide area on each side of the LTR stream channel. The narrow tail portion is bounded on both sides by private property, some of which includes residential parcels. There are four public road crossings, two power line crossings, and a railroad crossing along the tail portion.

The Chem-Nuclear Site (owned/operated by Energy Solutions), a low-level radioactive waste disposal facility located in Barnwell County, has a groundwater plume of tritium and various volatile organic compound plumes discharging into the upper reaches of Mary's Branch (Figure 1-5). The Chem-Nuclear Site operates under a Radioactive Materials License issued by the Infectious and Radioactive Waste Management Section of SCDHEC's Bureau of Land and Waste Management. Mary's Branch, located in the Middle subunit, is a tributary of LTR, which originates off-site and enters LTR ~3.2-km (2-mi) downstream of PAR Pond dam. SRS's annual environmental report monitoring program conducts periodic sampling of surface water in Mary's Branch and in LTR downgradient of Mary's Branch. Land use controls (LUCs) (i.e., perimeter fence and signage) are in place to control and restrict public and trespasser access to USDOE-owned property along LTR.

Starmet CMI (formally Carolina Metals) is a depleted uranium processing facility also located in Barnwell County in the LTR watershed (Figure 1-5). The Starmet facility is located in the Lower subunit (Figure 1-5) between Gantts Mill Creek and Bodiford Mill Creek, tributaries of LTR. SCDHEC issued an Emergency Administrative Order on June 24, 2002, based on numerous violations of the facility's Atomic Energy and Radiation Control Act license (issued by SCDHEC) and SCDHEC regulations. This order required the facility to cease operations. In 2004, the USEPA led a multiparty Administrative Order on Consent with the U.S. Enrichment Corporation, the USDOE, and the Department of the Army to complete a Time Critical Removal Action at the Starmet facility, including treatment of uranium contaminated wastewater, closure of ponds, treatment and stabilization of metal shavings, and packaging/transport/disposal of drums and debris.

Migration of particulates downstream of the LTR IOU Upper subunit pond systems has resulted in deposition of contaminated sediments in the Middle and Lower subunits. Consistent with the

Upper subunit, Cs-137 contamination is present in the Middle and Lower subunits at levels that could result in a risk to human receptors. Following a Time Critical Removal Action in 2012 in the Middle and Lower Subunits involving excavation of Cs-137 contaminated soil/sediments, LUCs (to install additional fencing and signage near the major road crossing and utility easements along the LTR tail portion) were selected as the remedial action for the Middle and Lower subunits and documented in an Explanation of Significant Difference (ESD) (SRNS 2012a) to the 1995 PAR Pond Interim Record of Decision (IROD) (WSRC 1995). The final remedial decision for the Middle and Lower subunits will be documented in the final ROD for the LTR IOU.

1.3.3 LTR IOU Regulatory Background

The regulatory activities pertinent to the LTR IOU are summarized below:

- PAR Pond was listed in the SRS FFA as a CERCLA waste unit due to Cs-137 contaminated sediment media. In 1991, the water level in PAR Pond was reduced to allow for dam repair, exposing large areas of the contaminated sediments at the reservoir's edge. In 1995, the USDOE issued an IROD (WSRC 1995) that selected refilling PAR Pond and maintaining the water level at a minimum of 59.4 meters (m [195-feet]) as an interim action to cover and shield the contaminated sediments. The IROD recognized that subsequent remedial actions would likely need to be performed for other components of the watershed, including the series of pre-cooler ponds and canals and the LTR stream system.

- In September 2004, the USDOE prepared the *Lower Three Runs IOU Early Action Fact Sheet* to document a response action along the Middle and Lower subunits to protect SRS workers and unintentional trespassers from exposure to Cs-137 contaminated floodplain sediment and soils using warning signs and fences (WSRC 2004a). The Fact Sheet was made available for public review and comment, and the removal action began in December 2004. On February 6, 2007, SCDHEC issued a Government Performance and Results Act Human Exposure Environmental Indicator letter (SCDHEC 2007) indicating that human exposure was not under control unless additional actions were taken along the LTR tail portion of the LTR IOU. In response, USDOE conducted an early action to post additional signs and document inspections along the LTR tail portion. Additionally, the USDOE notified (by letter) landowners with

property adjacent to USDOE property in the tail portion of the LTR IOU about trespassing on USDOE property. The correspondence to the property owners reiterated that Cs-137 contamination is present in stream and floodplain sediments and informed property owners of increased patrols by SRS law enforcement.

- In 2009 and 2010, an extensive characterization of the LTR IOU (i.e., canals, pre-cooler ponds, and stream channel/floodplains sediment/soil and surface water) was undertaken as part of the American Recovery and Reinvestment Act and documented in a SAP (SRNS 2009a). The characterization identified Cs-137 levels in the LTR IOU tail portion that resulted in an unacceptable cancer risk of 1×10^{-4} or greater to the adolescent trespasser (identified as the most likely human receptor for the tail portion). Because the Cs-137 contaminated sediment/soil was present at levels that pose an unacceptable future risk to adolescent trespassers, a Time-Critical Removal Action in the Middle and Lower subunits was performed. Excavation of contaminated soil/sediment in three hot spot locations was documented in the *Removal Site Evaluation Report (RSER) for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) Tail Portion (Middle and Lower Subunits) (U)* (SRNS 2012b) followed by an Action Memorandum.

- An ESD (SRNS 2012a) to the 1995 PAR Pond IROD (WSRC 1995) was issued in 2012 that documented LUCs as the remedial action for the Middle and Lower subunits of the LTR IOU. The remedial action included the installation of additional fencing and signage near the major road crossing and utility easements along the tail section. The *Early Action Land Use Control Implementation Plan (EALUCIP) for the Lower Three Runs Integrator Operable Unit Tail Portion (Middle and Lower Subunits) Early Action* (SRNS 2013a) was approved in 2013. The Core Team agreed that no additional remedial action for the Middle and Lower subunits is required.

- As previously stated, the SRS IOU program is implemented in three phases. In 2002, the *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (WSRC 2002) documented completion of Phase I for the LTR IOU and the LTR IOU entered Phase II. The status of Phase II activities for the LTR IOU was documented with the submittal of four Periodic Reports, including *Periodic Report 1 for the Lower Three Runs Integrator*

Operable Unit (U) (WSRC 2004b), Periodic Report 2 (WSRC 2007a), Periodic Report 3 (SRNS 2009b), and Periodic Report 4 (SRNS 2012c). Following completion of Periodic Report 4, the Core Team agreed to initiate Phase III for the LTR IOU.

Table 1-1 provides the CERCLA RI/FS completion status of all potential sources of contamination to the LTR IOU, as identified in the FFA (1993). P Area and R Area are the two major industrial areas associated with the LTR IOU. Final RODs were issued for the PAOU and the RAOU in 2010 and 2011, respectively.

1.4 Land Use

Current land use in the LTR IOU is mixed. Industrial areas, including PAOU and RAOU, cover less than 10% of the SRS portion of the LTR watershed (including PAOU and RAOU). The remainder of the watershed consists of managed forests, wetlands/floodplain habitats, and surface water impoundments and is no longer used for industrial purposes. The LTR IOU Upper subunit (including ponds and canals) and the Middle subunit (below PAR Pond dam) are well within the SRS property boundary. The Lower subunit includes a strip of USDOE property on both sides of the stream (tail portion) and is bounded on both sides by private property, some of which includes residential parcels (Figure 1-5). The USDOE-owned tail is ~0.20- to 0.40 km (0.125- to 0.25-mi) wide. There are four public road crossings, two power line crossings, and a railroad crossing along the tail portion of LTR. Previous remedial decisions for the Middle and Lower subunits of the LTR IOU were based on an adolescent trespasser exposure scenario.

For purposes of the Phase III risk assessment associated with the Upper subunit, the Core Team agreed that an "IOU onsite worker" was the most likely human receptor. The IOU onsite worker is based on an SRS researcher scenario and is also protective of the adolescent trespasser. This receptor was most recently evaluated in the BRA for the Wetland Area at Dunbarton Bay in Support of Steel Creek IOU (SRNS 2013b). Because it is known that some contaminants could bio-accumulate in fish, and fish are a mobile medium, the evaluation of human exposure in Appendix B also includes a recreational fisherman scenario.

1.5 Natural Resource Trustees Injury Evaluation

The potential for natural resource injuries is documented by completing the NRIE Checklist (Appendix F). The purpose of the NRIE Checklist is to identify potential natural resource injuries associated with CERCLA remedial activities. If potential injuries are identified, consideration is given as to whether trustee involvement is needed. The checklist is a starting point in potential injury identification and is not intended to be all-inclusive. The checklist has been designed as a series of questions to help identify the potential for natural resource injuries and what resources may be affected. It is based on the pre-assessment screen in 43 CFR 11.13.

The USDOE, as a trustee of its land, is responsible for identifying resources of concern. SRS integrates the Natural Resource Damage Assessment and RI/FS processes (USEPA 1992) to assess threats to natural resources during the remedial process. Trustees are consulted early in the scoping process so they can provide input for decisions regarding natural resources. The intent is to prevent potential injuries to natural resources that can occur as the result of remediation activities and to mitigate, to the extent practical, any injuries that have already occurred. The list of Trustees for the SRS is included in Table 1-2.

Refined constituents of concern (RCOCs) have been identified in the LTR IOU. Based on the NRIE Checklist (Appendix F), natural resources have been impacted by hazardous substances from the LTR IOU. Remedial alternatives may or may not address injuries to the natural resources and could cause additional injury based on the scope of the action (e.g., excavation within or adjacent to impacted surface water features). No irreversible or irretrievable resource losses are known to exist. The impact to natural resources will be considered during the remedial alternative evaluation and documented in the FS for the LTR IOU.

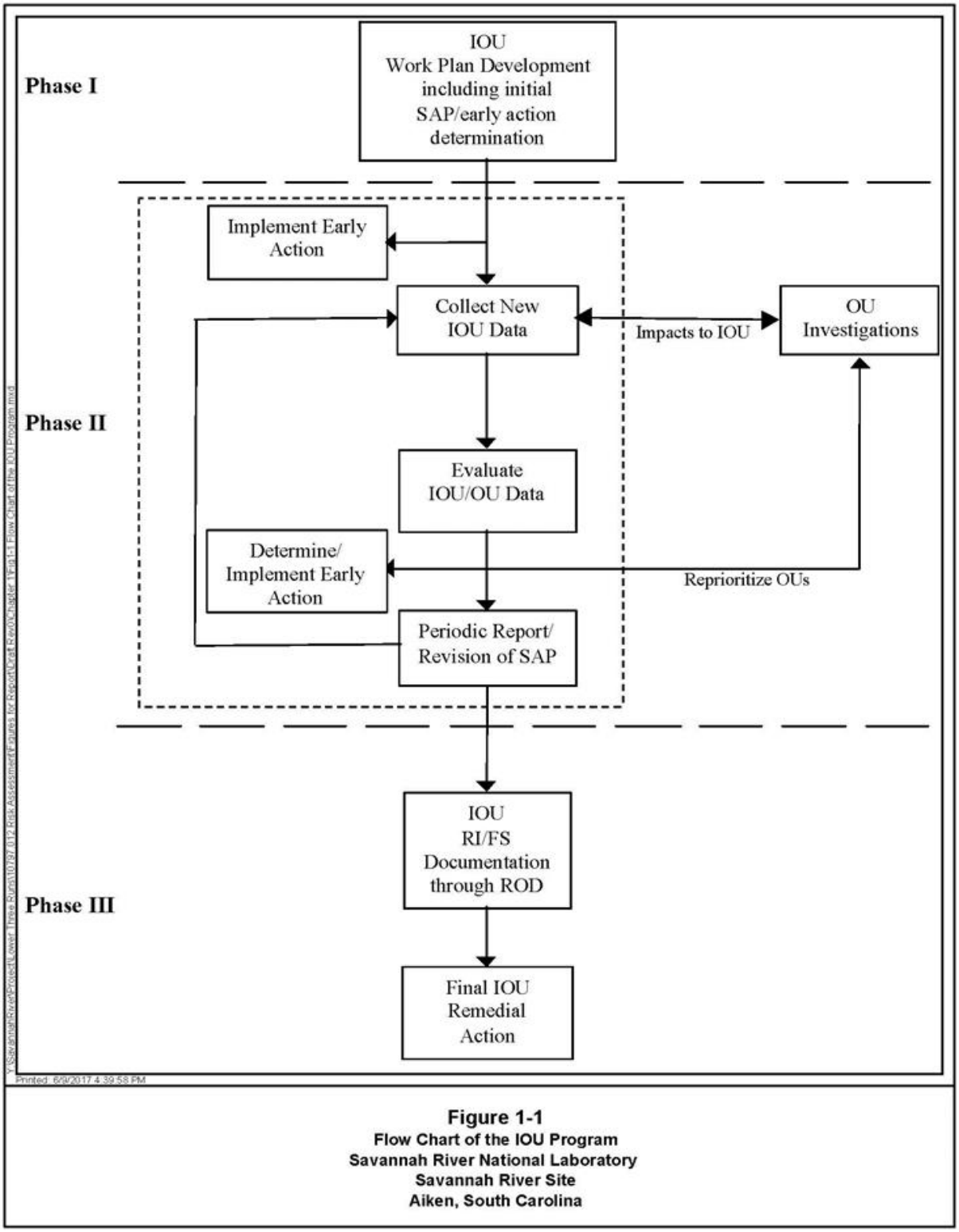


Figure 1-1. Flow Chart of the IOU Program

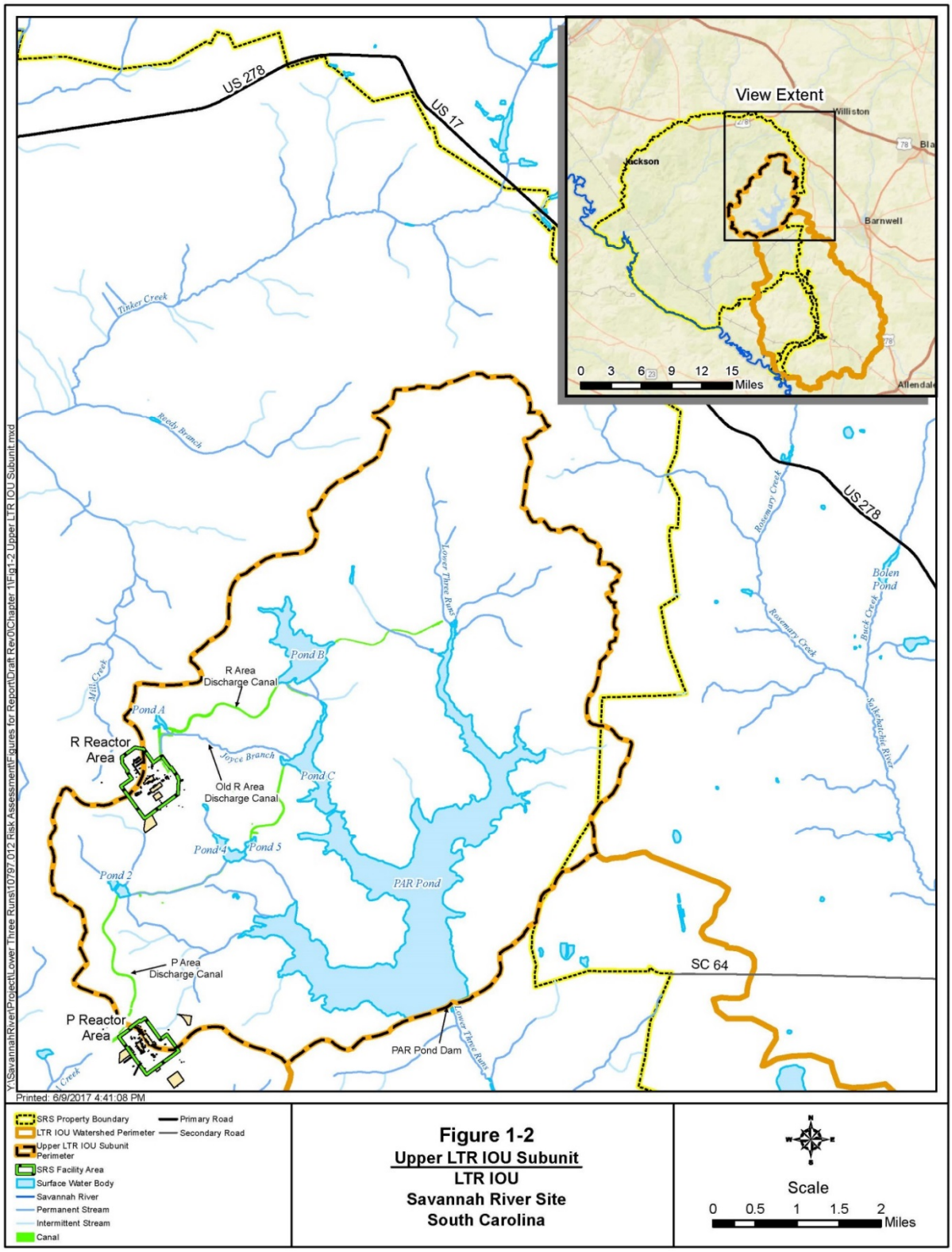


Figure 1-2. Upper LTR IOU Subunit

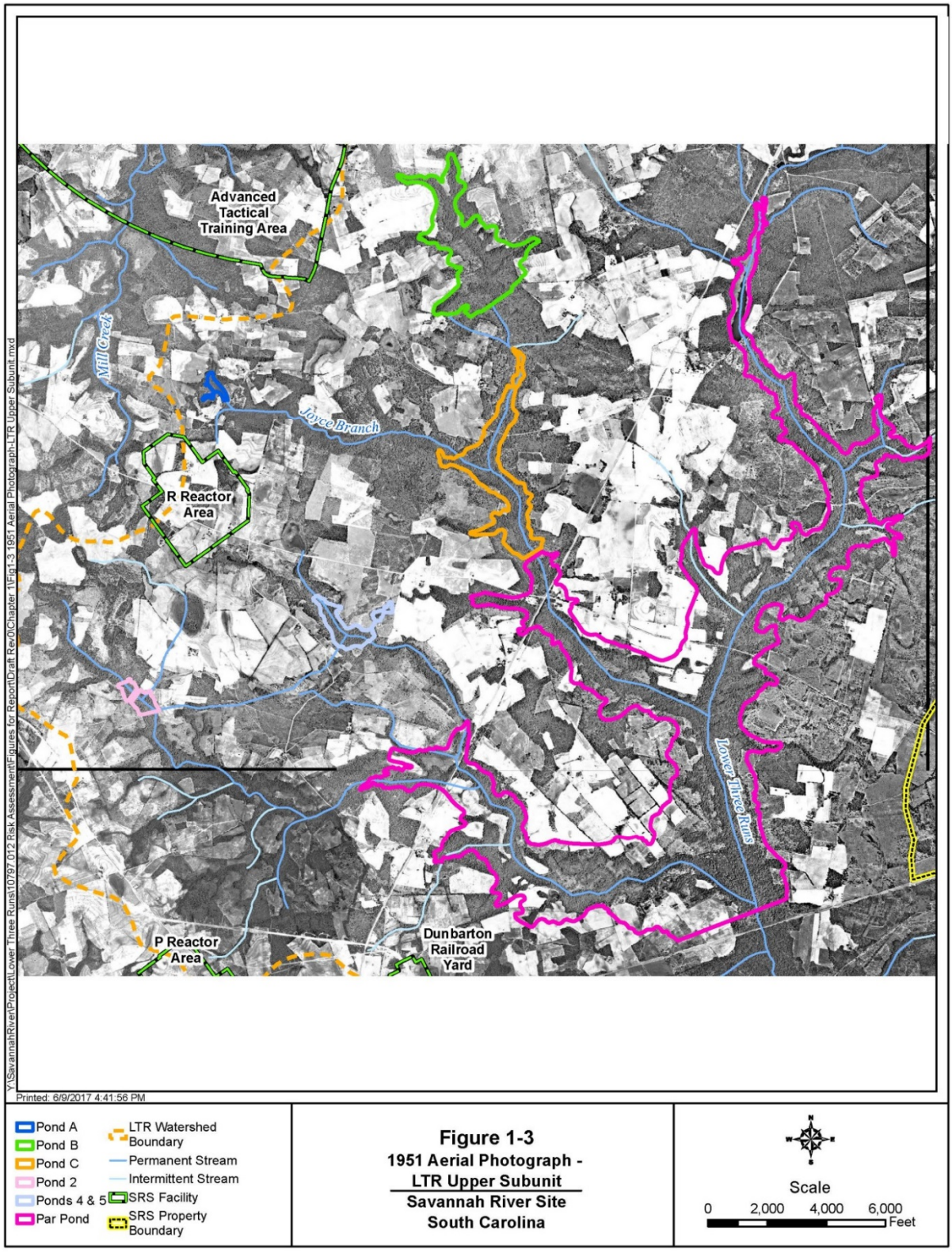


Figure 1-3. 1951 Aerial Photograph-LTR Upper Subunit

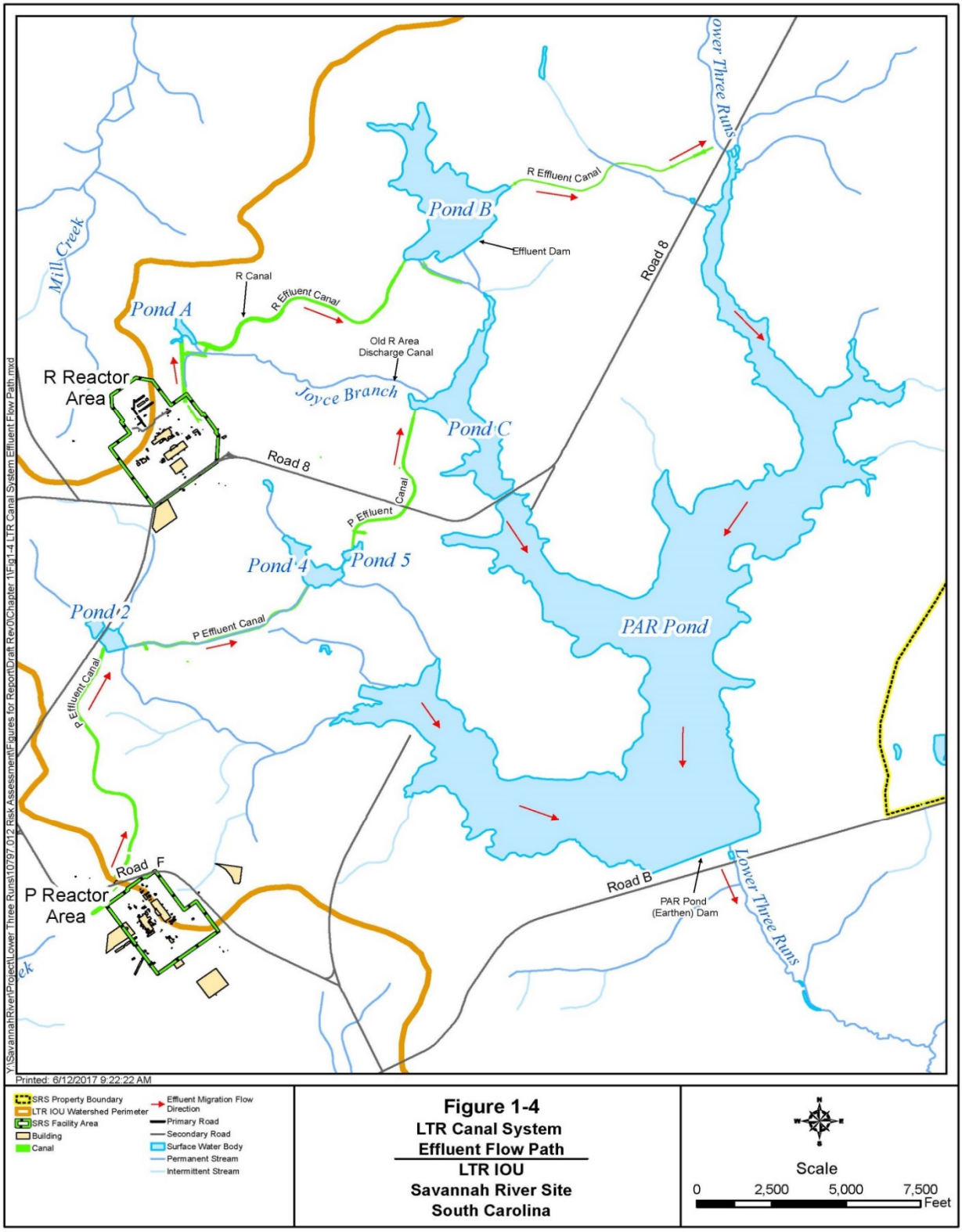


Figure 1-4. LTR Canal System Effluent Flow Path

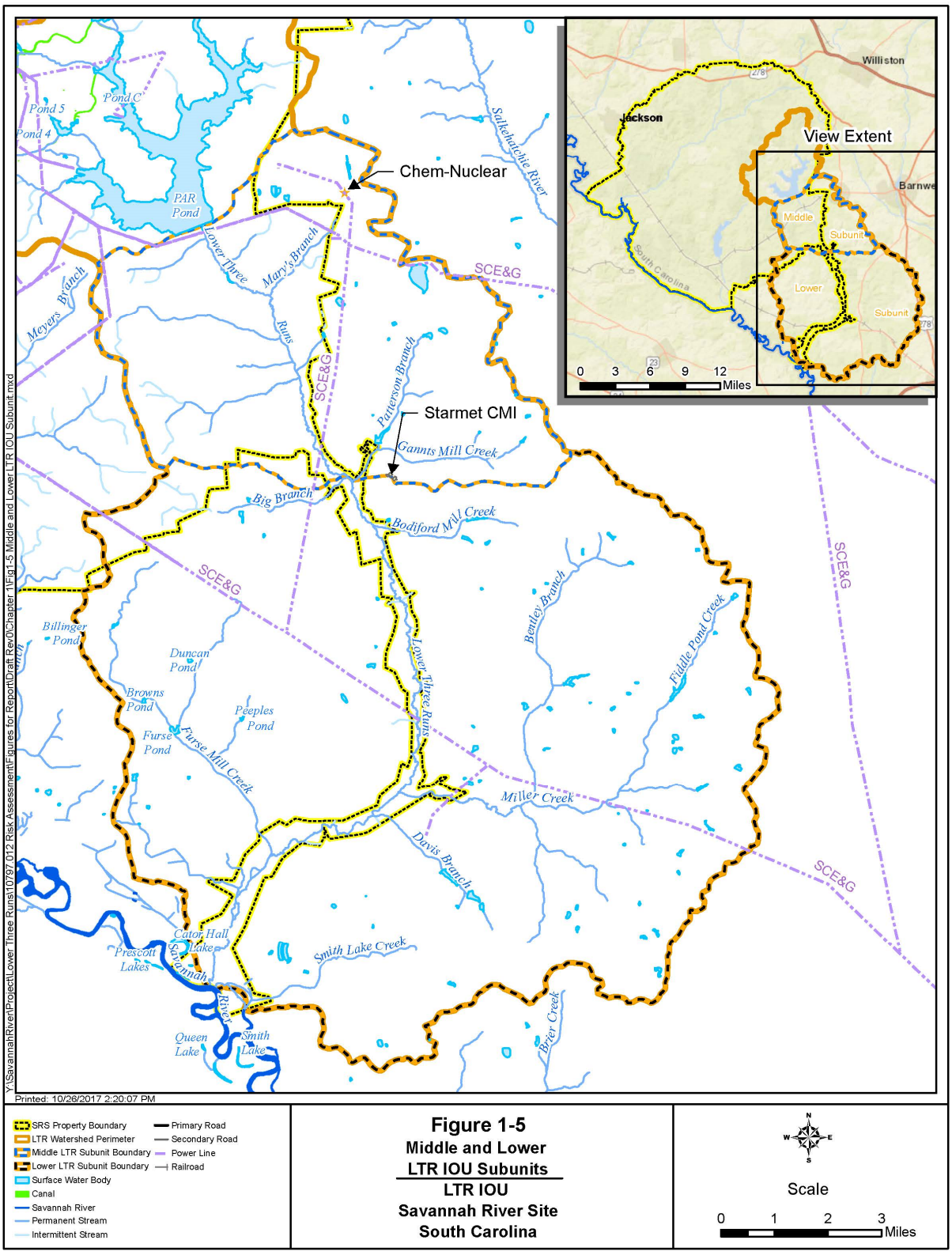


Figure 1-5. Middle and Lower LTR IOU Subunits

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Table 1-1. Summary of Disposition of LTR IOU Source Waste Sites

Area	Unit ID	Unit Name	Unit Status	Response Selected/ Implemented
G	39	Gunsite 218 Rubble Pile, 631-23G	ROD (No Action) issued November 3, 2010	Yes
G	110	PAR Pond (Including the Pre-Cooler Ponds and Canals), 685-G	Part of the LTR IOU	No
G	111	PAR Pond Sludge Land Application Site, 761-5G	No Action Approved	Yes
G	152	Second PAR Pond Site, 761-8G	NFA Approved	Yes
G	163	Gunsite 012 Rubble Pile, NBN	Combined with ECODS G-3, Rubble Pile across from Gunsite 012. ROD for LUCs, LUCIP approved by SCDHEC 8/2011 & USEPA 9/2011.	Yes
G	172	Miscellaneous Rubble Pile at Dunbarton, NBN	NFA Approved	Yes
G	173	Miscellaneous Trash at Snapp, NBN	NFA Approved	Yes
G	177	Pond B Dam Rubble Pile, NBN	NFA Approved	Yes
G	321	Patterson Mill Road Rubble Pile, NBN	NFA Approved	Yes
G	337	Rubble Pile across from Gunsite 012, NBN	Combined with ECODS G-3, Gunsite 012 Rubble Pile. ROD for LUCs, LUCIP approved by SCDHEC Aug 2011 & USEPA Sept 2011.	Yes
G	455	Stadia Lights with Poles, NBN	NFA Approved	Yes
G	505	Lower Three Runs Integrator Operable Unit	Phase III of the IOU program.	No
G	544	ECODS G-3 (Adjacent To Gunsite 012, NBN)	Combined with Rubble Pile Across from Gunsite 012, Gunsite 012 Rubble Pile. ROD for LUCs, LUCIP approved by SCDHEC Aug 2011 and USEPA Sept 2011.	Yes
G		General Area Outfalls GS-012	Deactivated as part of Gunsite 12 Project	Yes
G		PAR Pond Outfalls PP-1, PP-2	Outfalls retired, no longer discharging.	Yes
G	546	Dunbarton Railroad Yard, NBN; Outfalls Y-003 and Y-004	FFA Field Start/Site Evaluation Report date of December 2035. Part of the Steel Creek IOU.	No
P	17	P-Area Acid/Caustic Basin, 904-78G	NFA Approved	Yes
P	107	P-Area Bingham Pump Outage Pit, 643-4G	NFA Approved	Yes
P	143	P-Area Groundwater	RCRA/CERCLA unit, March 2020 FFA ROD Issuance. Part of the Steel Creek IOU	No
P	221	Sandblast Area CMP-003	NFA Approved	Yes
P	259	Combined Spills from 183-2P, NBN	NFA Approved	Yes
P	287	P-Area Acid/Caustic Basin (Groundwater)	NFA Approved	Yes

Table 1-1. Summary of Disposition of LTR IOU Source Waste Sites *(Continued)*

Area	Unit ID	Unit Name	Unit Status	Response Selected/ Implemented
P	314	Potential Release from P-Area Disassembly Basin, 105-P	ROD issued 7/22/2011 for PAOU with LUCs, remediation complete.	Yes
P	316	Potential Release from the P-Area Reactor Cooling Water System, 186/190-P	ROD issued 7/22/2011 for PAOU with LUCs, remediation complete.	Yes
P	428	Spill on 05/24/82 of 10 gal of 31.5% Acid from 183-P, NBN	NFA Approved	Yes
P	439	Spill on 06/26/86 of 1 gal of Tritiated Waste Oil from 110-P, NBN	NFA Approved	Yes
P	477	P-Reactor Area: P-Area Reactor Area Cask Car Railroad Tracks as Abandoned, NBN	ROD issued 7/22/2011 for PAOU with LUCs, remediation complete.	Yes
P	498	Sandblast Area CMP-002, NBN	NFA Approved	Yes
P	557	P-Area Process Sewer Lines as Abandoned, NBN	ROD issued 7/22/2011 for PAOU with LUCs, remediation complete.	Yes
P	587	P-Area Operable Unit	ROD issued 7/22/2011 for PAOU with LUCs, remediation complete except PSA-3A and PSA-3B ongoing soil vapor extraction. April 2013 PER report documented completion of soil vapor extraction.	Yes
P		P-Area Production Area Incidents and Unplanned Releases	All potential sources address under PAOU Completion.	Yes
P		P-Area Outfalls P-1, P-2, P-3, P-4, P-19, P-14	Outfalls retired. All potential sources address under PAOU completion.	Yes
R	42	108-4R Overflow Basin, 108-4R	NFA Approved	Yes
R	112	R-Area Acid/Caustic Basin, 904-77G	NFA Approved	Yes
R	113	R-Area Bingham Pump Outage Pits, 643-10G	Final Remediation Report Approved, LUCs	Yes
R	114	R-Area Bingham Pump Outage Pits, 643-8G	Final Remediation Report Approved, LUCs	Yes
R	115	R-Area Bingham Pump Outage Pits, 643-9G	Final Remediation Report Approved, LUCs	Yes
R	116	R-Area Burning/Rubble Pits, 131-1R	ROD Submittal 5/1/04 /RA Complete/ LUCs	Yes
R	117	R-Area Burning/Rubble Pits, 131-R	ROD Submittal 5/1/04 /RA Complete/ Continue Post-Closure Maintenance Activities	Yes
R	118	R-Area Rubble Pile, 631-25G	ROD Submittal 5/1/04 /RA Complete/ Continue Post-Closure Maintenance Activities	Yes

Table 1-1. Summary of Disposition of LTR IOU Source Waste Sites *(Continued)*

Area	Unit ID	Unit Name	Unit Status	Response Selected/ Implemented
R	119	R-Area Reactor Seepage Basins, 904-103G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	120	R-Area Reactor Seepage Basins, 904-104G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	121	R-Area Reactor Seepage Basins, 904-57G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	122	R-Area Reactor Seepage Basins, 904-58G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	123	R-Area Reactor Seepage Basins, 904-59G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	124	R-Area Reactor Seepage Basins, 904-60G	Biennial Groundwater Mixing Zone Reporting/ RA Complete	Yes
R	178	R-Area Asbestos Pit, 080-01R	NFA Approved	Yes
R	179	R-Area Rubble Pit, 131-2R	NFA Approved	Yes
R	230	Potential Release from the R-Area Concrete Lake, 183-1R/186R	NFA Approved	Yes
R	231	Area on the North Side of Building 105-R, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	233	Laydown Area North of 105-R, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	271	Cooling Water Effluent Sump, 107-R	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	288	R-Area Groundwater, NBN	ROD issued for RAOU 4/10/2011 with LUCs; MNA for Groundwater	Yes
R	312	Old R-Area Discharge Canal, NBN	Part of the LTR IOU. Also known as Joyce Branch.	No
R	324	Potential Release of NaOH/H_2 SO_4 from 183-2R, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	328	Purge Water Storage Basin, 109-R	D&D Unit #1924 – part of RAOU – no longer a source.	Yes
R	329	R-Area Ash Basin, 188-0R	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	330	Potential Release from R-Area Disassembly Basin, 105-R	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	478	R-Reactor Area: R-Area Reactor Area Cask Car Railroad Tracks as Abandoned, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	513	Release from the Decontamination of R-Area Reactor Disassembly Basin, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	517	Combined Spills North of Building 105-R, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	540	ECODS R-1A, -1B, -1C (East of R-Reactor)	CMIR/RACR documenting completion of RA for closure approved by USEPA (4/13/2011) and SCDHEC (3/30/2011)	Yes

Table 1-1. Summary of Disposition of LTR IOU Source Waste Sites *(Continued/End)*

Area	Unit ID	Unit Name	Unit Status	Response Selected/ Implemented
R	550	R-Area Unknown Pit #1 (Runk-1), NBN	ROD Approved	Yes
R	551	R-Area Unknown Pit #2 (Runk-2), NBN	ROD Approved	Yes
R	552	R-Area Unknown Pit #3 (Runk-3), NBN	ROD Approved	Yes
R	556	R-Area Process Sewer Lines as Abandoned, NBN	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R	588	R-Area Operable Unit	ROD issued for RAOU 4/10/2011 with LUCs; remediation complete	Yes
R		R-Area Incidents and Unplanned Releases	All potential sources addressed under RAOU completion.	Yes
R		R-Area Outfalls R-1 through R-4	Outfalls retired. R-4 has no discharge (basin is capped).	Yes

Table 1-2. Savannah River Site Natural Resource Trustees and Their Responsibilities

Governing Power	Responsibilities
USDOE, Savannah River Operations Office	All natural resources located on, over, or under land administered by USDOE
South Carolina Office of the Governor	All natural resources of the State of South Carolina
South Carolina Department of Health and Environmental Control, Bureau of Land and Waste Management	Geologic resources including soil, groundwater resources (including drinking water sources), air resources, and surface water resources
U.S. Department of the Interior	Threatened and endangered species (includes Red-Cockaded Woodpecker, Bald Eagle, Wood Stork, Shortnose Sturgeon, and Smooth Coneflower), migratory birds, anadromous species, National Park Service land (Fort Pulaski National Monument), Fish and Wildlife Service land (Savannah River National Wildlife Refuge), Tybee Island National Wildlife Refuge, and Orangeburg National Fish Hatchery
South Carolina Department of Natural Resources	Commercial species, game and non-game species, and state sensitive species
Georgia Department of Natural Resources	Savannah River resources, groundwater resources, air resources, and surface water resources
U.S. Department of Commerce, National Oceanic and Atmospheric Administration	Living and non-living natural resources in coastal and marine areas including the following: • All life stages, wherever they occur, of fishery resources on the Exclusive Economic Zone and continental shelf • Anadromous and catadromous species throughout their ranges, rivers, and tributaries to rivers, which historically or presently support the above species • Federally endangered and threatened species, including designated critical habitat and marine mammals for which NOAA has assigned responsibility • Tidal wetlands, salt marshes, estuaries, and all other habitats supporting all fishery and marine resources listed above • Living and non-living resources of National Marine Sanctuaries and National Estuarine Reserves
U.S. Army Corps of Engineers, Charleston, South Carolina District, Savannah, Georgia District	Savannah River resources, navigable waters resources, and waters of the United States resources

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2.0 SITE DESCRIPTION

A discussion of the physical attributes of the Lower Three Runs (LTR) Integrator Operable Unit (IOU) site is provided in the following sections. Figure 2-1 is the Comprehensive Site Features Map that depicts pertinent natural and man-made features relevant to the LTR IOU Remedial Investigation/Baseline Risk Assessment (BRA).

2.1 Physical Setting

The LTR IOU is defined as the LTR stream and its tributaries and impoundments, including surface water, sediment, floodplain soils (sediment/soil), and related biota in these water bodies and associated floodplains. LTR IOU habitats, ecological setting, surface features, meteorology, unit-specific geology and hydrogeology, surface water hydrology, and sediment/soils are described below.

2.1.1 Habitats and Ecological Setting

Savannah River Site (SRS) has 1,323 documented plant species that occur within the SRS boundary. Animals are represented by 86 fish species, 44 amphibians and 59 reptilian species, 255 birds (~120 of which are breeding residents), 54 mammals, and thousands of invertebrates. These species occur over many habitat types, from well-drained upland forests to swamps and Carolina bays. Brief descriptions of the habitats present within the project area are provided in Subsection 2.1.1.1.

2.1.1.1 Habitats

Wike et al. (2006) identified five major habitats at the SRS: 1) old fields/clear cuts, 2) planted pine, 3) scrub oak/longleaf pines, 4) upland and lowland hardwoods, and 5) aquatic/semiaquatic. Figure 2-2 shows the location of these habitats within the Upper subunit of the LTR IOU watershed (upland hardwood and bottomland hardwood habitats are identified separately in the figure). Figure 2-2 is a modified version of the 1997 SRS Habitat Map developed by Pinder et al. (1998).

The **old field/clearcut** habitat occupies 8% of the project area and primarily consists of grasses and forbs. This habitat type is ephemeral in a natural setting, and is typically associated with power line and other rights-of-way, clear-cut forests, and occasional natural forest gaps.

Planted pine make up nearly half of the Upper subunit of the LTR IOU. Both loblolly and slash pines (*Pinus taeda* and *P. elliottii*) are included in the SRS forestry program.

The **scrub oak/longleaf pine** habitat encompasses 18% of the project area. The habitat typically occurs on drier sites and sandy ridges. Turkey, bluejack, and black-jack oaks (*Quercus laevis, Q. incana*, and *Q. marilandica*) dominate the canopy with longleaf pine present in various densities. Understory species include *Vaccinium* spp., hollies, (*Ilex* spp.) *Lespedeza* spp.; and various lichens.

The **upland hardwoods** habitat occupies 11% of the project area. Typical canopy species include laurel oak (*Q. laurifolia*), yellow poplar (*Liriodendron tulipifera*), blackgum (*Nyssa sylvatica*), sweet-gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), hickories, and holly. Understory on the more mesic sites include *Vaccinium* spp., hollies, various ferns, grapes (*Vitis* spp.), sassafras (*Sassafras albidum*), dogwood (*Cornus florida*), and greenbriers (*Smilax* spp.).

Lowland (bottomland) hardwoods occur over ~4% of the project area, and are common in the Upper subunit of the LTR IOU. This habitat is found adjacent to rivers and streams. Typical canopy species include water oak (*Q. nigra)*, laurel oak, sweetgum, elms (*Ulmus alata* and *U. americana)*, red maple, and yellow poplar (Good and Whipple 1982; Whipple et al. 1981; Jensen et al. 1984). Holly (*Ilex opaca*), redbay (*Persea borbonia)*, sweet bay (*Magnolia virginiana*), hackberry (*Celtis laevigata)*, and ironwood (*Carpinus caroliniana*) are common in the sub-canopy and understory. Greenbriers, grapes, and other vines are common in the shrub and ground layers. Herbaceous plants are less common due to the dense shading. This habitat includes the highest diversity of terrestrial reptiles and amphibians.

The **aquatic/semiaquatic** habitat type covers nearly 13% of the watershed, but represents the vast majority of the Upper subunit of the LTR IOU. This habitat includes streams, reservoirs, marshes, Carolina bays, and bald cypress (*Taxodium distichum*) / water tupelo (*Nyssa aquatica*) swamps. Vascular aquatic vegetation within permanently ponded areas of the LTR canal/pond system and periphery include a variety of floating-leaved, submerged macrophytes, and emergent vegetation. Floating-leaved species include plants such as water lily (*Nymphaea odorata*), water shield, (*Brasenia schreberi*), and floating heart (*Nymphoides cordata*), which occur at shallower depths.

Both free-floating, nonrooted submerged forms of bladderworts, *(Utricularia floridana* and *Utricularia inflata*) are present. Rooted submerged species, principally fanwort *(Cabomba caroliniana*) and blue hyssop (*Bacopa caroliniana*) are present as well. Other rooted species include spike rush (*Eleocharis acicularis*), bushy pondweed (*Najas guadalupensis*), bag moss (*Mayaca aubleti*), and parrotfeather (*Myriophyllum brasiliense*). Three emergent species, pennywort (*Hydrocotyle umbellata),* arrowhead (*Sagitaria isoetiformis),* and cattail *(Typha latifolia)* are often widely distributed. The upper emergent/shrub zone is characterized by a variety of wooded plants including red maple (*Acer rubrum*), buttonbush (*Cephalanthus occidentalis*), black willow (*Salix nigra*), and bald cypress (Wike et al. 2006).

2.1.1.2 Wildlife

The SRS supports diverse faunal populations in a variety of upland and aquatic habitats. Fish assemblages in LTR stream are typical for unimpacted streams of similar size in the Southeast. Thirty fish species have been identified from PAR Pond. These species have also been reported from LTR stream, which together with the Savannah River represent the original source of all fish species represented in the LTR IOU system. PAR Pond cove rotenone studies showed the following species to be abundant in PAR Pond: largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), lake chubsucker (*Erimyzon sucetta*), brook silversides (*Labidesthes sicculus*), and eastern mosquitofish (*Gambusia holbrooki*). Largemouth bass is an important sport fish and the principal predator fish (Wike et al. 2006).

Waterfowl and wading birds, as well as many upland species, use SRS aquatic habitats year-round. Large numbers of waterfowl have wintered at the site since public access was restricted in the early 1950s and particularly since the construction of PAR Pond and L Lake. The Savannah River Ecology Laboratory (SREL) has been conducting waterfowl research and surveys On-Site for the past 40 years. The four most abundant species of waterfowl at PAR Pond include the lesser scaup, ring-necked ducks, buffleheads, and ruddy ducks. Mallards and wood ducks are the most abundant in the Savannah River swamp (Wike et al. 2006).

Several SRS mammals are commercially important game species or furbearers, including the Virginia opossum, eastern cottontail rabbit, marsh rabbit, gray squirrel, fox squirrel, beaver, muskrat, coyote, red fox, gray fox, bobcat, river otter, mink, long-tailed weasel, striped skunk, spotted skunk, raccoon, black bear, white-tailed deer, and wild pig. Aside from the public hunts for white-tailed deer and wild pigs, and the beaver and wild pig control programs, none of the aforementioned species populations is exploited on the SRS (Wike et al. 2006).

There are 103 reptile and amphibian species that occur on SRS. These include salamanders, frogs, toads, turtles, lizards, snakes and one crocodilian, the American alligator (*Alligator mississippiensis*). The amphibians and reptiles on SRS are year-round residents. The highest overall species diversity is in aquatic habitats. More than 70% of the site's amphibian and reptile species use stream corridors and Carolina bays. On average, slightly more than half (54%) of the amphibian species have been found in aquatic habitats, while 51% of the reptiles have been found in these areas.

2.1.1.3 Threatened, Endangered, and Sensitive Species

Threatened, Endangered, and Sensitive (TES) species include animals and plants federally protected by the Endangered Species Act (ESA) of 1973, as well as those species for which population viability is a concern. The SRS has designated 32 animals as sensitive. The purpose of identifying, monitoring, and managing sensitive species is proactive, to ensure viability and to prevent any trend toward endangerment that could result in the need for federal listing under the ESA. The SRS list of protective and sensitive species is based partially on the rarity/vulnerability rankings (global and state) of the Nature Conservancy and the South Carolina Department of Natural Resources (SCDNR).

The following TES animal information has been excerpted from *Ecology and Management of a Forested Landscape: Fifty Years on the Savannah River Site* (Kilgo and Blake 2005). Information regarding species occurrence within the LTR system are noted.

Mammal species of special concern at SRS include the Southeastern Myotis (*Myotis austroriparius*), Little Brown Bat (*Myotis lucifugus*), Rafinesque's Big-eared Bat

(*Corynorhinus rafinesquii*), Star-nosed Mole (*Condylura cristata*), Eastern Woodrat (*Neotoma floridana*), Swamp Rabbit (*Sylvilagus aquaticus*), and Black Bear (*Ursus americanus*)

Of the mammals, the Star-nosed Mole (*Condylura cristata*) is a semi-aquatic species typically found at the edges of swamps, bays, and reservoirs and may be present within the LTR IOU (Cothran et al. 1991, McCay et al. 1999 [in Kilgo and Blake 2005]).

Birds of special concern include Bachman's Sparrow (*Aimophila aestivalis*), Henslow's Sparrow (*Ammodramus henslowii*), Common Ground-dove (*Columbina passerina*), American Swallow-tailed Kite (*Elanoides forficatus*), American Kestrel (*Falco sparverius*), Bald Eagle (*Haliaeetus leucocephalus*), Loggerhead Shrike (*Lanius ludovicianus*), Wood Stork (*Mycteria americana*), Swainson's Warbler (*Limnothlypis swainsonii*), Painted Bunting (*Passerina ciris*), and Red-cockaded Woodpecker (*Picoides borealis*). Of these, the Bald Eagle, Red-cockaded Woodpecker, and the Wood Stork, are associated with the LTR IOU watershed. The Bald Eagle is known to nest near and forage in PAR Pond. The Wood Stork may utilize the Upper subunit as an occasional visitor, and a loggerhead shrike was observed during a TES survey within the Upper subunit of the LTR watershed (Section 2.1.1.4). The Red-cockaded Woodpecker nest and forage in the upland areas of the Upper subunit upgradient of the PAR Pond system within the LTR watershed boundary, but do not utilize the aquatic systems.

Amphibians of concern that occur on SRS include the Tiger Salamander (*Ambystoma tigrinum*) and Gopher Frog (*Rana capito*). Both species may utilize aquatic systems associated with the LTR IOU PAR Pond/Canal system. The Tiger Salamander is known to breed in permanent and temporary ponds such as Carolina bays, most of which are free of predatory fish, it largely remains in burrows in surrounding sandy uplands during the remainder of the year. It occurs in most temporary ponds and bays on SRS (Gibbons and Semlitsch, 1991 [in Kilgo and Blake 2005]).

Reptiles of concern at SRS include the American Alligator (*Alligator mississippiensis*) Gopher Tortoise (*Gopherus polyphemus*), Southern Hognose Snake (*Heterodon simus*), Florida Green Water Snake (*Nerodia floridana*), Pine Snake (*Pituophis melanoleucus*), and Eastern Coral Snake (*Micrurus fulvius*). The American alligator is known to inhabit the PAR Pond system including pre-cooler ponds. The Florida green water snake inhabits Carolina bays and other quiet waters,

including reservoirs at SRS; it does not occur in streams or swamps (Gibbons and Semlitsch, 1991 [in Kilgo and Blake 2005]). The Southern Hognose may utilize habitats within the LTR Upper subunit.

Fishes of concern include the Atlantic Sturgeon (*Acipenser oxyrinchus*). The Atlantic sturgeon has been observed in the river near SRS but is not known to occur in the LTR system.

Molluscs of special concern that may occur on SRS include the Brook Floater (*Alasmidonta varicosa*), Brother Spike Mussel (*Elliptio fraterna*), Mill Creek Elliptio (*Elliptio hepatica*), Yellow Lance (*Elliptio lanceolata*)., Yellow Lamp Mussel (*Lampsilis cariosa*), Rayed Pink Fatmucket Mussel (*Lampsilis splendida*), Savannah Lilliput (*Toxolasma pullus*), Notched Rainbow Mussel (*Villosa constricta*). Of these, the yellow lance has been collected in LTR (Kilgo and Blake 2005). However, it has not appeared in more recent (1990-1997) SRS surveys (M. Mulvey, pers. commun., 1997 [in Kilgo and Blake 2005]).

Insects of special interest include the Sand-burrowing Mayfly (*Dolania americana*). This species has been observed in the Upper Three Runs but is not known to exist in the LTR system.

Kilgo and Blake (2005) identified 44 TES plant species that are known to occur on SRS. Information related to these species is provided in Table 2-1.

2.1.1.4 TES Species Within the LTR IOU

The U.S. Department of Agriculture (USDA) Forest Service – Savannah River (USFS-SR) manages natural resources at the SRS operating under an Interagency Agreement and follows the SRS Strategic Plan goals and objectives (DOE 2011) to implement the Natural Resources Management Plan for the SRS. USFS-SR continues to improve habitat conditions for the endangered red-cockaded woodpecker (RCW) by removing brush and small hardwood vegetation from longleaf pine forests. Successful habitat restoration has increased the number of active RCW clusters from three in 1985 to 83 in 2014. The LTR Upper subunit of the watershed contains foraging and nesting locations of RCWs in the upland portions of the LTR watershed.

Three TES surveys have been conducted within the Upper subunit of the LTR with survey boundaries that overlap the IOU (Bumpus and Garner 1994a, 1994b; Hyatt 1994):

- Bumpus and Garner (1994a) survey was conducted at the P Area Bingham Pump Outage Pits. No TES species were identified during the survey. The survey report stated that habitats in the survey area generally did not meet the requirements for most TES species at SRS.
- Bumpus and Garner (1994b) survey was conducted at the R Area Bingham Pump Outage Pits. No TES species were identified during the survey. However, the researchers did observe a loggerhead shrike adjacent to the survey area.
- Hyatt (1994) survey was conducted at the R Area Reactor Seepage Basins. No TES species were identified, although the survey found that the area "is large enough to that one would expect some regular transient use by TES animals such as the bald eagle, wood stork, and loggerhead shrike".

Additionally, a review of Geographic Information System (GIS) data for TES flora on the SRS was reviewed. The GIS coverage is maintained by the USFS-SR. Results of the review for the LTR Upper subunit reveal observations of the Piedmont bladderwort (*Utricularia olivacea*) in Pond B and above the North Arm of PAR Pond, the Florida bladderwort (*Utricularia floridana*) in Pond B, and the slender arrowhead (*Sagittaria isoetiformis*) in Pond B.

TES animals known to utilize the Upper subunit of the LTR IOU include the bald eagle, red-cockaded woodpecker, and the wood stork as an occasional visitor. Wood storks may occasionally visit since they have been documented at Craig's Pond, Thunder Bay, and Eagle Bay – Carolina Bays located near the PAR Pond canal system.

The most prominent TES species for the LTR IOU is the bald eagle. Records of bald eagle sightings in the central Savannah River area date back to 1904. The presence of this species on SRS was documented as early as May 1959, when an adult bald eagle was observed on the newly filled PAR Pond (Norris, 1963 [in Kilgo and Blake 2005]) and bald eagles have continued to utilize, nest adjacent to, and forage in the LTR system. PAR Pond has been and continues to be the location of most of the eagle sightings on SRS. Observations of foraging activities of bald eagles on SRS indicate a varied diet composed of fish (largemouth bass [*Micropterus salmoides*]), waterfowl (coots [*Fulica americana*] and buffleheads [*Bucephala albeola*]), small mammals (gray squirrel, [*Sciurus carolinensis*]), and carrion.

There have been two confirmed bald eagle nesting territories documented on SRS. The Eagle Bay nesting territory was discovered on May 21, 1986. By June 6, 1986, the nest and the presence of two juvenile bald eagles were confirmed. Seven bald eagle chicks were hatched and fledged from that nest between 1986 and 1988. In 1989, both the nest and the single hatchling produced that season were presumed lost when extreme winds (87 miles per hour [mph]) knocked the nest out of the tree in April. The SCDNR installed a braced wooden and wire platform in the area of the original nest and constructed an artificial nest of pine limbs and twigs. The pair initiated nesting in 1990, but abandoned the nest by February of that year. A pair of great blue herons (*Ardea herodias*) took over the nest later that same month. In June of 1990, the second bald eagle nesting location (on Pen Branch) was discovered. A third nest was discovered east of PAR Pond after the 1995-1996 nesting season.

The USFS-SR began an active management program in 1986 for the Eagle Bay nesting territory and in 1990 for the Pen Branch nesting territory. These management plans encompass primary and secondary management zones for protecting the nesting territories and key areas along the shores of both PAR Pond and L Lake for perching and roosting activity. Through the use of management zones and because of the distances between the two nests and existing SRS facilities, it is expected that activities at SRS will have no adverse effect on the bald eagle. Other considerations in the management of eagles at SRS are related to disease and potential uptake of constituents of concern. A two-year study of the eagles at SRS suggests that mercury from prey items may pose a risk because SRS nestlings had higher mercury concentrations than other South Carolina nestlings (Bryan et al. 2002 [in Kilgo and Blake 2005]). However, the same study concluded that cesium is not a threat. In the late 1990s, two eagles were found dead on the SRS and tested positive for the affliction known as avian vacuolar myolenopathy. This pathogen has affected eagle populations in many other parts of the United States and is thought to be transmitted to the eagles through the American coot, which is one of their favorite prey items.

Sightings of the unlisted golden eagle (*Aquila chrysaetos*) on SRS are rare. Although SRS is not ideal golden eagle habitat, it does provide potential wintering habitat for this species. Historically, only three golden eagles have been recorded as being sighted on SRS. All the sightings have been

on PAR Pond (WSRC 2005 [in Kilgo and Blake 2005]). However, a recent carrion study conducted by the SREL noted several golden eagle short-term visitors on the SRS.

2.1.2 Surface Features

The general topography of the upper Coastal Plain of the SRS consists of rounded hills with gentle slopes. The highest elevation recorded on the SRS is ~128.0-meters (m [420-feet {ft}]) mean sea level (msl) near Tims Branch along the northwest boundary of SRS. Upper Coastal Plain slopes range from 1.5 to 6.1 m/mi (5 to 20 ft/mi), and many streams are bordered by swamps with wide flood plains.

LTR IOU is a remote area, located in the southeastern portion of SRS. LTR is a large blackwater stream that originates in the northeast portion of SRS and follows a southerly direction for ~40-km (24.5-mi) before it enters the Savannah River. This surface water feature has a deep, slow-moving channel flowing through forested swamps or wetlands; as vegetation decays, tannins leach into the water, resulting in transparent acidic water that is darkly stained, resembling tea or black coffee.

2.1.3 Meteorology

The climate of the central Savannah River area is humid and subtropical. It is characterized by hot summers and mild winters. Outbreaks of severe thunderstorms occur more frequently during the spring; rainfall is evenly distributed throughout the year. Except for the Savannah River valley, there are no topographic features that would significantly influence the general climate.

Meteorological monitoring has been conducted at the SRS since the 1950s. The Savannah River National Laboratory has established the Atmospheric Technologies Center (ATC) for Applied Meteorological Solutions which is responsible for managing the meteorological and climatological observations. The monitored meteorological data is used for predicting air dispersion of contaminants, health and safety planning, and assessing contaminant fate and hydrologic transport. The ATC operates a network of meteorological stations at SRS.

Monthly averages of temperature and precipitation based on a 50-year historical record of observations are presented in Table 2-2. During the summer months, temperatures at SRS

typically exceed 90 degrees Fahrenheit (°F) in daytime, dropping to near 70°F at night. On average, fall and spring temperatures vary approximately between 70°F and 85°F during the daytime and 45°F and 65°F in the night. Winter daytime temperatures are generally near 60°F with nighttime temperature near 40°F. Average precipitation is relatively consistent throughout the year, with slightly higher rainfall occurring during the summer months when the humidity levels are higher.

The predominant wind directions at SRS are from both the southwest and northeast with fewer winds from the west-northwest and south-southeast. Approximately 45% of the winds are between 4 to 8 meters per hours (mph [2 to 4 meters per second {mps}]) and 33% between 9 to 13 mph (4 to 6 mps). These values are based on wind observations from the Area H tower at a height of 200 ft. Ground-level wind speeds would be slightly slower. Average temperature and precipitation is noted below.

2.2 Geology and Hydrogeology

This section describes the geology, hydrogeology, surface water hydrology, and soil types for the LTR IOU.

2.2.1 Surface Water Hydrology

The five major streams that drain from the SRS to the Savannah River are: Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and LTR. From the PAR Pond Dam, LTR flows through the Middle and Lower subunits ~30 km (19 mi) before it enters the Savannah River (Figure 2-3).

The LTR watershed comprises ~460 km^2 (180 mi^2). LTR has an annual average discharge of 1.8 cubic meters per second (m^3/sec) or 64 cubic feet per second (ft^3/sec). The LTR IOU is defined as the LTR stream and its tributaries and impoundments, including surface water, sediment, floodplain soils (sediment/soil), and biota in these water bodies and associated floodplains. The average discharge of LTR at Patterson Mill Road during calendar year 2012 was 0.69 m^3/sec (24.5 ft^3/sec).

During reactor operations, the LTR stream system received reactor discharges in the form of reactor cooling water. The cooling water system received water from the Savannah River supplying both R- and P-Reactors.

The river water system pumped water from the Savannah River to R- and P-Reactors where the water passed through heat exchangers to absorb heat from the reactor core. The heated discharge water was ultimately returned to the Savannah River by way of the LTR stream. PAR Pond was constructed in 1958 to provide additional cooling water for P- and R- Reactors to dissipate the thermal effluents. To construct PAR Pond, the stream channel of the LTR stream was expanded, a dam built across a section of its path, and the upstream area flooded. PAR Pond has an average depth of 6.2 m (20 ft) and a maximum depth of 18 m (59 ft). At normal pool, the reservoir storage volume is ~65 million m^3 (52,800 acre-ft).

Potential inundation caused by recurrence-interval flow (100-year flow) exists. The 100-year flood plain approximate boundaries at the SRS were mapped using hydrologic data including drainage area, soil type, impervious surface area, and peak-flow records at United States Geological Survey (USGS) gaging stations (Figure 2-3). One Hundred-year flow for specific branches of the Savannah River on the SRS were modeled using less than detailed methods; that is, using surveyed cross-sections at road crossings or other easily accessed locations and then using interpolated intermediate cross-sections developed from survey data and 7.5-minute Quadrangle Topographic Maps (USGS 1963-65).

2.2.2 Unit Soils

The USDA soil types that are present at LTR IOU are: 1) upland soils, and 2) wetland soils.

Variances in upland and wetland soils are the result of the unique weathering environments associated with their position on the LTR IOU landscape, organic matter content, and soil texture. Wetland soils contain higher levels of organic matter and clay, and have higher levels of trace elements when compared to coarse-textured upland soils. Background concentrations of barium, beryllium, cobalt, copper and zinc observed in wetland soils at SRS were elevated when compared to coarse-textured upland soils, and therefore, represent the natural range for the finer textured

wetland soils. Soil concentrations of vanadium, chromium, nickel, copper, zinc, lead, uranium, beryllium, manganese, barium, and mercury were similar in both soil types (Dixon et al. 1997).

The soils within the LTR IOU are classified as Ultisols, Entisols, and Inceptisols. Ultisols are soils that are rich in clay, some mineral nutrients and metal oxides, and typically have a humus-rich surface horizon. These soils are generally well-formed and associated with areas of older geological settings.

There are three Entisol soil series located within the LTR IOU: Fluvaquents, Lakeland, and Udorthents series. Entisols are associated with areas of relatively recent geologic formation. These soils are typically associated with areas of land development and areas where disturbance of the land occurs either naturally or by man (i.e., erosion, deposition, excavation or construction activities).

Inceptisols are soils that have also been recently formed and exhibit soil horizons that consist of clay, minerals, metal oxides and/or humus that have accumulated early in the soil-forming process. The Pickney series is the only Inceptisol soil series located within the LTR IOU.

2.2.3 Geology

The SRS is located in the Atlantic Coastal Plain, a wedge of unconsolidated and semi-consolidated sediments that thickens toward the southeast. The investigations into regional and SRS are summarized in the *Hydrogeologic Framework of West-Central South Carolina* (Aadland et al. 1995). The general topography of the upper Coastal Plain of the SRS consists of rounded hills with gentle slopes. The highest elevation recorded on the SRS is ~128.0-m [420-ft) msl near Tims Branch along the northwest boundary of SRS (Aadland et al. 1995). Upper Coastal Plain slopes range from 1.5 to 6.1 m/mi (5 to 20 ft/mi), and many streams are bordered by swamps with wide flood plains.

Figure 2-4 depicts the geologic formations that are present at the surface within LTR IOU. Tertiary sedimentary deposits constitute the majority of surface present at the LTR IOU.

The Upland unit of Miocene origin is characterized by three distinct lithofacies: 1) coarse cross-bedded gravel and poorly sorted sand, 2) fine to course cross-bedded sand with weathered feldspar

grains and clay clasts, and 3) sandy clay beds that have manifested in multiple radiant colors due to the oxidation of heavy minerals. Upland geologic units are predominant on the western side of the LTR IOU between the Dune sand unit and Tobacco Road sand unit on the north and eastern sides of the area, with some outcrops that encroach the Tobacco Road unit surrounding PAR Pond.

Dry Branch Formation geologic units are comprised of a coarsening-upwards calcareous (fossiliferous) clay and marl, clay, interbedded sand and clay, and sand montmorillonite. (Prowell 1996, Map MF-2300). Dry Branch Formation geologic units encompass PAR Pond, Pond A, Pond C, and their adjoining stream systems of the LTR IOU.

Tobacco Road Sand geologic units contain mica, and a heavy mineral composition of dominantly brown ilmenite and sillimanite. Other heavy minerals observed in this geologic unit include brown hornblende, rutile, staurolite and zircon (Prowell 1996, Map MF-2300). Tobacco Road Sand geologic units exist as "buffer zones" between the Upland Unit and Dry Branch Formation surrounding PAR Pond. Pond 2, Pond 4 and 5, and Pond B are also encompassed by the Tobacco Road Sand unit.

2.2.4 Hydrogeology

According to Aadland et al. (1995), the hydrostratigraphy of the region consists of three main systems: the Floridan Aquifer System (upper near-surface aquifer contiguous with ground surface), the Meyers Branch Confining System, and the Dublin-Midville Aquifer system (deeper underlying aquifer). The Floridan and Dublin-Midville Aquifer Systems are further subdivided into an alternating composition of aquifers and confining units. Confining units are formations of rock and/or sediment that have relatively lower permeability that groundwater movement through these units is retarded or impeded. The Meyers Branch Confining System is mainly comprised of the Crouch Branch Confining Unit, which separates the Floridan and Dublin-Midville Aquifer Systems.

Hydrostratigraphy of Central-Southern SRS, which includes the LTR IOU, is illustrated in Figure 2-5 (Aadland et al. 1995). Figure 2-6 shows the potentiometric surface and apparent groundwater flow directions and surface water discharge areas of the near-surface water table aquifer systems within LTR IOU.

2.3 Conceptual Site Model

The conceptual site model (CSM) is an objective framework for assessing data pertinent to the investigation. The preliminary CSM (Figure 2-7) identifies and evaluates suspected sources of contamination, contaminant release mechanisms, potentially affected media (secondary sources of contamination), potential exposure pathways, and potential human and ecological receptors.

Exposure pathways describe the course a chemical or physical agent takes from the source to the exposed receptor. The following seven components constitute an exposure pathway:

- Primary Sources,
- Primary Sources Environmental Release Mechanisms,
- Secondary Sources,
- Secondary Sources Environmental Release Mechanisms,
- Exposure media (sediment, soil, surface water, etc.),
- Exposure route (external radiation, ingestion, dermal contact, inhalation, etc.), and
- Receptor (resident, worker, wildlife, etc.).

If any of these elements is missing, the pathway is incomplete and is not considered further in the quantitative risk assessment. A pathway is complete when all five components are present to permit potential exposure of a receptor to a source of contamination. Exposure analysis is important in terms of identifying all potentially complete exposure routes, understanding the nature and extent (as well as fate and transport) of contamination, and developing preliminary remedial alternatives. In a complete pathway, exposure occurs at exposure points that may represent only a small portion of the entire exposure route. If there is no exposure point, then there is no exposure, and the pathway is considered incomplete.

2.3.1 Primary Sources of Contamination

The primary sources of contamination in the LTR IOU are from liquid releases from past R-Reactor and P-Reactor operations and include process leaks, reactor disassembly basin purges, and thermal discharges which contained tritium, metallic contaminants, and other radiological

contaminants. Radiological contaminants, primarily Cs-137, present in the pre-cooler ponds and PAR Pond were sorbed onto the sediments.

2.3.2 Primary Sources Environmental Release Mechanisms

Environmental release mechanisms for primary sources of contamination to LTR IOU are P-Reactor and R-Reactor thermal releases as a result of historic facility operations, deposition, and runoff. Thermal releases from P Reactor to Steel Creek occurred during the early 1950s, and R-Reactor thermal releases to Joyce Branch occurred throughout the 1950s.

Intermittent thermal releases to the PAR canal system began in the mid-1950s until the system was fully operational in 1958, initiating regular thermal releases into the LTR IOU watershed. R-Reactor was placed in stand-by in 1964 and the use of Joyce Branch, Pond C, and the canal system for R-Reactor was terminated. Environmental release mechanisms for primary sources of contamination have been inactive since the early 1970s.

2.3.3 Secondary Sources of Contamination

As the primary source contacted other media, secondary sources of contamination were created. At LTR, the discharge of wastewater from the P-and R-Reactors at the historic outfalls (Figure 2-8) created the secondary sources including surface water, surface sediment/soil, and subsurface soil.

2.3.4 Secondary Sources Environmental Release Mechanisms

At the LTR, the secondary release mechanisms included volatilization, biotic uptake, fugitive dust by wind or other soil surface disturbances, and exposure to on-site workers during soil excavation.

2.3.5 Exposure Media

LTR IOU exposure media include air vapor, biota, surface water, air particulate, and surface sediment/soil. LTR IOU sediment/soil media are present beneath the surface water features and at locations within the 100-year floodplain boundary of each surface water feature. Surface water, sediment/soil, and biota (fish) sample locations are illustrated on Figure 2-9.

2.3.6 Exposure Routes

LTR IOU exposure routes include inhalation, external radiation, ingestion, and dermal contact.

2.3.7 Receptors (Human and Ecological)

Previous decisions for the Middle and Lower subunits of the LTR IOU were based on an adolescent trespasser exposure scenario, since the stream and its floodplain are more readily accessible from off-site. For the Upper subunit of the LTR IOU, the IOU On-Site Worker was determined to be the most likely receptor for risks associated with the ponds and canal system in the Upper subunit. The IOU On-Site Worker is based on an SRS wetland researcher scenario and is also protective of the IOU Adolescent Trespasser (i.e., 10 years, 90 days/yr, 18 hrs/day, and 16,200 total exposure hours).

For comparative purposes, a risk evaluation will also be conducted for the operable unit (OU) Resident and OU Industrial Worker. Because it is known that some contaminants have the potential to bio-accumulate in fish, and fish are a mobile media, the evaluation of human exposure for the Upper subunit also includes a recreational fisherman scenario.

A comparison of exposure assumptions to potential human exposure scenarios at SRS is provided below:

Potential Receptor	Years	Days/Year	Hours/Day	Exposure Hours
OU Resident	26	350	24	218,400
OU Industrial Worker	25	250	8	50,000
IOU On-Site Worker	20	150	8	24,000

Complete exposure pathways to potential human receptors for evaluation in the BRA include the following (Figure 2-7). Potential ecological receptors for LTR IOU may include terrestrial and aquatic/semi-aquatic wildlife.

The final CSM, which includes the refined constituents of concern discussed in Chapter 3, is presented in Figure 3-24.

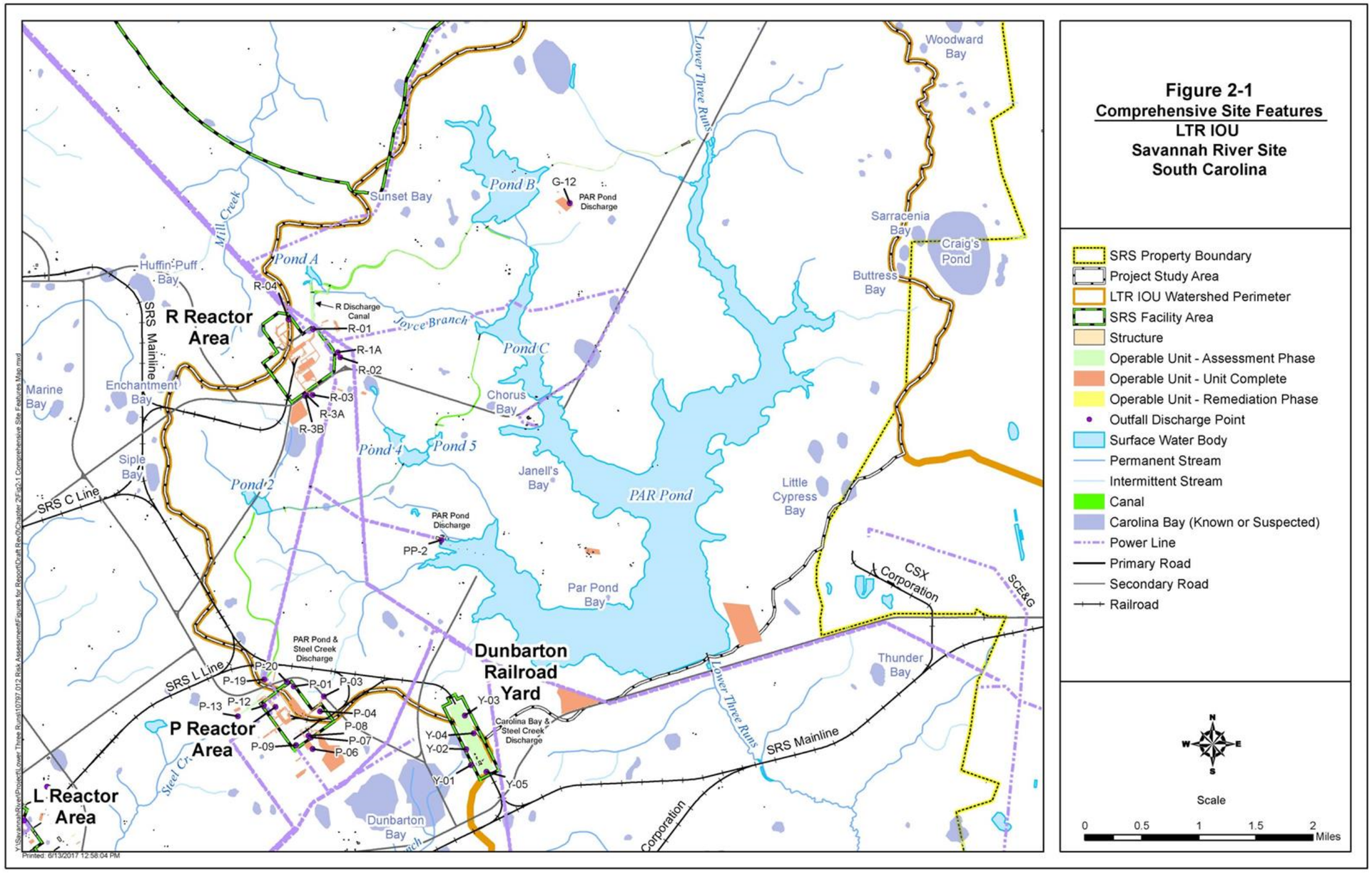


Figure 2-1. Comprehensive Site Features

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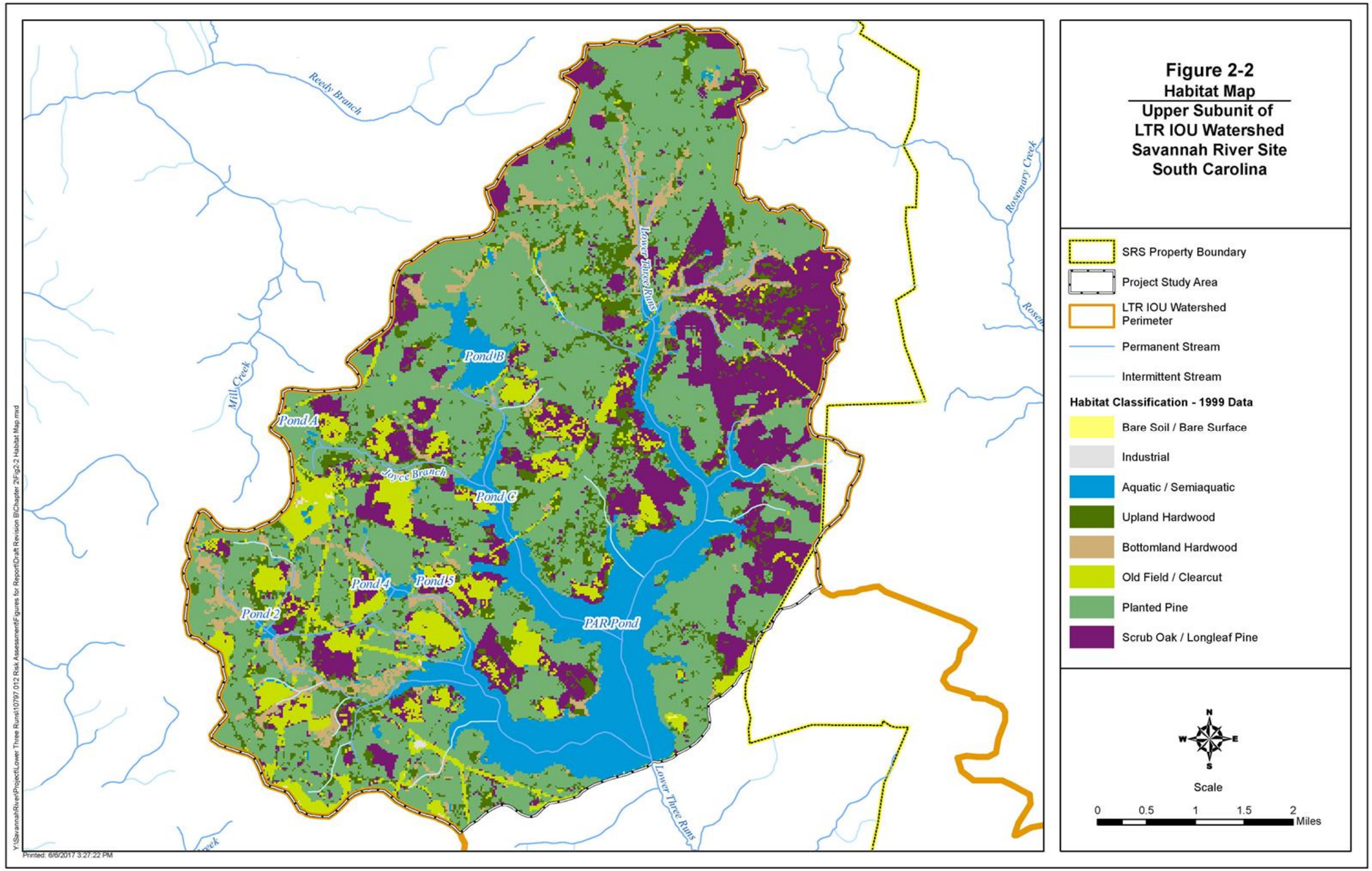
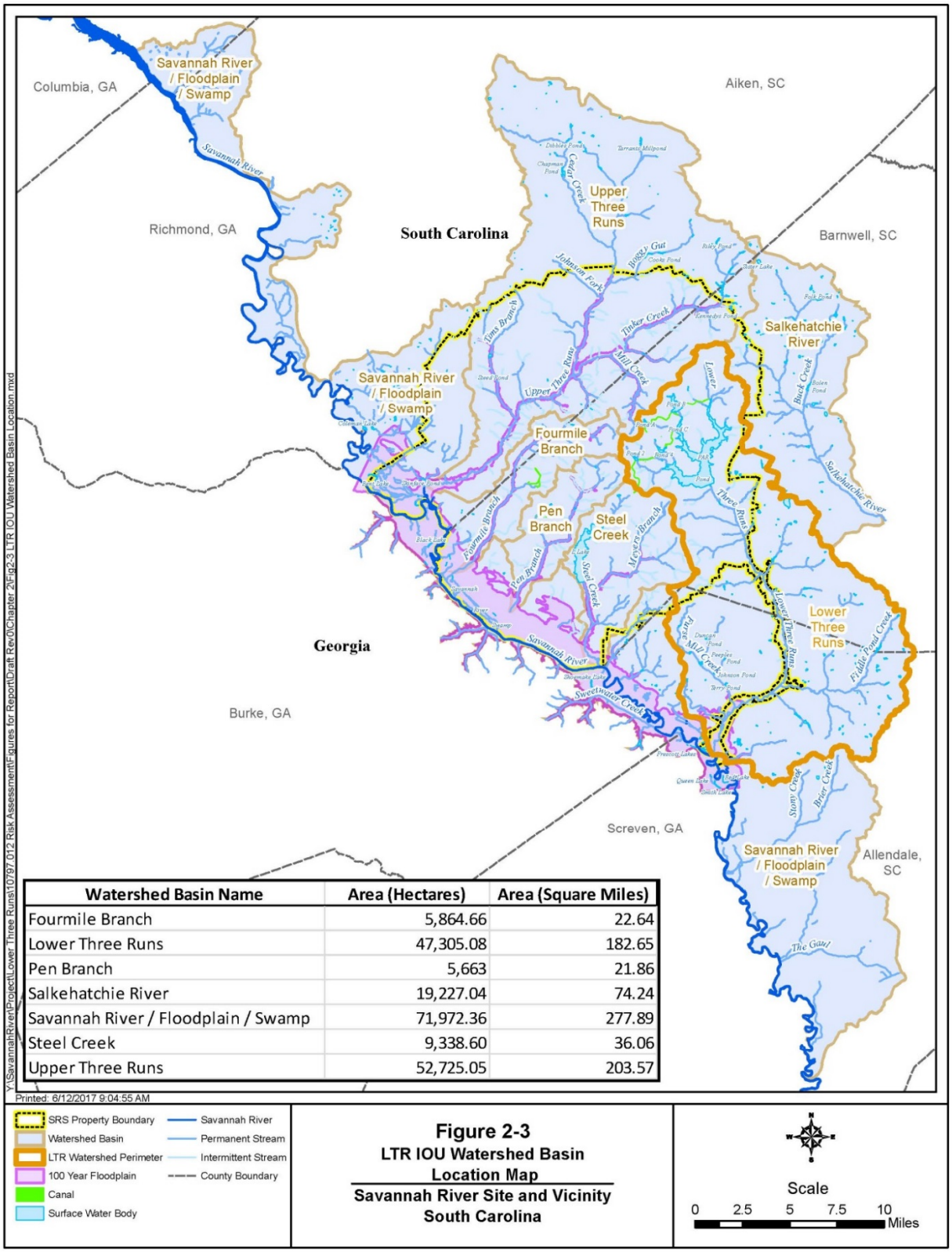


Figure 2-2. Habitat Map

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Watershed Basin Name	Area (Hectares)	Area (Square Miles)
Fourmile Branch	5,864.66	22.64
Lower Three Runs	47,305.08	182.65
Pen Branch	5,663	21.86
Salkehatchie River	19,227.04	74.24
Savannah River / Floodplain / Swamp	71,972.36	277.89
Steel Creek	9,338.60	36.06
Upper Three Runs	52,725.05	203.57

Figure 2-3. LTR IOU Watershed Basin Location Map

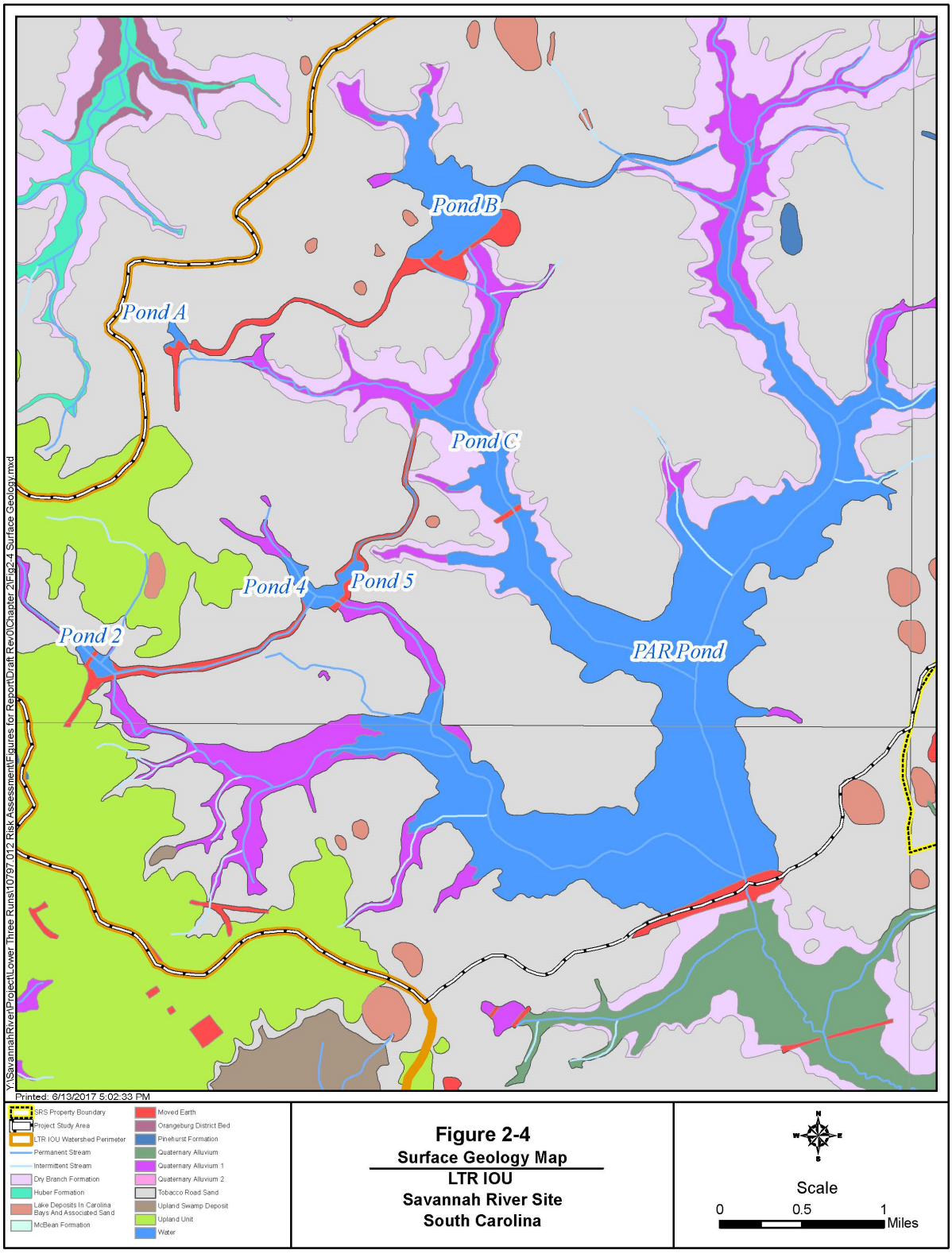


Figure 2-4. Surface Geology Map

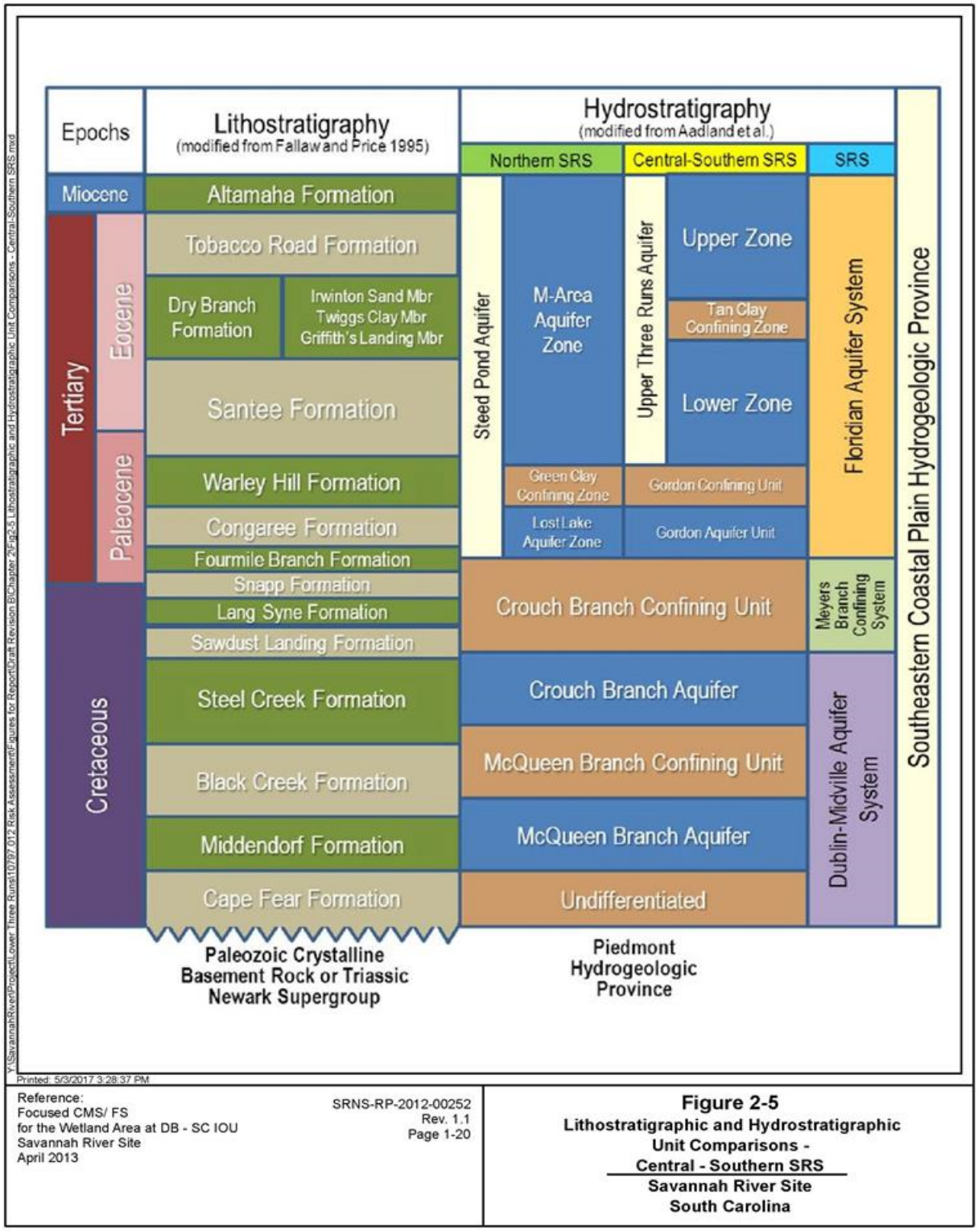


Figure 2-5. Lithostratigraphic and Hydrostratigraphic Unit Comparisons – Central – Southern SRS

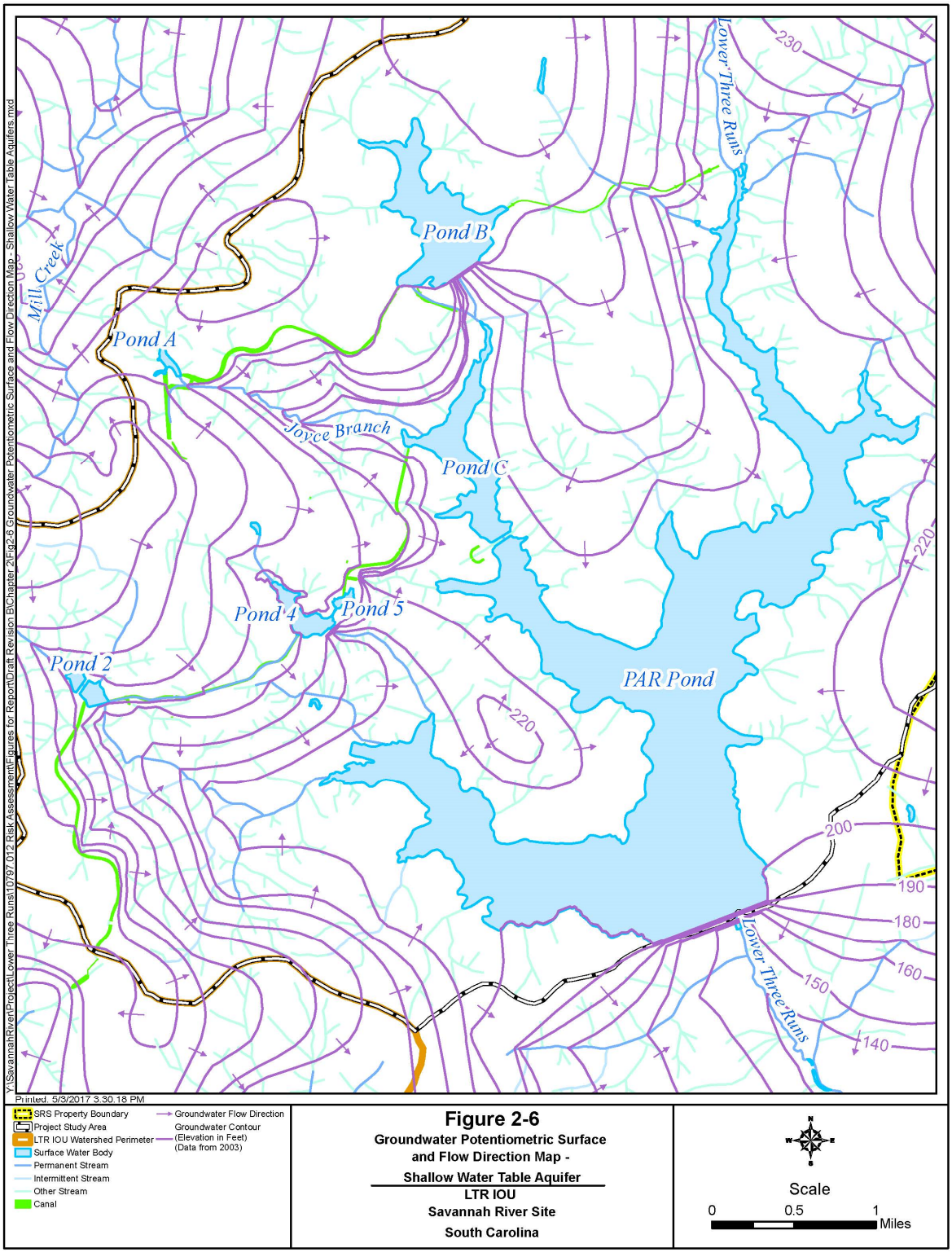
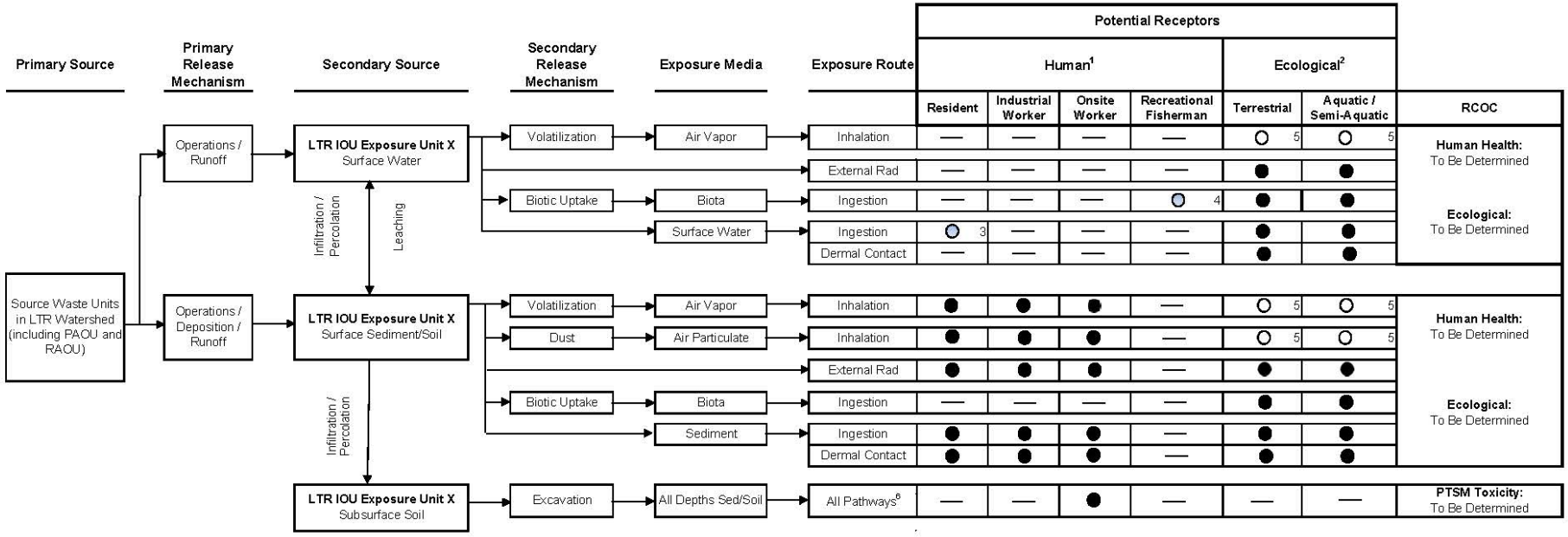


Figure 2-6. Groundwater Potentiometric Surface and Flow Direction Map – Shallow Water Table Aquifer



1 Human Health Risk Assessment will formally calculate risk/hazard for the default Resident, default Industrial Worker, and site-specific On-site Worker exposure scenarios. On-site Worker identified as the most appropriate receptor.

2 Ecological Risk Assessment will evaluate risk (hazard) for terrestrial and aquatic/semi-aquatic receptors.

3 Surface water media will be evaluated by comparison to maximum contaminant level (MCL).

4 Fish tissue ingestion will be evaluated by comparison to regional screening levels (RSLs) and preliminary remediation goals (PRGs) for site-specific recreational fisherman scenario.

5 In general, toxicity information for the inhalation pathway is not available for ecological receptors.

6 All pathways represents ingestion, inhalation, dermal contact, and external radiation exposure for the principal threat source material (PTSM) evaluation for toxicity.

Figure 2-7. Preliminary Conceptual Site Model for LTR IOU

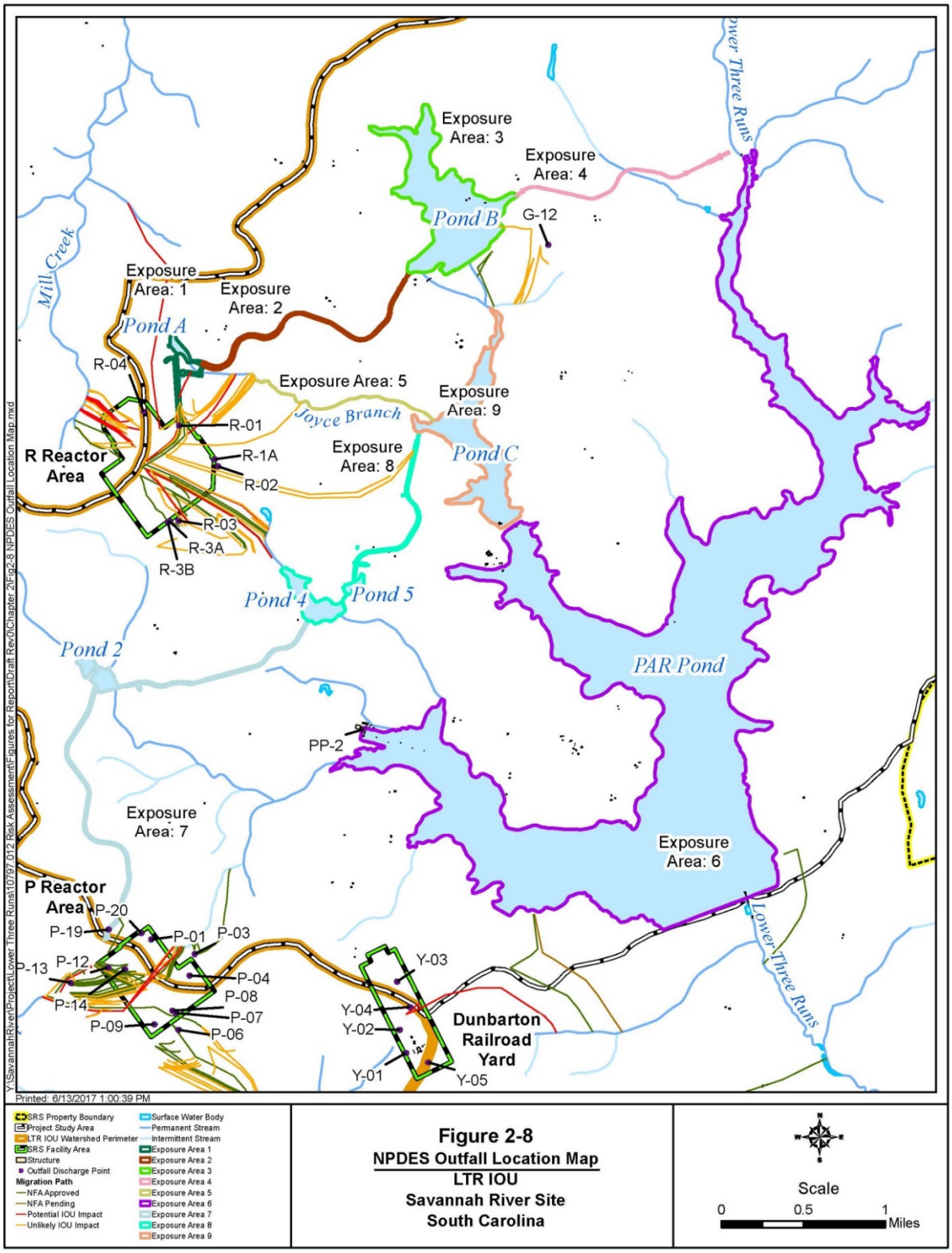


Figure 2-8. NPDES Outfall Location Map

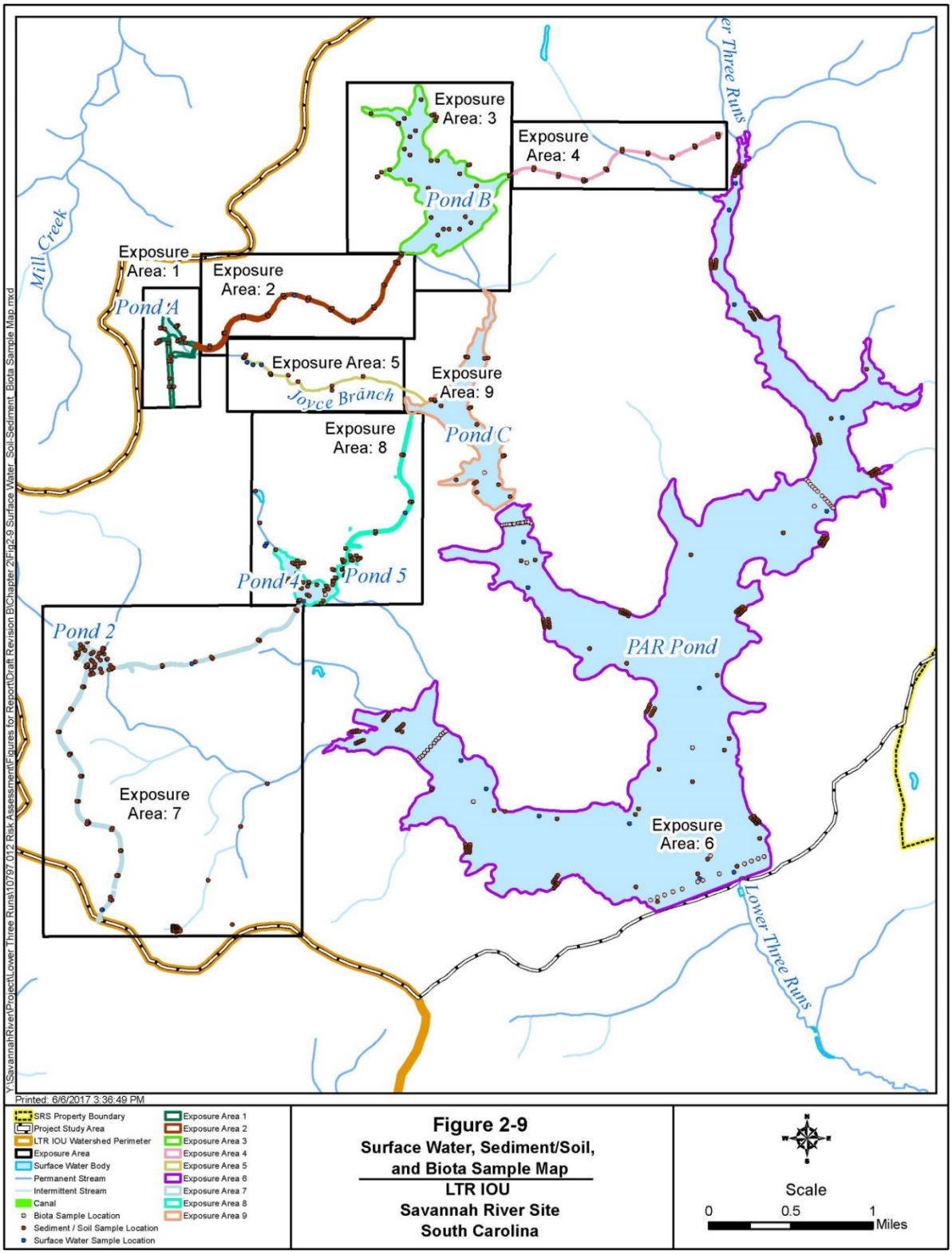


Figure 2-9. Surface Water, Sediment/Soil, and Biota Sample Map

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Table 2-1. TES Plant Species Known to Occur on SRS

Species	Habitat
Striped garlic (*Allium cuthbertii*)	Sandhills, granite domes, flatrocks.
Gerardia (*Agalinus decemloba*)	Dry clayey or sandy woods
Incised groovebur (*Agrimonia incisa*)	Pinelands
Dutchman's pipe (*Aristolochia macrophylla*)	Cove forests
Great Indian plantain (*Arnoglossum muehlenbergii*)	Cove forests, other mesic forests
Hairy milkpea (*Astragalus villosus*)	Sandhills and other dry, sandy places
Sandhills milkpea (*Astragalus michauxii*)	Sandhills
Lanceleaf wild indigo (*Baptisia lanceolata*)	Sandhills
Chapman's sedge (*Carex chapmanii*)	Edges of calcareous pine savannas, calcareous slopes and bottomlands, mesic hammocks, stream terraces
Collins sedge (*Carex collinsii*)	Bogs and Carolina bays
Cypress-knee sedge (*Carex decomposita*)	Blackwater swamp forests, river sloughs
Long sedge (*Carex folliculata*)	Bogs, boggy forests
Eastern few-fruit sedge (*Carex oligocarpa*)	Rich forests, over calcareous or mafic rocks
Nutmeg hickory (*Carya myristiciformis*)	Calcareous nonriverine swamps, oak flatwoods
Rose coreopsis (*Coreopsis rosea*)	Upland depression ponds
Elliott's croton (*Croton elliottii*)	Shores of clay-based Carolina bays
Carolina larkspur (*Delphinium carolinianum*)	Limestone glades
Smooth purple coneflower (*Echinacea laevigata*)	Open woodlands and glades over mafic or calcareous rocks
Little bur-head (*Echinodorus tenellum* var. *parvulus*)	Drawdown zones of coastal plain ponds, pineland ponds, blackwater riverbanks
Southern swamp privet (*Forestiera acuminata*)	Swamp forests
Green-fringe orchid (*Platanthera lacera*)	Swamps, bogs, seepages
Two-wing silverbell (*Halesia diptera*)	Bottomland forests, forested edges of brackish marshes
Little silverbell (*Halesia parviflora*)	Moist slopes, coves, creek-banks, bottomlands
Pondberry (*Lindera melissifolia*)	Wet flats and depressions, generally with pocosin shrubs
Bog spicebush (*Lindera subcoriacea*)	Peaty seepage bogs in headwaters of blackwater streams, with pocosin shrubs
Boykin's lobelia (*Lobelia boykinii*)	Cypress ponds and depression meadows

Table 2-1. TES Plant Species Known to Occur on SRS *(Continued/End)*

Species	Habitat
Spatulate seedbox (*Ludwigia spathulata*)	Sinkhole ponds, cypress-gum ponds, depression meadows, boggy shores
Carolina birds-in-a-nest (*Macbridea caroliniana*)	Swamp forests
Canada moonseed (*Menispermum canadense*)	Moist nutrient-rich forests, especially on floodplains or lower slopes
Indian olive (*Nestronia umbellula*)	Relatively mesic sites in sandhills
Sandhill lily (*Nolina georgiana*)	Sandhills
American nailwort (*Paronychia americana*)	Sandhills
Durand oak (*Quercus durandii*)	Alluvial and slope forests
Three-awned meadow-beauty (Rhexia aristosa)	Clay-based Carolina bays, depression meadows, and limesink ponds
West Indies meadow-beauty (*Rhexia cubensis*)	Limesink ponds
Oconee azalea (*Rhododendron flammeum*)	Sandhills, upland forests on slopes, ridges, stream bluffs
Drowned horned rush (*Rhynchospora inundata*)	Limesink depression ponds, intermittently flooded depression meadows
Slender arrowhead (*Sagittaria isoetiformis*)	Pineland ponds, clay-based Carolina bays, other seasonally flooded depressions
Sweet pitcher plant (*Sarracenia rubra*)	Seepage bogs and savannas
Canby's bulrush (*Scirpus etuberculatus*)	Beaver ponds, on peat in small depression ponds, in flowing blackwater streams
Baldwin's nut rush (*Scleria baldwinii*)	Wet savannas, under pines or pond cypress
Least trillium (*Trillium pusillum*)	Dry to dry-mesic forests and woodlands
Florida bladderwort (*Utricularia floridana*)	In deep water of natural Carolina bay lakes, other natural lakes, and limesink ponds
Dwarf bladderwort (*Utricularia olivacea*)	In floating mats (often algal) in water of limesink ponds, artificial lakes, or beaver ponds

Table 2-2. Average Temperature and Precipitation for SRS

Month	Temperature (°F)					Sweltering Days (> 90°F)	Freezing Days (< 32°F)	Rain (inches)
	Highest Maximum	Mean Maximum	Lowest Minimum	Mean Minimum	Average			
Jan	86	58	-3	37	47	0	9.8	4.2
Feb	86	60	12	39	50	0	6.7	4.2
Mar	90	69	11	46	57	0	2.1	4.8
Apr	99	77	29	53	65	0.9	0.1	3.1
May	99	84	38	61	73	5.1	0	3.6
Jun	108	90	48	69	79	14.1	0	5.0
Jul	107	92	58	72	82	19.8	0	5.3
Aug	107	91	56	71	81	16.5	0	5.1
Sep	104	86	41	66	76	7.0	0	3.9
Oct	96	76	28	55	66	0.5	0.1	2.9
Nov	89	68	18	45	56	0	2.2	2.8
Dec	82	59	7	39	49	0	7.4	3.7
Annual	**108**	**76**	**-3**	**54**	**65**	**63.9**	**28.4**	**48.5**

Notes:
> greater than
< less than
1. Period of record 1964-2013.
2. Source: *Trends in Atmospheric Climate Parameters Measured at SRS 1964-2013* (SRNS-STI-2016-00241, 2016).

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3.0 REMEDIAL INVESTIGATION

3.1 Lower Three Runs Integrator Operable Unit Investigation Overview

This section summarizes the data gathered during the Remedial Investigation (RI) and describes how data were assembled, synthesized, and analyzed for use in the Baseline Risk Assessment (BRA). The Lower Three Runs (LTR) Integrator Operable Unit (IOU) has undergone several data collection efforts since 2002 and has utilized data from various data stewards, prior to and subsequent to the initial data collection effort. This section describes collection of IOU data with particular focus on the 2009/2010 and 2016 characterization efforts conducted to collect the necessary data to support this BRA. This section will also discuss the historical data that were compiled annually by the IOU program for the initial RI Work Plan and subsequent periodic reports supporting investigation of the LTR IOU. Most of these data have been used in the past to conduct screening level assessments for the LTR IOU utilizing both IOU-collected data and data collected by other data stewards.

The Savannah River Site (SRS) IOU program is implemented in three phases to support a final Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for the IOU. Phase I of the IOU program (i.e., RI Work Plan) consists of an assessment of existing data to determine if early actions are necessary and to define additional data needs. Phase II of the IOU program consists of ongoing sampling and assessment of the IOU and refinement of the conceptual site model (CSM). The status of the IOU during Phase II is documented through submittal of Periodic Reports. Phase II concludes when the operable unit (OU) investigations that may impact the specific IOU are complete. At that time, the entire IOU is addressed holistically in Phase III through an assessment of all available data, development of the RI/BRA, completion of the Remedial Investigation/Feasibility Study (FS) process through the ROD, and remedial actions, if warranted.

The initial RI Work Plan (WSRC 2002) and subsequent Periodic Reports describe the data collection efforts for the LTR IOU. Assessment of data for the LTR IOU is provided in detail in the following reports:

- *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (WSRC 2002),
- *Periodic Report 1 for the Lower Three Runs Integrator Operable Unit* (WSRC 2004b) (i.e., Periodic Report 1),
- *Periodic Report 2 for the Lower Three Runs Integrator Operable Unit* (WSRC 2007a),
- *Periodic Report 3 for the Lower Three Runs Integrator Operable Unit* (Savannah River Nuclear Solutions [SRNS] 2009b), and
- *Periodic Report 4 for the Lower Three Runs Integrator Operable Unit* (SRNS 2012c).

The SRS LTR IOU database contains the data collected for the IOU program and supplemental data acquired from various data stewards, all of which supported Work Plan and Periodic Report development. The collection efforts were conducted for sediment, wetland and floodplain sediment/soils, surface water, and fish medium from the waterbodies/canal systems and streams/tributaries associated with the LTR IOU.

The LTR IOU database consists of data compiled from the following sources:

1. IOU Sampling Efforts:
    a. Initial RI Work Plan for the LTR IOU (2002)
    b. Periodic Reports 1 through 3 (2004 – 2010).
2. Operable Unit Investigations (various):
    a. P-Area Operable Unit (WSRC 2007b)
    b. R-Area Operable Unit (RAOU) (WSRC 2009)
    c. R-Area Groundwater (SRNS 2013c)
    d. R-Area Burning/Rubble Pits (WSRC 2000)
    e. P-Area Sludge Land Application Site (WSRC 2005).
3. SRS Annual Environmental Report Monitoring (1991 – 2015).
4. Historical SRS Studies:

a. Comprehensive Cooling Water Study (1983 – 1987)

b. PAR Pond Drawdown and Refill Studies (~ 1990 – 1996)

c. BRA Using Existing Data for PAR Pond (1992)

d. United States Department of Energy (USDOE), Final Environmental Impact Statement, Shutdown of the River Water System at the Savannah River Site (1997)

e. Savannah River National Laboratory Special Studies (Pond 2/5; TMDL Low-Level Mercury Study, PAR Pond fish, sediment, and water chemistry).

5. South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program Monitoring (conducted annually).

6. United States Environmental Protection Agency (USEPA) STORET (STOrage and RETrieval) Database (annual data retrievals).

7. Academia/Research Entities/Other:

   a. Savannah River Ecology Laboratory (SREL)

   b. Consortium for Risk Evaluation with Stakeholder Participation

   c. Phinizy Center for Water Sciences (Phinizy)

   d. Allied General Nuclear Services.

As indicated above, there are several SRS-specific sampling efforts that involve Site-wide studies (i.e., annual environmental report monitoring), and studies focused on particular systems, such as PAR Pond (Koch et al. 1996; Paller and Wike 1996a, 1996b). As such, there is a substantial amount of data associated with the LTR IOU. Much of the data were associated with particular locations or special studies, as well as targeted periodic IOU sampling focused primarily on determining the nature of contamination.

Additional characterization efforts for the LTR IOU were conducted in 2009/2010 through implementation of the approved *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2010a). Another sampling effort was conducted in 2016 for PAR Pond exclusively for sediment and surface water to supplement existing data. The sampling was implemented following the approved *Addendum to the Sampling and Analysis Plan for the*

Lower Three Runs Stream, Floodplain, and Headwaters (SRNS 2016a). A discussion of the 2009/2010 and 2016 sampling events are provided in more detail in Section 3.2.5 and Section 3.2.6, respectively. The 2009/2010 LTR IOU and 2016 PAR Pond characterization data were collected with the intent of determining the nature and extent of contamination to support development of the RI/BRA and future remedial action decisions.

3.2 Characterization Methodology and Data Usability

This section summarizes the characterization efforts for the LTR RI/BRA from the initial RI Work Plan through the 2016 PAR Pond sampling effort that produced the final dataset supporting the LTR RI/BRA. The RI Work Plan represents Phase I of the IOU process.

3.2.1 Initial RI Work Plan

The *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (WSRC 2002) compiled existing data that were available for the LTR IOU (including sediment, sediment/soil, surface water, and fish) from various sampling and monitoring efforts conducted by various investigators, which established the LTR IOU database. Summaries of several of the most prominent studies that provided data to the initial IOU database are provided below.

- Surface sediments in pre-cooler Ponds 2, 4, and 5: March 2000 (WSRC-TR-2000-00164, Savannah River Technology Center [SRTC])

  In March 2000, sediment samples were collected from pre-cooler Ponds 2, 4, and 5 by SRTC Environmental Analysis Section personnel. Samples were analyzed at the SRS Environmental Monitoring Section laboratories. Confirmation analyses were performed at General Engineering Laboratories to determine levels of radioactive, lead and mercury in sediments that could be exposed if the pre-cooler pond dams were eliminated or allowed to fail. Radioisotope levels measured in the pre-cooler pond sediment samples exceeded background levels for SRS soils. The highest average gross beta activity (173 pCi/g) was found in Pond 5 sediments, whereas the maximum gross beta measurement (462 pCi/g) occurred in a Pond 4 sample. The highest average gross alpha activity (50 pCi/g) was found in Pond 4 sediments. Pond 2 sediments had the lowest gross alpha (29 pCi/g) and beta (87 pCi/g) activities. The

average cesium-137 (Cs-137) level in sediments was highest in Pond 5 (40 pCi/g) and lowest in Pond 2 (18 pCi/g). The sediments also displayed evidence of lead and mercury contamination that exceeded background levels for SRS soils and exceeded ecological risk screening levels. The radionuclide inventory of Ponds 2, 4, and 5 was found to be dominated by Cs-137 and contained the manmade radionuclide cobalt-60 (Co-60). The Co-60 and Cs-137 activities in all three pre-cooler ponds exceeded human health risk screening levels. A dose assessment was performed to further assess the human health risks associated with drying of the sediments. Actual levels of activity found in the samples were used to calculate potential radiation doses to a person working in the pre-cooler pond areas. The largest potential dose to a pre-cooler pond worker was conservatively calculated to be 61 millirem/year (mrem/y), which was less than the 100 mrem/y dose that would require radiation worker classification and posting as a Soil Contamination Area.

- Results of Submerged Sediment Core Sampling and Analysis on PAR Pond, Pond C, and L Lake: July 1995 (WSRC-TR-96-0238, SRTC)

  Sediment cores from shallow and deep-water locations in PAR Pond, Pond C, and L Lake were collected and analyzed in 1995 for radioactive and nonradioactive constituents. This core analysis was conducted to develop a defensible characterization of contaminants found in the sediments of PAR Pond, Pond C, and L Lake. L Lake results will not be discussed as this water body is located within the Steel Creek Watershed. Cs-137, promethium-146, plutonium-238, and zirconium-95 had significantly higher concentrations in Pond C/PAR Pond sediments than in sediments from the background sites.

- Sampling and Analysis of Pond 2, Pond 5, and the P-Reactor Canal Sediments (WSRC-TR-96-0175, SRTC)

  In support of an Environmental Impact Statement to determine the consequences of shutting down the river water distribution system, sediment samples from Pond 2, Pond 5, and the P-Reactor canal were collected from above and below the existing water line. Samples were analyzed for gross alpha, gross beta, and gamma activity. The intent was not to characterize the ponds and canal, but to identify the maximum levels of contamination in sediments that

could be exposed by fluctuating water levels and determine whether those levels exceed levels used in risk assessments of exposed PAR Pond sediments.

Sediment samples were initially collected in August 1995 and April 1996 at four sites in Pond 2, eight sites in or near Pond 5, and one site along the canal between Pond 2 and Pond 5. Additional sampling was initiated in April 1996 because an examination of the August 1995 results indicated higher-than-expected contamination at some locations and because a reexamination of the gamma contours from aerial survey data identified additional locations with contamination. Gamma spectroscopy, gross alpha, and nonvolatile beta analysis were performed. Overall, activity levels in this study were comparable to activities measured during previous studies of the PAR Pond cooling system.

- Potential Ecological Effects of Contaminants in the Exposed PAR Pond Sediments (WSRC-TR-96-0292, SRTC)

  Sediment (from the exposed sediments of PAR Pond) and small mammal samples were collected in early 1995, shortly before the reservoir was refilled after a 4-year drawdown. Sampling was confined to elevations between 58- and 61-meters (m [190- and 200-feet {ft}]) above mean sea level (msl), which includes the sediments likely to be exposed if the PAR Pond water level is permitted to fluctuate naturally. Both sediment and small mammal samples were analyzed for a number of radionuclides and metals. Some of the sediment samples were also analyzed for organic contaminants. The objective of the study was to determine if contaminant levels in the PAR Pond sediments were high enough to cause deleterious ecological effects.

  None of the metals or organic constituents measured in the PAR Pond exposed sediments exceeded the USEPA, the National Oceanographic and Atmospheric Administration, or Canadian ecological screening criteria for contaminants in terrestrial soils. However, the maximum total mercury concentration (485 µg/kg, geometric mean of 62 µg/kg*)* slightly exceeded the USEPA screening criterion for ecological effects in submerged (i.e., aquatic) sediments. These results suggested that mercury may pose a problem when the PAR Pond sediments are submerged and mercury bioavailability increases, but not when the sediments are exposed and acting as terrestrial soils.

A number of radionuclides were detected in the PAR Pond sediments, but only Cs-137 occurred consistently and at levels in excess of background. From the data collected in early 1995 for the SRTC study, the geometric mean of Cs-137 concentration was 7.2 pCi/g; the maximum was 56.7 pCi/g (Paller and Wike 1996b). Cs-137 was non-uniformly distributed on both small and large spatial scales, but usually higher amounts at the lower elevations (58- to 59-m [190- to 195-ft] above msl) than upper elevations (59- to 61-m [195- to 200-ft] above msl). Cs-137 concentrations were higher in sediments with high organic content, and the patchy distribution of these sediments probably contributed to the patchy distribution of Cs-137. The spatial distribution of total mercury and Cs-137 in the exposed sediments was significantly correlated, but the correlation was relatively weak (R2 = 0.25).

Cotton rats were the most commonly collected small mammal on the exposed PAR Pond sediments. Cotton rats bioaccumulate Cs-137; the geometric mean total body burden of Cs-137 in PAR Pond cotton rats was 57.0 pCi/g, and the maximum was 181.0 pCi/g. Cs-137 levels in PAR Pond exposed sediments and in cotton rats were strongly correlated (R2 = 0.57 to 0.90). Other radionuclides occurred in PAR Pond cotton rats but inconsistently or at comparatively low levels when compared to cotton rats from background sites. The total radiation dose (internal and external) to cotton rats residing on the exposed sediments of PAR Pond was ~0.003 rad/day, well under the 1.0 rad/day standard set by the USDOE for the exposure of native organisms to radiation. There was no evidence that mercury bioaccumulated in PAR Pond cotton rats.

In summary, Cs-137 and mercury are the principal contaminants in the PAR Pond sediments at the elevations likely to be exposed if the PAR Pond water level were permitted to fluctuate naturally.

The RI Work Plan (WSRC 2002) presented the data from the aforementioned studies and data from data stewards summarized in Section 3.1. The Work Plan also described the first round of IOU sampling presented in the Sampling and Analysis Plan (SAP) contained in that report (WSRC 2002). The areas targeted for sampling by the SAP included:

- R-Area: R-Area Effluent Canal leading to Pond A, Joyce Branch (Old R-Area Effluent Canal), Carolina Bay and unnamed tributary for Carolina Bay to Pond 4, and the unnamed tributary south of the R-Area Ash Basin;
- P-Area: P-Area Discharge Canal, Unnamed tributary northeast of P-Area, and Unnamed tributary from Pond 2 to PAR Pond;
- PAR Pond and Pre-cooler Ponds: Effluent canals linking the reactor areas and the pre-cooler ponds to PAR Pond, and pre-cooler ponds, including Pond A, Pond B, Pond C, Pond 2, and Ponds 4/5; and
- General Areas: Unnamed tributary south of Pond B which discharges into Pond C, Unnamed tributary east of Dunbarton Railroad Yard, and Lower Three Runs between the PAR Pond dam and the tail portion of the LTR IOU.

Two types of data analysis were performed: field screening and definitive level. Field screening analyses included hand-held x-ray fluorescence (XRF) detector for metals, and a submersible sodium iodide detector for gamma-emitting radionuclides (specifically Cs-137) which was used to collect data for the sediment/soil medium only. Definitive level data were obtained for sediment, sediment/soil, and surface water, including laboratory analyses for gamma spectroscopy, gross alpha, nonvolatile beta, tritium (for surface water only), target compound list (TCL) organics, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and target analyte list (TAL) inorganics. The *Field Summary Report for the LTR IOU* (WSRC 2004c) details the sampling effort. The data associated with these sampling efforts became part of the LTR IOU database.

Upon completion of the Work Plan, the LTR IOU entered Phase II of the IOU program (investigation process). Phase II was the on-going monitoring and assessment of the IOU (with periodic reporting) prior to the onset of Phase III final action determinations.

3.2.2 Periodic Report 1

- The second round of LTR IOU sampling was described in the SAP located in the *Periodic Report 1 for the Lower Three Runs IOU* (WSRC 2004b) (i.e., Periodic Report 1). Areas targeted for additional sampling included Pond 2 and Ponds 4/5.

The investigation at Ponds 4/5 included an area targeted south of R-Area for a sodium iodide detector survey for gamma-emitting radionuclides, specifically Cs-137, and collection of sediment/soil samples for definitive level data. Definitive level analyses were conducted for a full suite of analytes (TCL, TAL), radionuclide indicators (gross alpha, nonvolatile beta), gamma spectroscopy, with contingent radionuclide speciation if triggers were exceeded, at the rate of 10% of the screening-level samples. This area did result in elevated Cs-137 activities and was administratively moved to the RAOU for final deposition.

The investigation at Pond 2 included an unnamed tributary northeast of P Area. Sampling utilized an XRF detector for metals, and sodium iodide detector for gamma emitters (primarily Cs-137) along the reach of the tributary. Definitive level analyses were for the full suite of analytes at the rate of 10% of the screening-level samples. Results of these data collection efforts were discussed in *Periodic Report 2 for the LTR IOU* (WSRC 2007a), and these data became part of the LTR IOU database.

3.2.3 Periodic Report 2

The third round of LTR IOU sampling was described in *Periodic Report 2 for the LTR IOU* (WSRC 2007a). Sampling consisted of follow-on speciation for alpha spectroscopy and nonvolatile beta-emitting radionuclides for sediments/soil at the area south of R Area targeted for Periodic Report 1 sampling. The gross alpha screening value (20 pCi/g) was exceeded at LTROU-41 south of R Area. Nonvolatile beta activities also exceeded the screening value (50 pCi/g) at two locations (134 pCi/g at LTROU-40 and 72 pCi/g at LTROU-41. The screening process identified elevated Cs-137 within a small wetland area adjacent to the R-Area Caustic Basin located south of R Area. This area was administratively transferred to the RAOU.

Fish tissue was also identified as a data need for the Lower LTR subunit (tail portion of LTR IOU) to be collected at the Patterson Mill, Highway 125, and Stinson Bridge road crossings. Samples consisted of whole fish composites of a predator, benthic species, and regional species and analyzed for metals, Cs-137, Co-60, strontium-89/90, plutonium series, and tritium.

3.2.4 Periodic Report 3

For *Periodic Report 3* (SRNS 2009b), fish tissue was identified as a data need for Ponds A, B, C, 2, Ponds 4/5 and for background locations to support the trophic modeling effort for LTR (Paller et al., 2008). Concentrations of arsenic, thallium, and mercury had previously been observed in fish tissue. However, previously collected samples may have represented background concentrations since concentrations reported from background areas were comparable to levels in reported in the LTR IOU. In order to provide adequate data to make this determination, three samples were taken at four separate locations within the LTR Upper subunit.

The background locations were chosen to represent the various environmental conditions present in the LTR IOU and included the following areas:

(1) Upper LTR IOU upgradient of the PAR Pond system and site operational effluents (an upgradient background unit location),

(2) Tinker Creek, a tributary of Upper Three Runs (comparable to the upper reaches of LTR),

(3) Meyers Branch, located in the Steel Creek IOU (comparable bottomland hardwood/cypress environment), and

(4) Crackerneck Wildlife Management Area (WMA), up-gradient of the mouth of Upper Three Runs (swamp habitat up gradient of LTR influenced by the Savannah River).

Each fish sample consisted of a particular species representing a benthic feeder, a regional species, or a predator. Selecting the species of fish for chemical analysis was based on the amount of fish tissue obtained, trophic level, size, and representativeness of each species as compared to other sampling locations. Analyzing comparable species is beneficial when comparing body burdens (i.e., total accumulation of contaminants) from different locations. Each composite sample consisted of a minimum of two fish and totaled at least 0.66 pounds (lb [300 grams {g}])

(the minimum acceptable for laboratory analysis). Samples were analyzed for TAL inorganics (including arsenic, antimony mercury, and thallium), gross alpha, nonvolatile beta, tritium, and gamma spectroscopy for gamma emitters (including Cs-137).

Fish and other biota (crayfish, bullfrog tadpole) were also collected by the SREL (Bryan et al., 2011). These samples were from Pond 2, Pond A, and R-Area Discharge Canal.

Periodic Report 3 also initiated the *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2009a). This SAP included extensive sampling characterization of all subunits (Upper, Middle and Lower) of the LTR IOU to augment prior data collection to ensure sufficient information was available for evaluating risks to human health and ecological receptors. Sampling was conducted in canals, pre-cooler ponds and stream channel/floodplains. The 2009/2010 characterization effort included both field- and laboratory-based sampling approaches. Samples were obtained from evenly spaced transects to collect an unbiased data population. Transects were established along reactor discharge canals beginning 250 m (820.2 ft) from the reactor discharge locations (i.e., the reactor cooling outfalls to the IOU). Transect locations after the first pre-cooler pond at R-Area discharge canal continued every 250 m; transect locations along the P-Area discharge canal were established every 500 m (1,640.4 ft). The even spacing of transects resulted in an unbiased population of data. The data consisted of field collected gamma readings (lanthanum bromide [LaBr] detector) along transects that were supplemented with the collection of sediment, sediment/soil, and surface water samples for laboratory analysis. The sampling effort also included collection of both filtered and unfiltered water samples, composite and two depth intervals for sediments/soils, from the LTR subunits, as well as several background locations for all media.

The biological data collection effort associated with the LTR characterization is described below as well as the field activities that were documented in the *Field Summary Report for the Characterization of Lower Three Runs Stream, Floodplain, and Headwater* report (SRNS 2010b).

Sediment/Soil

For the 2009/2010 characterization, radiological survey instruments were used for field analysis as a precursor to determining a gross-level of radioactivity in the identified survey areas prior to discrete sampling events. Gamma field surveys for sediment/soil were performed using Canberra Inspector 1000 with activated $LaBr_3$ scintillator detectors to obtain a total gamma count and identify gamma spectrum isotopes. Isotope identification utilized various algorithms that discriminated peaks, thus improving resolution, and allowing more accurate peak discrimination in ranges where isotopes typically have many overlapping peaks. $LaBr_3$ gamma surveys were conducted within a 2-m (6.6-ft) radius of sediment/soil sampling locations.

Hand augers were used to collect shallow sediment/soil samples (0- to 0.3-m [0- to 1-ft] below ground surface {bgs} and 0.3- to 1.2-m [1- to 4-ft] bgs) at subunits included in the LTR IOU. The sediment/soil samples were collected using either a 5.1- or 7.6 centimeters (cm [2- or 3-inch {in.}]) diameter stainless steel hand auger bucket. The boring was advanced by manual rotation of the hand auger T-handle. For locations that required volatile organic analyte (VOA) analyses, VOA sampling was conducted in accordance with USEPA Method 5035. The VOA aliquot was collected directly out of the auger bucket at the bottom of each pre-designated sample interval. Each aliquot was weighed to 5 g (0.011 lb) ± 0.5 g (0.0011 lb) using an electronic balance. One 5-g (0.011-lb) aliquot was transferred to a 40-mL (1.35-ounce [oz]) vial, which contained methanol preservative, and two 5-g (0.011-lb) aliquots were placed in two 40-mL (1.35-oz) vials containing sodium bicarbonate. For VOA samples to be analyzed at Test America Laboratories, an additional 5-g (0.011-lb) aliquot was placed in one 40-mL (1.35-oz) vial containing American Society for Testing and Materials Type 1 water. The remaining sample then was homogenized in a stainless-steel bowl prior to filling the sample containers for other analytes. A decontaminated hand auger bucket was used for each sampling interval to prevent cross-contamination.

Hand augers were used to collect shallow sediment samples (0- to 0.15-m [0- to 0.5-ft] bgs) at subunits included in the LTR IOU. The sediment samples were collected using either a 5.1- or 7.6-cm (2- or 3-in.) diameter stainless steel hand auger bucket. The boring was advanced by manual rotation of the hand auger T-handle.

The following provides a summary of the 2009/2010 characterization activities for sediment/soil in the LTR IOU.

Joyce Branch (Old R-Area Discharge Canal): Five sample transects (JBTran001 through JBTran005) were located along Joyce Branch and were investigated using an LaBr survey. Two soil samples per each transect (0- to 0.3-m [0- to 1-ft] bgs and 0.3- to 1.2-m [1- to 4-ft] bgs) were collected for laboratory analysis based on the highest total gamma count measured with the LaBr instrument. In total, 10 sediment/soil samples and 1 duplicate soil sample were collected. All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sample location (JBT003) also was analyzed for TCL VOAs, TCL semi-volatile organic analytes (SVOAs), TCL pesticides/PCBs, and TAL metals.

P-Area Discharge Canal: Eighteen sample transects (PDC001 through PDC018) were located along the P-Area Discharge Canal. Sample transects were spaced approximately every 250-m (820-ft) between P-Reactor and Pond 2 and every 500-m (1,640-ft) between Pond 2 and Pond C. At each sample transect, there were three sediment/soil sampling locations. The first two sampling locations were positioned perpendicular to the channel, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. Soil samples were collected from 0- to 0.3-m (0- to 1-ft) bgs and 0.3- to 1.2-m (1- to 4-ft) bgs depth intervals at both locations. The third sediment/soil sample was collected on the slope leading down to the stream channel. This location was sampled from 0- to 0.3-m (0- to 1-ft) bgs and was collected on alternate sides of the channel for every other transect. In total, 90 original sediment/soil samples and eight duplicate sediment/soil samples were collected at the P-Area Discharge Canal. All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99.

Seven of the sample locations (PDC003, PDC004, PDC006, PDC009, PDC010, PDC014, and PDC018) were also analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, and TAL metals.

R-Area Discharge Canal: Twenty-two sample transects (RDC001 through RDC022) were located along the R-Area Discharge Canal. Sample transects were spaced approximately every 250-m (820-ft) along the entire length of the R-Reactor discharge canal. At each sample transect, there were three sediment/soil sampling locations. The first two sampling locations were positioned perpendicular to the canal, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. Soil samples were collected from 0- to 0.3-m (0- to 1-ft) bgs and 0.3- to 1.2-m (1- to 4-ft) bgs depth intervals at both locations. The third sediment/soil sample was collected on the slope leading down to the stream channel. This location was sampled from 0- to 0.3-m (0- to 1-ft) bgs and was collected on alternate sides of the channel for every other transect. In total, 110 original sediment/soil samples and 13 duplicate sediment/soil samples were collected at the R-Area Discharge Canal. All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. Eight of the sample locations (RDC001, RDC005, RDC008, RDC010, RDC013, RDC015, RDC018, and RDC021) also were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, and TAL metals.

Pre-cooler Ponds: Three transects were established across each of six pre-cooler ponds (Pond A, Pond B, Pond C, Pond 2, and Ponds 4 and 5). Sediment/soil sample locations were established at each endpoint of the transect line and within 0.9 m (3 ft) of the water line (in dry soil) for a total of four sediment/soil sample locations per transect (two on each side of the pond). Due to higher-than normal water levels in the ponds, some of the transect endpoint sample locations had to be moved to collect a soil sample away from the water's edge. Soil/sediment samples were collected from 0- to 0.3-m (0- to 1-ft) bgs and 0.3- to 1.2-m (1- to 4-ft) bgs depth intervals at each location. In total, 144 original sediment/soil samples and 15 duplicate sediment/soil samples were collected at the ponds. All samples were analyzed for radionuclide

indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sediment sample per pond (PAT1, PBT3, PCT1, P2T3, P4T2, and P5T2) also was analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, and TAL metals.

Background: Nine sediment/soil samples (including one duplicate sample) were collected from four background sampling locations (BKGDSS001 through BKGDSS004) identified as areas within the SRS boundary that have not been affected by SRS processes. Background locations included the Crackerneck WMA located in the Savannah River floodplain upgradient of Upper Three Runs Creek (BKGDSS001), upper LTR located upgradient of PAR Pond (BKGDSS002), Meyers Branch identified as a tributary of Steel Creek (BKGDSS003), and Tinker Creek identified as a tributary of Upper Three Runs Creek (BKGDSS004). Soil samples were collected from 0- to 0.3-m (0- to 1-ft) bgs and 0.3- to 1.2-m (1- to 4-ft) bgs depth intervals at each of the background sampling locations and were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, radionuclide indicators (gross alpha and non-volatile beta), and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99.

Surface Water

Prior to collecting surface water samples, water quality parameters were measured using a calibrated Horiba U-10. Water quality parameters included pH, conductivity, turbidity, dissolved oxygen, and temperature. After measuring water quality parameters, filtered and unfiltered surface water samples were collected using one of the following methods: handheld bottle, swing sampler (dipper), handheld pump, or peristaltic pump. Turbidity (the presence of solids in the water) is common in wetland and stream samples. Therefore, both filtered and unfiltered water samples were collected to determine if any metal contaminants identified are associated with the more bioavailable aqueous portion of the sample or associated with the particulate fraction. The

additional surface water samples were collected to assess uncertainty associated with the results obtained from previous water samples, which in some cases had visible turbidity, and to provide additional characterization data. These data have supplemented historical data available in the IOU database and will be used to support future remedial decisions. The following provides a summary of the 2009/2010 characterization activities for surface water in the LTR IOU.

Joyce Branch (Old R-Area Discharge Canal): Eleven surface water samples (including one duplicate sample) were collected from five sample transects along Joyce Branch (JBT001 through JBT005). At each of the five sampling locations, both a filtered and unfiltered surface water sample were collected. Unfiltered surface water samples were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy, and tritium. With the exception of TCL VOAs, all filtered surface water samples were analyzed for the same suite as the unfiltered surface water samples.

P-Discharge Canal: Eighteen sample transects (PDC001 through PDC018) were located along the P-Area Discharge Canal. Sample transects were spaced approximately every 250-m (820-ft) between P-Reactor and Pond 2 and every 500-m (1,640-ft) between Pond 2 and Pond C. At each sample transect, both a filtered and unfiltered surface water sample were collected. In total, 36 original surface water samples and 4 duplicate surface water samples were collected at the P-Area Discharge Canal. Unfiltered surface water samples were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy, and tritium. With the exception of TCL VOAs and tritium, all filtered surface water samples were analyzed for the same suite as the unfiltered surface water samples.

R-Discharge Canal: Twenty-two sample transects (RDC001 through RDC022) were located along the R-Area Discharge Canal. Sample transects were spaced approximately every 250-m (820-ft) along the entire length of the R-Reactor discharge canal. At each sample transect, both a filtered and unfiltered surface water sample were collected. In total, 44 original surface water samples and 4 duplicate surface water samples were collected at the R-Area Discharge Canal. Unfiltered surface water samples were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy, and tritium. With the exception of TCL

VOAs and tritium, all filtered surface water samples were analyzed for the same suite as the unfiltered surface water samples.

Pre-cooler Ponds: In Pond A, Pond B, Pond C, Pond 2, and Ponds 4 and 5, one surface water sample location was established at each pond and both a filtered and unfiltered surface water sample was collected. Surface water samples for each pond were collected at the transect requiring full suite analyses for sediment/soil and were co-located with the sediment sample point. In total, 12 surface water samples and 2 duplicate surface water samples were collected at the ponds. Unfiltered surface water samples were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy, and tritium. With the exception of TCL VOAs and tritium, all filtered surface water samples were analyzed for the same suite as the unfiltered surface water samples.

Background: Nine surface water samples (including one duplicate sample) were collected from four background sampling locations (BKGDSW001 through BKGDSW004) identified as areas within the SRS boundary that have not been affected by SRS processes. Background locations included the Crackerneck WMA located in the Savannah River floodplain upgradient of Upper Three Runs Creek (BKGDSW001), upper LTR located upgradient of PAR Pond (BKGDSW002), Meyers Branch identified as a tributary of Steel Creek (BKGDSW003), and Tinker Creek identified as a tributary of Upper Three Runs Creek (BKGDSW004). At each of the four sampling locations, both a filtered and unfiltered surface water sample was collected. Unfiltered surface water samples were analyzed for TCL VOAs, TCL SVOAs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy, and tritium. With the exception of TCL VOAs, all filtered surface water samples were analyzed for the same suite as the unfiltered surface water samples.

Periodic Report 4 documented the completion of Phase II for the LTR IOU. No additional characterization was identified in Periodic Report 4. Following approval of Periodic Report 4, the USDOE, USEPA, and SCDHEC agreed that sufficient data was available to transition the LTR IOU project to Phase III of the IOU program (RI/BRA process).

Fish

Fish were collected for the 2009/2010 characterization effort from the LTR pond/canal system from Pond B, Pond 5, Pond C, and PAR Pond as well as the upgradient portion of the north arm of PAR Pond. The upgradient location was collected to serve as an unimpacted background location. This background location was supplemented by fish collected from Tinker Creek (the main tributary of the Upper Three Runs), Meyers Branch (the main tributary of Steel Creek), and the Crackerneck Wildlife Management Area (part of the Savannah River and Floodplain Swamp IOU upgradient of SRS discharges).

At each of these sampling locations, the sampling plan was to acquire three (3) composite fish samples. Each composite sample consisted of a minimum of three fish with a total mass of at least 150 g (0.33 lb) to meet the minimum acceptable mass requirement for laboratory analysis. Fish were collected by backpack electrofishing. Optimally, each location would consist of three species representing a benthic feeder (B), a regional species (R) such as redbreast sunfish, or a predator (P). The particular species of fish or type of fish collected for analysis at each location was based on the amount of fish tissue obtainable, the size of the fish, and the representativeness of the fish species as compared to other fish sampling locations. Fish samples were analyzed for TAL inorganics, gross alpha, nonvolatile beta, tritium, uranium series, and gamma spectroscopy. These constituents were selected on the basis of their known or suspected occurrence in fish tissue from past sampling efforts.

Fish collected from the LTR-PAR Pond system included:

- Pond B: largemouth bass (P), bluegill (R)
- Pond 5: largemouth bass (P)
- Pond C: largemouth bass (P), bluegill (R)
- PAR Pond: largemouth bass (P), lake chubsuckers (B), and bluegill (R)

Fish collected from background locations consisted of the following.

- LTR upgradient of the north arm of PAR Pond: largemouth bass (P), sunfish (R), various species), redfin pickerel (P)
- Tinker Creek: Spotted sucker (B), American eel (B), sunfish (R), various species)

- Meyers Branch: redfin pickerel (P), sunfish (R, various species), bluehead chub (B)
- Crackerneck: bullhead catfish (B), redfin pickerel (P)"

3.2.5 PAR Pond Characterization (2016)

While scoping the LTR RI/BRA, a data gap was identified for PAR Pond where elevated levels of Cs-137 were identified from historic sampling and to substantiate historical surface water data. An addendum to the *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2016a) was developed to address these data needs. Implementation of the addendum resulted in the collection of data from seventeen (17) sampling locations throughout PAR Pond consisting of fourteen (14) surface water locations and three (3) sediment locations. The sediment samples were collected at a depth of 0 to 0.15 m (0 to 0.5 ft) from the bottom of the pond at three locations using typical sediment collection techniques. Two (2) surface water samples (one filtered, one unfiltered) were collected from the 14 surface water sampling locations as grab samples below the water surface. Surface water samples collocated with sediment samples were collected prior to collection of sediment to avoid collecting disturbed suspended sediments.

The fourteen (14) surface water sample locations were spread throughout PAR Pond to provide a comprehensive analysis of the pond. The sediment samples were positioned as close as possible to existing sample locations that exhibited a high Cs-137 results from historical data collection efforts. The three (3) sediment locations were located near the edges of PAR Pond. The 2016 PAR Pond surface water and sediment characterization samples were collected with appropriate field quality assurance/quality control (QA/QC) through the use of QA/QC samples and the resulting data was 100% verified and validated. The 2016 data were collected in accordance with the *Area Completion Projects Quality Assurance Project Plan for Environmental Data Collection* and *Management (QAPP)* (SRNS 2012d).

SRS sampling procedures were followed through approved procedures found in the 3Q1 Manual: Section 3005: *Soils and Sediment Sampling* (SRNS 2016b); Section 9016: *Sampling Soils for Analytical Purposes* (SRNS 2016c); and Section 3001A: *Routine Grab Sampling* (SRNS 2016d). These procedures ensure representative sampling techniques are followed at all times in the field. Sample analyses were conducted using certified SCDHEC methods. The analytical method and

laboratory have been audited and approved by the USDOE Consolidated Audit Program (AD-1) and performed according to Quality Systems for Analytical Services requirements.

3.2.6 RI/BRA Data

The data compiled in the LTR IOU database represents data from multiple data stewards and data quality from screening level to definitive level data. When the LTR IOU data were used to support Phase II screening level assessments, lower quality screening-level data were appropriate. As the LTR IOU transitioned into Phase III of the IOU process, a more detailed evaluation of the available LTR IOU data was necessary to determine data usability in support of a quantitative RI/BRA. To access data quality, additional details and documentation on data collection efforts for all data stewards were obtained, if available. Historical data sets were assigned a high, medium, or low pedigree rating based on availability of published reports, level of QA/QC documentation, or an adequate peer review process. A high pedigree level was assigned if data collection efforts followed currently accepted QA/QC process requirements. A medium pedigree level was assigned if data was published indicating adequate peer review or documentation was available to substantiate that the appropriate QA/QC process was followed at the time of data collection. Data were assigned a low pedigree level if publications or documentation was not available to adequately access data quality.

To facilitate final deposition of the LTR IOU, the Upper subunit was segregated into Exposure Areas (EAs):

- EA 1 Pond A and the R-Reactor Area Discharge Canal,
- EA 2: Canal from Pond A to Pond B,
- EA 3: Pond B and the emergency release canal connecting Pond B to Pond C,
- EA 4: Canal from Pond B to the North Arm of PAR Pond,
- EA 5: Joyce Branch (Old R-Area Discharge Canal),
- EA 6: PAR Pond,
- EA 7: Pond 2 and the canal from P-Area to Pond 4,

- EA 8: Ponds 4 and 5 and the canal to Pond C, and
- EA 9: Pond C.

Data packages were developed for each EA and included the pedigree of each dataset (high, medium, or low) based on review of the data. The data review was based on the following criteria: 1) who collected the samples (i.e., data steward); 2) what medium/media were sampled; 3) what sampling method(s) were used; 4) were the results verifiable; and 5) the date of data collection. As previously stated, the pedigree level (high, medium or low) was assigned to each EA dataset based on review of available QA/QC related documentation, data summary reports, or publications indicating adequate peer review.

The Core Team (i.e., USDOE, USEPA, and SCDHEC representatives) reached agreement that only high and medium level data was appropriate to use in the final dataset for the RI/BRA. In assessing data quality for the RI/BRA, the data evaluation process removed data that was determined to be of low pedigree if sufficient documentation was not available to verify the quality of the data. Field screening data (i.e., XRF or NaI) were also determined to be low quality because the screening results may over-estimate or under-estimate levels. The data evaluation process also removed duplicate records and erroneous data. A data summary of the final BRA dataset is summarized for each EA and media in Appendix A. Data tables are provided for sediment/soil (0- to 0.3-m [0- to 1-ft] interval and all depths), surface water (unfiltered), and biota (fish). These tables do not include constituents for which all results were reported as non-detect (ND).

The data supporting this RI/BRA are discussed further in Section 3.8 based on each EA. Figures 3-1 through 3-9 show comprehensive sampling locations (often with abbreviated names) and include all media where sampled (sediment/soil, surface water, and biota [fish)]) for EA 1 through EA 9. These figures include all data deemed appropriate by the Core Team to sufficiently define the nature and extent of LTR IOU environmental impacts.

Figures 3-10 through 3-23 depict levels of Cs-137 and Co-60 in sediment/soil media for the 0- to 0.3-m (0- to 1-ft) interval for EA 1 through EA 9. These figures show the maximum value for each sampling location along with the relative decay-corrected values as of 1/1/2017. The decay-

corrected value indicates current levels based on radioactive decay given the half-life for Cs-137 (30.2 years) and Co-60 (5.3 years).

3.3 Background Data and Data Synthesis

Past characterization efforts have shown that Cs-137 is the major contaminant in the LTR system, and that other contaminants are present in the system to a lesser extent, as well. Characterization efforts have focused on determining the nature and extent of contamination in the LTR IOU. An important part of accessing contaminant levels is determining background levels and contributions from other anthropogenic sources that are not related to SRS operations. Background data were collected so unit contaminant levels may be compared to data from background locations to determine site-related contamination. Overall, the data collected are used to assess risks to human health and ecological receptors. The data will also supplement existing data available in the IOU database and will be used to support future remedial decisions.

3.3.1 Background Data

Background data were collected to compare contaminant levels within the LTR system with levels in the environment not impacted by historical operations. Background samples were collected to represent the various environmental conditions present in the LTR IOU. Background data for sediment/soil (0- to 0.3-m [0- to 1-ft] depth interval), surface water, and fish are presented in Appendix A. IOU background data were either collected by the IOU program or compiled from other data stewards during the initial *Remedial Investigation Work Plan* (WSRC 2002) and during periodic reporting. Background data are available from the following sources:

- 2009/2010 characterization effort (referred to as "IOU background").
- Wetland Study background data and other data collected and compiled within Tinker Creek/ Upper Three Runs, Meyers Branch, and Crackerneck WMA (referred to as "Wetland Study Background") (*Geochemical and Physical Properties of Wetland Soils at the Savannah River Site*, WSRC-TR-96-0115, Final, May 1997).

- Background Soils Study (referred to as "SRS background") (*Background Soils Statistical Summary Report for the Savannah River Site*, ERD-EN-2005-0223, Revision 1.0, October 2006).
- Additional upgradient/background data available from the IOU Database (referred to as supplemental background data).

The 2009/2010 background data were collected by implementation of the approved *Sampling and Analysis Plan for the Lower Three Runs IOU* (SRNS 2009a). The locations include Upper LTR upgradient of the North Arm of PAR Pond, Upper Three Runs IOU/Tinker Creek, Steel Creek IOU/Meyers Branch, and the SR and Floodplain Swamp IOU/Crackerneck WMA (SRNS 2009a, Figure 10, p32).

Tinker Creek is located upgradient of SRS discharges and is part of the E.P. Odum Wetland Set-Aside (*DOE Research Set-Aside Areas of the Savannah River Site*, SRO-NERP-25, http://srel.uga.edu/set-asides/set-asides.html, SREL, Drawer E, Aiken, SC). The overall SRS management policy has considered Upper Three Runs Creek and Tinker Creek as "control" streams. As such, these systems are to be managed to receive as little impact from SRS operations as possible, due in part to the substantial biodiversity of macroinvertebrates within the system.

Meyers Branch, within the Steel Creek IOU, is also part of the USDOE Set-Aside program and is referred to as the Ruth Patrick – Meyers Branch Set-Aside (Davis and Janecek 1997). Meyers Branch is one of the least disturbed streams on the SRS, and because it originates and terminates entirely on the SRS, this stream is not subjected to any impacts from outside of the SRS. Both the Tinker Creek and Meyers Branch systems are typical low-gradient coastal plain blackwater systems exhibiting a sandy substrate bottom are heavily canopied with well-developed riparian vegetation (Davis and Janecek 1997) and are comparable to other SRS coastal plain streams.

Crackerneck WMA and Ecological Reserve is located within the watershed of the Savannah River and Floodplain Swamp IOU upgradient of Upper Three Runs (SRNS 2009a, Figure 10, p32). This area is located within SRS property and is leased and managed by the South Carolina Department of Natural Resources (SCDNR). Crackerneck WMA is a public hunting and passive use area

covering over 39 km^2 (15 mi^2). Hunting and fishing are allowed during specified dates and times, and passive non-consumptive use is also permitted.

The Wetland Study background dataset, described in *Geochemical and Physical Properties of Wetland Soils at the Savannah River Site* (WSRC 1997), involved collecting wetland soil samples from numerous wetlands all across SRS and at several offsite locations. Samples were analyzed for selected metals, organics, physical properties, and agricultural parameters following established USEPA protocols and standard methods. The data were collected to characterize wetland soils at SRS and to supplement baseline data. The samples were analyzed for 259 chemical and physical parameters, including the Resource Conservation and Recovery Act (RCRA) Appendix IX list (metals, VOCs [PCBs]), other inorganic species (fluoride, nitrate and nitrite, phosphate, silicon, and sulfate), cation exchange capacity (CEC), pH, percent solids, and tritium. Background data from Dixon et al. (1997) is supplemented by additional data collected from the Upper Three Runs, Tinker Creek, Crackerneck WMA, and Meyers Branch that are also part of the IOU database since these locations have served as background locations for various data stewards, including IOU data collection efforts.

The SRS background data, described in the Background Soils Study (WSRC 2006), is a comprehensive background soils dataset based on data compiled from SRS site-wide inorganic and radionuclide data collected from 39 approved OU investigations between 1993 and 1999. The analyses included inorganic, radiological, and organic constituents as well as several polycyclic aromatic hydrocarbons and dioxins that may occur naturally from controlled burns or wildfires, or from an anthropogenic source such as asphalt.

The final background dataset includes supplemental data from the IOU database that may be useful in explaining why certain constituents are elevated within the LTR IOU. This data includes locations in the Savannah River upgradient of the SRS and is important from a lines-of-evidence approach since water from the Savannah River was used as cooling water for R-Reactor and P-Reactor. These data will be referred to as supplemental background data from the IOU database.

Data Sufficiency

The LTR IOU data are of sufficient quality to support final remedial decisions, including the baseline human health and ecological risk assessments (ERAs), are presented herein. The data are also of sufficient quality to support the 2017 trophic modeling for assessing metal threats to the kingfisher and river otter supporting the ERA process. Field screening techniques were used in conjunction with laboratory analysis in order to determine the optimal sampling locations for laboratory analysis.

Quality control samples were collected to verify that the data are technically and legally defensible and included sample duplicates, rinsate blanks, and trip blanks. The duplicate samples were collected concurrently with the associated primary sample by taking a representative portion of a collected primary sample. Field duplicates are two or more collocated independent samples collected from side-by-side locations at the same point in time and space and therefore considered identical. These separate samples represent the same population and are carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples were used to assess precision of the total method, including sampling, analysis, and site heterogeneity. Field duplicate samples were collected at a minimum rate of 5% (1 per 20 samples) in accordance with ER-SOP-043 and analyzed for the same parameters as the associated primary samples.

Equipment rinsate blanks were collected to monitor whether decontamination procedures were successful in preventing inter-sample contamination by the equipment used to collect samples. Rinsate blanks were a sample of water free of measurable contaminants poured over or through decontaminated field sampling equipment that was considered ready to collect or process a sample. The purpose of the rinsate blank was to assess the adequacy of the decontamination process. Rinsate blanks were collected at a minimum rate of 5% or one blank per 20 samples.

Trip blanks were used to monitor potential contamination of samples by volatile constituents during shipping and handling. All trip blanks consisted of clean, distilled-deionized water provided by the laboratory that was placed in every cooler at the rate of one trip blank per cooler.

Split Samples were collected which were two or more representative portions from a sample in the field, analyzed by at least two different laboratories and/or methods. These are quality control

samples used to assess precision, variability, and data comparability between laboratories, and were collected at a combined minimum rate of 5% (1 per 20 samples) for analyses of the same parameters as the associated primary samples.

All sediment/soil, sediment, and surface water data were verified by 100% data validation. The analytical data has been reviewed for precision by comparing duplicate samples and original samples for consistency and repeatability of the chemical and radiological analyses. Accuracy was assessed by preparing known standards for analysis and comparing the data to the known values. The analytical data were also reviewed for potential laboratory contamination and analytical carry-over between samples by comparing the analysis of a blank with the reported values. The data were then reviewed for completeness.

A Data Usability Report for the LTR IOU presents the analytical data verification, validation and usability assessment results for sampling in support of this RI/BRA. The report is provided under separate cover, concurrent with this RI/BRA submittal.

Other aspects of characterization, sampling, laboratory analysis, and data management procedures are described in detail in the following SRS documents.

- ERD-AG-2005-00001, Area Completion Projects Quality Assurance Project Plan for Environmental Data Collection and Management.
- WSRC-RP-96-234, Revision.1, Savannah River Site RCRA Facility Investigation/Remedial Investigation Work Plan Safety, Health, and Emergency Response Plan, Quality Assurance/Quality Control, and Data Management Requirements.
- WSRC Manual 1Q, Quality Assurance Manual.
- WSRC Manual 3Q5, Hydrogeological Data Collection Procedures and Specifications.
- ESH-EMS-95-0076, Environmental Monitoring Section Environmental Geochemistry Group Program Overview.
- USDOE Consolidated Audit Program, Procedure AD-1, Rev. 2.0.

3.3.2 Data Management Systems

The database incorporating the LTR RI/BRA data is evaluated using a data management system (DMS). The DMS is composed of a normalized, enterprise level database, project related logic applied as computer code, customized reports, and automated processes for all data analyses that are applied via computer code and scripts. The system design report that defines the relationship diagram, tables, fields, layouts, and code is provided on the associated electronic compact disc within the folder named "DMS Design."

The DMS manages all associated environmental data, all logic regarding data reduction, data grouping logic, statistical calculations, and automated generation of statistical summary tables. All parameters associated with calculations such as decay half-lives are stored and managed within the DMS. The environmental media include fish, surface water, and sediment/soil for the nine exposure areas. Analytical fractions include: volatile organics, semi-volatile organics, pesticide/PCBs, metals, inorganics, radionuclides, and other tentatively identified compounds.

The statistical data summary tables and data packages in Appendix A provide a comprehensive summary of the environmental data that was used in the development of this RI/BRA. The following sections provide details on the number of analytical records per environmental media.

3.3.2.1 Sediment/Soil

The sediment and soil samples were grouped into the following subgroups: 0- to 0.3-m [0- to 1-ft] and 0 to 1.22 m (0 to 4 ft). For the RI/BRA, and by agreement with the Core Team, sediment and sediment/soil samples were combined as a single medium referred to as "sediment." The numbers of analytical records for the sediment media are provided below:

Ponds and Canal System 2009/2010 Data	
Sediment	5,539
Sediment/Soil	26,750
Medium/High Pedigree Historical Data	
Sediment/Soil	53,822
2009/2010 Background Data	
Sediment	564
Sediment/Soil	1,040

3.3.2.2 Surface Water

The numbers of analytical records for the surface water media are provided below:

Ponds and Canal System 2009/2010 Data	15,455
Medium/High Pedigree Historical Data	33,124
2009/2010 Background Data	855

3.3.2.3 Biota (Fish)

Biota (fish) samples were collected in PAR Pond, Pond B, Pond C, and Pond 4. Fish included black crappie, bluegill, channel catfish, largemouth bass, redbreast sunfish, sunfish (Lepomis sp.), creek chub, and lake chub suckers. The number of analytical records for the fish media are provided below:

Ponds and Canal System 2009/2010 Data	504
Medium/High Pedigree Historical Data	4,945
2009/2010 Background Data	268

3.4 Human Health Risk Assessment Methodology

The purpose of the human health risk assessment (HHRA), presented in Appendix B, is to assess the potential for adverse effects to various human receptors associated with exposure to contaminants present at the LTR IOU. The evaluation for each EA estimates the risk potential in the absence of remedial actions (i.e., baseline risk) and provides a basis for determining whether or not remedial action is necessary. Statistical data summaries for each media of concern by EA are used in the process (see Appendix A). The HHRA includes the following:

- Exposure groups and exposure pathways,
- Identification of potential human receptors,
- Identification of constituents of potential concern (COPCs),
- Identification of constituents of concern (COCs), and
- Identification of refined constituents of concern (RCOCs).

Risk-based threshold levels (TLs) used in this assessment are obtained from the USEPA Regional Screening Level (RSL) website (USEPA 2016) for chemicals and from the Preliminary Remediation Goal (PRG) website (USEPA 2014) for radiological constituents.

For sediment/soil COPC screening, maximum detected concentrations (from the 0- to 0.3-m [0- to 1-ft] sampling interval) are compared to residential risk-based TLs, as well as to two times the average background concentration for each constituent. Those constituents that exceed both the TLs for sediment/soil and the background values are identified as COPCs and are carried forward into risk or hazard calculations for each of the following receptors: OU resident, OU industrial worker, and the IOU onsite worker, consistent with the CSM. As discussed in Chapter 2, the most likely human receptor for risks associated with the LTR IOU ponds and canal system is the IOU onsite worker. For comparative purposes, a risk evaluation was also conducted for the OU resident and OU industrial worker.

Exposure point concentrations (EPCs) consist of the lower of either the 95% upper confidence limit (UCL) on the mean concentrations for constituents or the maximum detected concentration used in the formal risk/hazard calculation. Results of the risk and hazard calculations identify human health COCs for sediment/soil where individual hazard quotients (HQs) exceed 1 for noncarcinogens and constituent-specific risk exceeds 1E-06. An uncertainty evaluation is performed for COCs to determine if the constituents should be identified as a RCOC and carried forward for further remedial evaluation.

For surface water and fish, maximum detected concentrations are compared to TLs only. For surface water, maximum contaminant levels (MCLs) (tap water PRGs/RSLs/ambient water quality criterion in the absence of a MCL) are identified as the TLs. For fish media, site-specific RSLs/PRGs for a recreational fisherman scenario were used as the TLs. Constituents with a maximum detected concentration greater than the TL were identified as COCs and brought forward into the RCOC evaluation.

Individual constituents that exceed the TL and identified as a COC are further evaluated in a refinement step. The refinement step is an uncertainty evaluation that includes an interpretive discussion of the applicable uncertainty factors (lines-of evidence) and a recommendation whether

the constituent should or should not be identified as a RCOC and carried forward for further remedial evaluation. The major categories of uncertainty used in the evaluation include the following:

- Unit related uncertainty related to the nature and extent of contamination, consistency with history of use, and presence in background;
- Data quality and risk assessment uncertainties related to data quality and physical characteristics; and
- Risk assessment uncertainty related to toxicity data and changes in constituent concentrations due to radioactive decay.

An additional risk calculation is also presented in the refinement step that considers radioactive decay for short-lived isotopes Co-60 (half-life = 5.3 years) and Cs-137 (half-life = 30.2 years). Remedial action objectives (RAOs) for protecting human health and the environment are developed for constituents identified as RCOCs and are discussed in more detail in Chapter 4.

3.5 Ecological Risk Assessment Methodology

The purpose of the ERA, presented in Appendix C, is to assess the potential for adverse effects to terrestrial and aquatic/semi-aquatic ecological receptors (wildlife) associated with exposure to contaminants present at the LTR IOU. The evaluation for each exposure area estimates the risk potential in the absence of remedial actions and provides a basis for determining whether remedial action is necessary. The process follows the latest available USEPA guidance (USEPA 2003, 2015), as well as input from the staff of USEPA Region IV and the SCDHEC. Statistical data summaries for each media of concern by EA are used in the process (see Appendix A). The ERA includes the following:

- Risk assessment exposure groups and exposure pathways,
- Identification of potential ecological (wildlife) receptors and assessment endpoints, including terrestrial and aquatic,
- Identification of constituent of potential ecological concern (COPECs),
- Identification of COPCs,

- Identification of refined COPC (RCOPCs),
- Identification of COCs, and
- Identification of RCOCs.

Risk-based TLs used in the ERA are no observed adverse effects level and lowest observed adverse effects level values obtained from the USEPA Region 4 ERA Supplemental Guidance Interim Draft (USEPA 2015) and the Los Alamos National Laboratory EcoRisk Database (LANL 2015).

The ERA is conducted by comparing constituent concentrations in sediment/soil and surface water within each EA with regulatory or other technically defensible screening values called ecological screening values (ESVs), as well as to media background concentrations. Constituents that are less than an ESV are eliminated from further consideration in the ERA, while those that both exceed an ESV and background are identified as COPECs and are retained for further examination by calculating refinement-level hazard (ecological HQs) using refinement screening values (RSVs). Constituents with a refinement HQ greater than 1 are identified as COPCs and brought forward in a RCOPCs/uncertainty evaluation.

A recommendation of whether or not a RCOPC should be carried forward for trophic modeling (food chain modeling) considers the following lines-of-evidence (same as HHRA):

- Unit related uncertainty related to the nature and extent of contamination, consistency with history of use, and presence in background.
- Data quality and risk assessment uncertainties related to data quality and physical characteristics.
- Risk assessment uncertainty related to toxicity data and changes in constituent concentrations due to radioactive decay.

The trophic model was developed by SRS and utilizes site-specific ecological receptors and associated input parameters. It considers site-specific biological sample results (i.e., tissue analysis) for upper-tier mammalian and avian receptors. Constituents with HQs greater than 1 are identified as COCs and brought forth into a second uncertainty evaluation, which discusses the

results of the trophic modeling and any other exceedances from the screening effort. An overall discussion of the results of the ERA provides a final recommendation concerning whether or not a particular constituent should be identified as an ecological RCOC.

The result of the process is the identification of problems warranting action (i.e., RCOCs), that is the media and constituents for which concentrations exceed levels protective of ecological receptors. RAOs for protection of human health and the environment are developed for constituents identified as RCOCs and are discussed in more detail in Chapter 4.

3.6 Principal Threat Source Material Methodology

The principal threat source material (PTSM) evaluation for the LTR IOU is presented in Appendix D. The concept of principal threat waste and low-level threat waste, as developed by the USEPA in the National Contingency Plan (40 Code of Federal Regulations [CFR] 300.430(a)(1)(iii)), is to be applied on a site-specific basis when characterizing source material. Source materials are those materials that include or contain hazardous substances, pollutants, or contaminants that can act as a reservoir for migration to surface water, or air, or that can act as a source for direct exposure (USEPA 1991). The determination of whether or not the source materials present at a waste unit would be classified as PTSM is based principally on the USEPA guidance document (USEPA 1991).

In determining whether the source should be preliminarily considered PTSM, the evaluation considers the cumulative effects of both the potential risk from carcinogenic constituents and the adverse health effects from non-carcinogens to human receptors. The toxicity assessment of the source material is based on the potential exposure of the onsite worker (a wetlands researcher), which is the most likely receptor scenario at the LTR IOU.

The source material from all depth intervals is preliminarily considered to be PTSM if the cumulative risk exceeds one of the following toxicity threshold criteria:

- Carcinogens: greater than 1E-03 onsite worker risk, and
- Non-carcinogens: onsite worker hazard index (HI) greater than 10.

If the threshold criteria for PTSM is not exceeded based on a maximum concentration, then PTSM is not present and it is not necessary to carry the assessment into an uncertainty evaluation. An uncertainty evaluation is performed on potential PTSM constituents using similar criteria as that done for the identification of human health RCOCs. This includes, but is not limited to, frequency of detection and comparing to maximum detected activity concentrations or EPCs for specific radionuclides that are decay-corrected based on the half-life, as applicable.

3.7 Exposure Area 1

3.7.1 Exposure Area 1 Description

EA 1 includes Pond A and the R-Area Discharge Canal. Pond A is ~2.6 hectare (ha [6.4 acre {ac}]) and received water from the R-Area Discharge Canal and subsequently discharged to Pond B. Water levels in Pond A fluctuate from year to year.

The canal from R-Reactor to Pond A is ~645-m (2,116.1-ft) long. The canal from the R-Discharge Canal to Joyce Branch is 233-m (764.4-ft) long. The canal flow area is ~3.0-m (9.8-ft) across the base of the canal.

3.7.2 Exposure Area 1 Characterization and Data Summary

Figure 3-1 shows the comprehensive sample locations for EA 1. Sediment and surface water samples have been routinely collected in the discharge canal since 1997. The characterization conducted during 2009/2010 collected 23 sediment samples and six surface water samples from EA 1. Each transect sample location included a $LaBr_3$ gamma survey taken every 5 m (16.4 ft) from the stream edge. Each transect included a $LaBr_3$ gamma spectrum and one soil/sediment sample collected from two depth intervals (0 to 0.3 m [0 to 1 ft] and 0.3 to 1.2 m [1 to 4 ft]). All samples were analyzed for radiological screening and samples from one transect were analyzed for TCL/TAL. Two surface water samples (both filtered and unfiltered) and one sediment sample were collected from the stream at each transect.

Appendix A includes the investigative data for the LTR IOU and presents statistical data tables and data summary by media (i.e., data package) for EA 1. Other data collected in addition to TCL/TAL and radionuclides include the following:

- **Sediment/Soil**: cation exchange capacity, nitrogen-nitrite, nitrogen-nitrate+nitrite, dissolved oxygen, pH, specific conductance, temperature, total dissolved solids, total organic carbon (TOC), total suspended solids, turbidity, and volatile solids.

- **Surface Water**: chemical oxygen demand, fixed residue, cation exchange capacity, nitrogen, nitrogen-nitrate+nitrite, percent solids, pH, phenols, TOC, total organic halogens, total organic nitrogen, and one amine.

3.7.3 Exposure Area 1 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D), Co-60, and mercury represent the principal constituents in EA 1. Both Cs-137(+D) and Co-60 are present in sediment/soil. No fish samples were collected in EA 1. However, results from adjacent EAs indicate that mercury and Cs-137(+D) are present in fish tissue. Therefore, results from the EAs in which fish samples were collected are used as a proxy for EA 1.

Figures 3-10 and 3-11 illustrate the nature and extent of contaminants at EA 1 and provide an overview of the overall contamination based on activities of Cs-137(+D) and Co-60, respectively. Figures 3-10 and 3-11 depict the maximum detected result for each sampling location along with the relative decay-corrected value as of 1/1/2017. The decay-corrected value indicates current levels based on radioactive decay given the half-life for Cs-137 (30.2 years) and Co-60 (5.3 years). Cs-137(+D) was detected in 44 out of 45 samples for the 0- to 0.3-m [0- to 1-ft] depth interval, with four results being estimated values ("J" qualified). Concentrations ranged from ND to 686 pCi/g with the highest detected concentration collected at location R-1, downstream of R-Area on 4/11/2005.

Co-60 was detected in 15 out of 45 samples, with two results being estimated values ("J" qualified). Concentrations ranged from ND to 0.648 pCi/g with the highest detected concentration collected at R-1, downstream of R-Area on 6/13/2001.

With Cs-137(+D) and Co-60 being the principal constituents in EA 1 and assuming 0.3-m (1-ft) depth of contaminated sediment/soil and 3.0-m (9.8-ft) canal flow area, the maximum potential

volume of contaminated sediment/soil in the canal system would be 791 cubic meters (m^3) (1,034.5 cubic yards [yd^3]). Contaminated sediment below the water surface in Pond A covers an area of ~25,900 square meters (m^2) (30,976.1 square yards [yd^2]). Assuming a 0.3-m (1-ft) depth of contaminated sediment, the maximum potential volume of contaminated sediment in Pond A would be 7,770 m^3 (10,162.8 yd^3) (see table below).

EA 1 Potential Volume of Contaminated Sediment/Soil

Media	Location	Estimated Volume
Sediment	Canal	791 m^3 (1,034.5 yd^3)
Sediment	Pond A	7,770 m^3 (10,162.8 yd^3)
	Total:	**8,561 m^3 (11,197.3 yd^3)**

3.7.4 Exposure Area 1 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 1. See Appendices B, C, and D for more detail.

3.7.4.1 Human Health Risk Assessment

3.7.4.1.1 Sediment/Soil Media

Details of the HHRA are provided in Appendix B. Those details include results of the risk calculations for the resident, industrial worker, and onsite worker receptor scenarios. However, based on the current and likely future land use of the LTR IOU area, results of the HHRA for sediment/soil media for EA 1 and all subsequent EAs are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results.

Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: chromium, iron, vanadium, americium-243(+D), Cs-137(+D), Co-60(+D), potassium-40, thorium-232(+D) and uranium-238(+D).
- COCs onsite worker scenario: Cs-137(+D), Co-60, potassium-40, and thorium-232(+D).

- RCOCs onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 8.2E-04) and Co-60 (risk = 1.7E-06) identified as RCOCs with a total cumulative risk (TCR) = 8.2E-04. Decay-adjusted Cs-137(+D) risk = 6.4E-04, decay-adjusted Co-60 risk = 3.8E-07, and decay adjusted TCR = 6.4E-04. As noted in above TCRs, Cs-137(+D) contributes 100% and is therefore the predominant human health RCOC in the LTR IOU. Figures 3-10 and 3-11 identify the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (0.18 pCi/g) and Co-60 (0.0832 pCi/g), respectfully.

3.7.4.1.2 Surface Water Media

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: manganese, potassium-40, thorium-234, and tritium.
- RCOCs for surface water: None.

3.7.4.1.3 Fish Media

- No fish samples were collected within EA 1. However, results for samples collected within other EAs (EA 3, EA 6, EA 8, and EA 9) that identified Cs-137(+D) and mercury as RCOCs are used as a proxy for EA 1.
- RCOCs for fish ingestion: Cs-137(+D), mercury.

3.7.4.2 Ecological Risk Assessment

3.7.4.2.1 Sediment/Soil Media

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: acetone, americium-243, bis[2-ethylhexyl]phthalate, bismuth-212, californium-244, carbon-14, curium-244, curium-245 and curium-246, cyanide, dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyltrichloroethane (DDT), lead-214, methyl acetate, potassium-40, thallium-208, toluene, and vanadium.

- COPCs: americium-243, bis[2-ethylhexyl]phthalate, bismuth-212, californium-244, carbon-14, curium-244, curium-245 and curium-246, lead-214, methyl acetate, potassium-40, thallium-208, and vanadium
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for sediment/soil: none.

3.7.4.2.2 Surface Water Media

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: aluminum, iron, manganese, chloromethane, DDT, curium-244, iodine-129, potassium-40, technetium-99, and thorium-234.
- COPCs: aluminum, iron, manganese, chloromethane, DDT, curium-244, iodine-129, potassium-40, technetium-99, and thorium-234.
- RCOPCs for trophic modeling: DDT.
- Trophic Modeling COCs: DDT.
- RCOCs for surface water: none.

3.7.5 Exposure Area 1 Principal Threat Source Material Results

Results of the PTSM screening for EA 1 indicate that using maximum concentrations and maximum activity concentrations of detected constituents, the only constituent that exceeds the PTSM threshold level (i.e., risk ≥1E-03) is Cs-137(+D). Based on the maximum detected activity concentration of 686 pCi/g from the all-depth sample interval (i.e., 0 to 1.22 m [0 to 4 ft]), the risk for the IOU onsite worker is 3.8E-03. However, recalculating the risk using the less conservative 95% UCL on the mean (148 pCi/g from the 0- to 0.3-m [0- to 1-ft] sample interval), the risk is 8.2E-04, which is below the PTSM threshold level. Further, with a half-life of 30.2 years and the time frame from which the data were collected in EA 1, the decay corrected 95% UCL would be expected to be lower (115 pCi/g) as would be the associated risk to the IOU On-Site Worker

(6.4E-04). Further, there are only five samples out of 61 (from all depth intervals) in which the activity concentrations exceed the PTSM threshold level, all from the same location (R Area downstream of R-1). Assuming this sample location represents a hotspot, the PTSM threshold level using a 2-m^2 (2.15-ft^2) area correction factor increases the PRG for Cs-137(+D) by a factor of ~4. Thus, the maximum detected value and the decay corrected maximum detected values 686 pCi/g, and 526 pCi/g, respectively, would be below the area-corrected PTSM threshold level.

Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 1. However, it is recognized that one location (R-Area Downstream of R-1) had five separate samples that are above the PTSM threshold for the onsite worker (Figure 3-10). This result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the in the Feasibility Study (FS) phase of the project.

3.7.6 Exposure Area 1 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.7.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors.

- Sediment/soil media: Cs-137(+D) (risk = 8.2E-04) and Co-60 (risk = 1.7E-06) are identified as RCOCs for the onsite worker receptor with a TCR = 8.2E-04. Decay-adjusted Cs-137(+D) risk = 6.4E-04, decay-adjusted Co-60 risk = 3.8E-07, and the decay adjusted TCR = 6.4E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.7.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.7.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.8 Exposure Area 2

3.8.1 Exposure Area 2 Description

EA 2 consists of the section of the canal system between Pond A and Pond B, and is ~2,837-m (9,307.7-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3.0-m (9.8-ft) across the base of the canal. Water levels in EA 2 fluctuate from year to year.

3.8.2 Exposure Area 2 Characterization and Data Summary

Figure 3-2 shows the comprehensive sample locations in EA 2 at the Discharge Canal between Pond A and Pond B. A total of 44 sediment/soil samples were collected from EA 2 during the 2009/2010 sampling event. The sample locations (transects) were spaced out to approximately every 250-m (820-ft) along the entire length of the Discharge Canal. Two sediment/soil samples were taken on either side of the canal, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. One sample was collected from 0- to 0.3-m [0- to 1-ft) bgs, and the second was taken from 0.3- to 1.22-m (1- to 4-ft) bgs. A third sediment/soil sample was collected on the slope leading down to the stream channel. This location was sampled from 0- to 0.3-m [0- to 1-ft) bgs and was collected on alternate sides of the channel for every other transect. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect.

The following analytical procedure for EA 2 sediment/soil samples was presented in the *Field Summary Report for the Characterization of Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2010b):

> "All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. Eight of the sample locations (RDC001, RDC005, RDC008, RDC010, RDC013, RDC015, RDC018, and RDC021) also were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals."

Twenty surface water samples were also taken at EA 2 during the 2009/2010 sampling event. Two surface water samples were collected at each transect location, with one water sample being filtered and the other unfiltered. Transect location RDC011-002 was considered dry by field personnel, so no surface water samples were collected for that location. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, TCL PCBs, TAL metals, gamma spectroscopy, and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 2.

3.8.3 Exposure Area 2 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and mercury represent the principal constituents in EA 2. Cs-137(+D) is present in sediment/soil within EA 2. No fish samples were collected in EA 2. However, results from adjacent EAs indicate that mercury and Cs-137(+D) are present in fish tissue. Therefore, results from the EAs in which fish samples were collected are used as a proxy for EA 2.

Figure 3-12 illustrates the nature and extent of environmental impacts at EA 2 and provides an overview of the overall contamination based on Cs-137(+D) activities in sediment/soil. Figure 3-12 depicts the maximum for each sampling location in EA 2 along with the decay corrected value for Cs-137 (+D) as of 1/1/2017. Cs-137(+D) was detected in 21 out of 44 samples,

with one sample being an estimated value (i.e., "J" qualified). Concentrations ranged from ND to 180 pCi/g with the highest detected concentration at location RDC007-001 collected on 4/14/2010.

Assuming 0.3-m (1-ft) depth of contaminated sediment and 3-m (9.8-ft) canal flow area, the maximum volume of contaminated sediment in the canal system would be 2,553 m^3 or 3,339.2 yd^3.

Surface water samples collected at EA 2 during the 2009/2010 sampling event had most concentrations reported below risk-based screening levels. Sample RDC009-002 reported a detection of bismuth-214 at 48 pCi/L, which exceeds the USEPA MCL of 15 pCi/L. All 10 of the unfiltered surface water samples collected at EA 2 reported detections of tritium with concentrations ranging from 520 pCi/L (RDC012-002) to 780 pCi/L (RDC009-002). However, all 10 detections were well below the USEPA MCL of 20,000 pCi/L.

3.8.4 Exposure Area 2 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 2. See Appendices B, C, and D for more detail.

3.8.4.1 Human Health Risk Assessment

3.8.4.1.1 Sediment/Soil Media

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media in EA 2 are presented only for the onsite worker scenario. A full presentation of the HHRA results for all receptors is provided in Appendix B. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, arsenic, chromium, iron, vanadium, bis[2-chloroethyl]ether, Cs-137(+D), potassium-40, thorium-232(+D) and uranium-238(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), potassium-40, and thorium-232(+D).
- RCOC for the onsite worker scenario for soil/sediment: Cs-137(+D) (risk = 2.7E-04) is identified as an RCOC. Decay- adjusted Cs-137(+D) risk = 2.3E-04. Within EA 2, Cs-137(+D)

is the single constituent that contributes to the above risk for this receptor. Figure 3-12 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.8.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: manganese, bis[2-ethylhexyl]phthalate, naphthalene, and bismuth-214.
- RCOCs for surface water: none.

3.8.4.1.3 Fish

- No fish samples were collected within EA 2. However, results for samples collected within other EAs (i.e., EA 3, EA 6, EA 8, and EA 9) that identified Cs-137(+D) and mercury as RCOCs are used as a proxy for EA 2.
- RCOC for fish ingestion: Cs-137(+D), mercury.

3.8.4.2 Ecological Risk Assessment

3.8.4.2.1 Sediment/Soil Media

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: acetone, actinium-228, americium-243, arsenic, bis[2-ethylhexyl]phthalate, bismuth-212, carbon-14, chromium, curium-243 and curium-244, curium-245 and curium-246, iron, lead, lead-212, lead-214, potassium-40, thallium-208, toluene, and vanadium.
- COPCs: actinium-228, americium-243, bismuth-212, carbon-14, curium-243 and curium-244, curium-245 and curium-246, lead-212, lead-214, potassium-40, thallium-208, toluene, and vanadium.
- RCOPCs for trophic modeling: none.

- Trophic Modeling COCs: none.
- RCOCs for sediment/soil: none.

3.8.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: aluminum, anthracene, bis[2-ethylhexyl]phthalate, bismuth-214, fluoranthene, iron, manganese, mercury, pyrene, and zinc.
- COPCs: aluminum, anthracene, bis[2-ethylhexyl]phthalate, bismuth-214, fluoranthene, iron, manganese, mercury, and pyrene.
- RCOPCs for trophic modeling: mercury.
- Trophic Modeling COCs: mercury.
- RCOCs for surface water: none.

3.8.5 Exposure Area 2 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 2 indicate that using maximum concentrations and activity concentrations of detected constituents, the only constituent that equates to the PTSM threshold level (i.e., risk ≥1E-03) is Cs-137(+D). Considering the maximum detected activity concentration of 180 pCi/g from the all-depth sample interval (i.e., 0 to 1.22 m [0 to 4 ft]), the resultant risk for the onsite worker is 1.0E-03. However, recalculating the risk using the less conservative 95% UCL on the mean (48.8 pCi/g from the 0- to 0.3-m [0- to 1-ft] sample interval), the resultant risk is 2.7E-04, which is below the PTSM threshold level. Further, with a half-life of 30.2 years and the time frame from which the data were collected in EA 2, the decay corrected maximum detected activity concentration would be expected to be lower (≈155 pCi/g), as would be the associated risk to the onsite worker (8.6E-04), which is below the PTSM threshold level.

Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 2. However, it is recognized that there is one location in EA 2 (RDC-007-001) where the measured activity of Cs-137 (in 2010) equaled the PTSM

threshold for the onsite worker. This result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

3.8.6 Exposure Area 2 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.8.6.1 HHRA

As detailed in Appendix B, the following is a Summary of the Problems Warranting Action for human receptors.

- Sediment/soil media: Cs-137(+D) (risk = 2.7E-04) is identified as a RCOC for the onsite worker. Decay-adjusted Cs-137(+D) risk = 2.3E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137(+D) and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.8.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.8.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.9 Exposure Area 3

3.9.1 Exposure Area 3 Description

EA 3 includes Pond B and the overflow canal connecting Pond B to Pond C. Pond B is ~82.1 ha (202.8 ac) and received water from the R-Area and subsequently discharged it to PAR Pond. Pond B generally maintains its water level from year to year. The overflow canal from Pond B is ~547-m (1,794.6-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the canal. Fifteen sediment samples were collected in EA 3. Cs-137 is the only risk driver for the onsite worker. Both mercury and Cs-137 are problems warranting action for the recreational fisherman. Surface water samples were collected in EA 3 during the 2009/2010 investigation with no analytes detected above screening thresholds.

3.9.2 Exposure Area 3 Characterization and Data Summary

Figure 3-3 shows the comprehensive sample locations in EA 3 at Pond B. The characterization conducted during 2009/2010 collected a total of 15 sediment/soil samples were collected from EA 3. The sample locations were determined by the transect lines that were established at Pond B. Two samples were taken at each end of the transect line in dry soil ~0.91-m (3-ft) away from the water line. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect line. The following analytical procedure for EA 3 sediment/soil samples was presented in the *Field Summary Report for the Characterization of Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2010b):

> "All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sediment sample per pond (PAT1, PBT3, PCT1, P2T3, P4T2, and P5T2) also was analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals."

Two surface water samples were also taken at Pond B during the 2009/2010 sampling event. Both surface water samples were collected at the transect location where the sediment/soil sample required a full analytical suite, with one water sample being filtered and the other unfiltered. The unfiltered surface water sample was analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water sample was analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

Biota samples (i.e., fish tissue) were collected at Pond B during the 2009/2010 sampling event in April and June 2010. These biota samples were analyzed for TAL inorganics, radionuclide indicators (gross alpha and non-volatile beta), tritium, and gamma spectroscopy for gamma emitters, including Cs-137.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 3.

3.9.3 Exposure Area 3 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the IOU onsite worker. Cs-137(+D) and mercury represent the principal constituents in EA 3. Cs-137(+D) is present in sediment/soil while both Cs-137(+D) and mercury are present in fish samples from EA 3.

Figure 3-13 depicts the nature and extent of environmental impacts at EA 3 and provides an overview of the overall contamination based on activities of Cs-137(+D). The majority of historic data for Cs-137 (+D) from Pond B were obtained from incremental analyses of two-centimeter intervals from cores collected from discrete sampling locations. To obtain an activity for Cs-137 from a discrete sampling location, the activities were combined and averaged for the results from the 0- to 0.3-m (0- to 1-ft) interval and the 0.3- to 1.22-m (1- to 4-ft) interval. Cs-137(+D) was detected in 44 out of 44 sediment/soil samples, with none being an estimated value (i.e., "J" qualified). Concentrations ranged from 0.093 pCi/g to 456.8 pCi/g with the highest concentration detected at location Main Body near Heron Island: SCB-34 on 9/14/1994. The maximum cm incremental activity in Pond B was 930 pCi/g from the Main Body near Mouth of Outlet Bay: SCB-29-0 location collected from the 14- to 15-cm (5.5- to 5.9-in.) depth interval on 9/20/1994.

Cs-137(+D) was detected in all 54 fish samples collected from Pond B. Concentrations ranged from 9.35 pCi/g to 113 pCi/g. Sample Pond B 28054 had the highest concentration, which was collected on 3/4/1998.

Mercury was detected in 77 out of 81 samples with one result being estimated (i.e., "J" qualified). Concentrations ranged from ND to 1.83 mg/kg with the highest detected concentration collected at location Pond B-32081 on 1/1/1998.

Both surface water samples collected at Pond B during the 2009/2010 sampling event did not report any concentrations that exceeded screening levels. However, biota (i.e. fish) sampled from Pond B has exhibited Cs-137 concentrations above risk-based screening levels. On average, Cs-137 levels in fish tissue were 13.68 pCi/g, which exceeds the recreational fisherman screening level of 0.0545 pCi/g. Additionally, mercury exceed risk-based screening levels of 0.154 mg/kg for the recreation fisherman.

Assuming 0.3-m (1-ft) depth of contaminated sediment and 3.0-m (9.8-ft) canal flow area, the maximum volume of contaminated sediment in the canal system would be 492 m^3 (643.5 yd^3). Contaminated sediment below the water surface in Pond B covers an area of ~820,703 m^2 (332,127.2 yd^2). Assuming a 0.3-m (1-ft) depth of contaminated sediment, the maximum volume of contaminated sediment in Pond B would be 246,211 m^3 or 322,031.8 yd^3.

Estimated Volume of Contaminated Sediment

Media	Location	Estimated Volume
Sediment	Pond B	820,703 m^3 (981,553 yd^3)
Sediment	Canal	492 m^3 (643.5 yd^3)
	Total:	**821,195 m^3 (952,196.5 yd^3)**

3.9.4 Exposure Area 3 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 3. See Appendices B, C, and D for more detail.

3.9.4.1 3.9.4.1 Human Health Risk Assessment

3.9.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, arsenic, chromium, cobalt, iron, vanadium, Cs-137(+D), thorium-232(+D) and uranium-238(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), and thorium-232(+D).
- RCOC for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 5.5E-04) is identified as an RCOC. Decay-adjusted Cs-137(+D) risk = 3.3E-04. Within EA 3, Cs-137(+D) is the single constituent that contributes to the above risk for this receptor. Figure 3-13 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.9.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: naphthalene.
- RCOCs for surface water: none.

3.9.4.1.3 Fish

- COCs: chromium, mercury, Cs-137(+D), Co-60, potassium-40, and strontium -89/-90.
- RCOC for fish ingestion: Cs-137(+D) and mercury.

3.9.4.2 Ecological Risk Assessment

3.9.4.2.1 Sediment/soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: acetone, aluminum, barium, beryllium, cadmium, carbon disulfide, chromium, copper, DDE, iron, lead, lead-214, magnesium, nickel, thallium-208, vanadium, and zinc.
- COPCs: barium, lead-214, thallium-208, and vanadium.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for sediment/soil: none.

3.9.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: anthracene, fluoranthene, mercury, and pyrene.
- COPCs: anthracene, fluoranthene, mercury, and pyrene.
- RCOPCs for Trophic Modeling: mercury.
- Trophic Modeling COCs: mercury.
- RCOCs: none.

3.9.5 Exposure Area 3 Principal Threat Source Material Results

Results of the PTSM screening for EA 3 indicate two separate locations that exceeded PTSM levels for the onsite worker. Using maximum concentrations and activity concentrations of detected constituents, the only constituent that exceeds the PTSM threshold level (i.e., risk ≥1E-03) is Cs-137(+D). Considering the maximum detected activity concentration of 457 pCi/g from the all-depth sample interval (i.e., 0 to 1.22 m [0 to 4 ft]), the resultant risk for the onsite worker is 2.5E-03. However, recalculating the risk using the less conservative 95% UCL on the

mean (98.4 pCi/g from the 0- to 0.3-m (0- to 0.98-ft) sample interval), the resultant risk is 5.5E-04, which is below the PTSM threshold level. With a half-life of 30.2 years and the time frame from which the data were collected in EA 3, the decay corrected maximum detected activity concentration would be expected to be lower (276 pCi/g), as would be the associated risk to the onsite worker (1.5E-03). Continued radioactive decay of Cs-137(+D) would result in a continuous drop in the calculated risk with time. Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 3. However, it is recognized that at two locations (SCB-29 and SCB-34) benthic sediments had sample results that are above the PTSM threshold for the onsite worker. The above PTSM result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the in the FS phase of the project.

3.9.6 Exposure Area 3 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.9.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 5.5E-04) is identified as a RCOC for the onsite worker. Decay-adjusted Cs-137(+D) risk = 3.3E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137(+D) and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.9.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.9.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.10 Exposure Area 4

3.10.1 Exposure Area 4 Description

EA 4 consists of the section of the canal system between Pond B and the North Arm of PAR Pond and is ~2,305-m (7,562.3-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3.0-m (9.8-ft) across the base of the canal. Thirty-six (36) sediment samples and 18 surface water samples were collected at EA 4.

3.10.2 Exposure Area 4 Characterization and Data Summary

Figure 3-4 shows the comprehensive sample locations for EA 4.

A total of 36 sediment/soil samples were collected from EA 4 during the 2009/2010 sampling event. The sample locations (transects) were spaced out to approximately every 250-m (820-ft) along the entire length of the Discharge Canal. Two sediment/soil samples were taken on either side of the canal, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. A third sediment/soil sample was collected on the slope leading down to the stream channel. This location was sampled from 0- to 0.3-m (0- to 1-ft) bgs and was collected on alternate sides of the channel for every other transect. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect. The following analytical procedure for EA 4 sediment/soil samples was presented in the *Field Summary Report for the Characterization of Lower Three Runs Stream, Floodplain, and Headwaters* (SRNS 2010b):

> "All samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129,

nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. Eight of the sample locations (RDC001, RDC005, RDC008, RDC010, RDC013, RDC015, RDC018, and RDC021) also were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals."

Eighteen surface water samples were also collected at EA 4 during the 2009/2010 sampling event. Two surface water samples were collected at each transect location, with one water sample being filtered and the other unfiltered. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

No biota samples (i.e. fish tissue) were collected at EA 4 during the 2009/2010 sampling event.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 4.

3.10.3 Exposure Area 4 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Only Cs-137(+D) in sediment/soil and mercury and Cs-137(+D) in fish represent the primary constituents in EA 4. No fish samples were collected in EA 4. However, results from adjacent EAs indicate that mercury and Cs-137(+D) are present in fish tissue. Therefore, results from the EAs in which fish samples were collected are used as a proxy for EA 4.

Figure 3-14 illustrates the nature and extent of contaminants at EA 4 and provides an overview of the overall contamination based on activities of Cs-137(+D). Cs-137(+D) was detected in 24 out of 36 samples, with five of these being an estimated value (i.e., "J" qualified). Concentrations ranged from ND to 50 pCi/g, with the highest detected concentration collected at location RDC015-001 on 4/20/2010.

Assuming 0.3-m (1-ft) depth of contaminated sediment/soil and 3-m (9.8-ft) canal flow area, the maximum volume of contaminated sediment in the canal system would be 2,075 m^3 or 2,714.0 yd^3.

3.10.4 Exposure Area 4 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 4. See Appendices B, C, and D for more detail.

3.10.4.1 Human Health Risk Assessment

3.10.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: iron, vanadium, and Cs-137(+D).
- COCs for the onsite worker scenario: Cs-137(+D).
- RCOC for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 1.0E-04) is identified as an RCOC. Decay-adjusted Cs-137(+D) risk = 8.8E-05. Within this EA, Cs-137(+D) is the single constituent that contributes to the above risk for this receptor. Figure 3-14 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.10.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: benzo(a)anthracene and bis[2-ethylhexl]phthalate.
- RCOCs for surface water: none.

3.10.4.1.3 Fish

- No fish samples were collected within EA 4. However, results for samples collected within other EAs (EA 3, EA 6, EA 8, and EA 9) are used as a proxy for EA 4.
- RCOC for fish ingestion: Cs-137(+D) and mercury.

3.10.4.2 Ecological Risk Assessment

3.10.4.2.1 Sediment/soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: americium-243, bis[2-ethylhexyl]phthalate, bismuth-212, carbon-14, curium-243 and curium-244, DDT, lead-214, thallium-208, and vanadium.
- COPCs: americium-243, bismuth-212, carbon-14, curium-243 and curium-244, DDT, lead-214, thallium-208, and vanadium.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for sediment/soil: none.

3.10.4.2.2 Surface water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: aluminum, anthracene, benzo[a]anthracene, bis[2-ethylhexyl]phthalate, caprolactam, fluoranthene, iron, manganese, and pyrene.
- COPCs: aluminum, anthracene, benzo[a]anthracene, bis[2-ethylhexyl]phthalate, caprolactam, fluoranthene, iron, manganese, and pyrene.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for surface water: none.

3.10.5 Exposure Area 4 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 4 indicate that using maximum concentrations and activity concentrations of detected constituents, no constituents exceed the PTSM threshold levels (i.e., HI greater than [>] 10 and risk ≥1E-03). There are no PTSM RCOCs for EA 4.

3.10.6 Exposure Area 4 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.10.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 1.0E-04) is identified as a RCOC for the onsite worker. Decay-adjusted Cs-137(+D) risk = 8.8E-05.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.10.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.10.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.11 Exposure Area 5

3.11.1 Exposure Area 5 Description

EA 5 consists of Joyce Branch (also known as the "Old R-Area Discharge Canal"), and is ~2,533-m (8,310.3-ft) long. Flow from the R-Reactor cooling water system was directed along the stream to LTR from 1953 until the diversion structure was built in 1958. The diversion structure, which was constructed coincident with the creation of PAR Pond and the canal system, was used to divert flow to the canal system and pre-cooler Ponds A, B, and C, thus eliminating reactor discharges to Joyce Branch (SRNS 2010b). The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the stream channel. Fifteen (15) sediment and sediment/soil samples were collected in EA 5 during the 2009/2010 investigation. Ten (10) surface water samples were collected in EA 5 during the 2009/2010 investigation with no analytes detected above screening thresholds.

3.11.2 EA 5 Characterization and Data Summary

Figure 3-5 shows the comprehensive sample locations for in EA 5 at Joyce Branch.

A total of five sediment samples and 10 sediment/soil samples were collected from EA 5 during the 2009/2010 sampling event. The sample locations (transects) were determined by conducting a LaBr survey investigation. Two sediment/soil samples were taken per transect at the part of the transect that recorded the highest total gamma measurements. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect. Samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sample location (JBT003) was also analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals.

Ten surface water samples were also taken at EA 5 during the 2009/2010 sampling event. Two surface water samples were collected at each of the five transect locations. Each sample consisted

of one filtered water sample and the one unfiltered water sample. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs.

No biota samples (i.e., fish tissue) were collected at EA 5 during the 2009/2010 sampling event.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 5.

3.11.3 Exposure Area 5 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and Co-60 are primary constituents in sediments/soils at EA 5. No fish samples were collected in EA 5; however, results from adjacent EAs indicate that mercury and Cs-137(+D) are present in fish tissue. Therefore, results from the EAs in which fish samples were collected are used as a proxy for EA 5.

Figures 3-15 and 3-16 show the nature and extent of contaminants above a threshold at EA 5. Cs-137(+D) was detected in 17 out of 17 sediment/soil samples with none of these results being an estimated value (i.e., "J" qualified). Concentrations ranged from 1.7 pCi/g to 405 pCi/g, with the highest detected concentration collected at location LTR ERDMS IOULTR2 Sampling Event: LTROU-02 on 4/28/2004.

Co-60 was detected in 6 out of 17 sediment/soil samples with no results being estimated values ("J" qualified). Concentrations ranged from ND to 1.83 pCi/g, with the highest detected concentration collected at location LTR ERDMS IOULTR2 Sampling Event: LTROU-02 on 4/28/2004.

No detections of Cs-137(+D) were reported for EA 5 surface water samples. All 10 surface water samples (filtered and unfiltered at each of the five transects) collected at EA 5 reported detections of tritium, with concentrations ranging from 828 pCi/L (RDC021-002) to 1,390 pCi/L (JBT001-002). However, all 10 detections were well below the USEPA MCL of 20,000 pCi/L.

Napthalene was detected in only one of seven surface water samples with this result being estimated (i.e., "J" qualified). The detected concentration was 0.222 µg/L from sample location LTR ERDMS IOULTR2 Sampling Event: LTROU-02 collected on 10/30/2003.

Bismuth-214 was detected in one of seven samples with this result being estimated (i.e., "J" qualified). The detected concentration was 70.2 pCi/L from sample location LTR ERDMS IOULTR2 Sampling Event: LTROU-02 collected on 10/30/2003.

Assuming 0.3-m (1-ft) depth of contaminated sediment and 3-m (9.8-ft) stream bed flow area, the maximum volume of contaminated sediment in the canal system would be 2,280 m^3 or 2,982.1 yd^3.

3.11.4 Exposure Area 5 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 5. See Appendices B, C, and D for more detail.

3.11.4.1 Human Health Risk Assessment

3.11.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, chromium, cobalt, iron, manganese, vanadium, americium-243(+D), Cs-137(+D), Co-60, potassium-40, thorium-232(+D), and uranium-238(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), Co-60, potassium-40, and thorium-232(+D).
- RCOC for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 1.3E-03) and Co-60 (risk = 9.1E-06) are identified as RCOCs with a TCR = 1.3E-03. Decay-adjusted Cs-137(+D) risk = 9.4E-04; decay-adjusted Co-60 risk = 1.7E-06 with a decay-adjusted TRC = 9.4E-04. As noted in the above TCRs, Cs-137(+D) is the predominant human health RCOC

in the LTR IOU. Figure 3-15 identifies the sample location in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.11.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: naphthalene and bismuth-214.
- RCOCs for surface water: none.

3.11.4.1.3 Fish

- No fish samples were collected within EA 5. However, results for samples collected within other EAs (EA 3, EA 6, EA 8, and EA 9) are used as a proxy for EA 5.
- RCOCs for fish ingestion: Cs-137(+D) and mercury.

3.11.4.2 Ecological Risk Assessment

3.11.4.2.1 Sediment/soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: acetone, actinium-228, americium-243, barium, chromium, copper, cyanide, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, potassium-40, thallium-208, vanadium, and zinc.
- COPCs: actinium-228, americium-243, barium, cyanide, DDE, DDT, lead-212, lead-214, mercury, potassium-40, thallium-208, and vanadium.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOPCs: none.

3.11.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: bismuth-214, DDT, iron, and lead-214.
- COPCs: bismuth-214, DDT, iron, and lead-214.
- RCOPC for Trophic Modeling: DDT.
- Trophic Modeling COCs: none.
- RCOPCs: none.

3.11.5 Exposure Area 5 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 5 indicate two separate locations within EA 5 that each exceeds PTSM levels for the onsite worker. Using maximum concentrations and activity concentrations of detected constituents, the only constituent that exceeds the PTSM threshold level (i.e., risk ≥1E-03) is Cs-137(+D). Based on the maximum detected activity concentration of 405 pCi/g from the all-depth sample interval (i.e., 0 to 1.22 m [0 to 4 ft]), the resultant risk for the onsite worker is 2.3E-03. With a half-life of 30.2 years and the time frame from which the data were collected in EA 5, decay would result in a lower activity concentration. The 95% UCL on the mean the decay corrected 95% UCL (168.3 pCi/g from the 0- to 0.3-m [0- to 1-ft] sample interval) the associated risk to the onsite worker (9.4E-04) is below the PTSM threshold level. There are only three samples out of 17 in which the activity concentrations exceed the PTSM threshold level. Assuming these sample locations represent hotspots, the PRG used may increase due to a smaller area correction factor used. Thus, the risk calculated using the maximum detected activity concentration and a hotspot-based PRG would be below the PTSM threshold level. Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation there are no PTSM RCOCs identified for EA 5. However, it is recognized that two locations (LTR-02 and LTR-04) had samples that are above the PTSM threshold for the onsite worker. The above PTSM result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the in the FS phase of the project.

3.11.6 Exposure Area 5 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.11.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 1.3E-03) and Co-60 (risk = 9.1E-06) are identified as RCOCs for the onsite worker receptor with a TCR = 1.3E-03. Decay-adjusted Cs-137(+D) risk = 9.4E-04 and decay-adjusted Co-60 risk = 1.7E-06, with a TCR = 9.4E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.11.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.11.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.12 Exposure Area 6

3.12.1 Exposure Area 6 Description

EA 6 includes PAR Pond only. PAR Pond is ~1,068.3 ha (2,640 ac) and received water from the R-Area and P-Area discharges. In 1995, an Interim Record of Decision established a minimum water elevation (61 +/- 0.3-m [200 +/- 1-ft msl]) and LUCs to manage exposure to contaminated

sediments. The subsequent National Environmental Policy Act document (ROD, Shutdown of the River Water System at the SRS, FR Vol. 63, No.18, 1/29/98) acknowledged PAR Pond can naturally fluctuate between 59.4- and 60.9-m (195- and 200-ft) msl and established a minimum water level of 59.4-m (195-ft) msl. Additionally, minimum outflow of 0.14 m^3/sec (5 ft^3/sec) per second from PAR Pond has been established (per 2009 Finding of No Significant Impact [FONSI]) to maintain downstream environments. No sediment, sediment/soil, or surface water samples were collected in EA 6 during the 2009/2010 investigation; however, in an effort to fill in data gaps from the 2009/2010 sampling event, sediment and surface water samples were collected at PAR Pond in May – June 2016.

3.12.2 Exposure Area 6 Characterization and Data Summary

Figure 3-6 shows the comprehensive sample locations in EA 6 at PAR Pond. A total of three sediment samples were collected from EA 6 during the May – June 2016 sampling event. All three samples were analyzed for radionuclide indicators (gross alpha [including radium-226] and non-volatile beta [including carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99]), gamma spectroscopy, TAL metals, tritium, and inorganics (cyanide, hexavalent chromium, and thallium).

Fourteen surface water samples were also taken at EA 6 during the May – June 2016 sampling event. Each sample consisted of one filtered water sample and one unfiltered water sample. Both the unfiltered and filtered surface water samples were analyzed for radionuclide indicators (gross alpha [including radium-226] and non-volatile beta [including carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99]), gamma spectroscopy, TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, tritium, and inorganics (cyanide, hexavalent chromium, and thallium).

Biota samples (i.e., fish tissue) were collected at PAR Pond during the sampling event in June 2010. These biota samples were analyzed for TAL inorganics, radionuclide indicators (gross alpha and non-volatile beta), tritium, and gamma spectroscopy for gamma emitters including Cs-137.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 6.

3.12.3 Exposure Area 6 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and Co-60 in sediment/soil and mercury and Cs-137(+D) in fish are principal constituents for EA 6. Figures 3-17, 3-17A, 3-17B and 3-18 depict the nature and extent of contaminants exceeding thresholds at EA 6.

Cs-137(+D) was detected in 510 out of 540 sediment/soil samples, with one of these results being an estimated value (i.e., "J" qualified). Concentrations ranged from ND to 124 pCi/g. Sample location PAR Pond Sediment Fish: PF3-5 had the highest detected concentration and was collected on 9/16/1995.

Co-60 was detected in 132 out of 259 sediment/soil samples, with no results being estimated values ("J" qualified). Concentrations ranged from ND to 1.13 pCi/g, with the highest detected concentration at location PAR Pond Sediment Fish: PF3-5 (see Figure 3-6) collected on 9/16/1995.

Cs-137(+D) was detected in 160 out of 165 fish samples, with one result being estimated (i.e., "J" qualified). Concentrations ranged from ND to 18.4 pCi/g. Sample PAR Pond 28055 had the highest activity concentration and was collected on 9/2/1993.

Mercury was detected in 224 out of 227 fish samples in which 38 of these results are estimated (i.e., "J" qualified). Concentrations ranged from ND to 3.18 mg/kg. Sample PAR Pond Sediment Fish PF2-2 105808 had the maximum detected fish concentration collected on 9/26/1995.

Contaminated sediment/soil at PAR Pond is estimated to be ~3,205,110 m^3 (4,192,125.6 yd^3). Surface water samples collected at EA 6 during the 2016 sampling event had all concentrations reported below risk-based screening levels.

Biota sampled from PAR Pond exhibited Cs-137 and mercury concentrations above risk-based screening levels. On average, Cs-137 levels in fish tissue were 11.09 pCi/g, which exceeds the recreational fisherman screening level of 0.0545 pCi/g.

3.12.4 Exposure Area 6 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 6. See Appendices B, C, and D for more detail.

3.12.4.1 Human Health Risk Assessment

3.12.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, antimony, arsenic, chromium, hexavalent chromium, cobalt, cyanide, iron, manganese, mercury, thallium, vanadium, barium-133, Cs-137(+D), Co-60, europium-152, potassium-40, strontium-89/-90, and thorium-232(+D).
- COCs for the onsite worker scenario: Cs-137(+D), Co-60, potassium-40, and thorium-232(+D).
- RCOC for the onsite worker scenario sediment/soil: Cs-137(+D) (risk = 4.9E-05) and Co-60 (risk = 1.2E-06) are identified as RCOCs with a TCR = 5.0E-05. Decay-adjusted Cs-137(+D) risk = 2.9E-05, decay-adjusted Co-60 risk = 7.2E-08, and decay-adjusted TCR = 2.9E-05. As noted in the above TCRs, Cs-137(+D) contributes 100% and is therefore the predominant human health RCOC in the LTR IOU. Figure 3-17 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.12.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: thallium, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, lead-212, potassium-40, and thorium-234.
- RCOCs for surface water: none.

3.12.4.1.3 Fish

- COCs: chromium, mercury, Cs-137(+D), lead-212, potassium-40, and thorium-234.
- RCOC for fish ingestion: Cs-137(+D) and mercury.

3.12.4.2 Ecological Risk Assessment

3.12.4.2.1 Sediment/Soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: 2-chlorophenol, acetone, antimony, arsenic, barium, barium-133, benzoic acid, bis[2-ethylhexyl]phthalate, cadmium, carbon disulfide, chloride, chromium, cinnamyl cinnamate, cobalt-58, cyanide, dibutylphthalate, europium-155, iron, lead, lead-214, manganese, manganese-54, mercury, methyl cyclopentane, methyl isobutyl ketone, neptunium-239, orthophosphate, phenols, phosphate, potassium-40, promethium-146, ruthenium-106, selenium, thallium, thorium-234, tin-113, vanadium, zinc-65, and zirconium-95.
- COPCs: barium-133, chloride, cinnamyl cinnamate, cobalt-58, europium-155, lead-214, manganese-54, mercury, methyl cyclopentane, methyl isobutyl ketone, neptunium-239, orthophosphate, phenols, phosphate, potassium-40, promethium-146, ruthenium-106, selenium, thallium, thorium-234, tin-113, vanadium, zinc-65, and zirconium-95.
- RCOPCs for Trophic Modeling: mercury.
- Trophic Modeling COCs: mercury.
- RCOC for sediment/soil: none.

3.12.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, lead-212, manganese, potassium-40, radium-226, radium-228, selenium, and thorium-234.

- COPCs: dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, lead-212, potassium-40, and thorium-234.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for surface water: none.

3.12.5 Exposure Area 6 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 6 indicate that using maximum concentrations and activity concentrations of detected constituents, no constituents exceed the PTSM threshold levels (i.e., HI >10 and risk ≥1E-03). There are no PTSM RCOCs for EA 6.

3.12.6 Exposure Area 6 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.12.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 4.9E-05) and Co-60 (risk = 1.2E-06) are identified as RCOCs for the onsite worker receptor with a TCR = 5.0E-05. Decay-adjusted Cs-137(+D) risk = 2.9E-05 and decay -adjusted Co-60 risk = 7.2E-08, with a TCR = 2.9E-05.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman scenario.

3.12.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/Soil media: No ecological RCOCs.

- Surface water media: No ecological RCOCs.

3.12.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/Soil media: No PTSM RCOCs.

3.13 Exposure Area 7

3.13.1 Exposure Area 7 Description

EA 7 includes Pond 2 and the Discharge Canal between P-Area and Ponds 4 and 5. Pond 2 is ~7.9 ha (19.6 ac) and received water from P-Area and subsequently discharged to Ponds 4 and 5. The canal from P-Area to Pond 2 is ~3,582-m (11,751.9-ft) long. The canal from Pond 2 to Ponds 4 and 5 is 2,081-m (6,827.4-ft) long. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the canal. Seventy-five (75) sediment or sediment/soil samples and 32 surface water samples were collected in EA 7 during the 2009/2010 sampling event.

3.13.2 Exposure Area 7 Characterization and Data Summary

Figure 3-7 shows the comprehensive sample locations in EA 7 at Pond 2 and the Discharge Canal. Pond 2 sample locations were determined by the established transect lines. Two samples were taken at each end of the transect line in dry soil ~0.91-m (3-ft) away from the water line. One sample was collected from 0- to 0.3-m [0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect line. P-Area Discharge Canal samples were collected at transect locations (PDC001 through PDC015) that were spaced approximately every 250-m (820-ft) between P-Reactor and Pond 2, and every 500-m (1,640-ft) between Pond 2 and Ponds 4 and 5. Two sediment/soil samples were taken on either side of the canal, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. One sample was collected from (0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. A third sediment/soil sample was collected on the slope leading down to the stream channel. This location

was sampled from (0- to 0.3-m (0- to 1-ft) bgs and was collected on alternate sides of the channel for every other transect.

Samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sediment sample per pond (PAT1, PBT3, PCT1, P2T3, P4T2, and P5T2) and seven P-Area Discharge Canal sample locations (PDC003, PDC004, PDC006, PDC009, PDC010, PDC014, and PDC018) were also analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals.

Two surface water samples were taken at Pond 2 and 30 were collected from the P-Area Discharge Canal between P-Area and Ponds 4 and 5 during the 2009/2010 sampling event. Both Pond 2 surface water samples were collected at the transect location where the sediment/soil sample required a full analytical suite (Pond 2 transect line 2 [P2T2] in the SRNS 2010b Figure 16, with one water sample being filtered and the other unfiltered. Two surface water samples were collected at each transect location of the P-Area Discharge Canal, with one water sample being filtered and the other unfiltered. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

No biota samples (i.e., fish tissue) were collected at EA 7 during the 2009/2010 sampling event.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 7.

3.13.3 Exposure Area 7 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and Co-60 are principal constituents in EA 7. No fish samples were collected in EA 7; however, results from adjacent EAs

indicate that mercury and Cs-137(+D) are present in fish tissue. Therefore, results from the EAs in which fish samples were collected are used as a proxy for EA 7.

Figures 3-19 and 3-20 illustrate the nature and extent of contaminants at EA 7 and provide an overview of the overall contamination based on activities of Cs-137(+D) and Co-60, respectively. Cs-137(+D) was detected in 97 out of 138 sediment/soil samples with four of these results being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 149 pCi/g, with the highest activity concentration at location Pond 2 P25-019-01 on 3/9/2000.

Co-60 was detected in 18 out of 109 sediment/soil samples with one result being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 15.5 pCi/g, with the highest activity concentration at Pond 2 P25-007-01 on 3/9/2000. Assuming 0.3-m (1-ft) depth of contaminated sediment and 3-m (9.8-ft) canal flow area, the maximum volume of contaminated sediment in the canal system would be 5,097 m^3 or 6,666.6 yd^3.

Contaminated sediment below the water surface in Pond 2 covers an area of ~79,318 m^2 (94,863.54 yd^2). Assuming a 0.3 m (1.0 ft) depth of contaminated sediment, the maximum volume of contaminated sediment in Pond 2 would be 23,796 m^3 or 31,123.9 yd^3.

EA 7 Estimated Volume of Contaminated Sediment

Media	Location	Estimated Volume
Sediment	Pond 2	23,796 m^3 (31,123.9 yd^3)
Sediment	Canal	5,097 m^3 (6,666.6 yd^3)
	Total:	**28,893 m^3 (37,790.5 yd^3)**

3.13.4 Exposure Area 7 Risk Assessment Results

Below is a summary of the HH and ERA results for EA 7. See Appendices B, C, and D for more detail.

3.13.4.1 Human Health Risk Assessment

3.13.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, arsenic, chromium, cobalt, iron, lead, manganese, mercury, vanadium, Cs-137(+D), Co-60, potassium-40, radium-226(+D), thorium-232(+D), uranium-235(+D), and uranium-238(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), Co-60, potassium-40, radium-226(+D), and thorium-232(+D).
- RCOC for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 7.7E-04) and Co-60 (risk = 9.6E-06) are identified as RCOCs with a TCR = 7.8E-04. Decay-adjusted Cs-137(+D) risk = 4.5E-04, decay-adjusted Co-60 risk = 1.0E-06, and decay-adjusted TCR = 4.5E-04). As noted in the above TCRs, Cs-137(+D) contributes 100% and is therefore the predominant human health RCOC in the LTR IOU. Figure 3-19 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.13.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: iron, manganese, bismuth-214, and lead-212.
- RCOCs for surface water: none.

3.13.4.1.3 Fish

- No fish samples were collected within EA 7. However, results for samples collected within other EAs (EA 3, EA 6, EA 8, and EA 9) are used as a proxy for EA 7.
- RCOC for fish ingestion: Cs-137(+D) and mercury.

3.13.4.2 Ecological Risk Assessment

3.13.4.2.1 Sediment/Soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of sediment/soil media are identified below:

- COPECs: acetone, actinium-228, aluminum, americium-243, arsenic, barium, beryllium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, cadmium, chromium, cobalt, copper, curium-243 and curium-244, cyanide, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, methyl acetate, nickel, PCB-1254, potassium-40, radium-224, thallium-208, thorium-231, thorium-234, toluene, and vanadium.
- COPCs: actinium-228, americium-243, barium, bismuth-212, bismuth-214, curium-243 and curium-244, cyanide, lead-212, lead-214, mercury, methyl acetate, potassium-40, radium-224, thallium-208, thorium-231, thorium-234, and vanadium.
- RCOPCs for Trophic Modeling: mercury.
- Trophic Modeling COCs: mercury.
- RCOCs for sediment/soil: none.

3.13.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of surface water media are identified below:

- COPECs: aluminum, bismuth-214, caprolactam, chloromethane, chromium, copper, DDT, iron, lead, lead-212, lead-214, and manganese.
- COPCs: aluminum, bismuth-214, caprolactam, chloromethane, DDT, iron, lead, lead-212, lead-214, and manganese.
- RCOPCs for Trophic Modeling: aluminum, iron, manganese, and DDT.
- Trophic Modeling COCs: aluminum.
- RCOCs for surface water: none.

3.13.5 Exposure Area 7 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 7 indicate that using maximum concentrations and activity concentrations of detected constituents, no individual constituents exceed the PTSM threshold level (i.e., risk ≥1E-03), although the cumulative risk does exceed the threshold level. This is due to summing the individual constituent risks for Cs-137(+D), potassium-40, radium-226(+D), and thorium-232(+D). Discounting the contributions of the naturally-occurring constituents' potassium-40, radium-226(+D), and thorium-232(+D), the resultant risk due solely to Cs-137(+D) (risk = 8.3E-04) using the maximum concentration is below the PTSM threshold level. Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 7.

3.13.6 Exposure Area 7 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.13.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 7.7E-04) and Co-60 (risk = 9.6E-06) are identified as RCOCs for the onsite worker receptor with a TCR = 7.8E-04. Decay-adjusted Cs-137(+D) risk = 4.5E-04 and decay-adjusted Co-60 risk = 1.0E-06, with a decay adjusted TCR = 4.5E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.13.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.13.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.14 Exposure Area 8

3.14.1 Exposure Area 8 Description

EA 8 includes Ponds 4 and 5 and the Discharge Canal between Ponds 4 and 5 and Pond C. Pond 4 is ~14.3 ha (35.3 ac) and received water from P-Area and subsequently discharged to Pond 5. Pond 5 is ~4.0 ha (9.9 ac) and received water from Pond 4 and subsequently discharged to Pond C via an 1,887-m (6,190.9-ft) long canal. The canal flow area (i.e., where contaminants most likely have been deposited) is ~3-m (9.8-ft) across the base of the canal. During the 2009/2010 sampling event, forty-two (42) sediment/soil samples and 10 surface water samples were collected in EA 8.

3.14.2 Exposure Area 8 Characterization and Data Summary

Figure 3-8 shows the comprehensive sample locations in EA 8 at Ponds 4 and 5, and the P-Area Discharge Canal. Thirty-three (33) sediment/soil samples and nine sediment samples were collected from EA 8 during the 2009/2010 sampling event. Pond 4 and 5 sample locations were determined by the established transect lines. Two samples were taken at each end of the transect line in dry soil ~0.91-m (3-ft) away from the water line. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect line. P-Area Discharge Canal samples were collected at transect locations (PDC016 through PDC018) that were spaced approximately every 500-m (1,640-ft) between Ponds 4 and 5 and Pond C. Two sediment/soil samples were taken on either side of the canal, ~3-m (10-ft) outside the high-water mark on each bank of the discharge canal. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. A third sediment/soil sample was collected on the slope leading down to the stream channel. Samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma

spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sediment sample per pond (PAT1, PBT3, PCT1, P2T3, P4T2, and P5T2) and seven P-Area Discharge Canal sample locations (PDC003, PDC004, PDC006, PDC009, PDC010, PDC014, and PDC018) were also analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals.

Two surface water samples were taken at Pond 4, two surface water samples were taken at Pond 5, and six surface water samples were collected from the P-Area Discharge Canal between Ponds 4 and 5 and Pond C during the 2009/2010 sampling event. Pond 4 and 5 surface water samples were collected at the transect location where the sediment/soil sample required a full analytical suite (Pond 4 transect line 2 [P4T2] and Pond 5 transect line 2 [P5T2] in the SRNS 2010b Figure 17), with one water sample being filtered and the other unfiltered. Two surface water samples were collected at each transect location of the P-Area Discharge Canal, with one water sample being filtered and the other unfiltered. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

Biota samples (i.e., fish tissue) were collected at Ponds 4 and 5 during the 2009/2010 sampling event in June 2010. These biota samples were analyzed for TAL inorganics, radionuclide indicators (gross alpha and non-volatile beta), tritium, and gamma spectroscopy for gamma emitters including Cs-137.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 8.

3.14.3 Exposure Area 8 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and Co-60 in sediment/soil and mercury and Cs-137(+D) in fish are principal constituents for EA 8.

Figure 3-21 illustrates the nature and extent of contaminants at EA 8 and provides an overview of the overall contamination based on activities of Cs-137(+D).

Cs-137(+D) was detected in 59 out of 71 sediment/soil samples with four of these results being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 125.6 pCi/g, with the highest activity concentration at location Pond 5 P25-042-01 on 3/27/2000.

Co-60 was detected in 5 out of 73 sediment/soil samples with one result being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 0.586 pCi/g with the highest activity concentration at Pond 4 (P25-022-01) on 3/2/2000.

Cs-137(+D) was detected in 1 out of 1 fish sample, at location LTR-P45, with a maximum activity concentration of 7.84 pCi/g on 6/10/2010.

Mercury was detected in 1 out of 1 fish sample, at location LTR-P45, with a maximum concentration of 0.854 mg/kg, which is "J" qualified (i.e. estimated), on 6/10/2010.

No individual constituents exceed the PTSM threshold levels (i.e., HI >10 and risk ≥1E-03). There are no PTSM RCOCs for EA 8.

Biota sampled from Ponds 4 and 5 exhibits Cs-137 concentrations above risk-based screening levels. The Cs-137 level in fish tissue was 7.84 pCi/g, which exceeds the recreational fisherman screening level of 0.0545 pCi/g. The mercury level in fish tissue was 0.854 mg/kg, which exceeds the recreational fisherman screening level of 0.154 mg/kg.

3.14.4 Exposure Area 8 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 8. See Appendices B, C, and D for more detail.

3.14.4.1 Human Health Risk Assessment

3.14.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite

worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, arsenic, chromium, cobalt, cyanide, iron, lead, manganese, mercury, vanadium, Cs-137(+D), Co-60, potassium-40, thorium-232(+D), and uranium-238(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), potassium-40 and thorium-232(+D).
- RCOC for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 2.8E-04) is identified as a RCOC. Decay-adjusted Cs-137(+D) risk = 1.9E-04. Within this EA, Cs-137(+D) is the single constituent that contributes to the above risk for this receptor. Figure 3.21 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(+D) (i.e., 0.18 pCi/g).

3.14.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: manganese and various organic compounds.
- RCOCs for surface water: none.

3.14.4.1.3 Fish

- COPCs: chromium, mercury, Cs-137(+D), and potassium-40.
- RCOC for fish ingestion: Cs-137(+D) and mercury.

3.14.4.2 Ecological Risk Assessment

3.14.4.2.1 Sediment/Soil

Details of the ERA are provided in Appendix C. Results of each step of the process of the evaluation of sediment/soil media are identified below:

- COPECs: acetone, actinium-228, aluminum, arsenic, barium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, cadmium, carbon disulfide, chromium, cobalt, copper, cyanide,

DDD, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, nickel, PCB-1242, PCB-1254, potassium-40, radium-224, thallium-208, vanadium, and zinc.

- COPCs: actinium-228, barium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, cyanide, DDD, DDE, DDT, lead, lead-212, lead-214, mercury, radium-224, thallium-208, vanadium, and potassium-40.
- RCOPCs for Trophic Modeling: cyanide, DDD, DDE, DDT, lead and mercury.
- Trophic Modeling COCs: mercury.
- RCOCs for sediment/soil: none.

3.14.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process of the evaluation of surface water media are identified below:

- COPECs: 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2-chloronaphthalene, 2-nitroaniline, 3,3-dichlorobenzidine, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-bromophenyl phenyl ether, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, aluminum, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, bis[2-ethylhexyl]phthalate, caprolactam, carbazole, chrysene, DDT, dibenz[a,h]anthracene, dibenzofuran, dimethylphthalate, dioctylphthalate, fluoranthene, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclopentadiene, indeno[1,2,3-cd]pyrene, iron, lead-214, manganese, and pyrene.
- COPCs: 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2-chloronaphthalene, 2-nitroaniline, 3,3-dichlorobenzidine, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-bromophenyl phenyl ether, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, aluminum, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, bis[2-ethylhexyl]phthalate, caprolactam, carbazole, chrysene, DDT, dibenz[a,h]anthracene, dibenzofuran, dimethylphthalate, dioctylphthalate, fluoranthene,

hexachlorobenzene, hexachlorocyclopentadiene, indeno[1,2,3-cd]pyrene, iron, lead-214, manganese, and pyrene.

- RCOPCs for Trophic Modeling: DDT.
- Trophic Modeling COCs: none.
- RCOCs for surface water: none.

3.14.5 Exposure Area 8 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 8 indicate that using maximum concentrations and activity concentrations of detected constituents, no individual constituents exceed the PTSM threshold levels (i.e., HI >10 and risk ≥1E-03). However, the cumulative risk for PTSM evaluation for EA 8 (1.42E-03) slightly exceeds the PTSM level. This is due to summing the individual risk estimates for Cs-137(+D), Ra-226(+D), and Th-232(+D).

However, discounting the contributions of the naturally-occurring constituents' radium-226(+D) and thorium-232(+D), the resultant risk due solely to Cs-137(+D) (risk = 7.0E-04, based on maximum concentration) is below the PTSM threshold level. Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 8.

3.14.6 Exposure Area 8 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA, and PTSM evaluation.

3.14.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 2.8E-04) is identified as a RCOC for the onsite worker. Decay-adjusted Cs-137(+D) risk = 1.9E-04.
- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury are identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.14.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.14.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.15 Exposure Area 9

3.15.1 Exposure Area 9 Description

EA 9 includes Pond C. Pond C is ~53.5 ha (132.4 ac) and received water from the R-Area and P-Area discharged directly from Joyce Branch, and through the canal system. Water from Pond C flows to PAR Pond through a reverse riser (referred to commonly as the "bubble-up"). As long as PAR Pond is above 59.5-m (195.25-ft) msl, Pond C and PAR Pond will be at the same level. If PAR Pond drops below 59.5-m (195.25-ft) msl, Pond C will remain at 59.5-m (195.25-ft) msl (unless the drain gate is opened to release water).

3.15.2 Exposure Area 9 Characterization and Data Summary

Figure 3-9 shows the comprehensive sample locations in EA 9 at Pond C. Twelve sediment/soil samples and three sediment samples were collected from EA 9 during the 2009/ 2010 sampling event. Pond C sample locations were determined by the established transect lines. Two samples were taken at each end of the transect line in dry soil ~0.91-m (3-ft) away from the water line. One sample was collected from 0- to 0.3-m (0- to 1-ft) bgs, and the second was taken from 0.3- to 1.2-m (1- to 4-ft) bgs. Also, one manually-collected sediment sample was obtained from 0- to 0.15-m (0- to 0.5-ft) bgs for each transect line. Samples were analyzed for radionuclide indicators (gross alpha and non-volatile beta) and gamma spectroscopy. If gross alpha exceeded 20 pCi/g, the sample also was analyzed for alpha spectroscopy and radium-226. If non-volatile beta

exceeded 50 pCi/g, the sample also was analyzed for carbon-14 (low-level), iodine-129, nickel-59, nickel-63 (low-level), promethium-147, radium-228, strontium-90, and technetium-99. One sediment sample per pond (PAT1, PBT3, PCT1, P2T3, P4T2, and P5T2) was also analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, and TAL metals.

Two surface water samples were taken at Pond C during the 2009/2010 sampling event. Pond C surface water samples were collected at the transect location where the sediment/soil sample required a full analytical suite (Pond C transect line 1 [PCT1] in SRNS 2010b Figure 15), with one water sample being filtered and the other unfiltered. The unfiltered surface water samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides/PCBs, TAL metals, gamma spectroscopy and tritium. The filtered surface water samples were analyzed for all the unfiltered sample analyses except for TCL VOCs and tritium.

Biota samples (i.e., fish tissue) were collected at Pond C during the 2009/2010 sampling event in April and June 2010. These biota samples were analyzed for TAL inorganics, radionuclide indicators (gross alpha and non-volatile beta), tritium, and gamma spectroscopy for gamma emitters including Cs-137.

Appendix A includes the investigative data for the LTR IOU and presents the statistical data tables and data summary by media (i.e., data package) for EA 9.

3.15.3 Exposure Area 9 Nature and Extent of Contamination

The nature and extent of contamination discussion for the LTR IOU is focused on those constituents that pose a potential threat to the onsite worker. Cs-137(+D) and Co-60 in sediment/soil and mercury and Cs-137 (+D) in fish are the primary constituents for EA 9.

Figure 3-22 and Figure 3-23 illustrate the nature and extent of contaminants at EA 9 and provide an overview of the overall contamination based on activities of Cs-137(+D) and Co-60, respectively. Cs-137(+D) was detected in 51 out of 54 sediment/soil samples with four of these results being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 116.5 pCi/g, with the highest activity concentration at location Pond C Site No. 3 Elevation 59.5 m (195 ft) on 7/30/1991.

Co-60 was detected in 4 out of 24 sediment/soil samples with none of these results being estimated (i.e., "J" qualified). Activity concentrations ranged from ND to 0.448 pCi/g, with the highest activity concentration at location Pond C SED12, Pond C SED 28 on 7/14/1995. Contaminated soil/sediment at Pond C is estimated to be ~146,978 m^3 (192,240 yd^3).

Cs-137(+D) was detected in 2 out of 2 fish samples with no result being estimated (i.e., "J" qualified). Concentrations ranged from 1.18 pCi/g to 42.5 mg/kg pCi/g. Sample LTR-PC had the highest activity concentration and was collected on 4/14/2010. On average, Cs-137 levels in fish tissue were 21.8 pCi/g, which exceeds the recreational fisherman screening level of 0.0545 pCi/g.

Mercury was detected in 2 out of 2 fish samples with one result being estimated (i.e., "J" qualified). Concentrations ranged from 0.0206 mg/kg to 0.854 mg/kg. Sample LTR-PC had the maximum detected fish concentration and was collected on 4/14/2010.

No detections of Cs-137 were reported for EA 9 surface water samples.

3.15.4 Exposure Area 9 Risk Assessment Results

Below is a summary of the human health and ERA results for EA 9. See Appendices B, C, and D for more detail.

3.15.4.1 Human Health Risk Assessment

3.15.4.1.1 Sediment/Soil

Details of the HHRA are provided in Appendix B. Based on the current and likely future land use of the LTR IOU, results of the HHRA for sediment/soil media are presented only for the onsite worker scenario. Refer to Appendix B for a full presentation of the HHRA results. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPCs: aluminum, chromium, cobalt, iron, manganese, thallium, vanadium, Cs-137(+D), Co-60, potassium-40, and thorium-232(+D).
- COCs for the onsite worker scenario: chromium, Cs-137(+D), Co-60, potassium-40 and thorium-232(+D).

- RCOCs for the onsite worker scenario for sediment/soil: Cs-137(+D) (risk = 1.2E-04) and Co-60 (risk = 1.4E-06) are identified as RCOCs with a TCR = 1.2E-04. Decay-adjusted Cs-137(+D) risk = 6.7E-05, decay-adjusted Co-60 risk = 9.6E-08, and decay-adjusted TCR = 6.7E-05. As noted in the above TCRs, Cs-137(+D) contributes 100% and is therefore the predominant human health RCOC in the LTR IOU. Figure 3-22 identifies the sample locations in which the maximum analytical results exceed the onsite worker PRG for Cs-137(D+) (i.e., 0.18 pCi/g).

3.15.4.1.2 Surface Water

Details of the HHRA are provided in Appendix B. Results of each step of the process for the evaluation of surface water are identified below:

- COCs: none.
- RCOCs for surface water: none.

3.15.4.1.3 Fish

- COCs: chromium, Hg, Cs-137, potassium-40.
- RCOCs for fish ingestion: Cs-137(+D) and mercury.

3.15.4.2 Ecological Risk Assessment

3.15.4.2.1 Sediment/Soil

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the sediment/soil media are identified below:

- COPECs: acetone, barium, benzoic acid, bis[2-ethylhexyl]phthalate, camphene, carbon disulfide, chloride, chloromethane, chromium, cyanide, dibutylphthalate, docosane, lead, lead-212, lead-214, manganese-54, methyl isobutyl ketone, orthophosphate, phenols, phosphate, potassium-40, thallium, thallium-208, thorium-234, and vanadium.
- COPCs: camphene, chloride, chloromethane, docosane, lead-212, lead-214, manganese-54, methyl isobutyl ketone, orthophosphate, phenols, phosphate, potassium-40, thallium, thallium-208, thorium-234, and vanadium.

- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for sediment/soil: none.

3.15.4.2.2 Surface Water

Details of the ERA are provided in Appendix C. Results of each step of the process for the evaluation of the surface water media are identified below:

- COPECs: chloromethane, iron, manganese, and silver.
- COPCs: chloromethane, iron, manganese, and silver.
- RCOPCs for Trophic Modeling: none.
- Trophic Modeling COCs: none.
- RCOCs for surface water: none.

3.15.5 Exposure Area 9 Principal Threat Source Material Results

Results of the PTSM evaluation for EA 9 indicate that using maximum concentrations and activity concentrations of detected constituents, no constituents exceed the PTSM threshold levels (i.e., HI >10 and risk ≥1E-03). There are no PTSM RCOCs for EA 9.

3.15.6 Exposure Area 9 Summary of Problems Warranting Action

The following is a summary of the HHRA, ERA and PTSM evaluation.

3.15.6.1 HHRA

As detailed in Appendix B, the following is a summary of the problems warranting action for human receptors:

- Sediment/soil media: Cs-137(+D) (risk = 1.2E-04) and Co-60 (risk = 1.4E-06) are identified as RCOCs for the onsite worker receptor with a TCR = 1.2E-04. Decay-adjusted Cs-137(+D) risk = 6.7E-05 and decay-adjusted Co-60 risk = 9.6E-08 with a decay adjusted TCR = 6.7E-05.

- Surface Water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury were identified as RCOCs in fish tissue for the recreational fisherman receptor.

3.15.6.2 ERA

As detailed in Appendix C, the following is a summary of the problems warranting action for ecological receptors:

- Sediment/soil media: No ecological RCOCs.
- Surface water media: No ecological RCOCs.

3.15.6.3 PTSM

As detailed in Appendix D, the following is a summary of the problems warranting action:

- Sediment/soil media: No PTSM RCOCs.

3.16 RCOCs and Final Conceptual Site Model

Table 3-1 and Figure 3-24 present an overall summary of the RCOCs for LTR IOU by EA. For more details, refer to Chapter 5 Conclusions and Appendices B, C, and D.

3.17 Applicable or Relevant and Appropriate Requirements Evaluation

Analytical data from the LTR IOU are compared to the chemical-specific applicable or relevant and appropriate requirements (ARARs) for sediment/soil and surface water media. The ARAR evaluation for sediment/soil media considers the LTR IOU dataset as a whole and is not performed separately for each EA. The ARAR evaluation summarizes the results of the HH and ERA risk assessments presented in Appendices B and C, respectively.

3.17.1 Sediment/Soil

There are no established ARARs for sediment media. The LTR IOU sediment/soil media is considered to be soil for the purposes of this conservative evaluation. For soil, chemical-specific ARARs or to-be-considered (TBC) requirements exist under Federal and State regulations for

PCBs and lead. PCBs are governed by the Toxic Substances Control Act (40 CFR 761). The final rule for PCB disposal was established on August 20, 1998; it addresses residual levels of PCB remediation waste that can be left in place. Action levels are based on site-specific conditions.

For high-occupancy areas (both residential and industrial scenarios), 40 CFR 176.125 (4)(v) states that spills be decontaminated to 10-mg/kg PCBs, provided that soil is excavated to a minimum depth of 25 cm (10 in.) and that the excavated soil is replaced with clean soil (i.e., soil containing less than 1-mg/kg PCBs). For low-occupancy areas (e.g., the most likely onsite worker scenario), the regulation requires that action levels be established in the range of 25 to 50 mg/kg and recognizes that PCB concentrations near the high end of this range may be protective of human health and the environment at sites where exposure is limited through institutional controls. Soil at the LTR IOU was evaluated against the more conservative high-occupancy remediation level of 10 mg/kg. The maximum detected concentration at of PCBs is 0.101 mg/kg (PCB-1254) from EA 8 (Appendix A, Table A.1.8.1.2). The highest detected concentration of PCBs in LTR IOU sediment/soil is below the ARAR soil screening level.

For lead in soil, the CERCLA value of 400 mg/kg was set by the USEPA Office of Solid Waste Emergency Response and adopted as a TBC for the screening process (USEPA 1994). The maximum detected concentration of lead is 98.12 mg/kg from EA 8 (Appendix A, Table A.1.8.1.2). The highest detected concentration of lead in LTR IOU sediment/soil is below the ARAR soil screening level.

There are no ARAR RCOCs for sediment/soil media at the LTR IOU.

3.17.2 Surface Water

ARARs for surface water are identified as 1) MCLs promulgated under USEPA Drinking Water Regulations and Health Advisories, or 2) SCDHEC Ambient Water Quality Criteria (AWQC) (SC R.61-68), and 3) USEPA National AWQC.

The HHRA presented in Appendix B compares the constituents in surface water to MCLs for each EA. In the absence of a MCL, promulgated AWQC (for the consumption of water and organism) is also considered as a screening threshold. Any exceedances of these thresholds are further

evaluated in a refinement step that provides a recommendation whether or not a particular constituent is a problem warranting action. No constituents are identified as surface water RCOCs in the HHRA, Appendix B.

The ERA presented in Appendix C considers the SCDHEC Water Classifications and Standards (freshwater aquatic life chronic values) regulation (SCDNR 2014) as well as the National Recommended Surface Water Criteria chronic values as compiled in USEPA *Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft* (USEPA 2015). Exceedances of these thresholds are also subject to an uncertainty evaluation in an effort to identify problems warranting remedial action. No constituents are identified as surface water RCOCs in the ERA, Appendix C.

There are no ARAR RCOCs for surface water media at the LTR IOU.

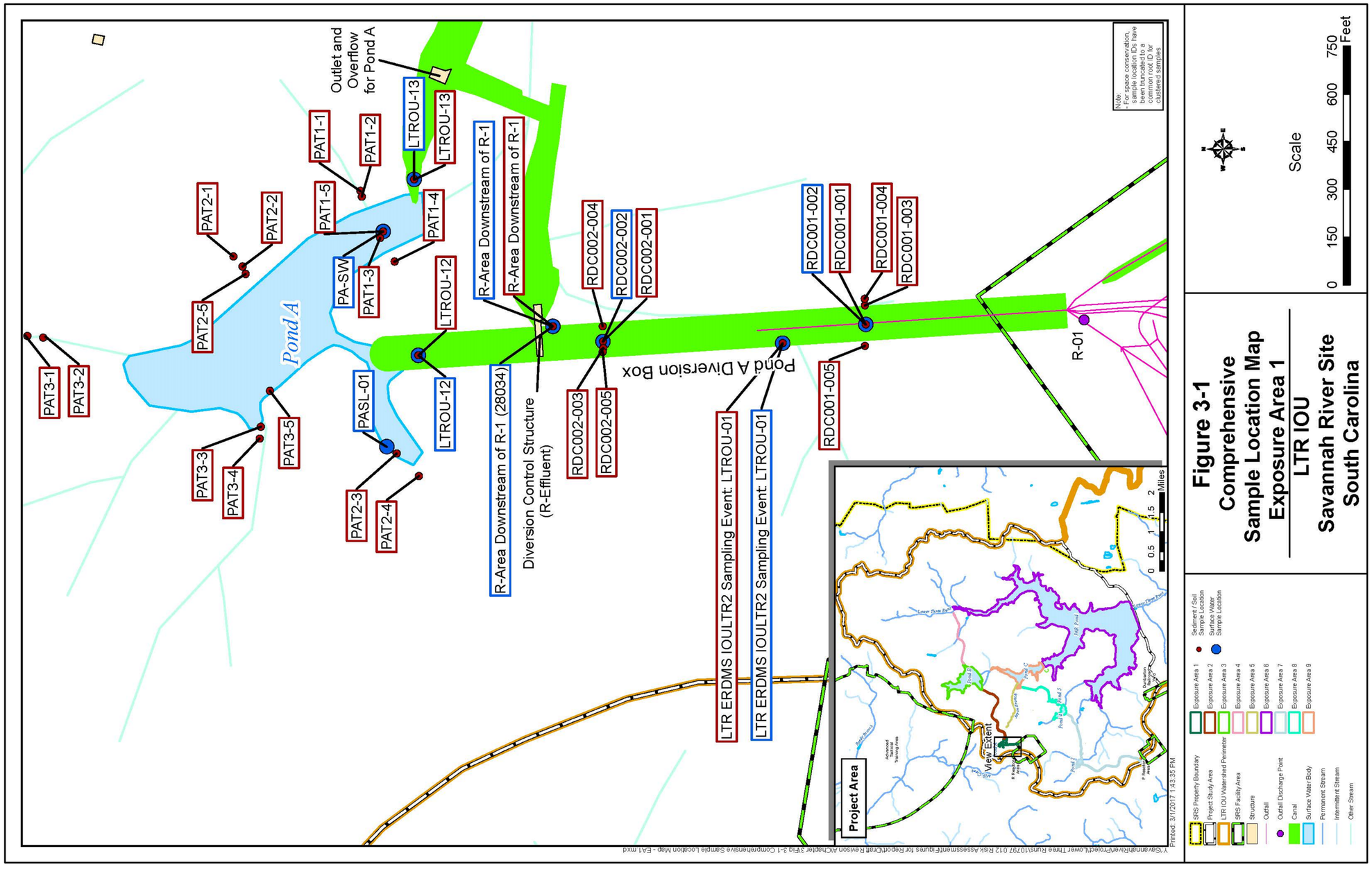


Figure 3-1. Comprehensive Sample Location Map – Exposure Area 1

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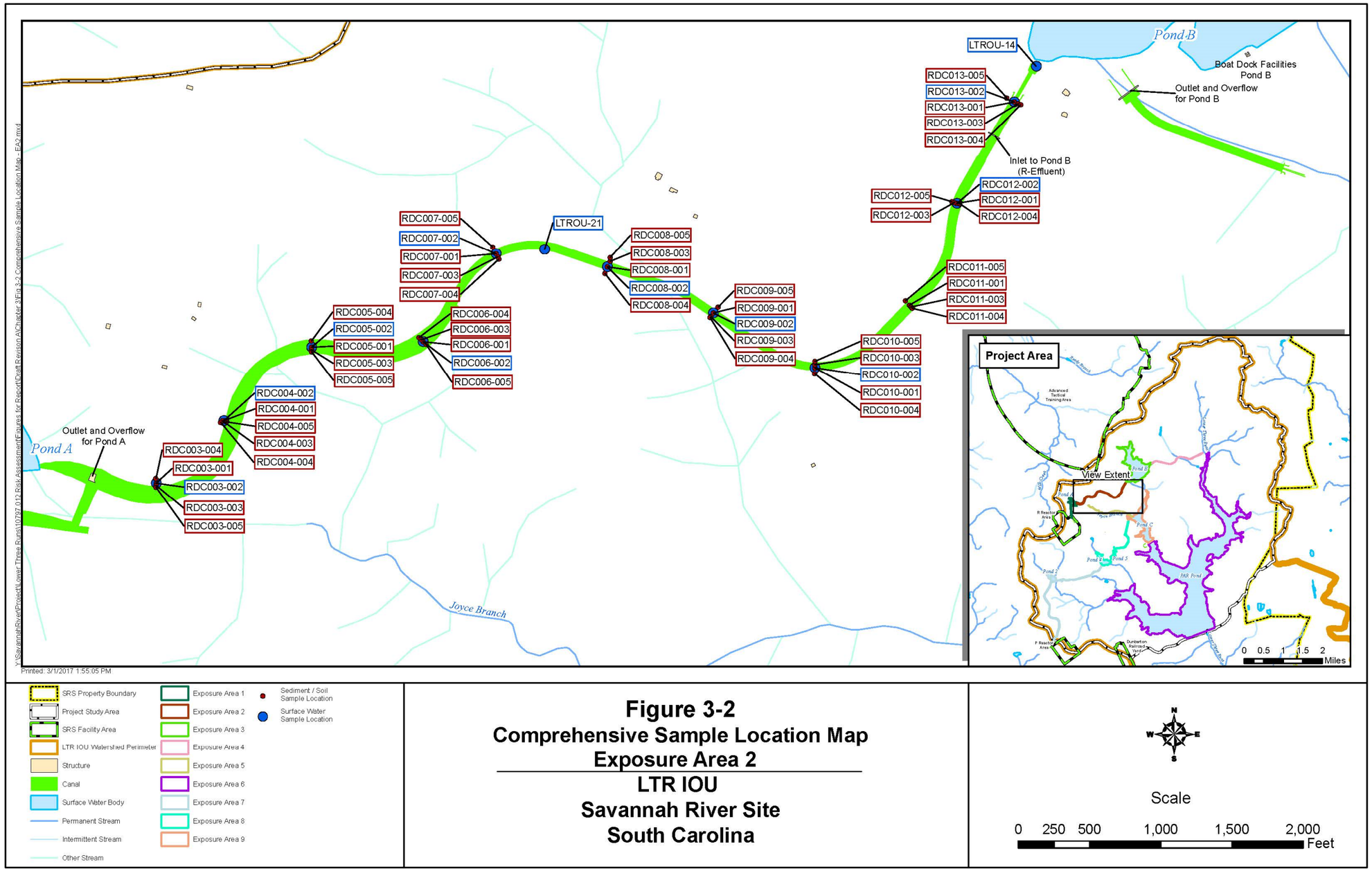


Figure 3-2. Comprehensive Sample Location Map – Exposure Area 2.

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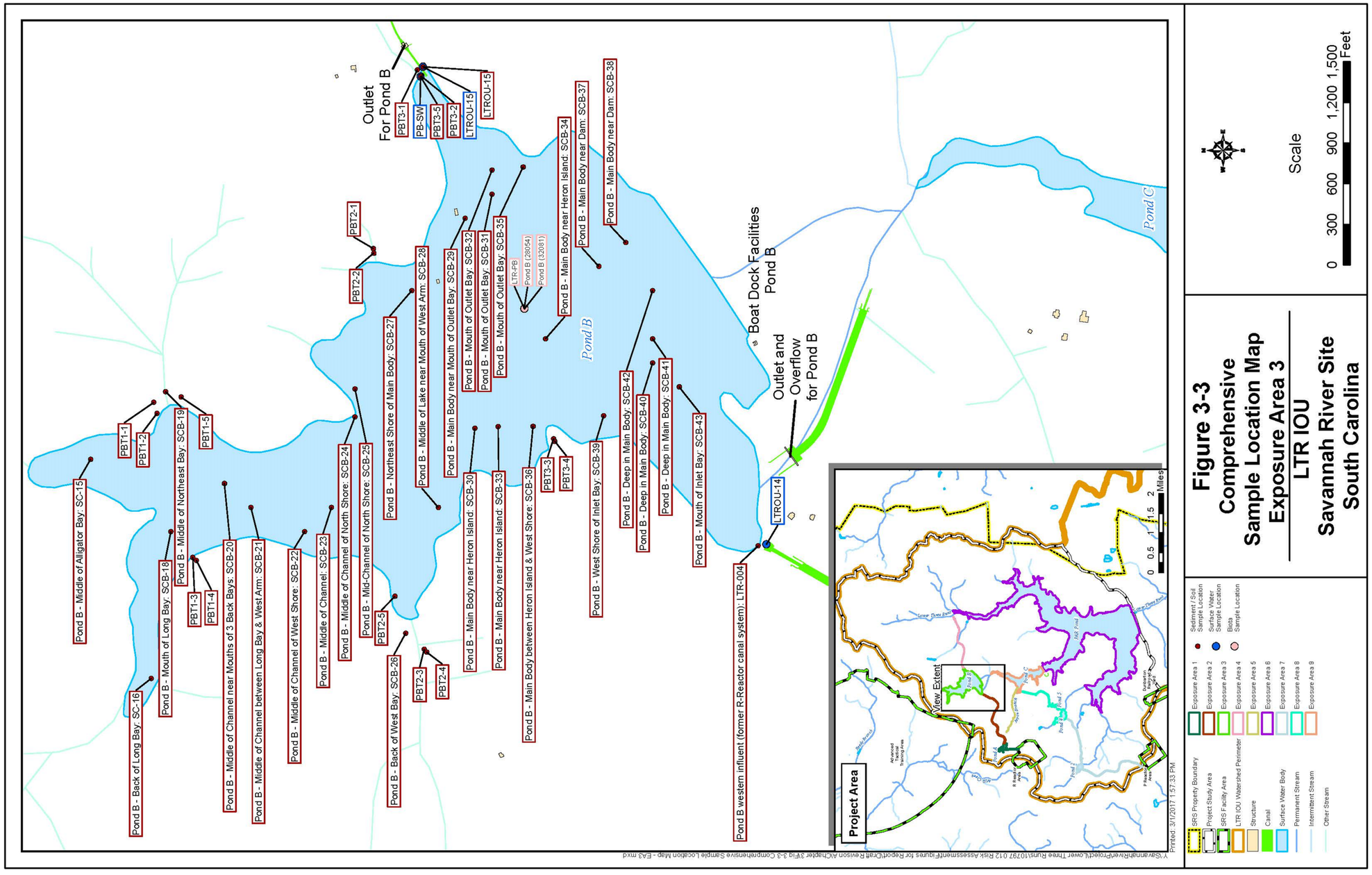


Figure 3-3. Comprehensive Sample Location Map – Exposure Area 3

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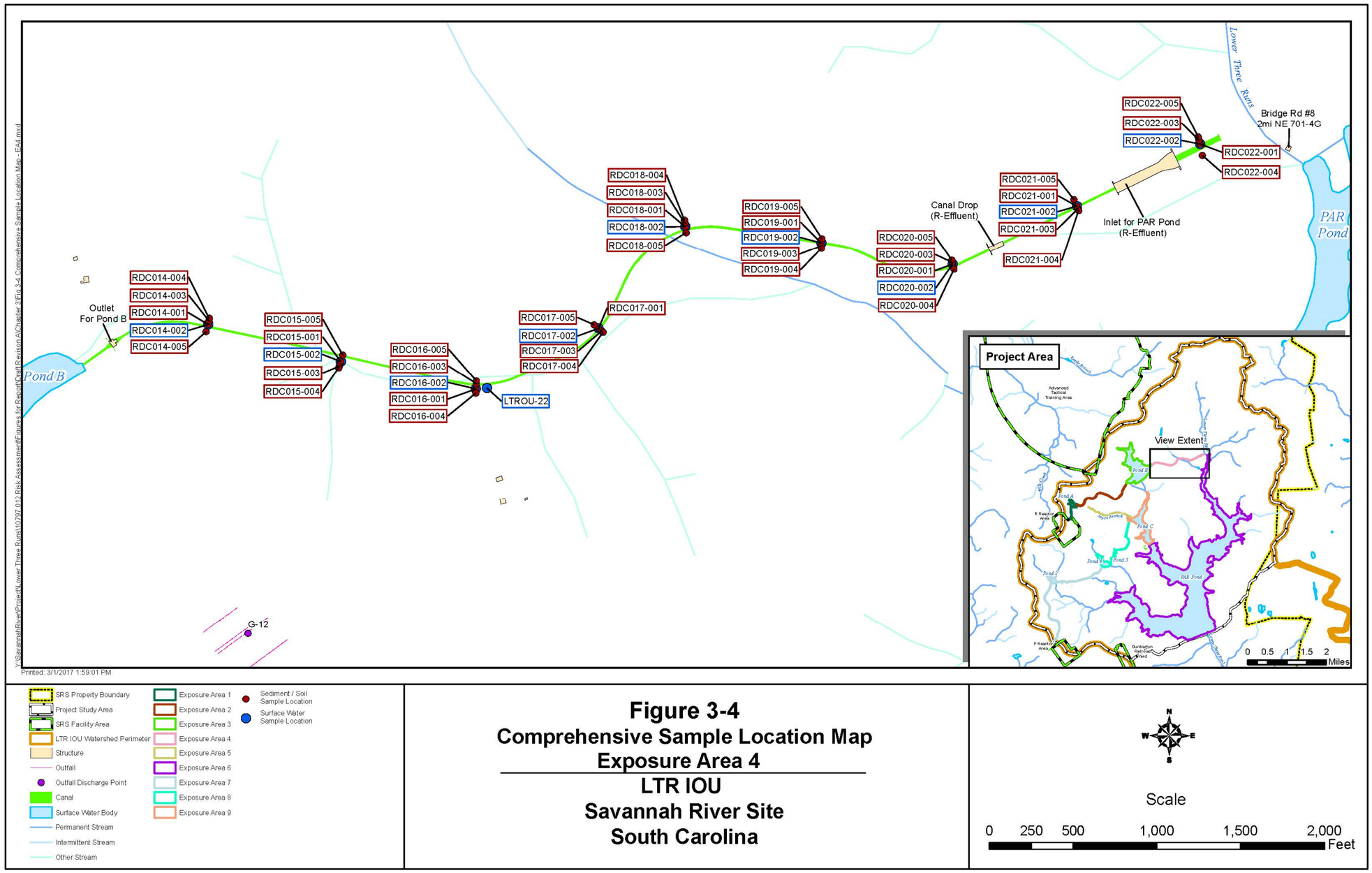


Figure 3-4. Comprehensive Sample Location Map – Exposure Area 4

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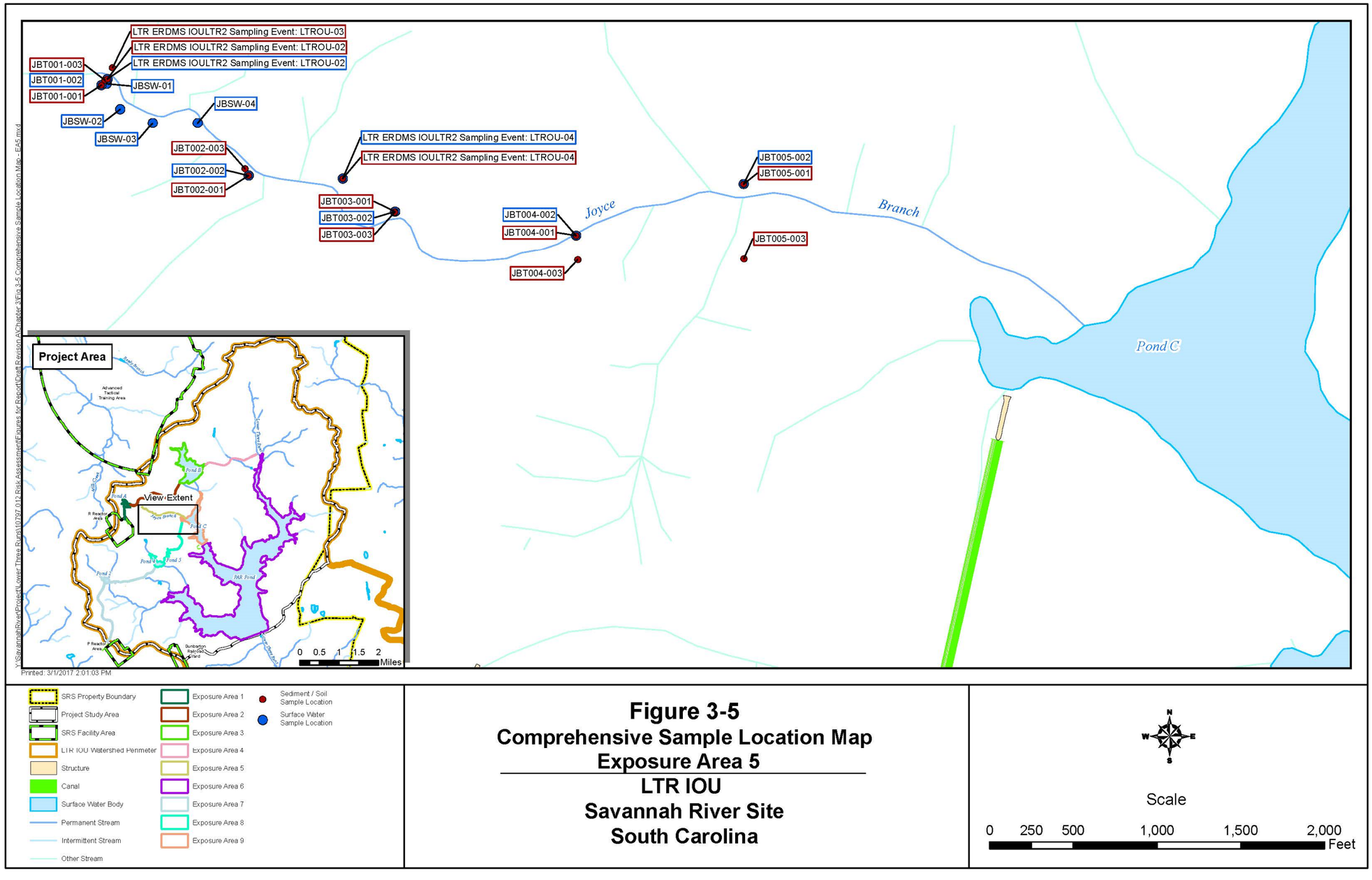


Figure 3-5. Comprehensive Sample Location Map – Exposure Area 5

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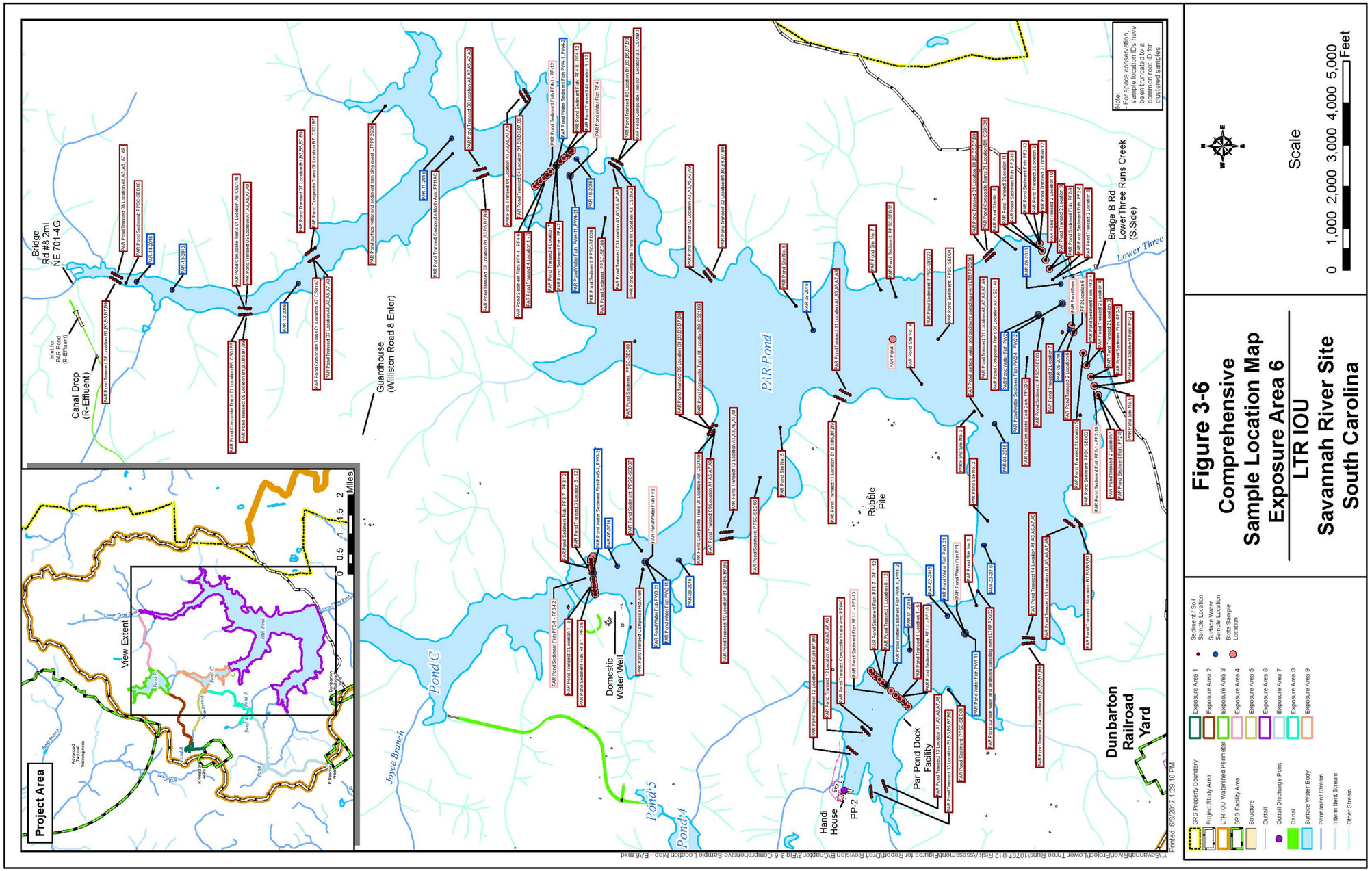


Figure 3-6. Comprehensive Sample Location Map – Exposure Area 6

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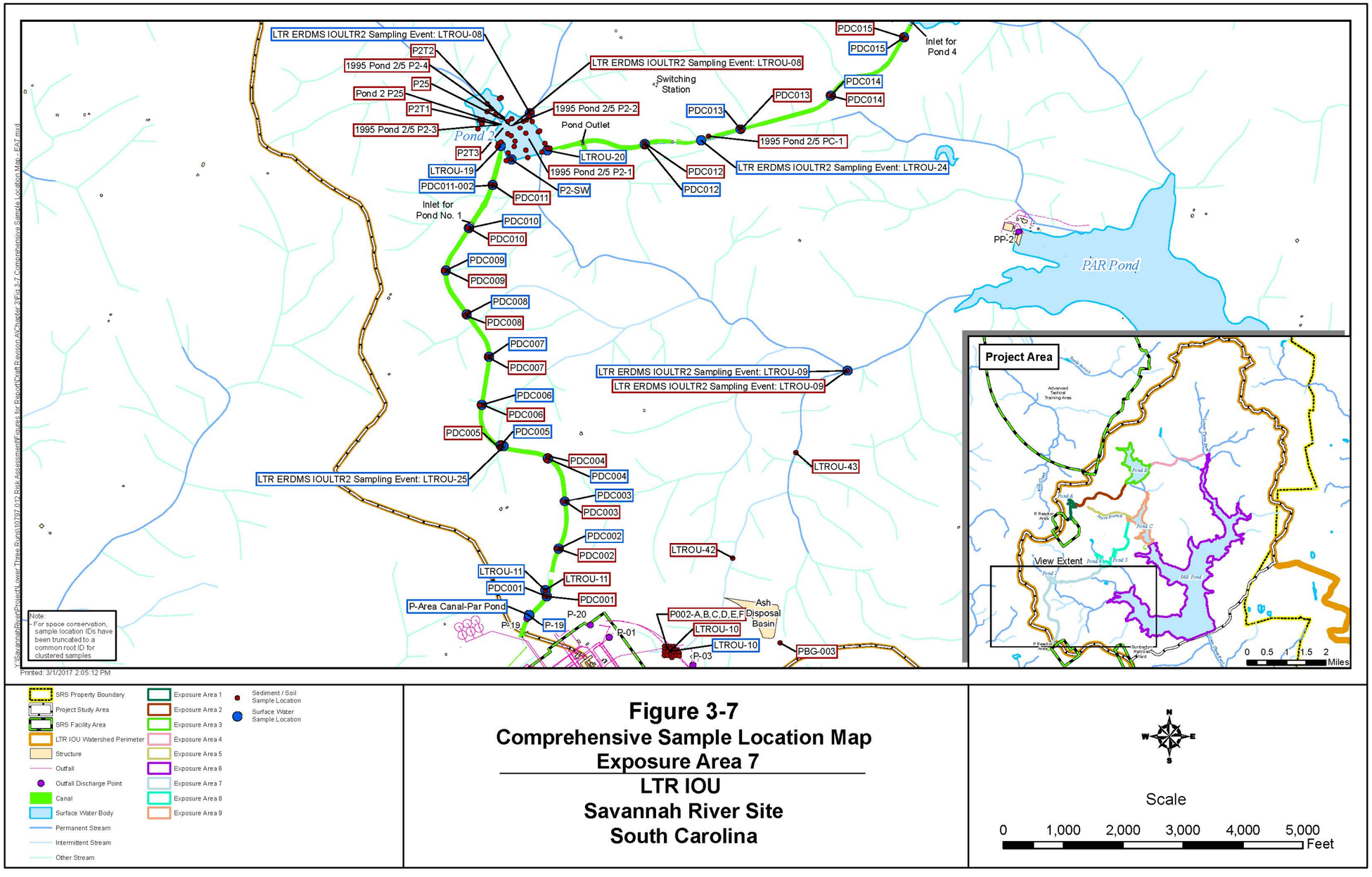


Figure 3-7. Comprehensive Sample Location Map – Exposure Area 7

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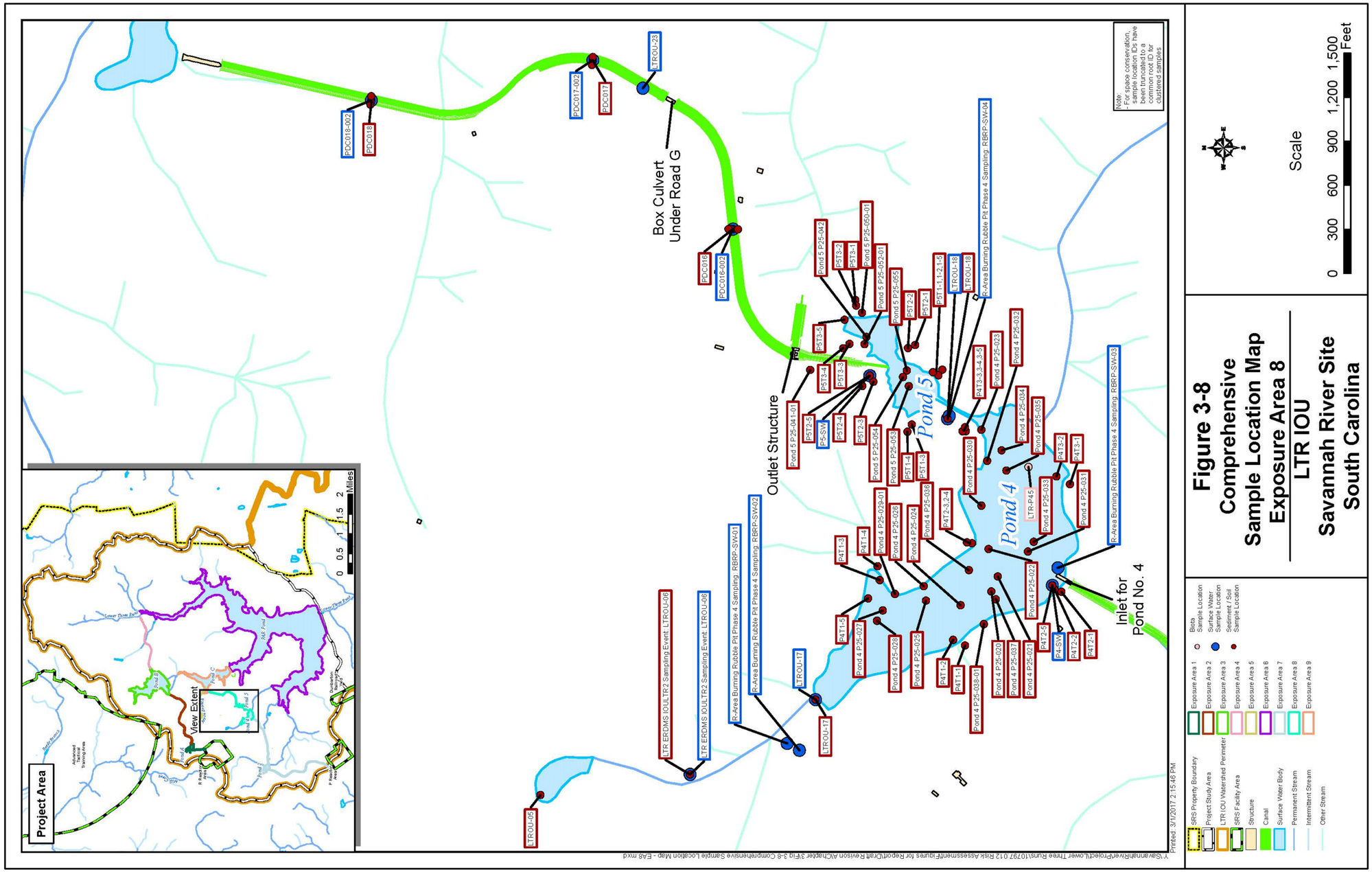


Figure 3-8. Comprehensive Sample Location Map – Exposure Area 8

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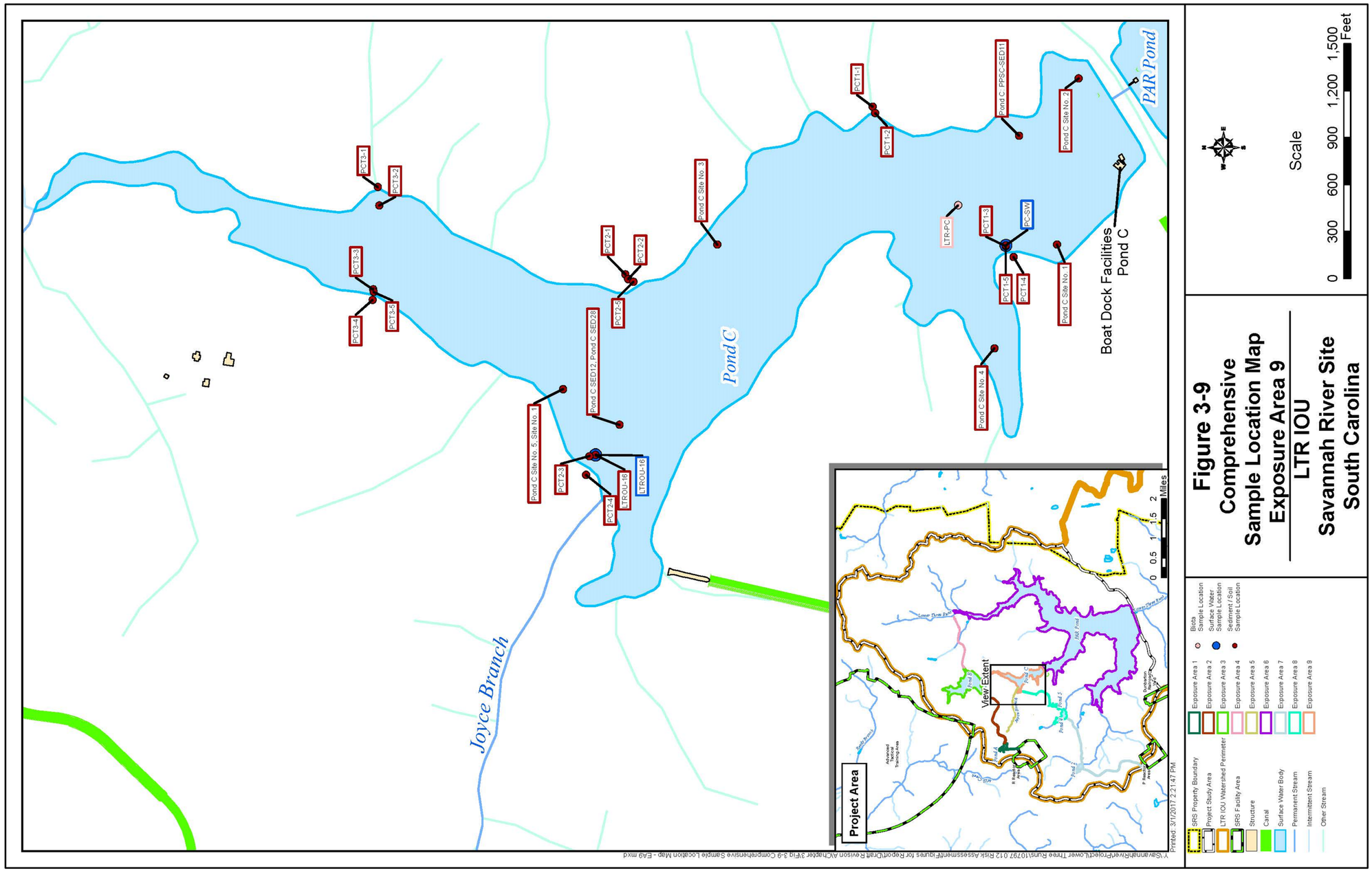


Figure 3-9. Comprehensive Sample Location Map – Exposure Area 9

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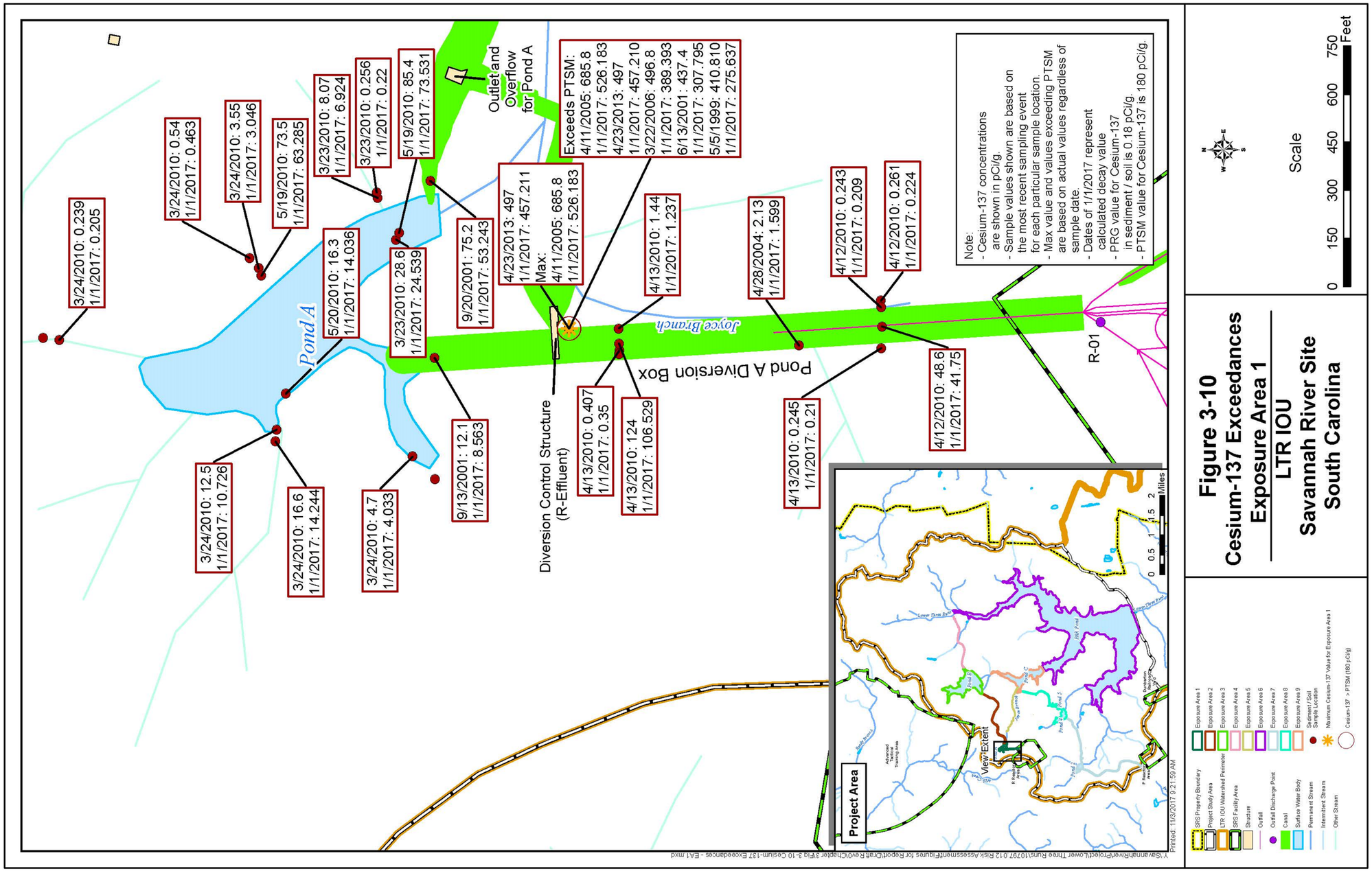


Figure 3-10. Cesium-137 Exceedances – Exposure Area 1

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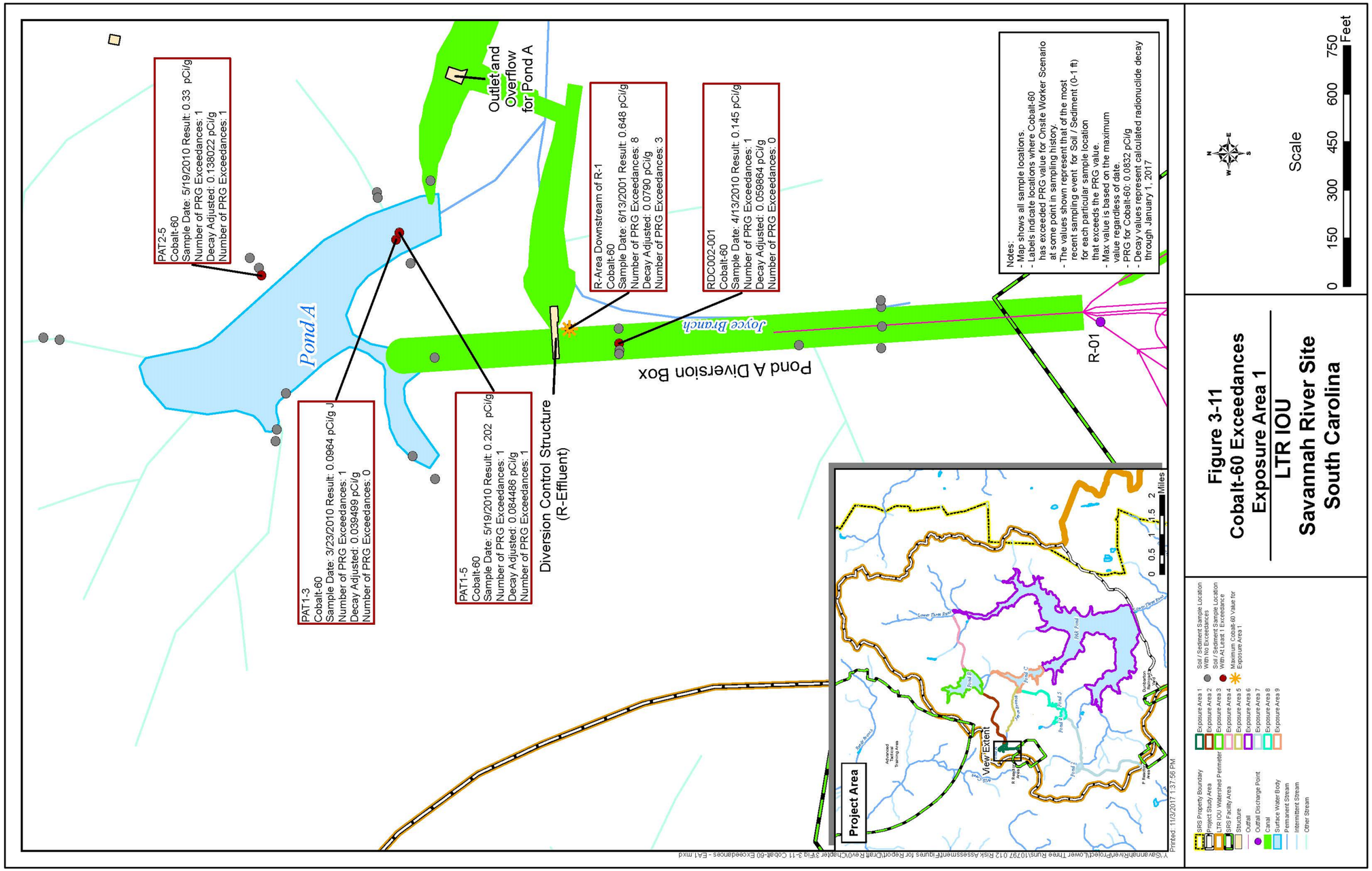


Figure 3-11. Co-60 Exceedances – Exposure Area 1

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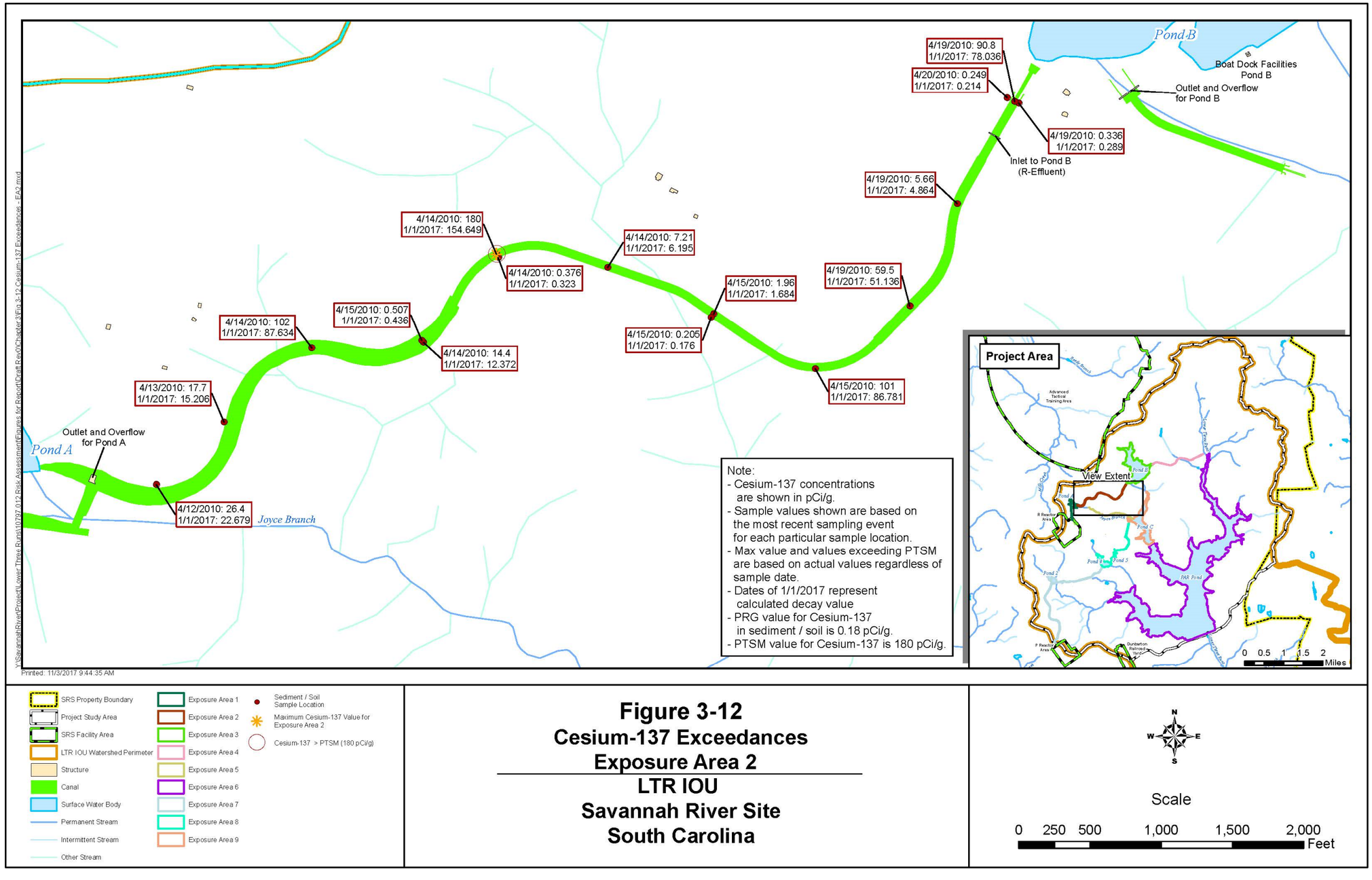


Figure 3-12. Cesium-137 Exceedances – Exposure Area 2

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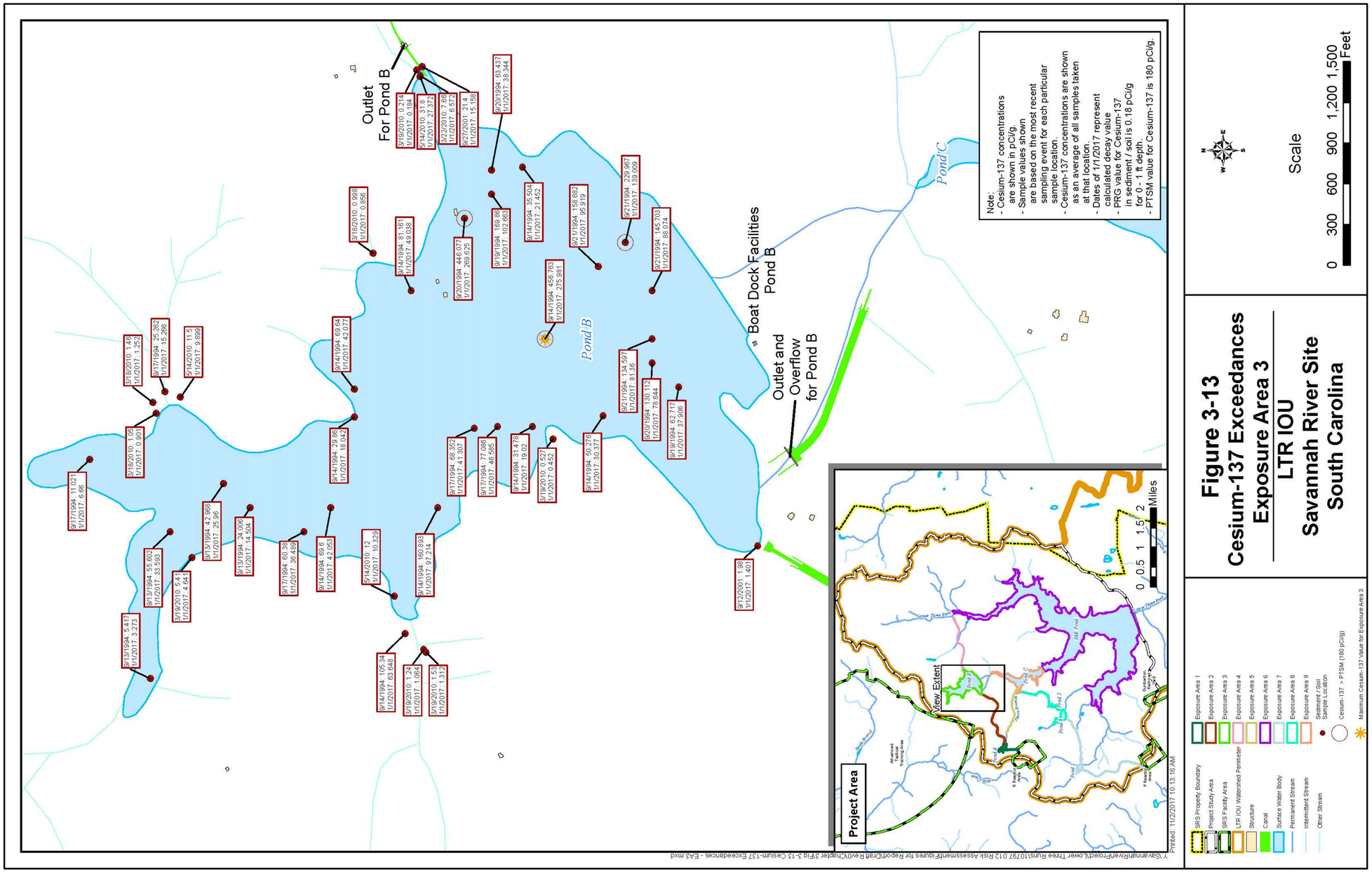


Figure 3-13. Cesium-137 Exceedances – Exposure Area 3

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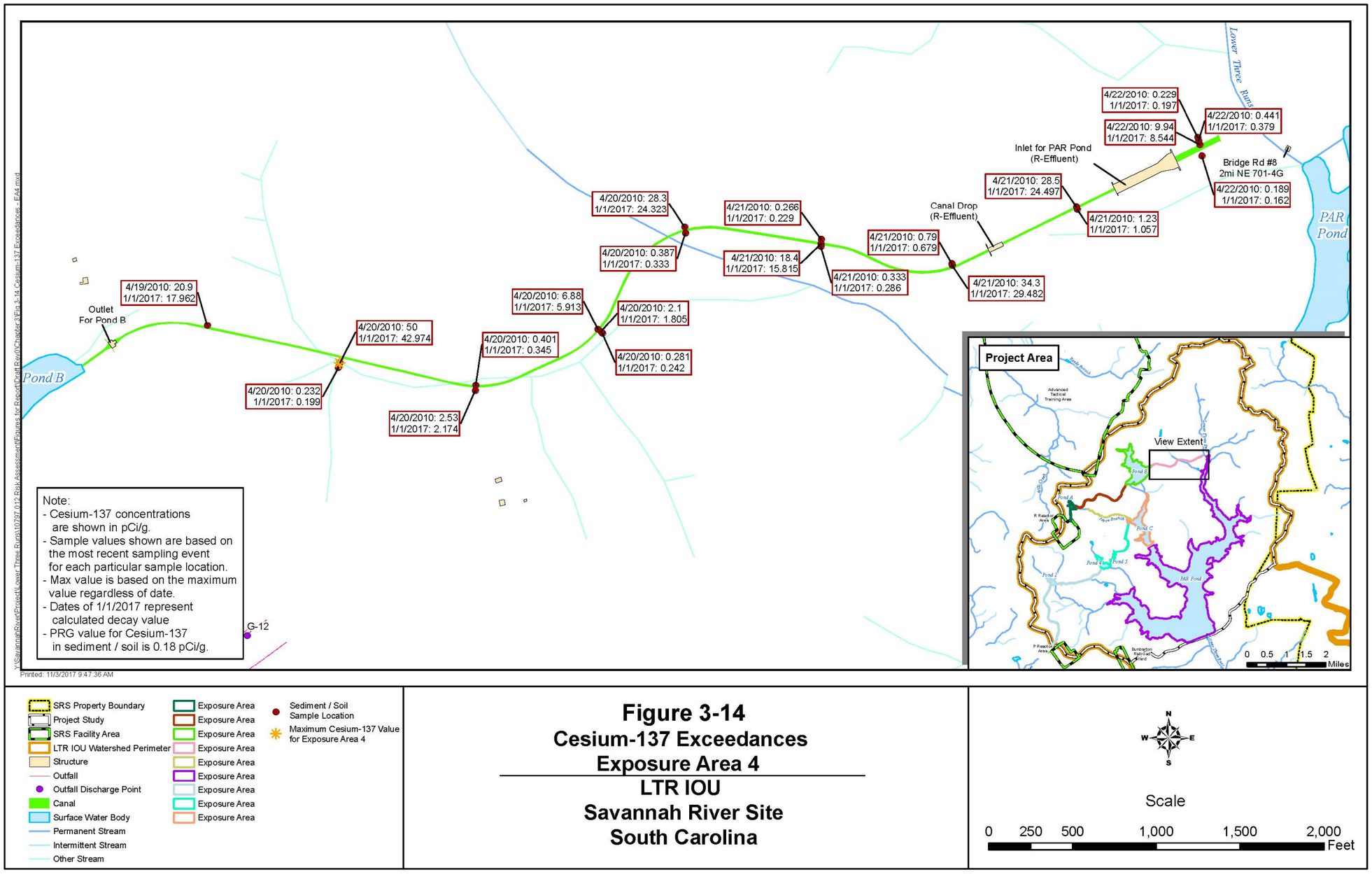


Figure 3-14. Cesium-137 Exceedances – Exposure Area 4

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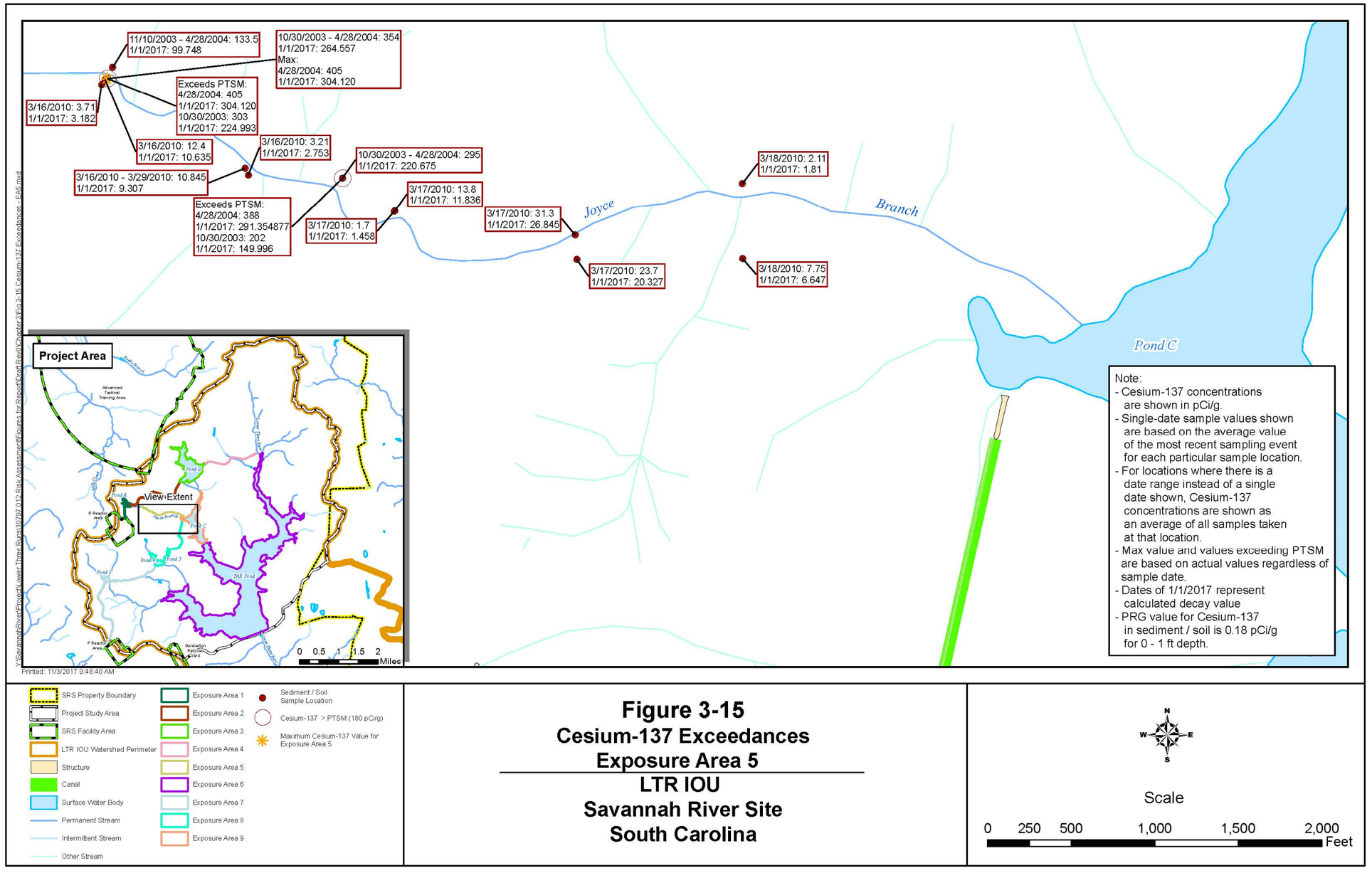


Figure 3-15. Cesium-137 Exceedances – Exposure Area 5

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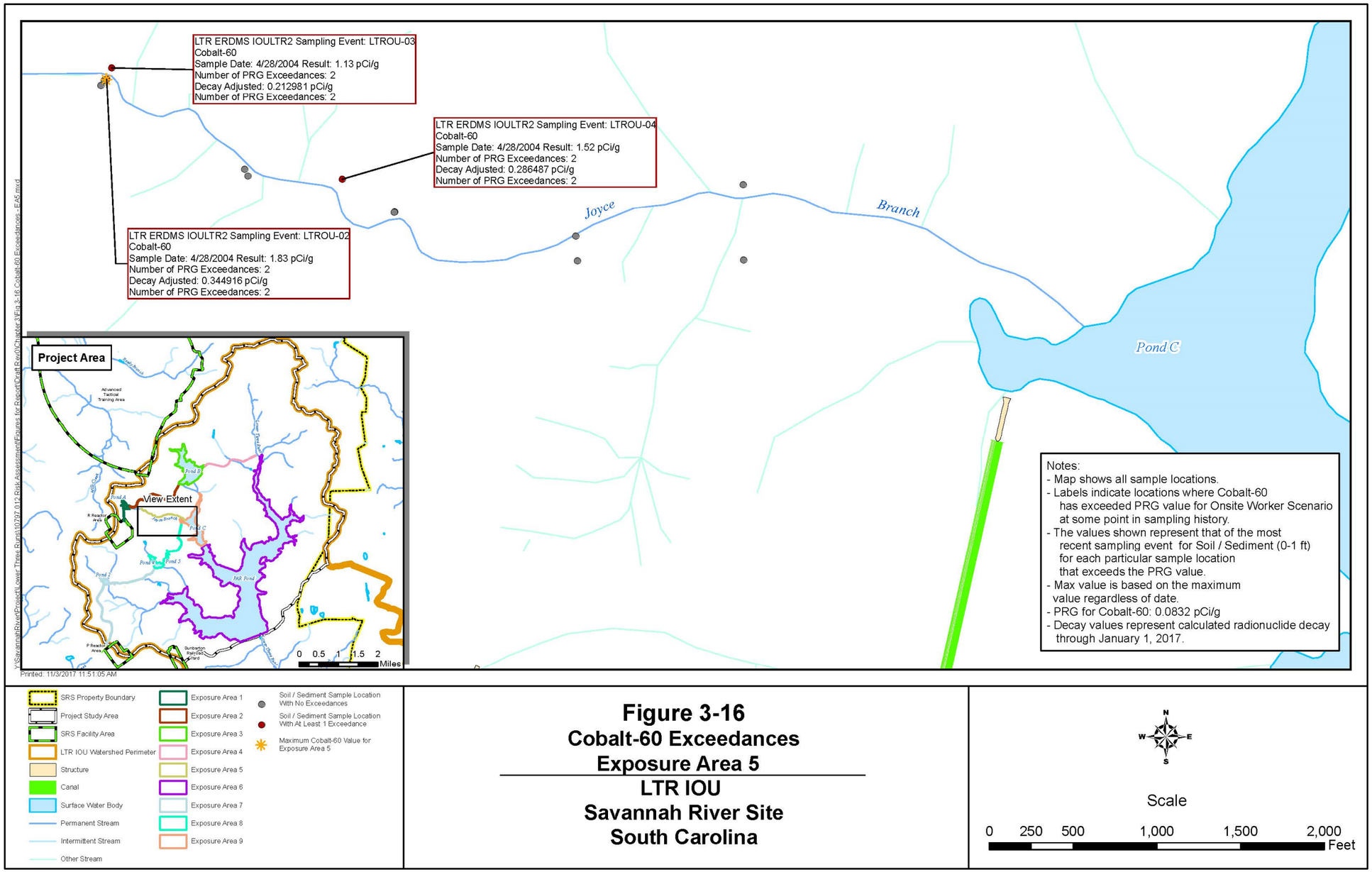


Figure 3-16. Co-60 Exceedances – Exposure Area 5

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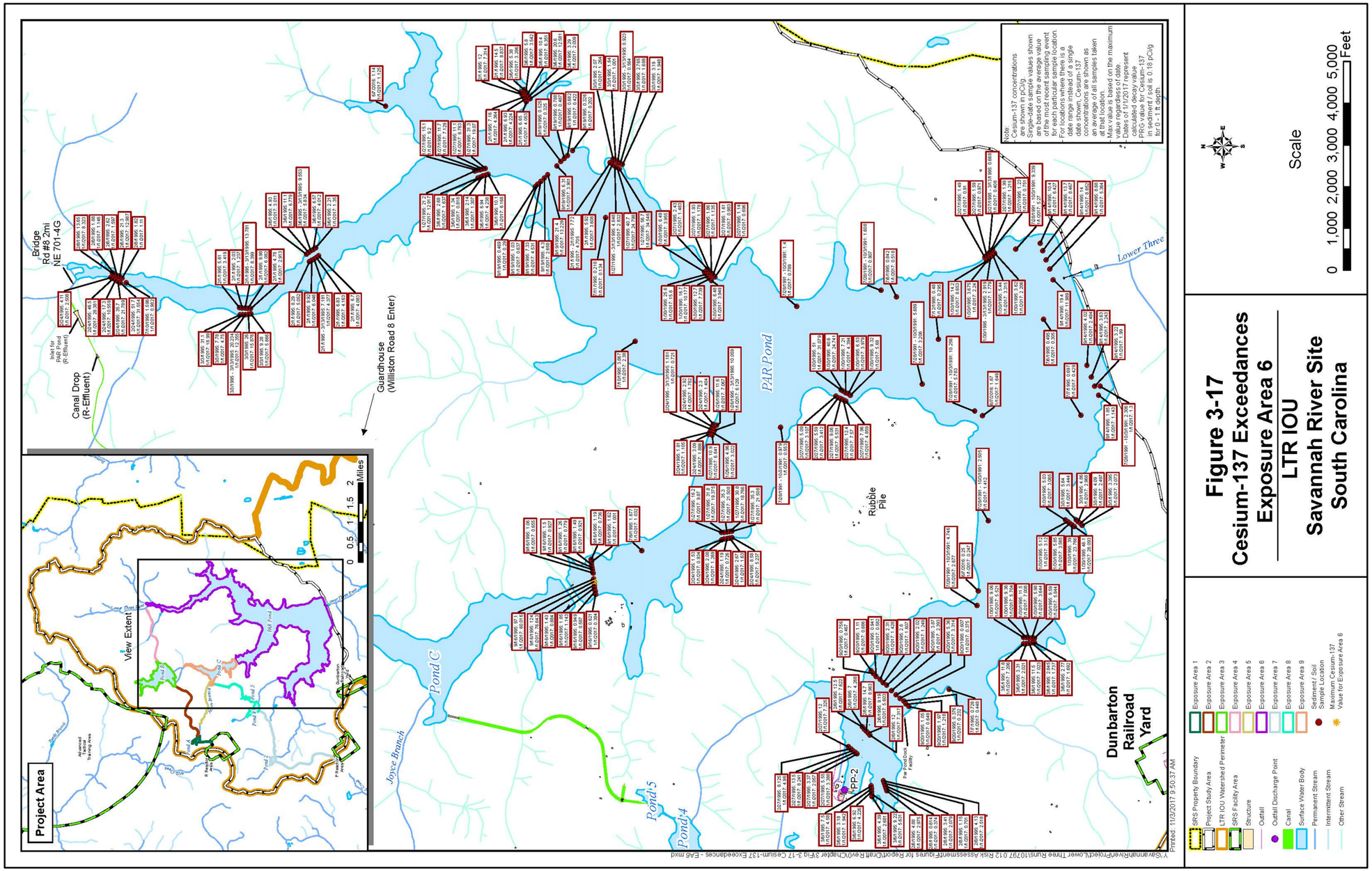


Figure 3-17. Cesium-137 Exceedances – Exposure Area 6

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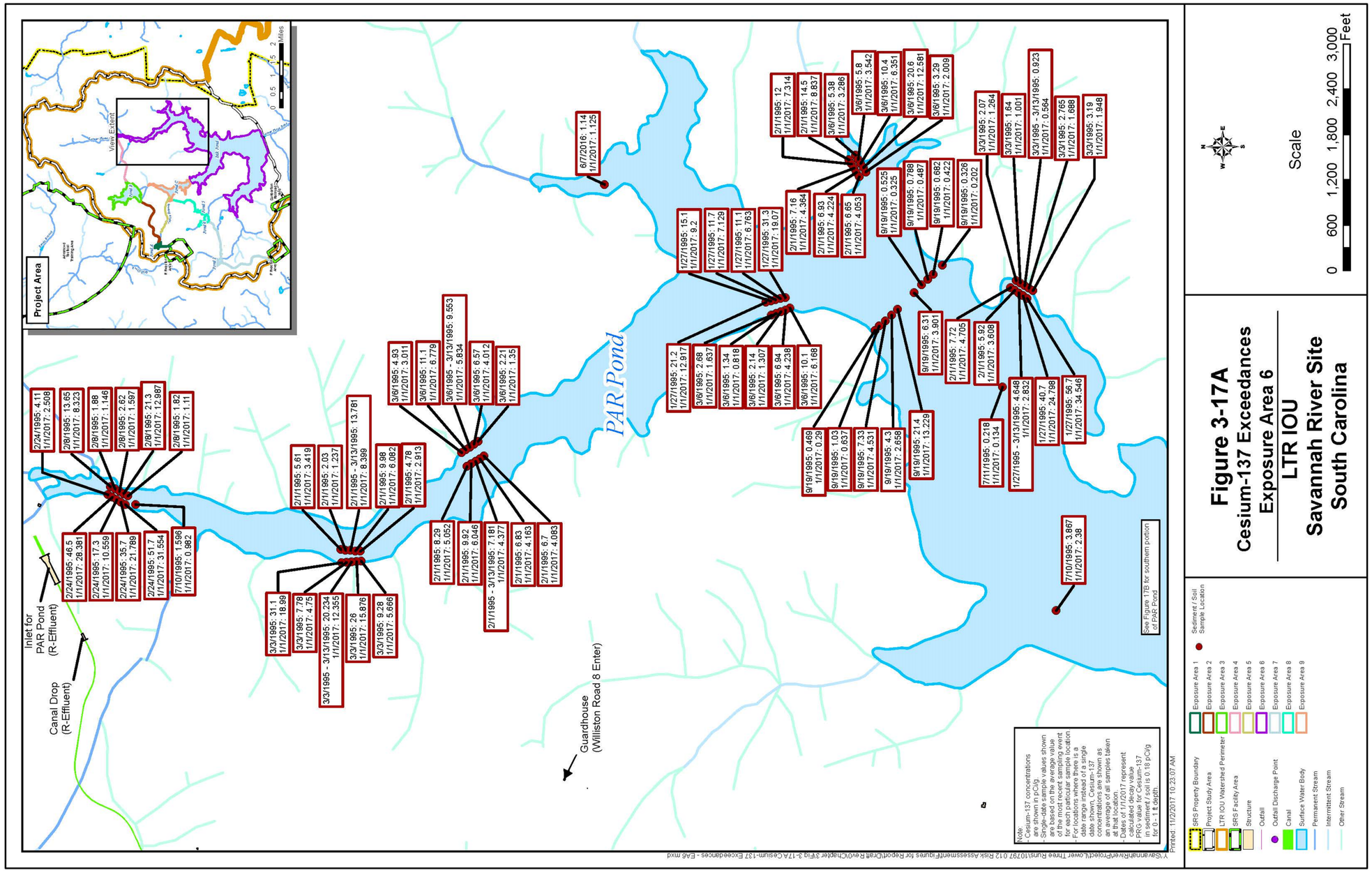


Figure 3-17A. Cesium-137 Exceedances – Exposure Area 6

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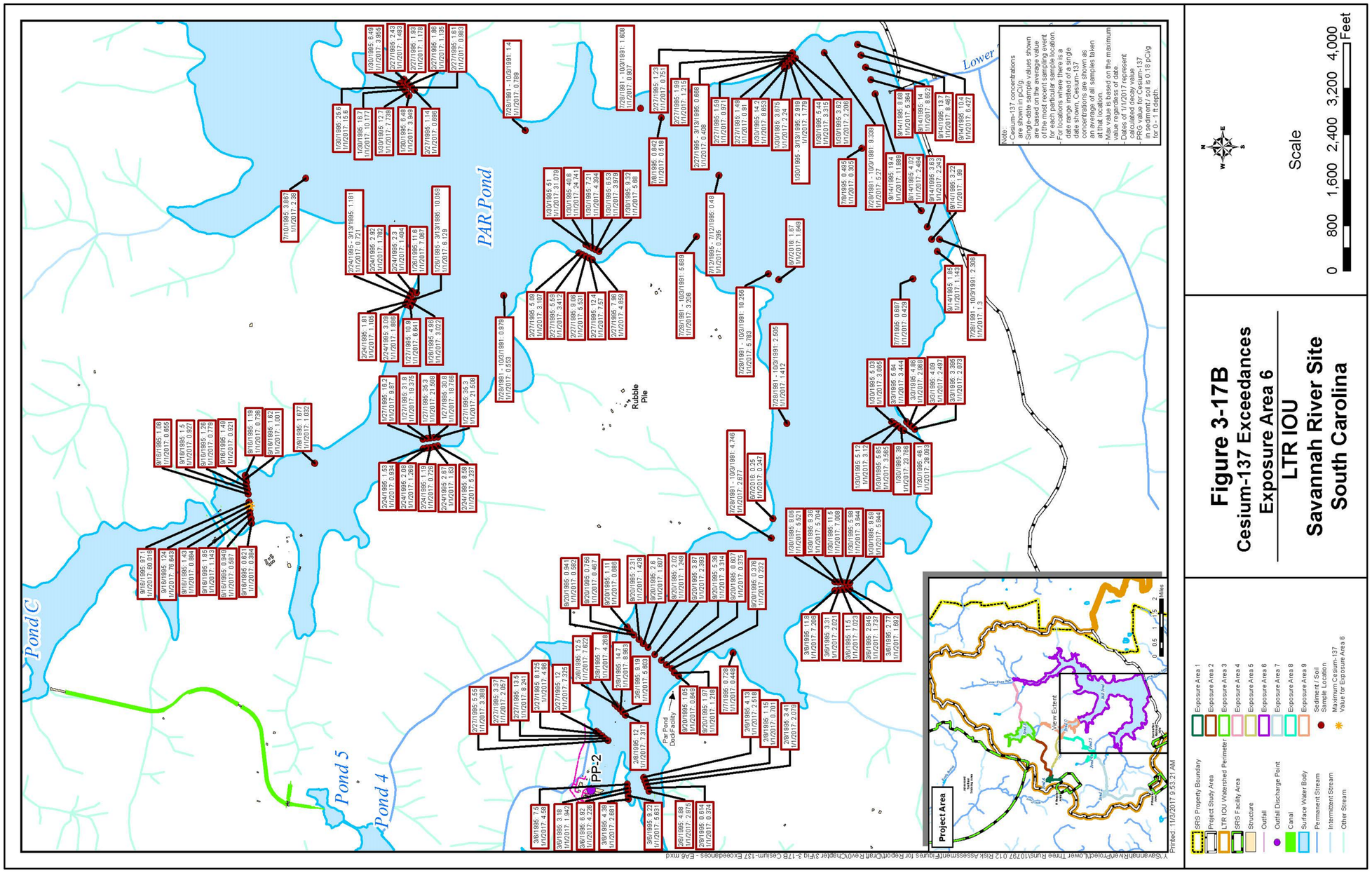


Figure 3-17B. Cesium-137 Exceedances – Exposure Area 6

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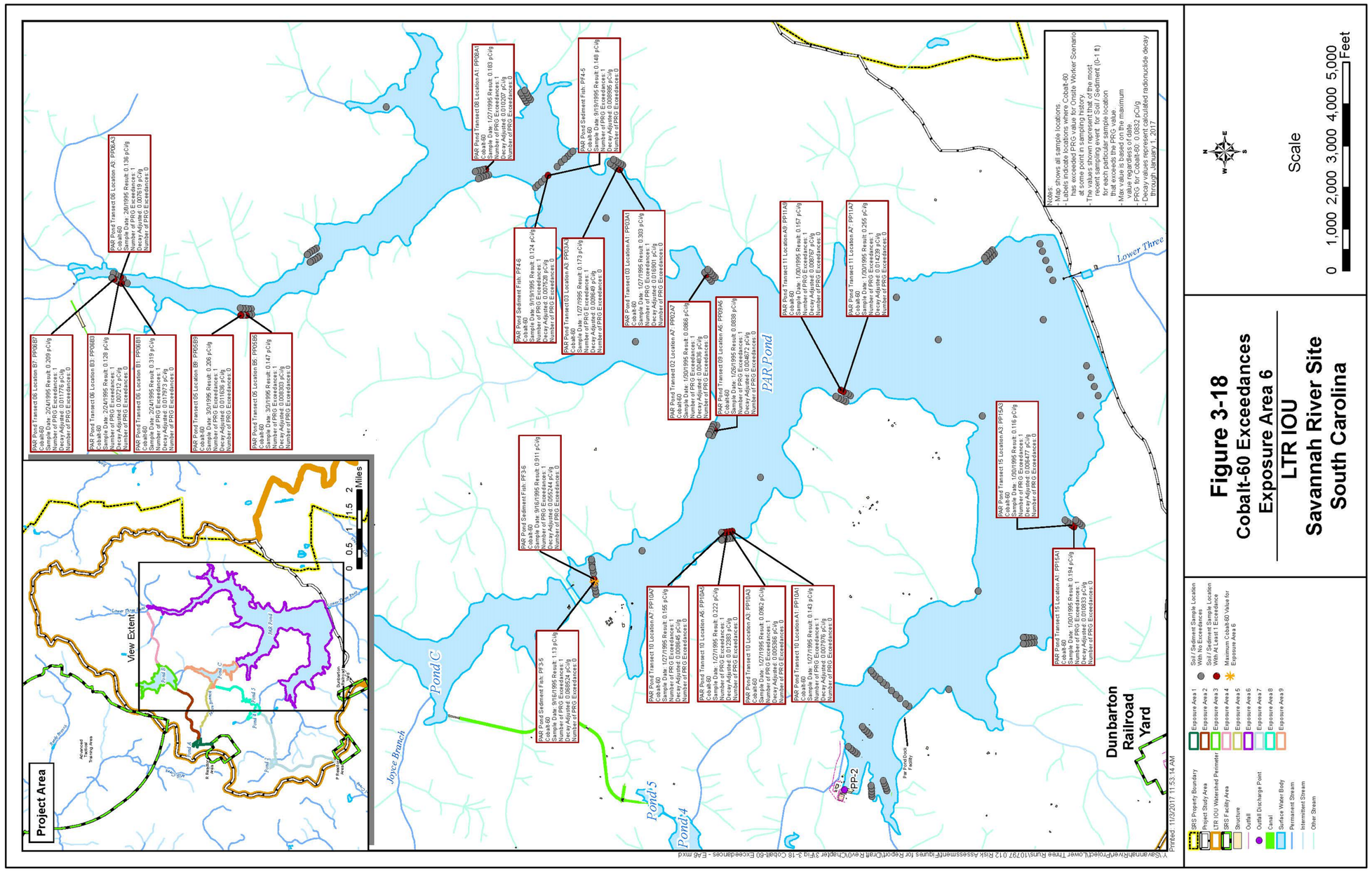


Figure 3-18. Co-60 Exceedances – Exposure Area 6

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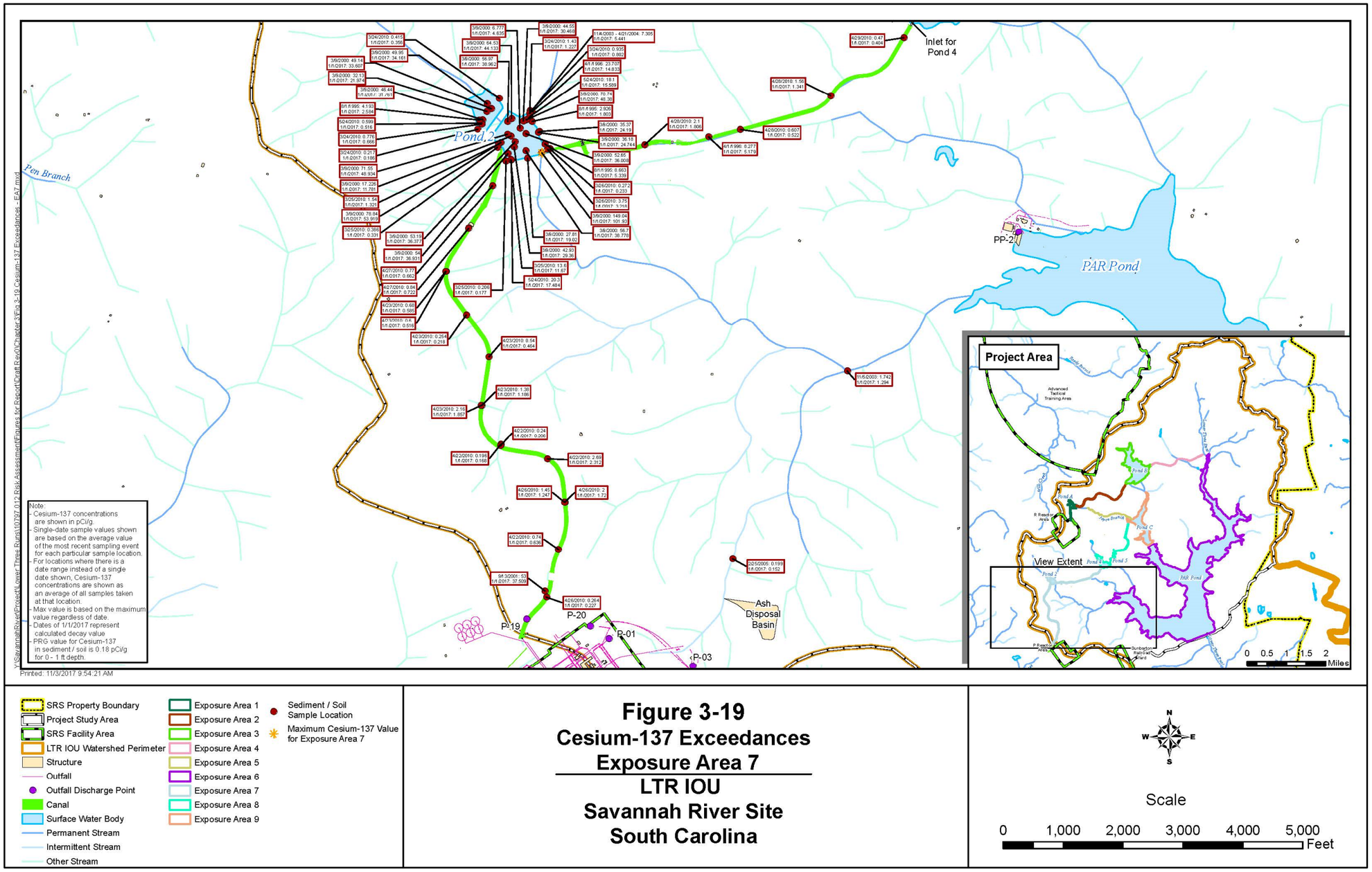


Figure 3-19. Cesium-137 Exceedances – Exposure Area 7

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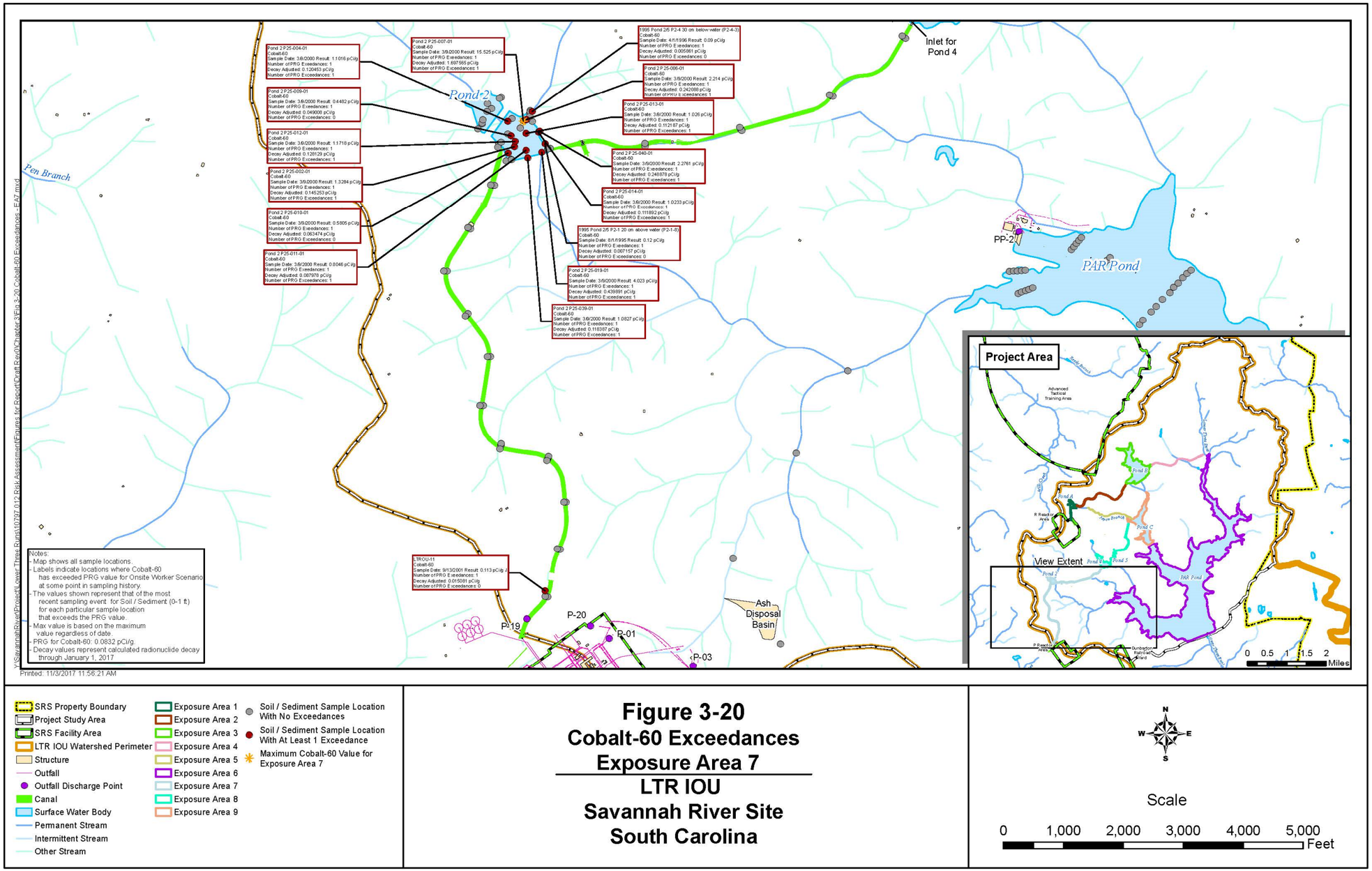


Figure 3-20. Co-60 Exceedances – Exposure Area 7

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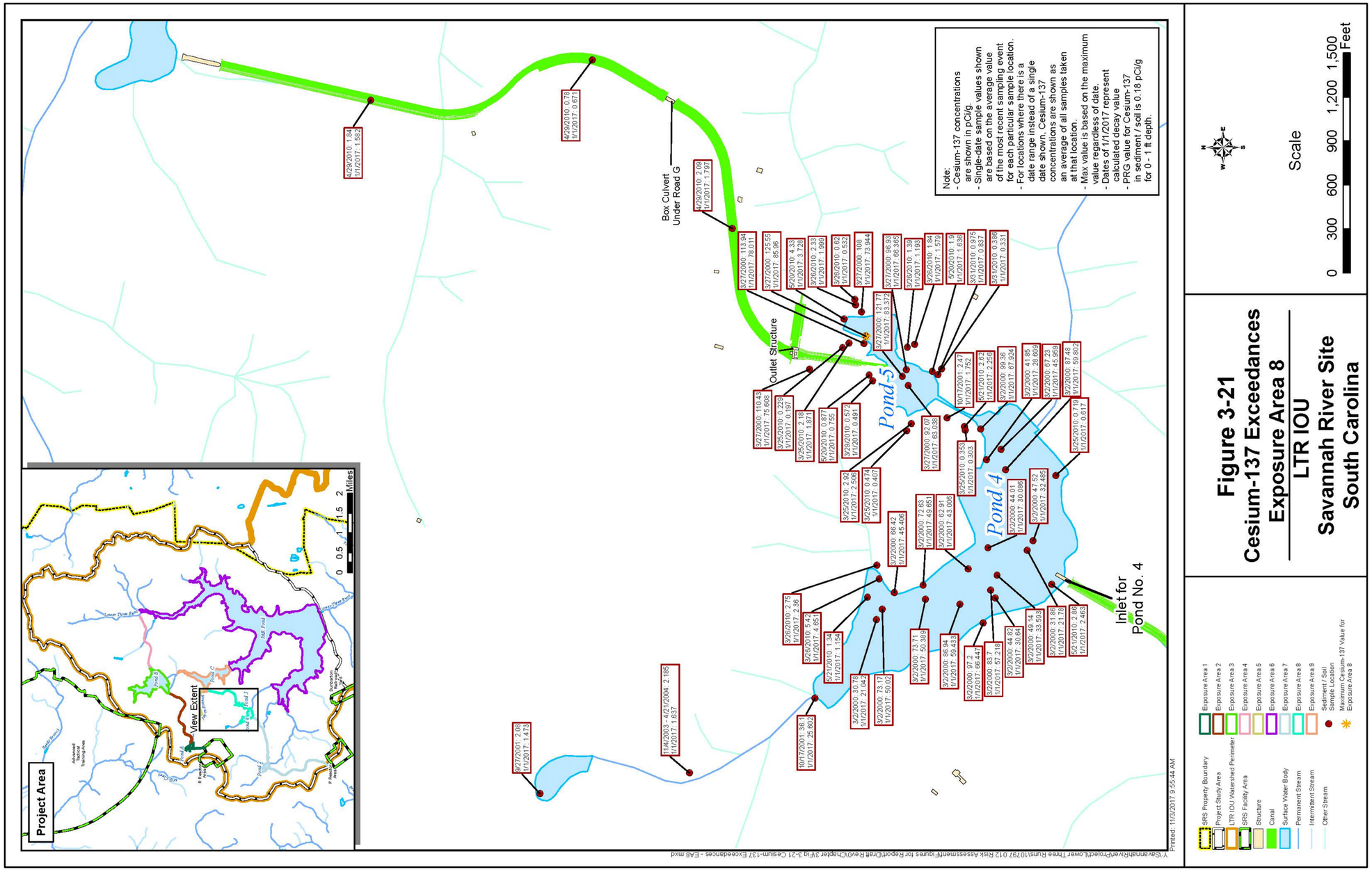


Figure 3-21. Cesium-137 Exceedances – Exposure Area 8

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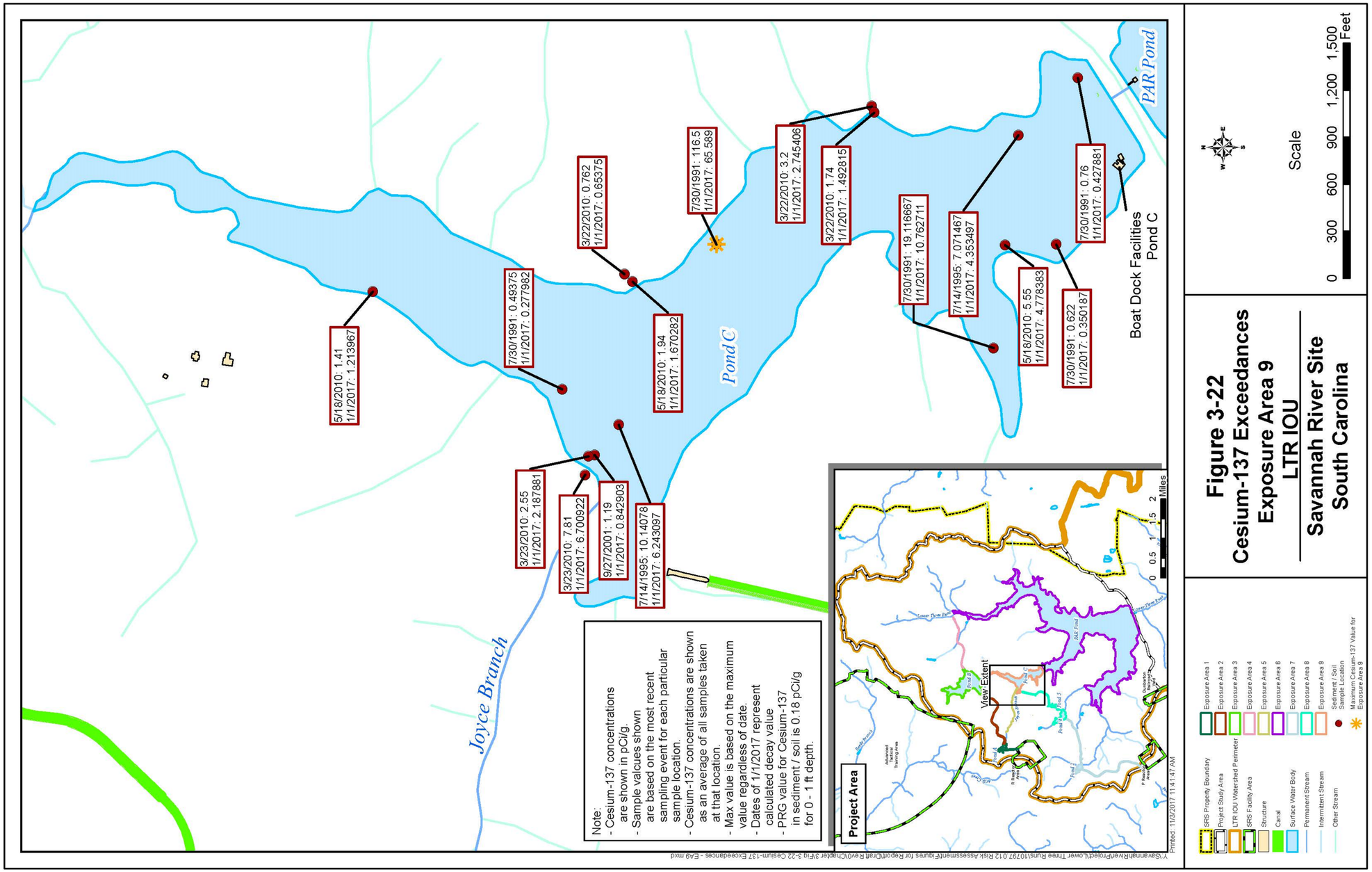


Figure 3-22. Cesium-137 Exceedances – Exposure Area 9

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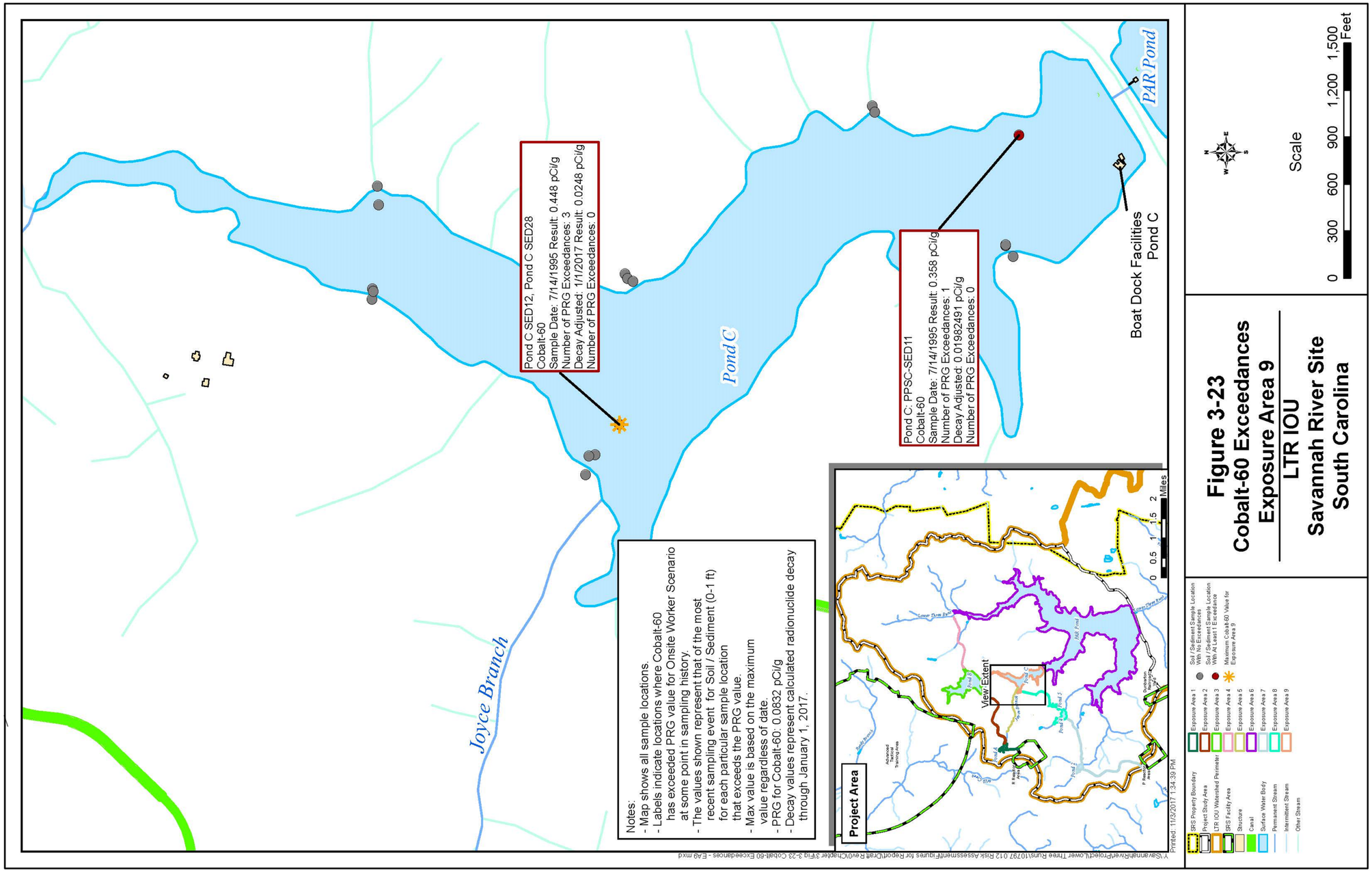
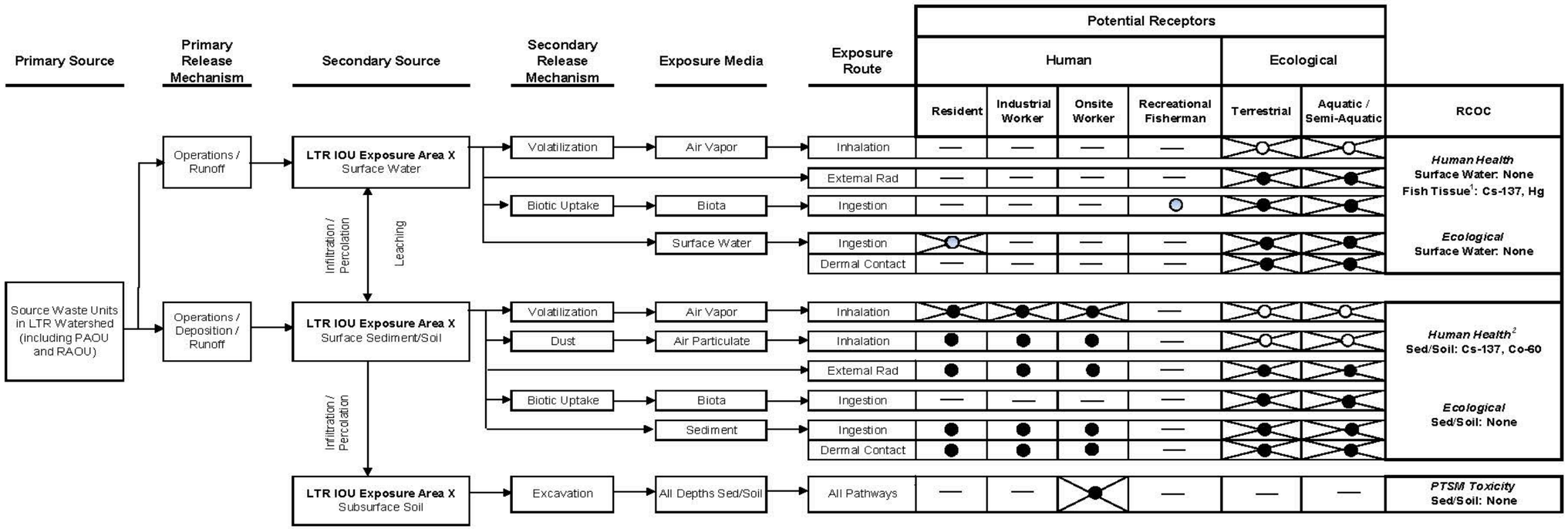


Figure 3-23. Co-60 Exceedances – Exposure Area 9

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→ Pathways: historic, current and future

● Complete exposure pathway based on quantitative evaluation (i.e., formal risk calculation); refined constituents of concern (RCOCs) identified.

⊗ Incomplete exposure pathway based on quantitative evaluation (i.e., formal risk calculation); no RCOCs identified.

◉ Complete exposure pathway based on quantitative comparison (i.e., comparison to threshold levels); RCOCs identified.

⊗ Incomplete exposure pathway based quantitative comparison (i.e., comparison to threshold levels); no RCOCs identified.

⊗ Incomplete exposure pathway based on qualitative discussion; no RCOCs identified.

— Incomplete exposure pathway

1 Cs-137 and Hg identified as human health RCOCs in fish tissue for recreational fisherman scenario in all exposure areas (EAs).

2 Cs-137 and Co-60 identified as human health RCOCs in sediment/soil for resident, industrial worker and onsite worker scenarios. RCOCs/ risk levels associated with onsite worker scenario for each EA identified below:

EA1 Cs-137 risk = 8.2E-04 (decay corrected risk = 6.4E-04); Co-60 risk = 1.7E-06 (decay corrected risk = 3.8E-07); total cumulative risk (TCR) = 8.2E-04 (decay corrected TCR = 6.4E-04)

EA2 Cs-137 risk = 2.7E-04 (decay corrected risk = 2.3E-04)

EA3 Cs-137 risk = 5.5E-04 (decay corrected risk = 3.3E-04)

EA4 Cs-137 risk = 1.0E-04 (decay corrected risk = 8.8E-05)

EA5 Cs-137 risk = 1.3E-03 (decay corrected risk = 9.4E-04); Co-60 risk = 9.1E-06 (decay corrected risk = 1.7E-06); TCR = 1.3E-03 (decay corrected TCR = 9.4E-04)

EA6 Cs-137 risk = 4.9E-05 (decay corrected risk = 2.9E-05); Co-60 risk = 1.2E-06 (decay corrected risk = 7.2E-08); TCR = 5.0E-05 (decay corrected TCR = 2.9E-05)

EA7 Cs-137 risk = 7.7E-04 (decay corrected risk = 4.5E-04); Co-60 risk = 9.6E-06 (decay corrected risk = 1.0E-06); TCR = 7.8E-04 (decay corrected TCR = 4.5E-04)

EA8 Cs-137 risk = 2.8E-04 (decay corrected risk = 1.9E-04)

EA9 Cs-137 risk = 1.2E-04 (decay corrected risk = 6.7E-05); Co-60 risk = 1.4E-06 (decay corrected risk = 9.6E-08); TCR = 1.2E-04 (decay corrected TCR = 6.7E-05)

Figure 3-24. Final Conceptual Site Model for LTR IOU

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Table 3-1. LTR IOU Risk Summary / Refined Constituents of Concern

Upper Exposure Area	HH[1] Sediment/Soil RCOCs	HH Surface Water RCOCs	HH Fish Tissue RCOCs	PTSM RCOCs	Ecological RCOCs
EA 1: Pond A Including R Discharge Canal	Cs-137(+D) risk = 8.2E-04 (Decay adj. risk = 6.4E-04) Co-60 risk = 1.7E-06 (Decay adj. risk = 3.8E-07) TCR = 8.2E-04 (Decay adj. risk = 6.4E-04)	None	Cs-137(+D), Hg	None	None
EA 2: Canal from Pond A to Pond B	Cs-137(+D) risk = 2.7E-04 (Decay adj. risk = 2.3E-04)	None	Cs-137(+D), Hg	None	None
EA 3: Pond B	Cs-137(+D) risk = 5.5E-04 (Decay adj. risk = 3.3E-04)	None	Cs-137(+D), Hg	None	None
EA 4: Canal from Pond B to North Arm of PAR Pond	Cs-137(+D) risk = 1.0E-04 (Decay adj. risk = 8.8E-05)	None	Cs-137(+D), Hg	None	None
EA 5: Joyce Branch (Old R-Area Discharge Canal)	Cs-137(+D) risk = 1.3E-03 (Decay adj. risk = 9.4E-04) Co-60 risk = 9.1E-06 (Decayed adj. risk = 1.7E-06) TCR = 1.3E-03 (Decay adj. TCR = 9.4E-04)	None	Cs-137(+D), Hg	None	None
EA 6: PAR Pond	Cs-137(+D) risk = 4.9E-05 (Decay adj. risk = 2.9E-05) Co-60 risk = 1.2E-06 (Decay adj. risk = 7.2E-08) TCR = 5.0E-05 (Decay adj. TCR = 2.9E-05)	None	Cs-137(+D), Hg	None	None

Table 3-1. LTR IOU Risk Summary / Refined Constituents of Concern *(Continued/End)*

Upper Exposure Area	HH[1] Sediment/Soil RCOCs	HH Surface Water RCOCs	HH Fish Tissue RCOCs	PTSM RCOCs	Ecological RCOCs
EA 7: Canal from P-Area to Ponds 4 and 5 – Including Pond 2	Cs-137(+D) risk = 7.7E-04 (Decay adj. risk = 4.5E-04) Co-60 risk = 9.6E-06 (Decay adj. risk = 1.0E-06) TCR = 7.8E-04 (Decay adj. TCR = 4.5E-04)	None	Cs-137(+D), Hg	None	None
EA 8: Ponds 4 and 5 – Including Canal from Ponds 4 and 5 to Pond C	Cs-137(+D) risk = 2.8E-04 (Decay adj. risk = 1.9E-04)	None	Cs-137(+D), Hg	None	None
EA 9: Pond C	Cs-137(+D) risk = 1.2E-04 (Decay adj. risk = 6.7E-05) Co-60 risk = 1.4E-06 (Decay adj. risk = 9.6E-08) TCR = 1.2E-04 (Decay adj. TCR = 6.7E-05)	None	Cs-137(+D), Hg	None	None

RCOC = Refined constituent of concern
1 HH RCOCs and risk levels identified for IOU onsite worker receptor scenario.
TCR = total cumulative risk

4.0 REMEDIAL ACTION OBJECTIVES AND REMEDIAL GOAL OPTIONS

4.1 Remedial Action Objectives

Remedial action objectives (RAOs) are media-specific or site-specific objectives for protection of human health and the environment. RAOs usually specify the refined constituents of concern (RCOCs) for the potential receptors, media of concern, and exposure pathways. RAOs describe what the remediation must accomplish and are used as a framework for developing remedial alternatives in the Feasibility Study (FS).

Section 121(d) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (1980), as amended by the Superfund Amendments and Reauthorization Act (1986), requires that remedial actions comply with requirements or standards set forth under Federal and State environmental laws (i.e., applicable, relevant, and appropriate requirements [ARARs]), as well as, non-promulgated advisories, guidance, or proposed standards that are not legally binding but provide useful approaches or recommendations (called "to-be-considered" [TBC] requirements).

ARARs and TBCs include action-specific, location-specific, and chemical-specific requirements that are to be achieved unless a waiver is invoked. In addition, the National Contingency Plan requires the development of health-based, site-specific levels for constituents (i.e., risk-based levels) where such promulgated limits do not exist and where there is a concern with their potential health or environmental effects. RAOs are developed, as applicable, from ARARs, TBCs, or risk-based levels that address the constituent, receptor, and media of concern.

For the Lower Three Runs (LTR) Integrator Operable Unit (IOU), RAOs are presented for each exposure area (EA) including the potential receptors to be protected and exposure pathway.

4.1.1 Exposure Area 1

According to the analysis performed in Appendices B (Human Health Risk Assessment [HHRA]), C (Ecological Risk Assessment [ERA]), and D (Principal Threat Source Material [PTSM] Evaluation), and the results summarized in Chapter 3, the following are problems warranting action for EA 1:

- Cesium-137 (Cs-137) and cobalt-60 (Co-60) in sediment/soil pose a total cumulative risk (TCR) of 8.2E-04 to the onsite worker (decay corrected to 6.4E-04):
  - Cs-137: Exposure Point Concentration (EPC) = 148 pCi/g; risk to the onsite worker = 8.2E-04; (decay corrected to 6.4E-04)
  - Co-60: EPC = 0.144 pCi/g; risk to the onsite worker = 1.7E-06; (decay corrected to 3.8E-07).
- Cs-137 and Hg in fish tissue as measured in adjoining EAs exceeds risk-based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 1:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.2 Exposure Area 2

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 2:

- Cs-137 in sediment/soil (EPC = 48.8 pCi/g) poses a 2.7E-04 risk to the onsite worker (decay corrected to 2.3E-04); and
- Cs-137 and Hg in fish tissue as measured in adjoining EAs exceeds risk-based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 2:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and

- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.3 Exposure Area 3

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 3:

- Cs-137 in sediment/soil (EPC = 98.3 pCi/g) poses a 5.5E-04 risk to the onsite worker (decay corrected to 3.3E-04); and

- Cs-137 in fish tissue (maximum = 113 pCi/g; preliminary remediation goal [PRG] = 0.054 pCi/g) and mercury (maximum = 1.83 mg/kg; Regional Screening Level (RSL) = 0.154 mg/kg) exceed the risk-based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 3:

- Protect onsite workers receptor from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold level or background level. The primary exposure route of concern is the external radiation pathway; and

- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.4 Exposure Area 4

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3 of the Remedial Investigation (RI), the following are problems warranting action for EA 4:

- Cs-137 in sediment/soil (EPC = 18.3 pCi/g) poses a 1.0E-04 risk to the onsite worker (decay corrected to 8.8E-05); and

- Cs-137 and Hg in fish tissue as measured in adjoining EAs exceeds screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 4:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.5 Exposure Area 5

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 5:

- Cs-137 and Co-60 in sediment/soil pose a TCR of 1.3E-03 to the onsite worker (decay corrected to 9.4E-04):
  - Cs-137: EPC = 228 pCi/g; risk to the onsite worker = 1.3E-03; (decay corrected to 9.4E-04); and
  - Co-60: EPC = 0.76 pCi/g; risk to the onsite worker = 9.1E-06; (decay corrected to 1.7E-06).
- Cs-137 and Hg in fish tissue as measured in adjoining EAs exceeds risk based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 5:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.6 Exposure Area 6

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 6:

- Cs-137 and Co-60 in sediment/soil pose a TCR of 5.0E-05 to the onsite worker (decay corrected to 2.9E-05):
  - Cs-137: EPC = 8.82 pCi/g; risk to the onsite worker = 4.9E-05; (decay corrected to 2.9E-05); and
  - Co-60: EPC = 0.097 pCi/g; risk to the onsite worker = 1.2E-06; (decay corrected to 7.2E-08).
- Cs-137 (maximum = 18.4 pCi/g; PRG = 0.054 pCi/g) and Hg (maximum = 3.18 mg/kg; RSL = 0.154 mg.kg) in fish tissue exceeds risk based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 6:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.7 Exposure Area 7

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 7:

- Cs-137 and Co-60 in sediment/soil pose a TCR of 7.8E-04 to the onsite worker (decay corrected to 4.5E-04):
  - Cs-137: EPC = 139 pCi/g; risk to the onsite worker = 7.7E-04; (decay corrected to 4.5E-04); and
  - Co-60: EPC = 0.802 pCi/g; risk to the onsite worker = 9.6E-06; (decay corrected to 1.0E-06).

- Cs-137 and Hg in fish tissue as measured in adjoining EAs exceeds risk based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 7:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.8 Exposure Area 8

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3, the following are problems warranting action for EA 8:

- Cs-137 in sediment/soil (EPC = 50.3 pCi/g) poses a 2.8E-04 risk to the onsite worker (decay corrected to 1.9E-04); and
- Cs-137 in fish tissue (maximum = 7.84 pCi/g; PRG = 0.054 pCi/g) and mercury (maximum = 0.854 mg/kg; RSL = 0.154 mg/kg) in fish tissue exceeds risk based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 8:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceed 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.1.9 Exposure Area 9

According to the analysis performed in Appendices B, C, and D and the results summarized in Chapter 3 of the RI, the following are problems warranting action for EA 9:

- Cs-137 and Co-60 in sediment/soil pose a TCR of 1.2E-04 to the onsite worker (decay corrected to 6.7E-05):
  - Cs-137: EPC = 20.9 pCi/g; risk to the onsite worker = 1.2E-04; (decay corrected to 6.7E-05)
  - Co-60: EPC = 0.114 pCi/g; risk to the onsite worker = 1.4E-06; (decay corrected to 9.6E-08).
- Cs-137 (maximum = 42.5 pCi/g; PRG = 0.054 pCi/g) and mercury (maximum = 0.244 mg/kg; RSL = 0.154 mg/kg) in fish tissue exceeds risk based screening levels for the recreational fisherman.

Based on the problems warranting action, the following RAOs apply for EA 9:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold level or Savannah River Site (SRS) background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

4.2 Remedial Goal Development

Remedial goal options (RGOs) serve to provide a range of cleanup goals for each RCOC and are typically identified along with the RAOs. RGOs can be qualitative statements or numerical values often expressed as concentrations in soil and groundwater or actions (e.g., installation of engineered barriers, placement of caps and covers, etc.) that achieve the RAO. Following public comment and approval of the Proposed Plan, the RGOs for the selected remedy are documented as final cleanup goals or remedial goals in the Record of Decision (ROD).

The selection of final RGOs is subject to approval by the risk managers for the SRS. The risk managers are the key decision makers and include representatives of the United States Department of Energy (USDOE), the South Carolina Department of Health and Environmental Control (SCDHEC), and United States Environmental Protection Agency (USEPA). In addition, the Citizens Advisory Board and the SRS Natural Resource Trustees will serve the risk managers in an advisory role.

The development of RGOs for the LTR IOU is described below.

4.2.1 Human Health RGOs

The HHRA is presented in Appendix B of this document. Human health RCOCs were identified in sediment/soil media and fish tissue media; no RCOCs were identified for the surface water media. The human health RGOs for the LTR IOU are presented in Appendix E. RGOs are calculated for all human health receptors evaluated in the HHRA for both carcinogenic and noncarcinogenic constituents as follows:

- For carcinogenic constituents, RGOs are calculated at the risk levels 1E-06, 1E-05, and 1E-04.
- For noncarcinogenic constituents, RGOs are calculated at the hazard quotient (HQ) levels 0.1, 1, and 3.

RGOs for all human health receptors (i.e., resident, industrial worker, recreational fisherman) are presented in Appendix E. Based on the current and likely future land use of the LTR IOU, human health RGOs are presented for the following receptors:

- Onsite worker (sediment/soil media):
- Recreational fisherman (fish tissue media).

4.2.2 Ecological RGOs

As presented in Appendix C and summarized in Chapter 3, there are no ecological RCOCs for any EA within the LTR IOU. Therefore, no ecological RGOs are presented.

4.2.3 PTSM RGOs

As presented in Appendix D and summarized in Chapter 3, there are no PTSM RCOCs for any EA within the LTR IOU. Therefore, no PTSM RGOs are presented.

4.2.4 Applicable or Relevant and Appropriate Requirements

As presented in Chapter 3, there are no ARAR-derived constituents of concern for any EA within the LTR IOU. Therefore, no ARAR RGOs are presented.

4.3 Most Likely Remedial Goal Options

Risk-based RGOs for the onsite worker for sediment/soil media and recreational fisherman for fish tissue media are identified in Table 4-1. The risk-based RGOs presented in the table correspond to a risk of 1E-06 for carcinogens (i.e., Cs-137 and Co-60) and an HQ of 1 for noncarcinogens (i.e., Hg).

The most likely RGOs also consider a comparison to background levels. Because of the inherently conservative nature of the risk assessment and RGO calculations, it is possible for the risk-based RGO to be less than what occurs naturally in background soil. In this case, the RGO defaults to the background concentration to be technically practical to achieve. Background levels presented in Table 4-1 are based on the *SRS Background Soils Statistical Summary Report* (WSRC 2006) and the IOU Background Dataset (Appendix A), as available.

The SRS soil background two times (2x) the 95th percentile concentration is identified as the most likely RGO for Cs-137 in sediment/soil media for the onsite worker since this is the generally accepted concentration for "typical" anthropogenic fallout, and has been accepted as the RG for other SRS projects, specifically the SRS Wetland Area at Dunbarton Bay In Support of Steel Creek Integrator Operable Unit project (Savannah River Nuclear Solutions [SRNS] 2014). For cobalt-60, the most-likely RGO is identified as the 1E-06 risk-based concentration (i.e., the PRG) for the onsite worker.

For fish tissue media, the risk based RGOs are identified as the most likely RGOs.

The most likely RGOs presented in this chapter are a good starting point for developing remedial alternatives. Final RGs will be agreed upon by USDOE, SCDHEC, and USEPA concurrent with selection of a remedial action. Final RGs will be documented in the ROD.

4.4 Natural Resource Injury Checklist

CERCLA and the Oil Pollution Act (OPA) broadly defines natural resources as "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources..." "belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State, an Indian Tribe, a local government, or a foreign government" [CERCLA §101(16); OPA §1001(20)]. The Natural Resource Injury Evaluation (NRIE) is the first step in determining the potential for natural resource injuries in the conduct and planning of remedial activities. The ERA evaluated the potential of adverse ecological effects that may occur as a result of the release of hazardous substances within the LTR IOU. Information developed during the ERA will be used by the Core Team and Trustees to identify potential additional actions, beyond the response needed, to address potential future injuries to natural resources during remedial action. Appendix F provides a NRIE Checklist as an initial inquiry to identify potential natural resource injuries and assess remedial alternatives.

The human health RCOCs for the LTR IOU study area are Cs-137 and, to a lesser extent, Co-60 that originated from reactor processes, and accidental environmental releases from R-Reactor and P-Reactor. Joyce Branch and the PAR Pond cooling pond/canal systems were directly affected by these processes and releases; therefore, all associated media (i.e., surface water, sediment, soil, and biota) within the LTR IOU watershed reflect some degree of Cs-137 contamination.

Mercury is another RCOC that has been reported with elevated concentrations in biota samples only. The Savannah River water used for reactor cooling water and atmospheric deposition provide sources of mercury for methylation that occurs naturally in wetland systems of the southeastern United States, which contribute to these elevated levels.

A brief description of the known or suspected natural resource injuries for the LTR IOU study area is presented in the following subsections.

4.4.1 Surface Water Resources

Joyce Branch, Ponds A, B, C, 2, 4 5, PAR Pond, and the R-Reactor and P-Reactor Discharge Canals are surface water features that were created by and/or affected by historical facility operations. Since these water bodies received thermal effluent from both reactors during their operational periods, Cs-137 and Co-60 has been detected in sediment/soil samples that underlie surface water resources at LTR IOU, and the potential for Cs-137 and Co-60 contamination in surface water exists. However, the half-life of Cs-137 is ~30 years, which means that depending on the location, there may only be trace amounts with potentially no detection of Cs-137 in the surface water at this time, and residual Cs-137 will continue to naturally decay below threshold criteria. For Co-60, with a half-life of ~5 years, residual contamination is much less over time.

Another component of reducing surface water contamination is regular addition of ambient water inputs such as rainwater and the movement of surface water that enhances dispersion and ultimate deposition of contaminants within surface water systems. Water inputs dilute residual contaminants in LTR IOU, and gravity and flow can disperse residual contamination throughout the water bodies, which also function as a natural method of contaminant reduction and natural recovery as contaminants move through the systems or become deposited and adsorbed to sediment particles. According to the surface water results from the 2009/2010 IOU investigation, there were no exceedances of the maximum contaminant levels for Cs-137 indicating that these natural phenomena are occurring.

4.4.2 Groundwater Resources

An evaluation of potential natural resource injury to groundwater resources was not evaluated in this RI/Baseline Risk Assessment (BRA). Groundwater was not considered part of the LTR IOU investigation and is currently being addressed under the P-Area Groundwater operable unit (OU) and the R-Area OU.

4.4.3 Air Resources

An evaluation of potential natural resource injury to air resources was not evaluated in this RI/BRA. An evaluation of potential natural resource injury to air resources was not evaluated in this RI/BRA since air media was not a medium of concern for the LTR IOU investigation, as no

air pollutants are currently being emitted from sediments/soils or surface waters within any EA. However, impacts of future remedial actions on air quality will be evaluated as part of the short-term effectiveness criterion, as necessary, during the alternatives evaluation in the FS for the LTR IOU.

4.4.4 Geologic Resources

Sediment/soil that was evaluated in this RI/BRA is in contact with the underlying geologic resources beneath LTR IOU. Subsurface materials below 4-ft in depth were not evaluated in this RI/BRA. Therefore, potential natural resource injury to geologic resources is not evaluated.

However, Cs-137 contamination of the sediment/soil within the LTR IOU cooling pond/canal systems represents the primary risk driver for human health within the study area. The onsite worker receptor scenario involves a worker who is performing maintenance, collecting samples, or conducting research. Site-specific assumptions are based on input provided by the Savannah River Ecology Laboratory for a wetlands researcher.

Remedial actions that would most likely be considered in order to protect the onsite worker from exposure to Cs-137 and Co-60 in sediments at the LTR IOU include, but are not limited to, no action (i.e. leaving the contamination in place and not implementing any form of restriction or cleanup), land use controls (LUCs), monitored natural recovery, excavation and disposal of sediment and soil from highly contaminated areas, and soil amendments. In order to further reduce risk to human health, more than one action can be implemented if deemed appropriate.

4.4.5 Biological Resources

Biological resources in the LTR IOU study area that are potentially impacted the most from reactor operation contamination are aquatic life. In order to determine the extent of the contamination, biota (i.e., fish tissue) samples included collection of higher trophic level species (i.e., species like the largemouth bass) from EA 3, EA 6, EA 8 and EA 9. This data set is considered to be representative of all nine EAs for the cooling pond/canal systems. Because it is known that some contaminants could bio-accumulate in fish, and fish are a mobile media, the evaluation of human exposure also includes the recreational fisherman scenario. Biota data from the IOU investigation

sampling exceeded screening levels for Cs-137 and mercury, based on screening levels calculated for this receptor scenario. The recreational fisherman receptor scenario focuses on an individual who fishes in the LTR IOU infrequently and consumes fish daily.

Response actions that would most likely be considered in order to protect the recreational fisherman from exposure to contaminated fish at the LTR IOU include, but are not limited to, LUCs. Additionally, SCDHEC publishes an annual document that informs the public of restricted areas for fishing within the state, which specifies if fish can or cannot be consumed from those areas, and recommended consumption quantities.

Table 4-1. RGOs for LTR IOU

Media	RCOC	Units	Onsite Worker	Recreational Fisherman	SRS BKGRD 95th %tile	2X SRS BKGRD 95th %tile	SRS BKGRD Max	IOU BKGRD Max	Most Likely RGO
Sediment/ Soil	Cesium-137 (+D) Cobalt-60	pCi/g pCi/g	0.18 *0.0832*	NA NA	0.34 NA	*0.68* NA	3.3 NA	0.623 0.011	0.68 0.0832
Fish Tissue	Cesium-137 (+D) Mercury	pCi/g mg/kg	NA NA	*0.0544* *0.154*	NA NA	NA NA	NA NA	0.488 0.24	0.0544 0.154

(+D) indicates that the contribution from daughters in the decay chain are considered.

5.0 SUMMARY

This document presented a summary of data collected for the Lower Three Runs (LTR) Integrator Operable Unit (IOU), described the nature and extent of the contaminants in affected media, provided an evaluation of the potential risk to human health and ecological receptors, and identified remedial action objectives (RAOs) and remedial goal options (RGOs).

The LTR IOU is defined by the surface water bodies and associated wetlands located in the LTR watershed. For administrative purposes, the LTR IOU is further delineated into the Upper subunit located above the PAR Pond dam, and the Middle, and Lower subunits located below the dam. The Upper subunit was the subject of this Remedial Investigation (RI)/Baseline Risk Assessment (BRA).

In support of RI/BRA development, the LTR IOU Core Team comprised of representatives from the United States Environmental Protection Agency (USEPA), South Carolina Department of Health and Environmental Control, and the United States Department of Energy (USDOE) – Savannah River, agreed to a strategy to segregate the LTR IOU Upper subunit into nine exposure areas (EAs). EAs represent geographically distinct locations within the Upper subunit, each of which contains environmental media to which a receptor may be exposed. This approach allows for remedial decisions to be made on a smaller scale within the larger LTR IOU area. The EAs are comprised of the following:

1. Pond A and R Discharge Canal;
2. Canal between Pond A and Pond B;
3. Pond B;
4. Canal between Pond B and PAR Pond;
5. Joyce Branch/Old Discharge Canal;
6. PAR Pond;
7. Pond 2 and associated canals;
8. Ponds 4 and 5 and Canal to Pond C; and
9. Pond C.

The data used for the LTR RI/BRA is maintained in the LTR IOU database and contains a vast amount of historical data collected for the IOU program from various data stewards that supported Work Plan and Periodic Report development. The collection efforts were conducted for sediment, wetland and floodplain sediment/soils, surface water, and fish medium from the waterbodies/canal systems and streams/tributaries associated with the LTR IOU. In support of the RI/BRA,

additional characterization efforts were conducted in 2009/2010 and 2016 to supplement the historical information.

The following Core Team agreements were reached in support of the LTR IOU RI/BRA.

- Historical data and 2009/2010 and 2016 supplemental data were sufficient to proceed with development of the RI/BRA.
- High and medium level data, previously reviewed and agreed to by the Core Team for each EA, was appropriate to use in the final dataset for the RI/BRA.
- The "IOU onsite worker" was the most likely human receptor for the Upper subunit. The IOU onsite worker is based on an Savannah River Site (SRS) researcher scenario and is protective of the adolescent trespasser previously evaluated for the Middle and Lower subunits of the LTR IOU. Because it is known that some contaminants could bio-accumulate in fish, and fish are a mobile media, the evaluation of human exposure also includes a recreational fisherman scenario.

The data packages for each EA were used to evaluate the risk to human receptors (principally the onsite worker), potential ecological threats, and whether principal threat source material (PTSM) is present. No ecological refined constituents of concern (RCOCs) are identified for either the sediment/soil or surface water medium. No PTSM RCOCs are identified for any EA within the LTR IOU. However, EA 1, EA 3, and EA 5 had specific locations where Cs-137 levels were above the PTSM threshold, and EA 2 had a single location that was equal to the PTSM threshold. The locations with higher Cs-137 activity concentrations will be re-evaluated in the Feasibility Study (FS) phase to ensure that a full range of alternatives is considered in the remedy selection process. A summary of the results for each EA is provided below.

5.1 Exposure Area 1

5.1.1 Problem Warranting Action

Cesium-137 (Cs-137) and cobalt-60 (Co-60) in sediment/soil and mercury and Cs-137 in fish are the primary constituents of concern (COCs) for human receptors for EA 1. Cs-137 in sediment/soil at the exposure point concentration (EPC) of 148 pCi/g and Co-60 in sediment/soil at the EPC of

0.144 pCi/g, pose a total cumulative risk (TCR) of 8.2E-04 to the onsite worker receptor predominantly via the external radiation pathway. Although fish samples were not collected in EA 1, the results for other EAs where fish samples were collected are used as proxy results for EA 1. Proxy results indicate that the maximum detected concentration of mercury and maximum detected activity concentration of Cs-137 in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.1.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 1 include:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceed 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway; and
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.1.3 Uncertainties

Potential PTSM (see Appendix D) at one location (R-1) had five separate samples that are above the PTSM threshold for the onsite worker in both the original and decay corrected datasets. This result, including the decay corrected risk, will be taken into consideration in the remedial evaluation process documented in the FS phase of the project.

5.2 Exposure Area 2

5.2.1 Problem Warranting Action

Cs-137 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 2. Cs-137 in sediment/soil at the EPC of 48.8 pCi/g poses a risk of 2.7E-04 to the onsite worker receptor predominantly via the external radiation pathway. Although fish samples were not collected in EA 2, the results for other EAs where fish samples were collected are used as proxy results for EA 2. Proxy results indicate that maximum detected concentration of mercury

and maximum detected activity concentration of Cs-137 in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.2.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 2 include:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.2.3 Uncertainties

Potential PTSM is present (see Appendix D) at one location in EA 2 (RDC-007-001) where the measured activity of Cs-137 equaled the PTSM threshold for the onsite worker. This result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

5.3 Exposure Area 3

5.3.1 Problem Warranting Action

Cs-137 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 3. Cs-137 in sediment/soil at the EPC of 98.3 pCi/g poses a risk of 5.5E-04 to the onsite worker receptor predominantly via the external radiation pathway. Also, the maximum detected concentrations of mercury (1.83 mg/kg) and Cs-137 (113 pCi/g) in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.3.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 3 include:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.3.3 Uncertainties

Potential PTSM (see Appendix D) is present at two specific locations in EA 3 (SCB-29 and SCB-34) where measured activities of Cs-137 (circa 1994) exceeded the PTSM threshold for the onsite worker receptor. These results, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

5.4 Exposure Area 4

5.4.1 Problem Warranting Action

Cs-137 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 4. Cs-137 at the EPC of 18.3 pCi/g in sediment/soil poses a risk of 1.0E-04 to the onsite worker receptor predominantly via the external radiation pathway. Although fish samples were not collected in EA 4, the results for other EAs where fish samples were collected are used as proxy results for EA 4. Proxy results indicate that the maximum detected concentration of mercury and maximum detected activity concentration of Cs-137 in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.4.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 4 include:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.4.3 Uncertainties

None.

5.5 Exposure Area 5

5.5.1 Problem Warranting Action

Cs-137 and Co-60 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 5. Cs-137 in sediment/soil at the EPC of 228 pCi/g and Co-60 in sediment/soil at the EPC of 0.76 pCi/g pose a TCR of 1.3E-03 to the onsite worker receptor predominantly via the external radiation pathway. Although fish samples were not collected in EA 5, the results for other EAs where fish samples were collected are used as proxy results for EA 5. Proxy results indicate that maximum detected concentration of mercury and maximum detected activity concentration of Cs-137 in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.5.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 5 include:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.5.3 Uncertainties

Potential PTSM (see Appendix D) is present in four samples total (two each) at two specific locations (LTR-02 and LTR-04) with measured activities (from 2003-2004) above the PTSM threshold for Cs-137 for the onsite worker receptor. These results, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

5.6 Exposure Area 6

5.6.1 Problem Warranting Action

Cs-137 and Co-60 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 6. Cs-137 in sediment/soil at the EPC of 8.82 pCi/g and Co-60 at EPC of 0.097 pCi/g in sediment/soil pose a TCR of 5.0E-05 to the onsite worker receptor predominantly via the external radiation pathway. Also, the maximum detected concentrations of mercury (3.18 mg/kg) and Cs-137 (18.4 pCi/g) in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.6.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 6 include:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.6.3 Uncertainties

None.

5.7 Exposure Area 7

5.7.1 Problem Warranting Action

Cs-137 and Co-60 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 7. Cs-137 in sediment/soil at the EPC of 139 pCi/g and Co-60 in sediment/soil at the EPC of 0.802 pCi/g pose a TCR of 7.8E-04 to the onsite worker receptor predominantly via the external radiation pathway. Although fish samples were not collected in EA 7, the results for other EAs where fish samples were collected are used as proxy results for EA 7. Proxy results indicate that the maximum detected concentration of mercury and maximum detected activity concentration of Cs-137 in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.7.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 7 include:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.7.3 Uncertainties

None.

5.8 Exposure Area 8

5.8.1 Problem Warranting Action

Cs-137 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 8. Cs-137 in sediment/soil at the EPC of 50.3 pCi/g poses a 2.8E-04 risk to the onsite worker receptor predominantly via the external radiation pathway. Also, the maximum detected

concentrations of mercury (0.854 mg/kg) and Cs-137 (7.84 pCi/g) in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.8.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 8 include:

- Protect onsite workers from exposure to Cs-137 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.8.3 Uncertainties

None.

5.9 Exposure Area 9

5.9.1 Problem Warranting Action

Cs-137 and Co-60 in sediment/soil and mercury and Cs-137 in fish are the primary COCs for human receptors for EA 9. Cs-137 in sediment/soil at the EPC of 20.9 pCi/g poses and Co-60 in sediment/soil at the EPC of 0.114 pCi/g pose a TCR of 1.2E-04 to the onsite worker receptor predominantly via the external radiation pathway. Also, the maximum detected concentrations of mercury (0.214 mg/kg) and Cs-137 (42.5 pCi/g) in fish exceed recreational fisherman screening levels based on the ingestion exposure route.

5.9.2 Remedial Action Objectives

The RAOs to protect human receptors associated with contaminants in sediment/soil and fish associated with EA 9 include:

- Protect onsite workers from exposure to Cs-137 and Co-60 in sediment/soil that exceeds 1E-06 risk based threshold or background levels. The primary exposure route of concern is the external radiation pathway.
- Protect recreational fisherman from exposure to contaminated fish. The primary route of exposure is the ingestion of fish pathway.

5.9.3 Uncertainties

None.

5.10 Exposure Area Summary

Past characterization efforts have shown that Cs-137 is the major contaminant in the LTR IOU system and that other contaminants are present to a lesser extent. The results of the RI/BRA confirmed that Cs-137 is indeed the predominant contaminant that drives the risk for the onsite worker. Co-60 is present at a lesser degree in sediment/soil, and Cs-137 and mercury are present in fish tissue at levels that exceed the threshold level for the recreational fisherman. The characterization and risk evaluations for each EA confirm that contamination in the LTR IOU system is relatively homogeneous.

- Cs-137 was identified as an RCOC for the onsite worker in sediment/soil media in all nine EAs.
- Co-60 was identified as an RCOC for the onsite worker in sediment/soil media in EA 1, EA 5, EA 6, EA 7, and EA 9.
- Cs-137 and mercury was identified as RCOCs for the in-fish tissue in all nine EAs (based on biota [fish] data from EA 3, EA 6, EA 8, and EA 9).

5.11 Summary of RGOs for the LTR IOU

Risk-based RGOs for the onsite worker for sediment/soil media and recreational fisherman for fish tissue media are identified in Table 5-1. The risk-based RGOs presented in the table correspond to a risk of 1E-06 for carcinogens (i.e., Cs-137 and Co-60) and a hazard quotient of 1 for noncarcinogens (i.e., Hg). The most likely RGOs presented are the starting point for developing

remedial alternatives. Final remedial goals will be agreed upon by the Core Team concurrent with selection of a remedial action. Final RGs will be documented in the Record of Decision.

5.12 Implementation Schedule

A summary of the key deliverables and submittal dates for the LTR IOU project are shown below.

Deliverable	Submittal Date
Submit Rev.0 RI/BRA	July 3, 2017
Submit Rev.0 Feasibility Study	April 5, 2018
Submit Rev. 0 Proposed Plan	November 30, 2018
Submit Rev. 0 Record of Decision	July 22, 2019
Issuance of the Record of Decision	March 31, 2020
Remedial Action Start	May 27, 2021

Table 5-1. Risk-Based RGOs for the Onsite Worker

Media	RCOC	Units	HHRA Onsite Worker	HHRA Recreational Fisherman	SRS BKGRD 95th %tile	2X SRS BKGRD 95th %tile	SRS BKGRD Max	IOU BKGRD Max	Most Likely RGO
Sediment/ Soil	Cesium-137 (+D) Cobalt-60	pCi/g pCi/g	0.18 *0.0832*	NA NA	0.34 NA	*0.68* NA	3.3 NA	0.623 0.011	0.68 0.0832
Fish Tissue	Cesium-137 (+D) Mercury	pCi/g mg/kg	NA NA	*0.0544* *0.154*	NA NA	NA NA	NA NA	0.488 0.24	0.0544 0.154

HHRA = Human Health Risk Assessment
IOU = Integrated Operable Unit
RGO = Remedial Goal Option

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APPENDIX A

Investigation Data

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Table A.1.1.1.1__Statistical Summary Table: EA1 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
1	Inorganics	Cyanide	mg/kg	3	2	1	1			0.09705	NA	ND	0.223	0.223	LTROU-13	J
	Metals	Aluminum	mg/kg	12	0	12	2	N	1	5327.5	6584	1120	9020	6584	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Antimony	mg/kg	12	8	4	4	X	5	0.2245625	0.251	ND	0.556	0.251	PAT1-2	J
		Arsenic	mg/kg	12	3	9	6	X	5	1.038875	1.423	ND	2.34	1.423	LTROU-13	NQ
		Barium	mg/kg	12	0	12	0	N	1	21.27416667	28.49	2.09	50.9	28.49	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Beryllium	mg/kg	12	3	9	8	G	2	0.124741667	0.219	ND	0.372	0.219	PAT1-3	J
		Cadmium	mg/kg	12	8	4	4	X	3	0.0398375	0.0515	ND	0.0616	0.0515	RDC001-001	J
		Calcium	mg/kg	12	0	12	4	N	1	186.35	254.6	15.1	446	254.6	PAT1-5	NQ
		Chromium	mg/kg	12	0	12	0	N	1	7.7675	9.792	1.43	15	9.792	PAT1-5	NQ
		Cobalt	mg/kg	12	2	10	4	X	5	0.610625	0.904	ND	1.99	0.904	PAT1-5	NQ
		Copper	mg/kg	12	0	12	5	N	1	3.21925	4.125	0.441	6.69	4.125	PAT1-5	NQ
		Iron	mg/kg	12	0	12	1	N	1	3921.166667	5810	814	13300	5810	LTROU-13	NQ
		Lead	mg/kg	12	0	12	0	N	1	4.2425	5.345	1.04	8.54	5.345	PAT1-5	NQ
		Magnesium	mg/kg	12	0	12	1	L	6	124.2416667	232.5	27.1	467	232.5	PAT1-5	NQ
		Manganese	mg/kg	12	0	12	0	G	2	50.16	109.6	3.76	177	109.6	LTROU-13	NQ
		Mercury	mg/kg	12	1	11	5	X	5	0.022114583	0.0271	ND	0.0358	0.0271	PAT1-2	NQ
		Nickel	mg/kg	12	2	10	0	X	5	1.304916667	1.735	ND	2.92	1.735	PAT1-5	NQ
		Potassium	mg/kg	12	0	12	4	G	2	72.2	112.4	17.1	218	112.4	PAT1-5	NQ
		Selenium	mg/kg	12	7	5	2	X	5	0.546833333	0.851	ND	1.89	0.851	PAT1-5	J
		Sodium	mg/kg	12	11	1	1			7.232083333	NA	ND	21.9	21.9	PAT1-5	J
		Vanadium	mg/kg	12	0	12	0	G	2	18.48	32.1	2.28	61.4	32.1	RDC001-001	NQ
		Zinc	mg/kg	12	0	12	3	L	6	7.335833333	16.98	1.19	26.8	16.98	RDC001-001	NQ
	Pesticides/PCBs	DDD	mg/kg	12	11	1	1			0.000226625	NA	ND	0.000632	0.000632	PAT1-5	J
		DDE	mg/kg	12	8	4	2	X	5	0.000939083	0.0016	ND	0.0038	0.0016	RDC001-003	NQ
		DDT	mg/kg	12	11	1	0			0.000557083	NA	ND	0.0025	0.0025	RDC001-005	NQ
		PCB-1260	mg/kg	12	10	2	2	X	5	0.002642917	0.0025	ND	0.0035	0.0025	PAT1-3	J
	Radionuclides	Actinium-228	pCi/g	29	1	28	0	G	2	1.145792938	1.306	ND	2.5	1.306	PAT3-2	NQ
		Americium-241	pCi/g	17	2	15	2	G	2	0.222125471	0.671	ND	1.84	0.671	R-Area Downstream of R-1	NQ
		Americium-243	pCi/g	5	3	2	0	X	3	0.1261	0.332	ND	0.277	0.277	RDC002-001	NQ
		Bismuth-212	pCi/g	13	6	7	0	X	5	0.733767466	0.987	ND	1.3095	0.987	R-Area Downstream of R-1	NQ
		Bismuth-214	pCi/g	32	0	32	0	G	2	0.934291131	1.093	0.24165	3.41	1.093	PAT2-5	NQ
		Californium-244	pCi/g	2	1	1	0			0.087	NA	ND	0.174	0.174	R-Area Downstream of R-1	NQ
		Carbon-14	pCi/g	5	2	3	1	X	5	0.9784	2.016	ND	2.69	2.016	PAT1-5	J
		Cesium-137	pCi/g	45	1	44	4	G	2	87.33528789	148	ND	685.8	148	R-Area Downstream of R-1	NQ
		Cobalt-60	pCi/g	45	30	15	2	X	5	0.110919583	0.144	ND	0.648	0.144	R-Area Downstream of R-1	NQ
		Curium-244	pCi/g	9	2	7	0	X	4	0.015458244	0.0289	ND	0.04455	0.0289	R-Area Downstream of R-1	NQ
		Curium-245 and Curium-246	pCi/g	4	2	2	0	X	3	0.1255	0.385	ND	0.269	0.269	RDC002-001	NQ
		Gross Alpha	pCi/g	26	0	26	7	L	6	18.94230769	24.78	4.94	42	24.78	RDC002-005	NQ
		Lead-212	pCi/g	32	0	32	0	N	1	1.093340244	1.209	0.19953	2.16	1.209	PAT3-2	NQ
		Lead-214	pCi/g	33	1	32	0	X	5	0.993981336	1.173	ND	3.71	1.173	PAT2-5	NQ
		Non-volatile Beta	pCi/g	25	1	24	9	X	7	39.5326	67.06	ND	232	67.06	RDC002-001	NQ
		Plutonium-238	pCi/g	23	4	19	1	G	2	0.079272858	0.138	ND	0.486	0.138	R-Area Downstream of R-1	NQ
		Plutonium-239	pCi/g	17	1	16	0	G	2	0.22166833	0.823	ND	2.16	0.823	R-Area Downstream of R-1	NQ
		Plutonium-239 and Plutonium-240	pCi/g	7	1	6	2	X	5	0.433525714	0.716	ND	1.18	0.716	PAT1-5	NQ
		Potassium-40	pCi/g	32	12	20	8	X	7	1.297523291	3.897	ND	4.15	3.897	PAT3-2	NQ
		Radium-226	pCi/g	6	0	6	0	N	1	1.358833333	2.259	0.55	3.41	2.259	PAT2-5	NQ
		Radium-228	pCi/g	4	0	4	0	N	1	1.13	1.419	0.94	1.48	1.419	PAT2-5	NQ
		Strontium-89 and Strontium-90	pCi/g	18	4	14	0	G	2	0.283373343	0.54	ND	1.5363	0.54	R-Area Downstream of R-1	NQ
		Thallium-208	pCi/g	33	0	33	3	N	1	0.391376636	0.437	0.0756	0.729729	0.437	R-Area Downstream of R-1	NQ
		Thorium-228	pCi/g	8	0	8	1	N	1	1.5605	2.206	0.635	3.7	2.206	R-Area Downstream of R-1	NQ
		Thorium-230	pCi/g	8	0	8	1	N	1	0.89825	1.191	0.343	1.6	1.191	PAT3-2	NQ
		Thorium-232	pCi/g	8	0	8	0	N	1	1.407625	2.015	0.44	3.32	2.015	R-Area Downstream of R-1	NQ
		Uranium-233 and Uranium-234	pCi/g	6	0	6	1	N	1	0.928333333	1.339	0.369	1.64	1.339	PAT2-5	NQ
		Uranium-234	pCi/g	12	1	11	0	X	5	0.893423986	1.256	ND	2.78	1.256	R-Area Downstream of R-1	NQ
		Uranium-235	pCi/g	18	8	10	0	G	2	0.049761931	0.0571	ND	0.137	0.0571	R-Area Downstream of R-1	NQ
		Uranium-238	pCi/g	18	1	17	2	G	2	0.845591156	1.198	ND	2.73	1.198	R-Area Downstream of R-1	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	12	10	2	1			0.331552083	NA	ND	3.57	3.57	LTROU-13	NQ
	Volatiles	Acetone	mg/kg	12	3	9	4	X	4	0.0596125	0.337	ND	0.4	0.337	LTROU-13	J
		Ethylbenzene	mg/kg	12	11	1	1			0.000275125	NA	ND	0.000647	0.000647	PAT1-2	J

Table A.1.1.1.1__Statistical Summary Table: EA1 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Isopropylbenzene	mg/kg	12	11	1	0			0.000441708	NA	ND	0.00259	0.00259	PAT1-5	NQ
		Methyl acetate	mg/kg	12	11	1	1			0.001630417	NA	ND	0.00391	0.00391	PAT1-3	J
		Methyl ethyl ketone	mg/kg	12	6	6	6	X	3	0.00416875	0.0128	ND	0.0242	0.0128	LTROU-13	J
		Toluene	mg/kg	12	5	7	6	X	4	0.001783542	0.011	ND	0.0124	0.011	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.1.1.2__Statistical Summary Table: Exposure Area 1 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
1	Inorganics	Cyanide	mg/kg	3	2	1	1			0.09705	NA	ND	0.223	0.223	LTROU-13	J
	Metals	Aluminum	mg/kg	18	0	18	2	N	1	5021.66667	5920	1120	9020	5920	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Antimony	mg/kg	18	14	4	4	X	5	0.19671944	0.189	ND	0.556	0.189	PAT1-2	J
		Arsenic	mg/kg	18	3	15	12	X	5	0.94425	1.203	ND	2.34	1.203	LTROU-13	NQ
		Barium	mg/kg	18	0	18	1	N	1	20.4327778	25.28	2.09	50.9	25.28	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Beryllium	mg/kg	18	5	13	12	X	7	0.11281111	0.168	ND	0.372	0.168	PAT1-3	J
		Cadmium	mg/kg	18	13	5	5	X	3	0.04021667	0.0415	ND	0.0616	0.0415	RDC001-001	J
		Calcium	mg/kg	18	0	18	5	N	1	167.011111	216	15.1	446	216	PAT1-5	NQ
		Chromium	mg/kg	18	0	18	0	N	1	6.915	8.335	1.43	15	8.335	PAT1-5	NQ
		Cobalt	mg/kg	18	2	16	8	X	3	0.52297222	1.001	ND	1.99	1.001	PAT1-5	NQ
		Copper	mg/kg	18	0	18	9	N	1	2.70394444	3.367	0.441	6.69	3.367	PAT1-5	NQ
		Iron	mg/kg	18	0	18	2	G	2	3198.5	4849	713	13300	4849	LTROU-13	NQ
		Lead	mg/kg	18	0	18	0	N	1	3.89722222	4.651	1.04	8.54	4.651	PAT1-5	NQ
		Magnesium	mg/kg	18	0	18	1	L	6	107.988889	155.1	27.1	467	155.1	PAT1-5	NQ
		Manganese	mg/kg	18	0	18	0	G	2	42.3255556	70.74	3.76	177	70.74	LTROU-13	NQ
		Mercury	mg/kg	18	1	17	9	X	5	0.01916194	0.0231	ND	0.0358	0.0231	PAT1-2	NQ
		Nickel	mg/kg	18	2	16	0	X	5	1.3265	1.612	ND	2.92	1.612	PAT1-5	NQ
		Potassium	mg/kg	18	0	18	8	N	1	63.4333333	82.63	17.1	218	82.63	PAT1-5	NQ
		Selenium	mg/kg	18	11	7	3	G	2	0.48441667	0.769	ND	1.89	0.769	PAT1-5	J
		Sodium	mg/kg	18	16	2	2	X	3	6.57694444	11.62	ND	21.9	11.62	PAT1-5	J
		Vanadium	mg/kg	18	0	18	1	G	2	15.5594444	22.55	2.28	61.4	22.55	RDC001-001	NQ
		Zinc	mg/kg	18	0	18	7	X	3	5.65888889	12.82	1.19	26.8	12.82	RDC001-001	NQ
	Pesticides/PCBs	DDD	mg/kg	18	17	1	1			0.00020583	NA	ND	0.000632	0.000632	PAT1-5	J
		DDE	mg/kg	18	14	4	2	X	5	0.00069358	0.00112	ND	0.0038	0.00112	RDC001-003	NQ
		DDT	mg/kg	18	17	1	0			0.00042725	NA	ND	0.0025	0.0025	RDC001-005	NQ
		Methoxychlor	mg/kg	18	17	1	1			0.00102472	NA	ND	0.00292	0.00292	PAT1-3	J
		PCB-1260	mg/kg	18	16	2	2	X	5	0.00227722	0.002	ND	0.0035	0.002	PAT1-3	J
	Radionuclides	Actinium-228	pCi/g	45	1	44	2	G	2	1.12788878	1.245	ND	2.5	1.245	PAT3-2	NQ
		Americium-241	pCi/g	18	3	15	2	G	2	0.21356294	0.626	ND	1.84	0.626	R-Area Downstream of R-1	NQ
		Americium-243	pCi/g	6	4	2	0	X	3	0.11300833	0.296	ND	0.277	0.277	RDC002-001	NQ
		Bismuth-212	pCi/g	17	8	9	0	X	5	0.69905747	0.923	ND	1.3095	0.923	R-Area Downstream of R-1	NQ
		Bismuth-214	pCi/g	48	0	48	0	G	2	0.86481909	0.967	0.2417	3.41	0.967	PAT2-5	NQ
		Californium-244	pCi/g	2	1	1	0			0.087	NA	ND	0.174	0.174	R-Area Downstream of R-1	NQ
		Carbon-14	pCi/g	5	2	3	1	X	5	0.9784	2.016	ND	2.69	2.016	PAT1-5	J
		Cesium-137	pCi/g	61	11	50	5	X	3	64.4914321	177.8	ND	685.8	177.8	R-Area Downstream of R-1	NQ
		Cobalt-60	pCi/g	61	46	15	2	X	5	0.09087182	0.109	ND	0.648	0.109	R-Area Downstream of R-1	NQ
		Curium-244	pCi/g	9	2	7	0	X	4	0.01545824	0.0292	ND	0.04455	0.0292	R-Area Downstream of R-1	NQ
		Curium-245 and Curium-246	pCi/g	5	3	2	0	X	3	0.10818	0.329	ND	0.269	0.269	RDC002-001	NQ
		Gross Alpha	pCi/g	42	0	42	9	G	2	18.9295238	22.22	4.14	42	22.22	RDC002-005	NQ
		Lead-212	pCi/g	48	0	48	0	G	2	1.07118516	1.175	0.1995	2.16	1.175	PAT3-2	NQ
		Lead-214	pCi/g	49	1	48	0	X	5	0.94135478	1.066	ND	3.71	1.066	PAT2-5	NQ
		Non-volatile Beta	pCi/g	41	2	39	16	X	7	29.4242683	39.93	ND	232	39.93	RDC002-001	NQ
		Plutonium-238	pCi/g	24	5	19	1	G	2	0.08178232	0.133	ND	0.486	0.133	R-Area Downstream of R-1	NQ
		Plutonium-239	pCi/g	17	1	16	0	G	2	0.22166833	0.823	ND	2.16	0.823	R-Area Downstream of R-1	NQ
		Plutonium-239 and Plutonium-240	pCi/g	8	2	6	2	X	5	0.3882725	0.645	ND	1.18	0.645	PAT1-5	NQ
		Potassium-40	pCi/g	45	18	27	14	G	2	1.17596101	1.498	ND	4.15	1.498	PAT3-2	NQ
		Radium-226	pCi/g	7	0	7	0	N	1	1.22157143	2.002	0.398	3.41	2.002	PAT2-5	NQ
		Radium-228	pCi/g	4	0	4	0	N	1	1.13	1.419	0.94	1.48	1.419	PAT2-5	NQ
		Strontium-89 and Strontium-90	pCi/g	18	4	14	0	G	2	0.28337334	0.54	ND	1.5363	0.54	R-Area Downstream of R-1	NQ
		Thallium-208	pCi/g	49	0	49	3	N	1	0.37602916	0.411	0.0756	0.729729	0.411	R-Area Downstream of R-1	NQ
		Thorium-228	pCi/g	9	0	9	1	N	1	1.51488889	2.08	0.635	3.7	2.08	R-Area Downstream of R-1	NQ
		Thorium-230	pCi/g	9	0	9	1	N	1	0.914	1.169	0.343	1.6	1.169	PAT3-2	NQ
		Thorium-232	pCi/g	9	0	9	0	N	1	1.39788889	1.924	0.44	3.32	1.924	R-Area Downstream of R-1	NQ
		Uranium-233 and Uranium-234	pCi/g	7	0	7	2	N	1	0.85728571	1.219	0.369	1.64	1.219	PAT2-5	NQ
		Uranium-234	pCi/g	12	1	11	0	X	5	0.89342399	1.256	ND	2.78	1.256	R-Area Downstream of R-1	NQ
		Uranium-235	pCi/g	19	9	10	0	G	2	0.04985341	0.0552	ND	0.137	0.0552	R-Area Downstream of R-1	NQ
		Uranium-238	pCi/g	19	1	18	3	G	2	0.82713899	1.157	ND	2.73	1.157	R-Area Downstream of R-1	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	18	15	3	2	X	5	0.23311806	0.625	ND	3.57	0.625	LTROU-13	NQ
	Volatiles	Acetone	mg/kg	18	8	10	4	X	7	0.0416225	0.098	ND	0.4	0.098	LTROU-13	J

Table A.1.1.1.2__Statistical Summary Table: Exposure Area 1 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Ethylbenzene	mg/kg	18	17	1	1			0.00025358	NA	ND	0.000647	0.000647	PAT1-2	J
		Isopropylbenzene	mg/kg	18	17	1	0			0.00036464	NA	ND	0.00259	0.00259	PAT1-5	NQ
		Methyl acetate	mg/kg	18	17	1	1			0.00142861	NA	ND	0.00391	0.00391	PAT1-3	J
		Methyl ethyl ketone	mg/kg	18	12	6	6	X	3	0.00306611	0.00908	ND	0.0242	0.00908	LTROU-13	J
		Toluene	mg/kg	18	9	9	8	X	3	0.00129442	0.00434	ND	0.0124	0.00434	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.1.2 __ Statisical Summary Table: Exposure Area 1 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
1	Inorganics	Cyanide	µg/L	3	2	1	1			1.775	NA	ND	3.02	3.02	LTROU-12	J
		Thallium	µg/L	6	5	1	1			2.205	NA	ND	1.5	1.5	RDC002-002	J
	Metals	Aluminum	µg/L	6	2	4	1	X	4	235.7916667	2836	ND	1060	1060	RDC001-002	J
		Barium	µg/L	6	0	6	0	N	1	21.565	31.16	9.83	37.7	31.16	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Calcium	µg/L	6	0	6	0	N	1	6483.333333	10522	1140	12700	10522	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Chromium	µg/L	6	5	1	1			0.877	NA	ND	1.32	1.32	LTROU-13	J
		Cobalt	µg/L	6	4	2	2	X	3	0.743333333	3.319	ND	3.03	3.03	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	J
		Copper	µg/L	6	4	2	2	L	6	1.095833333	1.107	ND	0.98	0.98	RDC001-002	J
		Iron	µg/L	6	0	6	1	N	1	3292	7171	206	12600	7171	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Lead	µg/L	6	5	1	1			1.144166667	NA	ND	0.67	0.67	RDC001-002	J
		Magnesium	µg/L	6	0	6	0	N	1	921.6666667	1363	473	1900	1363	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Manganese	µg/L	6	0	6	1	N	1	375.2	763.9	26.3	1180	763.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Nickel	µg/L	6	5	1	1			0.456333333	NA	ND	0.64	0.64	RDC001-002	J
		Potassium	µg/L	6	0	6	1	G	2	1764.566667	18452	51.4	8130	8130	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Sodium	µg/L	6	0	6	0	N	1	1730	2313	370	2310	2310	LTROU-12	NQ
		Vanadium	µg/L	6	4	2	2	X	3	1.211666667	4.093	ND	3.9	3.9	RDC001 002	J
		Zinc	µg/L	6	2	4	1	X	5	9.025833333	17.33	ND	26.9	17.33	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
	Pesticides/PCBs	DDE	µg/L	6	5	1	1			0.004081667	NA	ND	0.00934	0.00934	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	J
		DDT	µg/L	6	5	1	0			0.02995	NA	ND	0.137	0.137	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
	Radionuclides	Americium-241	pCi/L	9	4	5	0	G	2	0.010067275	0.0322	ND	0.04015602	0.0322	R-Area Downstream of R-1 (28034)	NQ
		Cesium-137	pCi/L	320	63	257	5	X	3	18.58570822	23.3	ND	176.34915	23.3	R-Area Downstream of R-1 (28034)	NQ
		Cobalt-60	pCi/L	241	184	57	0	G	2	1.210358169	0.826	ND	7.58	0.826	R-Area Downstream of R-1 (28034)	NQ
		Curium-244	pCi/L	10	5	5	0	X	5	0.002669619	0.00465	ND	0.01	0.00465	R-Area Downstream of R-1 (28034)	NQ
		Gross Alpha	pCi/L	491	277	214	0	X	3	0.966689472	1.851	ND	20.685483	1.851	R-Area Downstream of R-1 (28034)	NQ
		Gross Beta	pCi/L	87	0	87	0	G	2	27.47720318	30.59	5.39	99.91188	30.59	R-Area Downstream of R-1 (28034)	NQ
		Iodine-129	pCi/L	7	6	1	0			4.699761262	NA	ND	32.29524	32.29524	R-Area Downstream of R-1 (28034)	NQ
		Non-volatile Beta	pCi/L	409	1	408	1	X	3	12.20269025	14.41	ND	89.81847	14.41	R-Area Downstream of R-1 (28034)	NQ
		Plutonium-238	pCi/L	11	5	6	0	X	5	0.008537922	0.015	ND	0.03730698	0.015	R-Area Downstream of R-1 (28034)	NQ
		Plutonium-239	pCi/L	10	6	4	0	X	5	0.002923501	0.00548	ND	0.011098647	0.00548	R-Area Downstream of R-1 (28034)	NQ
		Plutonium-239 and Plutonium-240	pCi/L	1	0	1	0			0.01	NA	0.01	0.01	0.01	R-Area Downstream of R-1 (28034)	NQ
		Potassium-40	pCi/L	139	118	21	0	X	3	29.93604289	54.93	ND	464.40002	54.93	R-Area Downstream of R-1	NQ
		Strontium-89 and Strontium-90	pCi/L	11	1	10	0	X	5	1.251059791	1.687	ND	3.011121	1.687	R-Area Downstream of R-1 (28034)	NQ
		Technetium-99	pCi/L	9	6	3	0	X	5	0.23671908	0.32	ND	0.5657472	0.32	R-Area Downstream of R-1 (28034)	NQ
		Thorium-234	pCi/L	1	0	1	0			710.1	NA	710.1	710.1	710.1	R-Area Downstream of R-1 (28034)	NQ
		Tritium	pCi/L	505	1	504	4	X	3	13342.57751	19722	ND	314412.3	19722	R-Area Downstream of R-1 (28034)	NQ
		Uranium-234	pCi/L	11	0	11	0	L	6	0.052185862	0.129	0.01	0.202972973	0.129	R-Area Downstream of R-1	NQ
		Uranium-235	pCi/L	8	6	2	0	X	3	0.002564351	0.0169	ND	0.008197254	0.008197254	R-Area Downstream of R-1 (28034)	NQ
		Uranium-238	pCi/L	10	1	9	0	X	4	0.051485426	0.164	ND	0.18117	0.164	R-Area Downstream of R-1 (28034)	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	µg/L	6	5	1	1			0.786466667	NA	ND	2.68	2.68	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	J
	Volatiles	Acetone	µg/L	6	5	1	0			1.983333333	NA	ND	9.63	9.63	LTR ERDMS IOULTR2 Sampling Event: LTROU-01	NQ
		Chloromethane	µg/L	6	5	1	1			0.203666667	NA	ND	0.562	0.562	PA-SW	J
		Toluene	µg/L	6	4	2	2	X	7	0.278333333	0.651	ND	0.725	0.651	PA-SW	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code
(as determined by ProUCL)
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.2.1.1__Statistical Summary Table: EA2 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
2	Inorganics	Thallium	mg/kg	16	14	2	2	X	5	0.10159375	0.205	ND	0.514	0.205	RDC013-004	J
	Metals	Aluminum	mg/kg	16	0	16	0	G	2	8,055	11,190	2,150	21,800	11,190	RDC010-001	NQ
		Antimony	mg/kg	16	10	6	6	X	5	0.081809375	0.124	ND	0.2	0.124	RDC005-001	J
		Arsenic	mg/kg	16	1	15	3	G	2	3.1359375	5.531	ND	11.8	5.531	RDC010-003	NQ
		Barium	mg/kg	16	0	16	0	N	1	11.7025	14.39	2.28	21.1	14.39	RDC010-001	NQ
		Beryllium	mg/kg	16	0	16	12	G	2	0.11666875	0.15	0.0433	0.315	0.15	RDC010-001	NQ
		Cadmium	mg/kg	16	1	15	15	X	3	0.01258125	0.0277	ND	0.0613	0.0277	RDC010-001	J
		Calcium	mg/kg	16	1	15	7	G	2	96.5125	200	ND	518	200	RDC010-001	NQ
		Chromium	mg/kg	16	0	16	0	N	1	11.698125	15.55	2.02	32	15.55	RDC010-001	NQ
		Cobalt	mg/kg	16	0	16	2	G	2	0.6879375	0.911	0.19	1.59	0.911	RDC010-001	NQ
		Copper	mg/kg	16	0	16	2	N	1	4.764	6.255	0.994	13.1	6.255	RDC010-001	NQ
		Iron	mg/kg	16	0	16	0	G	2	12214.375	19,421	1,520	49,000	19421	RDC010-001	NQ
		Lead	mg/kg	16	0	16	0	L	6	5.540625	7.611	1.9	25.8	7.611	RDC010-001	NQ
		Magnesium	mg/kg	16	0	16	6	N	1	109.08125	141.2	31.7	300	141.2	RDC010-001	J
		Manganese	mg/kg	16	0	16	0	N	1	25.97125	33.33	9.34	59.9	33.33	RDC013-003	NQ
		Mercury	mg/kg	16	3	13	13	X	5	0.016853125	0.0214	ND	0.0352	0.0214	RDC005-003	J
		Nickel	mg/kg	16	0	16	0	N	1	2.1174375	2.558	0.789	3.91	2.558	RDC010-001	NQ
		Potassium	mg/kg	16	0	16	1	N	1	81.44375	104.7	29.4	198	104.7	RDC010-001	NQ
		Selenium	mg/kg	16	0	16	9	G	2	0.6498125	0.878	0.246	2.06	0.878	RDC013-004	NQ
		Vanadium	mg/kg	16	0	16	0	N	1	31.661875	43.84	3.75	112	43.84	RDC010-001	NQ
		Zinc	mg/kg	16	0	16	0	G	2	5.38625	7.42	2.29	19.6	7.42	RDC010-001	NQ
	Radionuclides	Actinium-228	pCi/g	44	0	44	4	G	2	1.050454545	1.176	0.36	2.84	1.176	RDC010-001	NQ
		Americium-241	pCi/g	16	10	6	2	X	5	0.03234375	0.0456	ND	0.087	0.0456	RDC013-001	J
		Americium-243	pCi/g	16	12	4	2	X	5	0.04034375	0.0546	ND	0.126	0.0546	RDC013-001	J
		Bismuth-212	pCi/g	44	25	19	5	X	5	0.686136364	0.886	ND	2.7	0.886	RDC010-001	J
		Bismuth-214	pCi/g	44	0	44	3	G	2	0.83	0.912	0.24	1.71	0.912	RDC010-001	NQ
		Carbon-14	pCi/g	8	7	1	1			0.32875	NA	ND	0.7	0.7	RDC010-001	J
		Cesium-137	pCi/g	44	23	21	1	X	3	13.86555682	48.79	ND	180	48.79	RDC007-001	NQ
		Curium-243 and Curium-244	pCi/g	16	14	2	0	X	3	0.030125	0.0408	ND	0.057	0.0408	RDC012-005	NQ
		Curium-245 and Curium-246	pCi/g	16	14	2	2	X	5	0.03825	0.0491	ND	0.076	0.0491	RDC013-001	J
		Gross Alpha	pCi/g	44	0	44	10	N	1	33.86590909	36.65	13.3	57.5	36.65	RDC011-004	NQ
		Lead-212	pCi/g	44	0	44	2	N	1	1.058863636	1.164	0.41	2.59	1.164	RDC010-001	NQ
		Lead-214	pCi/g	44	0	44	4	N	1	0.909545455	1.001	0.44	2.33	1.001	RDC010-001	NQ
		Neptunium-237	pCi/g	16	15	1	0			0.01909375	NA	ND	0.023	0.023	RDC007-001	NQ
		Non-volatile Beta	pCi/g	44	0	44	0	X	3	45.05454545	85.16	11.5	330	85.16	RDC013-001	NQ
		Plutonium-238	pCi/g	16	12	4	1	X	5	0.02640625	0.0327	ND	0.044	0.0327	RDC011-001	NQ
		Plutonium-239 and Plutonium-240	pCi/g	16	11	5	0	X	5	0.030625	0.0438	ND	0.119	0.0438	RDC013-001	NQ
		Potassium-40	pCi/g	44	33	11	3	G	2	0.892045455	1.195	ND	4.6	1.195	RDC006-001	NQ
		Radium-226	pCi/g	16	0	16	1	N	1	0.778125	0.886	0.52	1.5	0.886	RDC010-001	NQ
		Radium-228	pCi/g	8	0	8	1	N	1	1.2075	1.615	0.57	2.27	1.615	RDC010-001	NQ
		Strontium-90	pCi/g	8	7	1	0			0.2625	NA	ND	0.46	0.46	RDC007-001	NQ
		Thallium-208	pCi/g	44	0	44	2	N	1	0.415068182	0.458	0.201	1.02	0.458	RDC010-001	NQ
		Thorium 228	pCi/g	15	0	15	0	N	1	0.926666667	1.043	0.58	1.56	1.043	RDC007 001	NQ
		Thorium-230	pCi/g	15	0	15	0	N	1	0.642	0.723	0.41	1	0.723	RDC011-001	NQ
		Thorium-232	pCi/g	15	0	15	0	N	1	0.91	1.053	0.44	1.64	1.053	RDC007-001	NQ
		Uranium-233 and Uranium-234	pCi/g	16	0	16	0	N	1	0.58175	0.672	0.302	1.17	0.672	RDC010-001	NQ
		Uranium-235	pCi/g	16	8	8	2	X	5	0.028875	0.0385	ND	0.057	0.0385	RDC010-001	J
		Uranium-238	pCi/g	16	0	16	0	N	1	0.5965	0.701	0.301	1.35	0.701	RDC010-001	NQ
	Semivolatiles	Bis[2-chloroethyl] ether	mg/kg	16	15	1	0			0.06784375	NA	ND	0.8	0.8	RDC010-001	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	16	15	1	1			0.02121875	NA	ND	0.044	0.044	RDC008-004	J
	Volatiles	Acetone	mg/kg	16	9	7	1	X	5	0.012659375	0.0205	ND	0.046	0.0205	RDC013-001	NQ
		Toluene	mg/kg	16	15	1	0			0.0121475	NA	ND	0.19	0.19	RDC013-001	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.2.1.2__Statistical Summary Table: Exposure Area 2 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
2	Inorganics	Thallium	mg/kg	24	20	4	4	X	5	0.1219375	0.228	ND	0.845	0.2280	RDC008-005	J
	Metals	Aluminum	mg/kg	24	0	24	0	N	1	7,712.50	9,437	1,420	21,800	9,437.0000	RDC010-001	NQ
		Antimony	mg/kg	24	16	8	8	G	2	0.088789583	0.149	ND	0.439	0.1490	RDC008-004	J
		Arsenic	mg/kg	24	3	21	4	G	2	2.850604167	4.302	ND	11.8	4.3020	RDC010-003	NQ
		Barium	mg/kg	24	0	24	0	N	1	11.16791667	13.16	2.28	21.1	13.1600	RDC010-001	NQ
		Beryllium	mg/kg	24	0	24	18	N	1	0.107408333	0.128	0.0331	0.315	0.1280	RDC010-001	NQ
		Cadmium	mg/kg	24	5	19	19	L	6	0.0104625	0.0131	ND	0.0613	0.0131	RDC010-001	J
		Calcium	mg/kg	24	2	22	14	X	7	75.39791667	106.1	ND	518	106.1000	RDC010-001	NQ
		Chromium	mg/kg	24	0	24	0	N	1	11.28958333	14.2	1.7	32	14.2000	RDC010-001	NQ
		Cobalt	mg/kg	24	0	24	2	G	2	0.63075	0.776	0.19	1.59	0.7760	RDC010-001	NQ
		Copper	mg/kg	24	0	24	4	N	1	4.311666667	5.42	0.49	13.1	5.4200	RDC010-001	NQ
		Iron	mg/kg	24	0	24	0	G	2	11395	16,420	1,020	49,000	16,420.0000	RDC010-001	NQ
		Lead	mg/kg	24	0	24	0	G	2	5.332916667	7.108	1.14	25.8	7.1080	RDC010-001	NQ
		Magnesium	mg/kg	24	0	24	11	N	1	99.26666667	121.5	31.7	300	121.5000	RDC010-001	J
		Manganese	mg/kg	24	0	24	0	G	2	24.11541667	30.32	7.53	59.9	30.3200	RDC013-003	NQ
		Mercury	mg/kg	24	6	18	18	X	5	0.015404167	0.0191	ND	0.0352	0.0191	RDC005-003	J
		Nickel	mg/kg	24	0	24	0	N	1	2.003583333	2.325	0.789	3.91	2.3250	RDC010-001	NQ
		Potassium	mg/kg	24	0	24	3	G	2	72.59166667	90.62	28.5	198	90.6200	RDC010-001	NQ
		Selenium	mg/kg	24	0	24	15	G	2	0.632291667	0.809	0.176	2.06	0.8090	RDC013-004	NQ
		Vanadium	mg/kg	24	0	24	0	N	1	31.24625	40.56	2.36	112	40.5600	RDC010-001	NQ
		Zinc	mg/kg	24	0	24	1	X	3	4.65125	7.896	1.68	19.6	7.8960	RDC010-001	NQ
	Radionuclides	Actinium-228	pCi/g	66	1	65	5	X	5	1.069545455	1.165	ND	2.84	1.1650	RDC010-001	NQ
		Americium-241	pCi/g	17	11	6	2	X	5	0.032852941	0.0451	ND	0.087	0.0451	RDC013-001	J
		Americium-243	pCi/g	17	13	4	2	X	5	0.040117647	0.0537	ND	0.126	0.0537	RDC013-001	J
		Bismuth-212	pCi/g	66	37	29	5	X	5	0.726818182	0.891	ND	2.7	0.8910	RDC010-001	J
		Bismuth-214	pCi/g	66	0	66	3	N	1	0.821666667	0.88	0.24	1.71	0.8800	RDC010-001	NQ
		Carbon-14	pCi/g	8	7	1	1			0.32875	NA	ND	0.7	0.7000	RDC010-001	J
		Cesium-137	pCi/g	66	45	21	1	X	3	9.260689394	33.1	ND	180	33.1000	RDC007-001	NQ
		Curium-243 and Curium-244	pCi/g	17	15	2	0	X	3	0.031588235	0.0408	ND	0.057	0.0408	RDC012-005	NQ
		Curium-245 and Curium-246	pCi/g	17	15	2	2	X	5	0.038176471	0.0483	ND	0.076	0.0483	RDC013-001	J
		Gross Alpha	pCi/g	66	0	66	15	N	1	33.26818182	35.35	13.3	57.5	35.3500	RDC011-004	NQ
		Lead-212	pCi/g	66	0	66	2	N	1	1.072	1.154	0.41	2.59	1.1540	RDC010-001	NQ
		Lead-214	pCi/g	66	0	66	6	G	2	0.9005	0.972	0.21	2.33	0.9720	RDC010-001	NQ
		Neptunium-237	pCi/g	17	16	1	0			0.019352941	NA	ND	0.023	0.0230	RDC007-001	NQ
		Non-volatile Beta	pCi/g	66	0	66	0	X	3	37.6	64.89	11.5	330	64.8900	RDC013-001	NQ
		Plutonium-238	pCi/g	17	13	4	1	X	5	0.026617647	0.0327	ND	0.044	0.0327	RDC011-001	NQ
		Plutonium-239 and Plutonium-240	pCi/g	17	12	5	0	X	5	0.030117647	0.0424	ND	0.119	0.0424	RDC013-001	NQ
		Potassium-40	pCi/g	66	55	11	3	G	2	0.795378788	0.873	ND	4.6	0.8730	RDC006-001	NQ
		Radium-226	pCi/g	17	0	17	1	N	1	0.79	0.893	0.52	1.5	0.8930	RDC010-001	NQ
		Radium-228	pCi/g	8	0	8	1	N	1	1.2075	1.615	0.57	2.27	1.6150	RDC010-001	NQ
		Strontium-90	pCi/g	8	7	1	0			0.2625	NA	ND	0.46	0.4600	RDC007-001	NQ
		Thallium-208	pCi/g	66	0	66	2	G	2	0.410833333	0.443	0.165	1.02	0.4430	RDC010-001	NQ
		Thorium-228	pCi/g	16	0	16	0	N	1	0.968125	1.098	0.58	1.59	1.0980	RDC003-005	NQ
		Thorium-230	pCi/g	16	0	16	0	N	1	0.665625	0.752	0.41	1.02	0.7520	RDC003-005	NQ
		Thorium-232	pCi/g	16	0	16	0	N	1	0.939375	1.082	0.44	1.64	1.0820	RDC007-001	NQ
		Uranium-233 and Uranium-234	pCi/g	17	0	17	0	N	1	0.595176471	0.683	0.302	1.17	0.6830	RDC010-001	NQ
		Uranium-235	pCi/g	17	8	9	2	X	5	0.030470588	0.04	ND	0.057	0.0400	RDC010-001	J
		Uranium-238	pCi/g	17	0	17	0	G	2	0.597294118	0.706	0.301	1.35	0.7060	RDC010-001	NQ
	Semivolatiles	Benzaldehyde	mg/kg	24	23	1	0			0.087916667	NA	ND	0.47	0.4700	RDC010-005	NQ
		Bis[2-chloroethyl] ether	mg/kg	24	23	1	0			0.051375	NA	ND	0.8	0.8000	RDC010-001	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	24	23	1	1			0.020291667	NA	ND	0.044	0.0440	RDC008-004	J
	Volatiles	Acetone	mg/kg	24	16	8	2	X	5	0.009702083	0.0158	ND	0.046	0.0158	RDC013-001	NQ
		Toluene	mg/kg	24	23	1	0			0.008190208	NA	ND	0.19	0.1900	RDC013-001	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.2.2__Statisical Summary Table: Exposure Area 2 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
2	Inorganics	Thallium	µg/L	12	7	5	5	X	5	0.791666667	0.938	ND	1.9	0.938	RDC004-002	J
	Metals	Aluminum	µg/L	12	0	12	2	G	2	164.8	235.7	49.4	454	235.7	LTROU-21	NQ
		Antimony	µg/L	12	11	1	1			0.629166667	NA	ND	1.5	1.5	RDC013-002	J
		Arsenic	µg/L	12	10	2	2	X	5	1.389166667	2.034	ND	2.1	2.034	RDC006-002	J
		Barium	µg/L	12	0	12	0	N	1	24.975	33.52	13.9	72.8	33.52	LTROU-21	NQ
		Calcium	µg/L	12	0	12	0	X	3	8,671.67	22,539	4,090	43,200	22539	LTROU-21	NQ
		Chromium	µg/L	12	10	2	1	X	3	2.140041667	6.048	ND	9.49	6.048	LTROU-14	NQ
		Cobalt	µg/L	12	5	7	7	X	3	0.709791667	1.673	ND	2.2	1.673	LTROU-21	J
		Copper	µg/L	12	2	10	10	X	5	0.759166667	0.755	ND	1.1	0.755	RDC003-002	J
		Iron	µg/L	12	0	12	0	N	1	2,306	3159	573	6,890	3159	RDC012-002	NQ
		Magnesium	µg/L	12	0	12	0	N	1	1007.333333	1403	690	3410	1403	LTROU-21	NQ
		Manganese	µg/L	12	0	12	0	N	1	340.55	466.8	19.2	910	466.8	RDC012-002	NQ
		Mercury	µg/L	12	11	1	0			0.079208333	NA	ND	0.449	0.449	LTROU-14	NQ
		Nickel	µg/L	12	10	2	2	X	5	0.353583333	0.619	ND	0.85	0.619	RDC012-002	J
		Potassium	µg/L	12	0	12	0	L	6	1189.333333	1871	355	5230	1871	LTROU-21	NQ
		Sodium	µg/L	12	0	12	0	X	3	2149.833333	4256	822	6300	4256	LTROU-21	NQ
		Vanadium	µg/L	12	10	2	2	X	5	0.861666667	1.242	ND	1.21	1.21	LTROU-14	J
		Zinc	µg/L	12	0	12	8	L	6	11.65083333	20.81	1.7	68.8	20.81	LTROU-21	NQ
	Radionuclides	Bismuth-214	pCi/L	13	12	1	0			15.37961538	NA	ND	48	48	RDC009-002	NQ
		Gross Alpha	pCi/L	2	1	1	1			1.6675	NA	ND	2.76	2.76	LTROU-21	J
		Non-volatile Beta	pCi/L	2	1	1	0			16.12	NA	ND	31.6	31.6	LTROU-21	NQ
		Tritium	pCi/L	12	1	11	1	X	5	642.0416667	722.5	ND	866	722.5	LTROU-14	J
	Semivolatiles	2-Methylnaphthalene	µg/L	12	11	1	1			0.446958333	NA	ND	0.291	0.291	LTROU-14	J
		Acenaphthene	µg/L	12	11	1	1			0.4524	NA	ND	0.395	0.395	LTROU-14	J
		Acenaphthylene	µg/L	12	11	1	1			0.448191667	NA	ND	0.33	0.33	LTROU-14	J
		Anthracene	µg/L	12	11	1	1			0.455666667	NA	ND	0.405	0.405	LTROU-14	J
		Bis[2-ethylhexyl]phthalate	µg/L	12	11	1	0			1.711529167	NA	ND	16	16	RDC010-002	NQ
		Fluoranthene	µg/L	12	11	1	1			0.449416667	NA	ND	0.335	0.335	LTROU-14	J
		Pyrene	µg/L	12	11	1	1			0.447458333	NA	ND	0.302	0.302	LTROU-14	J
	Semivolatiles/Volatiles	Naphthalene	µg/L	12	11	1	1			0.452166667	NA	ND	0.368	0.368	LTROU-14	J
	Volatiles	Acetone	µg/L	12	3	9	1	X	5	3.089166667	4.321	ND	6.8	4.321	RDC007-002	NQ
		Styrene	µg/L	12	11	1	1			0.091666667	NA	ND	0.32	0.32	RDC008-002	J
		Toluene	µg/L	12	3	9	3	X	5	0.6775	1.052	ND	2.2	1.052	RDC012-002	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL)**:**
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.3.1.1__Statistical Summary Table: EA3 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
3	Inorganics	Thallium	mg/kg	6	5	1	1			0.834083333	NA	ND	0.944	0.944	PBT3-5	J
	Metals	Aluminum	mg/kg	6	0	6	1	G	2	9,731.67	36,109	2,500	31700	31700	LTROU-15	J
		Arsenic	mg/kg	6	1	5	4	X	5	2.60325	4.1	ND	5.3	4.1	PBT3-2	J
		Barium	mg/kg	6	0	6	0	G	2	17.83166667	81.47	2.9	64.7	64.7	LTROU-15	NQ
		Beryllium	mg/kg	6	0	6	6	N	1	0.383166667	0.567	0.145	0.796	0.567	LTROU-15	J
		Cadmium	mg/kg	6	5	1	1			0.15325		ND	0.605	0.605	LTROU-15	J
		Calcium	mg/kg	6	0	6	5	X	4	102.3	8374	19.1	486	486	LTROU-15	NQ
		Chromium	mg/kg	6	0	6	0	G	2	16.23666667	88.13	1.88	61.4	61.4	LTROU-15	NQ
		Cobalt	mg/kg	6	2	4	2	G	2	1.269416667	14.97	ND	5.63	5.63	LTROU-15	NQ
		Copper	mg/kg	6	0	6	2	N	1	7.566333333	13.59	0.918	20.9	13.59	LTROU-15	NQ
		Iron	mg/kg	6	0	6	0	N	1	16,113.33	25,870	1350	32600	25870	PBT3-2	NQ
		Lead	mg/kg	6	0	6	0	N	1	10.485	16.86	2.2	23.3	16.86	LTROU-15	NQ
		Magnesium	mg/kg	6	0	6	3	X	4	156.55	2,462	21.2	744	744	LTROU-15	NQ
		Manganese	mg/kg	6	0	6	0	X	4	43.98166667	529.1	9.59	176	176	LTROU-15	NQ
		Mercury	mg/kg	6	2	4	4	X	3	0.017880833	0.069	ND	0.0731	0.069	LTROU-15	J
		Nickel	mg/kg	6	0	6	1	L	6	3.041833333	17.33	0.791	11.9	11.9	LTROU-15	NQ
		Potassium	mg/kg	6	0	6	2	X	4	119.7666667	4.396	26.2	552	552	LTROU-15	NQ
		Selenium	mg/kg	6	4	2	2	X	5	0.527	0.99	ND	1.23	0.99	PBT3-2	J
		Sodium	mg/kg	6	4	2	1	X	3	14.5	63.83	ND	58.5	58.5	LTROU-15	NQ
		Vanadium	mg/kg	6	0	6	0	N	1	34.42	53.96	3.46	57.8	53.96	LTROU-15	NQ
		Zinc	mg/kg	6	0	6	5	X	4	12.03166667	166.4	1.8	56.6	56.6	LTROU-15	NQ
	Pesticides/PCBs	DDE	mg/kg	6	5	1	1			0.000729083	NA	ND	0.00328	0.00328	LTROU-15	J
	Radionuclides	Actinium-228	pCi/g	16	0	16	0	N	1	1.373	1.576	0.687	2.55	1.576	PBT1-2	NQ
		Bismuth-214	pCi/g	16	0	16	0	N	1	0.88375	1.012	0.431	1.57	1.012	LTROU-15	NQ
		Cesium-137	pCi/g	44	0	44	0	G	2	63.93159918	98.3	0.0929	456.762508	98.3	xy spatial grouping at 0 to 1 foot	NQ
		Gross Alpha	pCi/g	16	0	16	1	N	1	12.8525	14.75	5.71	21.3	14.75	PBT1-2	NQ
		Lead-212	pCi/g	16	0	16	0	N	1	1.3164375	1.496	0.634	2.24	1.496	PBT1-2	NQ
		Lead-214	pCi/g	16	0	16	0	N	1	1.0281875	1.16	0.66	1.79	1.16	LTROU-15	NQ
		Non-volatile Beta	pCi/g	16	0	16	4	N	1	12.863125	16.56	5.38	34.3	16.56	PBT3-5	NQ
		Potassium-40	pCi/g	14	3	11	4	X	5	1.531178571	2.062	ND	3.04	2.062	PBT3-5	NQ
		Radium-226	pCi/g	1	0	1	0			1.33	NA	1.33	1.33	1.33	PBT1-2	NQ
		Thallium-208	pCi/g	16	0	16	0	N	1	0.4085	0.466	0.229	0.689	0.466	PBT1-2	NQ
		Thorium-228	pCi/g	1	0	1	0			3.13	NA	3.13	3.13	3.13	PBT1-2	NQ
		Thorium-230	pCi/g	1	0	1	0			1.35	NA	1.35	1.35	1.35	PBT1-2	NQ
		Thorium-232	pCi/g	1	0	1	0			2.45	NA	2.45	2.45	2.45	PBT1-2	NQ
		Uranium-233 and Uranium-234	pCi/g	1	0	1	0			1.88	NA	1.88	1.88	1.88	PBT1-2	NQ
		Uranium-238	pCi/g	1	0	1	0			1.68	NA	1.68	1.68	1.68	PBT1-2	NQ
	Volatiles	Acetone	mg/kg	6	1	5	2			0.081374167		ND	0.407	0.407	LTROU-15	J
		Carbon disulfide	mg/kg	6	4	2	2	X	3	0.00281	0.0122	ND	0.0111	0.0111	LTROU-15	J
		Methyl ethyl ketone	mg/kg	6	3	3	3	X	5	0.011289167	0.0336	ND	0.0604	0.0336	LTROU-15	J
		Toluene	mg/kg	6	3	3	3	X	5	0.000822583	0.00185	ND	0.00293	0.00185	LTROU-15	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.3.1.2__Statistical Summary Table: Exposure Area 3 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
3	Inorganics	Thallium	mg/kg	10	9	1	1			0.6157	NA	ND	0.944	0.944	PBT3-5	J
	Metals	Aluminum	mg/kg	10	0	10	1	L	6	7,353	13,235	2,500	31,700	13235	LTROU-15	J
		Arsenic	mg/kg	10	1	9	8	X	5	2.11915	3.037	ND	5.3	3.037	PBT3-2	J
		Barium	mg/kg	10	0	10	0	G	2	13.864	29.76	2.61	64.7	29.76	LTROU-15	NQ
		Beryllium	mg/kg	10	0	10	10	N	1	0.3055	0.419	0.145	0.796	0.419	LTROU-15	J
		Cadmium	mg/kg	10	9	1	1			0.11505		ND	0.605	0.605	LTROU-15	J
		Calcium	mg/kg	10	0	10	9	X	3	68.64	270.9	11.4	486	270.9	LTROU-15	NQ
		Chromium	mg/kg	10	0	10	0	G	2	11.78	27.22	1.88	61.4	27.22	LTROU-15	NQ
		Cobalt	mg/kg	10	4	6	3	X	3	0.8844	3.312	ND	5.63	3.312	LTROU-15	NQ
		Copper	mg/kg	10	0	10	4	N	1	5.6281	9.169	0.918	20.9	9.169	LTROU-15	NQ
		Iron	mg/kg	10	0	10	0	N	1	12,507	18,595	1,350	32,600	18595	PBT3-2	NQ
		Lead	mg/kg	10	0	10	0	N	1	8.209	12.13	1.58	23.3	12.13	LTROU-15	NQ
		Magnesium	mg/kg	10	0	10	5	X	3	110.09	417.7	19.5	744	417.7	LTROU-15	NQ
		Manganese	mg/kg	10	0	10	0	X	3	30.18	101.2	6.61	176	101.2	LTROU-15	NQ
		Mercury	mg/kg	10	4	6	6	X	3	0.0124475	0.0436	ND	0.0731	0.0436	LTROU-15	J
		Nickel	mg/kg	10	0	10	1	X	3	2.2218	6.931	0.787	11.9	6.931	LTROU-15	NQ
		Potassium	mg/kg	10	0	10	4	X	3	83.41	310.7	16.7	552	310.7	LTROU-15	NQ
		Selenium	mg/kg	10	8	2	2	X	5	0.43145	0.796	ND	1.23	0.796	PBT3-2	J
		Sodium	mg/kg	10	8	2	1	X	3	10.3135	42.61	ND	58.5	42.61	LTROU-15	NQ
		Vanadium	mg/kg	10	0	10	0	N	1	27.994	39.84	3.46	57.8	39.84	LTROU-15	NQ
		Zinc	mg/kg	10	0	10	9	X	3	8.11	31.64	1.79	56.6	31.64	LTROU-15	NQ
	Pesticides/PCBs	DDD	mg/kg	10	9	1	1			0.0003086	NA	ND	0.00078	0.00078	PBT3-2	J
		DDE	mg/kg	10	8	2	2	X	3	0.0005854	0.00241	ND	0.00328	0.00241	LTROU-15	J
	Radionuclides	Actinium-228	pCi/g	28	0	28	0	N	1	1.506	1.707	0.687	3.89	1.707	PBT2-3	NQ
		Americium-243	pCi/g	4	3	1	1			0.1095	NA	ND	0.254	0.254	PBT2-3	J
		Bismuth-214	pCi/g	28	0	28	0	G	2	0.921535714	1.041	0.431	2.02	1.041	PBT2-3	NQ
		Cesium-137	pCi/g	45	0	45	0	G	2	62.40781403	98.38	0.05129	456.7625081	98.38	xy spatial grouping at 0 to 4 foot	NQ
		Gross Alpha	pCi/g	28	0	28	4	N	1	13.52107143	15.17	4.39	25.3	15.17	PBT3-1	NQ
		Lead-212	pCi/g	28	0	28	0	G	2	1.455464286	1.657	0.634	3.88	1.657	PBT2-3	NQ
		Lead-214	pCi/g	28	0	28	0	G	2	1.086928571	1.21	0.66	2.48	1.21	PBT2-3	NQ
		Non-volatile Beta	pCi/g	28	0	28	8	N	1	11.74785714	14.05	3.91	34.3	14.05	PBT3-5	NQ
		Potassium-40	pCi/g	26	3	23	8	X	5	1.551403846	1.842	ND	3.04	1.842	PBT3-5	NQ
		Radium-226	pCi/g	4	0	4	0	N	1	1.36025	1.943	0.821	2.02	1.943	PBT2-3	NQ
		Thallium-208	pCi/g	28	0	28	0	N	1	0.449678571	0.507	0.229	1.15	0.507	PBT2-3	NQ
		Thorium-228	pCi/g	4	0	4	0	N	1	2.6375	3.511	1.67	3.3	3.3	PBT2-3	NQ
		Thorium-230	pCi/g	4	0	4	0	N	1	1.161	1.43	0.834	1.35	1.35	PBT1-2	NQ
		Thorium-232	pCi/g	4	0	4	0	N	1	2.28	3.345	1.39	3.47	3.345	PBT2-3	NQ
		Uranium-233 and Uranium-234	pCi/g	4	0	4	1	N	1	1.32525	2.008	0.521	1.88	1.88	PBT1-2	NQ
		Uranium-235	pCi/g	4	3	1	1			0.133875	NA	ND	0.338	0.338	PBT3-1	J
		Uranium-238	pCi/g	4	0	4	1	N	1	1.22125	1.901	0.375	1.68	1.68	PBT1-2	NQ
	Volatiles	Acetone	mg/kg	10	3	7	4	X	3	0.056664	0.232	ND	0.407	0.232	LTROU-15	J
		Carbon disulfide	mg/kg	10	8	2	2	X	3	0.001988	0.00812	ND	0.0111	0.00812	LTROU-15	J
		Methyl ethyl ketone	mg/kg	10	5	5	5	X	3	0.007529	0.0349	ND	0.0604	0.0349	LTROU-15	J
		Toluene	mg/kg	10	5	5	5	X	5	0.00074775	0.00136	ND	0.00293	0.00136	LTROU-15	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.3.2__Statisical Summary Table: Exposure Area 3 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
3	Metals	Aluminum	µg/L	3	2	1	1			33.51666667	NA	ND	49.4	49.4	LTROU-14	J
		Barium	µg/L	3	0	3	0	N	1	16.47	32.58	7.61	26.6	26.6	LTROU-15	NQ
		Calcium	µg/L	3	0	3	0	N	1	5,761.67	14,143	975	10,900	10900	LTROU-14	NQ
		Chromium	µg/L	3	2	1	0			3.460166667	NA	ND	9.49	9.49	LTROU-14	NQ
		Iron	µg/L	3	0	3	0	N	1	711.6666667	1,056	509	917	917	PB-SW	NQ
		Lead	µg/L	3	2	1	1			2.37	NA	ND	3.67	3.67	PB-SW	J
		Magnesium	µg/L	3	0	3	0	N	1	778	1,391	389	1,110	1110	LTROU-15	NQ
		Manganese	µg/L	3	0	3	0	N	1	31.1	49.27	19.2	40.2	40.2	PB-SW	NQ
		Mercury	µg/L	3	2	1	0			0.172833333	NA	ND	0.449	0.449	LTROU-14	NQ
		Nickel	µg/L	3	2	1	1			0.6905	NA	ND	0.95	0.95	LTROU-15	J
		Potassium	µg/L	3	0	3	1	N	1	303.3333333	597.9	118	465	465	LTROU-14	NQ
		Sodium	µg/L	3	0	3	0	N	1	4,296.67	8,133	1,780	6,210	6210	LTROU-15	NQ
		Vanadium	µg/L	3	2	1	1			0.751666667	NA	ND	1.21	1.21	LTROU-14	J
		Zinc	µg/L	3	1	2	0	X	7	4.613333333	12.28	ND	6.71	6.71	LTROU-14	NQ
	Radionuclides	Cesium-137	pCi/L	5	3	2	2			4.077	NA	ND	8.3	8.3	PB-SW	J
		Tritium	pCi/L	3	0	3	3	N	1	722.6666667	954.4	592	866	866	LTROU-14	J
	Semivolatiles	2-Methylnaphthalene	µg/L	3	2	1	1			0.170833333	NA	ND	0.291	0.291	LTROU-14	J
		Acenaphthene	µg/L	3	2	1	1			0.19445	NA	ND	0.395	0.395	LTROU-14	J
		Acenaphthylene	µg/L	3	2	1	1			0.1592	NA	ND	0.33	0.33	LTROU-14	J
		Anthracene	µg/L	3	2	1	1			0.189	NA	ND	0.405	0.405	LTROU-14	J
		Bis[2-ethylhexyl]phthalate	µg/L	3	2	1	1			0.44835	NA	ND	0.326	0.326	LTROU-15	J
		Fluoranthene	µg/L	3	2	1	1			0.164	NA	ND	0.335	0.335	LTROU-14	J
		Pyrene	µg/L	3	2	1	1			0.172833333	NA	ND	0.302	0.302	LTROU-14	J
	Semivolatiles/Volatiles	Naphthalene	µg/L	3	2	1	1			0.191666667	NA	ND	0.368	0.368	LTROU-14	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.3.3__Statistical Summary Table: Exposure Area 3 / Fish Media

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
3	Metals	Aluminum	mg/kg	2	1	1	1			9.8125	NA	ND	16.5	16.5	LTR-PB	J
		Barium	mg/kg	2	0	2	1			4.1235	NA	0.18	8.07	8.07	LTR-PB	NQ
		Calcium	mg/kg	2	0	2	0			13,660	NA	5620.00	21,700	21700	LTR-PB	NQ
		Chromium	mg/kg	2	1	1	1			0.2195	NA	ND	0.37	0.37	LTR-PB	J
		Copper	mg/kg	2	1	1	1			0.2375	NA	ND	0.337	0.337	LTR-PB	J
		Iron	mg/kg	2	0	2	1			28.7	NA	12.00	45.4	45.4	LTR-PB	NQ
		Magnesium	mg/kg	2	0	2	0			440	NA	307.00	573	573	LTR-PB	NQ
		Manganese	mg/kg	2	0	2	1			15.8105	NA	0.32	31.3	31.3	LTR-PB	NQ
		Mercury	mg/kg	81	4	77	1	X	5	0.64313183	0.734	ND	1.83	0.734	Pond B 32081	NQ
		Potassium	mg/kg	2	0	2	1			2,700	NA	2630.00	2,770	2770	LTR-PB	J
		Sodium	mg/kg	2	0	2	0			1,112.50	NA	885.00	1,340	1340	LTR-PB	NQ
		Zinc	mg/kg	2	0	2	0			19.05	NA	13.70	24.4	24.4	LTR-PB	NQ
	Radionuclides	Cesium-137	pCi/g	54	0	54	0	X	3	60.34719644	79.2	9.35	112.98663	79.2	Pond B 28054	NQ
		Cobalt-60	pCi/g	41	35	6	0	X	5	1.004146256	0.00686	ND	0.0405	0.00686	Pond B (28054)	NQ
		Gross Alpha	pCi/g	58	39	19	0	X	5	0.308260604	0.347	ND	2.5351326	0.347	Pond B 28054	NQ
		Non-volatile Beta	pCi/g	57	0	57	0	G	2	32.38160691	38.86	1.98	112.672	38.86	Pond B 28054	NQ
		Plutonium-238	pCi/g	1	0	1	0			0.000050848	NA	0.00	0.000050848	0.000050848	Pond B 28054	NQ
		Potassium-40	pCi/g	48	0	48	0	N	1	2.951365463	3.068	2.03	3.888	3.068	Pond B 28054	NQ
		Strontium-89 and Strontium-90	pCi/g	1	0	1	0			0.093856003	NA	0.09	0.093856003	0.093856003	Pond B 28054	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.4.1.1__Statistical Summary Table: EA4 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
4	Metals	Aluminum	mg/kg	12	0	12	6	N	1	5,441.67	6,592	2,100	9,490	6592	RDC015-005	NQ
		Arsenic	mg/kg	12	1	11	4	X	5	1.261791667	1.65	ND	2.8	1.65	RDC018-003	NQ
		Barium	mg/kg	12	0	12	0	G	2	12.39166667	19.77	2.97	30.1	19.77	RDC015-003	NQ
		Beryllium	mg/kg	12	0	12	9	N	1	0.088125	0.107	0.0454	0.176	0.107	RDC021-001	NQ
		Cadmium	mg/kg	12	1	11	11	X	5	0.009020833	0.0105	ND	0.0133	0.0105	RDC021-001	J
		Calcium	mg/kg	12	0	12	7	N	1	65.35833333	83.14	21.7	128	83.14	RDC015-004	NQ
		Chromium	mg/kg	12	0	12	0	N	1	7.749166667	9.628	2.77	13	9.628	RDC015-005	NQ
		Cobalt	mg/kg	12	0	12	0	N	1	0.5145	0.602	0.309	0.81	0.602	RDC018-001	NQ
		Copper	mg/kg	12	0	12	1	N	1	2.303333333	2.756	0.82	3.96	2.756	RDC015-005	NQ
		Iron	mg/kg	12	0	12	0	G	2	6,243.33	9,666	1,890	13,900	9666	RDC018-003	NQ
		Lead	mg/kg	12	0	12	0	N	1	3.865833333	4.877	1.75	8.84	4.877	RDC021-001	NQ
		Magnesium	mg/kg	12	0	12	5	N	1	71.05833333	85.58	37.2	118	85.58	RDC015-005	NQ
		Manganese	mg/kg	12	0	12	0	G	2	32.5425	58.25	7.98	104	58.25	RDC018-005	NQ
		Mercury	mg/kg	12	9	3	3	X	5	0.006291667	0.0109	ND	0.0196	0.0109	RDC015-003	J
		Nickel	mg/kg	12	0	12	1	G	2	1.346916667	1.758	0.726	2.84	1.758	RDC015-003	NQ
		Potassium	mg/kg	12	0	12	0	N	1	55.325	66.48	37.1	109	66.48	RDC015-005	NQ
		Selenium	mg/kg	12	1	11	9	X	5	0.3635	0.463	ND	0.725	0.463	RDC018-005	NQ
		Vanadium	mg/kg	12	0	12	0	N	1	24.13166667	31.03	6.08	51.1	31.03	RDC021-001	NQ
		Zinc	mg/kg	12	0	12	0	N	1	3.711666667	4.166	2.52	5.46	4.166	RDC021-003	NQ
	Pesticides/PCBs	DDT	mg/kg	12	11	1	0			0.00068125	NA	ND	0.0049	0.0049	RDC018-003	NQ
	Radionuclides	Actinium-228	pCi/g	36	2	34	2	X	5	1.093888889	1.222	ND	1.93	1.222	RDC021-001	NQ
		Americium-241	pCi/g	13	11	2	1	X	5	0.021461538	0.0288	ND	0.032	0.0288	RDC018-001	J
		Americium-243	pCi/g	13	12	1	1			0.030423077	NA	ND	0.067	0.067	RDC022-005	J
		Bismuth-212	pCi/g	36	20	16	7	X	5	0.703472222	0.9	ND	1.98	0.9	RDC016-001	NQ
		Bismuth-214	pCi/g	36	0	36	1	N	1	0.896944444	0.966	0.5	1.61	0.966	RDC022-001	NQ
		Carbon-14	pCi/g	7	5	2	1	X	5	0.370714286	0.589	ND	0.63	0.589	RDC015-001	J
		Cesium-137	pCi/g	36	12	24	5	X	3	5.766694444	18.33	ND	50	18.33	RDC015-001	NQ
		Curium-243 and Curium-244	pCi/g	13	12	1	1			0.030961538	NA	ND	0.04	0.04	RDC016-001	J
		Gross Alpha	pCi/g	36	0	36	14	G	2	39.4	42.63	21.5	71.2	42.63	RDC022-004	NQ
		Lead-212	pCi/g	36	0	36	1	N	1	1.089444444	1.172	0.51	1.66	1.172	RDC021-001	NQ
		Lead-214	pCi/g	36	0	36	17	N	1	0.979722222	1.058	0.6	1.8	1.058	RDC022-001	NQ
		Non-volatile Beta	pCi/g	36	0	36	6	X	3	35.84166667	53.45	15.8	111	53.45	RDC020-001	NQ
		Plutonium-238	pCi/g	13	11	2	1	X	3	0.030269231	0.0694	ND	0.108	0.0694	RDC016-003	J
		Plutonium-239 and Plutonium-24	pCi/g	13	11	2	0	X	3	0.019346154	0.0305	ND	0.026	0.026	RDC014-001	NQ
		Potassium-40	pCi/g	36	24	12	8	G	2	0.907222222	1.179	ND	2.83	1.179	RDC015-003	NQ
		Radium-226	pCi/g	13	0	13	4	N	1	0.821538462	0.95	0.47	1.44	0.95	RDC022-001	NQ
		Radium-228	pCi/g	7	0	7	2	N	1	1.101428571	1.323	0.65	1.48	1.323	RDC021-001	NQ
		Thallium-208	pCi/g	36	1	35	0	X	5	0.412222222	0.447	ND	0.73	0.447	RDC016-001	NQ
		Thorium-228	pCi/g	13	0	13	0	N	1	0.921538462	1.111	0.38	1.68	1.111	RDC016-001	NQ
		Thorium-230	pCi/g	13	0	13	0	N	1	0.693384615	0.826	0.254	1.11	0.826	RDC022-003	NQ
		Thorium-232	pCi/g	13	0	13	0	N	1	0.942153846	1.09	0.338	1.42	1.09	RDC021-001	NQ
		Uranium-233 and Uranium-234	pCi/g	13	0	13	0	N	1	0.608153846	0.711	0.268	0.88	0.711	RDC022-001	NQ
		Uranium-235	pCi/g	13	12	1	1			0.022576923	NA	ND	0.035	0.035	RDC022-005	J
		Uranium-238	pCi/g	13	0	13	0	N	1	0.628076923	0.735	0.259	0.95	0.735	RDC022-001	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	12	11	1	1			0.021791667	NA	ND	0.052	0.052	RDC018-001	J
		Chrysene	mg/kg	12	11	1	1			0.021416667	NA	ND	0.042	0.042	RDC015-003	J
	Volatiles	Acetone	mg/kg	12	10	2	1	X	3	0.0052125	0.0159	ND	0.023	0.0159	RDC018-004	NQ
		Carbon disulfide	mg/kg	12	11	1	1			0.000484583	NA	ND	0.0024	0.0024	RDC021-001	J
		Chloroform	mg/kg	12	11	1	1			0.00036	NA	ND	0.0011	0.0011	RDC018-004	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.4.1.2__Statistical Summary Table: Exposure Area 4 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
4	Metals	Aluminum	mg/kg	18	0	18	9	N	1	5,771.67	6,806	2,100	10,500	6806	RDC015-004	NQ
		Arsenic	mg/kg	18	1	17	7	X	5	1.308527778	1.623	ND	2.8	1.623	RDC018-003	NQ
		Barium	mg/kg	18	0	18	0	G	2	14.91777778	21.21	2.97	46.5	21.21	RDC015-004	NQ
		Beryllium	mg/kg	18	0	18	14	N	1	0.087822222	0.104	0.0453	0.176	0.104	RDC021-001	NQ
		Cadmium	mg/kg	18	3	15	15	X	5	0.008219444	0.0098	ND	0.0133	0.0098	RDC021-001	J
		Calcium	mg/kg	18	0	18	11	G	2	66.75	91.36	21.7	188	91.36	RDC015-004	NQ
		Chromium	mg/kg	18	0	18	0	N	1	8.309444444	9.982	2.77	17.1	9.982	RDC021-004	NQ
		Cobalt	mg/kg	18	0	18	0	N	1	0.542833333	0.625	0.309	1.05	0.625	RDC015-004	NQ
		Copper	mg/kg	18	0	18	2	N	1	2.356166667	2.776	0.741	4.19	2.776	RDC015-004	NQ
		Iron	mg/kg	18	0	18	0	G	2	6,331.67	8,665	1,890	15,800	8665	RDC021-004	NQ
		Lead	mg/kg	18	0	18	0	N	1	3.654444444	4.413	1.3	8.84	4.413	RDC021-001	NQ
		Magnesium	mg/kg	18	0	18	7	N	1	79.62777778	95.45	37.2	184	95.45	RDC015-004	NQ
		Manganese	mg/kg	18	0	18	0	G	2	40.28222222	67.63	3.16	203	67.63	RDC015-004	NQ
		Mercury	mg/kg	18	14	4	4	X	5	0.006955556	0.0123	ND	0.0317	0.0123	RDC015-004	J
		Nickel	mg/kg	18	0	18	1	G	2	1.491944444	1.829	0.726	2.99	1.829	RDC015-004	NQ
		Potassium	mg/kg	18	0	18	0	N	1	58.7	69.12	29.8	118	69.12	RDC015-004	NQ
		Selenium	mg/kg	18	1	17	13	X	5	0.401611111	0.504	ND	1.06	0.504	RDC015-004	NQ
		Vanadium	mg/kg	18	0	18	0	N	1	23.09166667	28.35	6.08	51.1	28.35	RDC021-001	NQ
		Zinc	mg/kg	18	0	18	0	N	1	3.625555556	3.968	2.52	5.46	3.968	RDC021-003	NQ
	Pesticides/PCBs	DDT	mg/kg	18	17	1	0			0.000489167	NA	ND	0.0049	0.0049	RDC018-003	NQ
	Radionuclides	Actinium-228	pCi/g	54	2	52	3	G	2	1.100185185	1.201	ND	1.93	1.201	RDC021-001	NQ
		Americium-241	pCi/g	15	13	2	1	X	5	0.022366667	0.0287	ND	0.032	0.0287	RDC018-001	J
		Americium-243	pCi/g	15	14	1	1			0.031333333	NA	ND	0.067	0.067	RDC022-005	J
		Bismuth-212	pCi/g	54	29	25	11	X	5	0.739537037	0.901	ND	1.98	0.901	RDC016-001	NQ
		Bismuth-214	pCi/g	54	0	54	1	N	1	0.896666667	0.953	0.5	1.61	0.953	RDC022-001	NQ
		Carbon-14	pCi/g	7	5	2	1	X	5	0.370714286	0.598	ND	0.63	0.598	RDC015-001	J
		Cesium-137	pCi/g	54	30	24	5	X	3	3.861851852	9.934	ND	50	9.934	RDC015-001	NQ
		Curium-243 and Curium-244	pCi/g	15	14	1	1			0.0316	NA	ND	0.04	0.04	RDC016-001	J
		Gross Alpha	pCi/g	54	0	54	22	N	1	38.11481481	40.47	21.5	71.2	40.47	RDC022-004	NQ
		Lead-212	pCi/g	54	0	54	1	N	1	1.099814815	1.167	0.49	1.66	1.167	RDC021-001	NQ
		Lead-214	pCi/g	54	0	54	24	N	1	0.958888889	1.022	0.55	1.8	1.022	RDC022-001	NQ
		Non-volatile Beta	pCi/g	54	0	54	9	N	1	31.78888889	36.51	14.6	111	36.51	RDC020-001	NQ
		Plutonium-238	pCi/g	15	13	2	1	X	3	0.031133333	0.0638	ND	0.108	0.0638	RDC016-003	J
		Plutonium-239 and Plutonium-240	pCi/g	15	13	2	0	X	3	0.0197	0.0305	ND	0.026	0.026	RDC014-001	NQ
		Potassium-40	pCi/g	54	41	13	8	X	5	0.82	1.015	ND	2.83	1.015	RDC015-003	NQ
		Radium-226	pCi/g	15	0	15	6	N	1	0.816666667	0.926	0.47	1.44	0.926	RDC022-001	NQ
		Radium-228	pCi/g	7	0	7	2	N	1	1.101428571	1.323	0.65	1.48	1.323	RDC021-001	NQ
		Thallium-208	pCi/g	54	1	53	0	X	5	0.418722222	0.448	ND	0.73	0.448	RDC016-001	NQ
		Thorium-228	pCi/g	15	0	15	0	G	2	0.904	1.108	0.38	1.68	1.108	RDC016-001	NQ
		Thorium-230	pCi/g	15	0	15	0	N	1	0.706933333	0.822	0.254	1.11	0.822	RDC022-003	NQ
		Thorium-232	pCi/g	15	0	15	0	N	1	0.928533333	1.058	0.338	1.42	1.058	RDC021-001	NQ
		Uranium-233 and Uranium-234	pCi/g	15	0	15	0	N	1	0.637733333	0.732	0.268	0.88	0.732	RDC022-001	NQ
		Uranium-235	pCi/g	15	13	2	2	X	5	0.0237	0.0359	ND	0.049	0.0359	RDC022-005	J
		Uranium-238	pCi/g	15	0	15	0	N	1	0.647666667	0.743	0.259	0.95	0.743	RDC022-001	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	18	17	1	1			0.020555556	NA	ND	0.052	0.052	RDC018-001	J
		Chrysene	mg/kg	18	17	1	1			0.020305556	NA	ND	0.042	0.042	RDC015-003	J
	Volatiles	Acetone	mg/kg	18	15	3	2	X	5	0.004941667	0.00903	ND	0.023	0.00903	RDC018-004	NQ
		Carbon disulfide	mg/kg	18	17	1	1			0.000421389	NA	ND	0.0024	0.0024	RDC021-001	J
		Chloroform	mg/kg	18	17	1	1			0.000330278	NA	ND	0.0011	0.0011	RDC018-004	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.4.2__Statisical Summary Table: Exposure Area 4 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
4	Inorganics	Thallium	µg/L	10	5	5	4	X	5	0.8485	1.219	ND	2	1.219	RDC014-002	NQ
	Metals	Aluminum	µg/L	10	0	10	1	G	2	97.24	182.7	24.5	364	182.7	RDC020-002	NQ
		Antimony	µg/L	10	9	1	1			0.443	NA	ND	0.53	0.53	RDC019-002	J
		Barium	µg/L	10	0	10	0	N	1	10.79	14.84	6.8	26.9	14.84	LTROU-22	NQ
		Beryllium	µg/L	10	9	1	1			0.05735	NA	ND	0.12	0.12	RDC020-002	J
		Cadmium	µg/L	10	8	2	2	X	5	0.0478	0.0702	ND	0.09	0.0702	RDC020-002	J
		Calcium	µg/L	10	0	10	0	X	3	1,477.40	3,255	900	5,100	3255	LTROU-22	NQ
		Chromium	µg/L	10	8	2	2			1.73905	NA	ND	3.6	3.6	RDC018-002	J
		Cobalt	µg/L	10	9	1	1			0.23375	NA	ND	0.95	0.95	RDC020-002	J
		Copper	µg/L	10	6	4	3	X	3	0.446	1.063	ND	1.5	1.063	RDC020-002	NQ
		Iron	µg/L	10	0	10	0	X	3	1,275.60	3,233	458	5,260	3233	RDC020-002	NQ
		Lead	µg/L	10	9	1	1			0.449	NA	ND	0.81	0.81	RDC020-002	J
		Magnesium	µg/L	10	0	10	0	N	1	523.1	602.1	415	793	602.1	RDC020-002	NQ
		Manganese	µg/L	10	0	10	0	X	3	59	164.9	12.4	237	164.9	RDC020-002	NQ
		Mercury	µg/L	10	9	1	1			0.05055	NA	ND	0.097	0.097	RDC022-002	J
		Potassium	µg/L	10	0	10	0	X	3	500.7	1,571	173	2,650	1571	RDC020-002	NQ
		Sodium	µg/L	10	0	10	0	N	1	1,889	2,080	1,700	2,760	2080	LTROU-22	NQ
		Vanadium	µg/L	10	9	1	1			0.829	NA	ND	1.09	1.09	LTROU-22	J
		Zinc	µg/L	10	4	6	5	G	2	2.9805	6.815	ND	11.1	6.815	RDC020-002	NQ
	Radionuclides	Non-volatile Beta	pCi/L	2	0	2	2			2.09	NA	1.91	2.27	2.27	LTROU-22	J
		Tritium	pCi/L	10	1	9	0	X	5	471.75	578.6	ND	680	578.6	RDC020-002	NQ
	Semivolatiles	1,4-Dichlorobenzene	µg/L	11	10	1	1			0.1359091	NA	ND	0.525	0.525	LTROU-22	J
		Anthracene	µg/L	11	10	1	1			0.4357727	NA	ND	0.231	0.231	LTROU-22	J
		Benzo[a]anthracene	µg/L	11	10	1	1			0.4415545	NA	ND	0.309	0.309	LTROU-22	J
		Bis[2-ethylhexyl]phthalate	µg/L	11	7	4	2	X	5	2.5014773	5.506	ND	12	5.506	RDC015-002	NQ
		Caprolactam	µg/L	11	10	1	1			2.2086364	NA	ND	1.28	1.28	LTROU-22	J
		Fluoranthene	µg/L	11	10	1	1			0.4378636	NA	ND	0.259	0.259	LTROU-22	J
		Fluorene	µg/L	11	10	1	1			0.4311364	NA	ND	0.185	0.185	LTROU-22	J
		Pyrene	µg/L	11	10	1	1			0.4429545	NA	ND	0.305	0.305	LTROU-22	J
	Volatiles	Bromoform	µg/L	10	9	1	0			0.183	NA	ND	0.94	0.94	RDC019-002	NQ
		Dibromochloromethane	µg/L	10	9	1	1			0.103	NA	ND	0.39	0.39	RDC019-002	J
		Toluene	µg/L	10	5	5	4	X	5	0.221	0.339	ND	0.53	0.339	RDC019-002	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL)**:**

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.5.1.1__Statistical Summary Table: EA5 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
5	Inorganics	Cyanide	mg/kg	3	0	3	0	N	1	0.8333333	1.504	0.516	1.28	1.28	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
	Metals	Aluminum	mg/kg	5	0	5	1	N	1	9,389.80	17,678	670	21,300	17678	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Antimony	mg/kg	5	4	1	1			0.2842	NA	ND	0.598	0.598	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	J
		Arsenic	mg/kg	5	2	3	0	X	5	1.0269	2.171	ND	2.9	2.171	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Barium	mg/kg	5	0	5	0	N	1	50.1	95.8	1.31	102	95.8	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Beryllium	mg/kg	5	1	4	2	X	5	0.4692	0.85	ND	0.961	0.85	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Cadmium	mg/kg	5	3	2	2	X	5	0.10252	0.196	ND	0.223	0.196	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Calcium	mg/kg	5	0	5	0	G	2	8,755.90	247,480	29.8	43,000	43000	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Chromium	mg/kg	5	0	5	0	N	1	27.106	50.76	1.06	56.2	50.76	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Cobalt	mg/kg	5	1	4	0	X	5	4.9635	9.244	ND	9.9	9.244	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Copper	mg/kg	5	0	5	2	N	1	11.3972	22.78	0.467	28.3	22.78	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Iron	mg/kg	5	0	5	1	N	1	10,388	19,508	1,020	24,600	19508	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Lead	mg/kg	5	0	5	0	N	1	13.032	23.42	1.4	25.6	23.42	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Magnesium	mg/kg	5	1	4	0	X	5	498.11	1,007	ND	1,270	1007	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Manganese	mg/kg	5	0	5	0	N	1	501.428	937.9	2.14	952	937.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Mercury	mg/kg	5	2	3	0	X	5	0.098647	0.205	ND	0.229	0.205	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Nickel	mg/kg	5	0	5	1	N	1	3.828	6.958	0.313	8.03	6.958	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Potassium	mg/kg	5	1	4	0	X	5	203.068	399.5	ND	501	399.5	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Selenium	mg/kg	5	4	1	1			0.2804	NA	ND	0.596	0.596	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	J
		Sodium	mg/kg	5	4	1	0			10.113	NA	ND	37.6	37.6	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Vanadium	mg/kg	5	0	5	0	N	1	19.078	35.78	2.76	45.1	35.78	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Zinc	mg/kg	5	0	5	2	N	1	28.684	53.36	1.13	53.4	53.36	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
	Pesticides/PCBs	DDE	mg/kg	4	2	2	2	X	5	0.0017984	0.0047	ND	0.00441	0.00441	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		DDT	mg/kg	4	3	1	0			0.0032771	NA	ND	0.0114	0.0114	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		PCB-1260	mg/kg	4	3	1	0			0.0018475	NA	ND	0.0053	0.0053	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
	Radionuclides	Actinium-228	pCi/g	15	0	15	1	G	2	1.5810667	2.185	0.561	3.99	2.185	JBT002-003	NQ
		Americium-241	pCi/g	6	5	1	1			0.0533167	NA	ND	0.212	0.212	JBT002-003	J
		Americium-243	pCi/g	5	4	1	1			0.09671	NA	ND	0.341	0.341	JBT002-003	J
		Bismuth-214	pCi/g	17	1	16	1	X	5	1.265	1.613	ND	2.99	1.613	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Cesium-137	pCi/g	17	0	17	0	G	2	99.198235	227.9	1.7	405	227.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Cobalt-60	pCi/g	17	11	6	0	X	5	0.4673294	0.76	ND	1.83	0.76	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Gross Alpha	pCi/g	13	1	12	4	G	2	18.242692	35.47	ND	73.9	35.47	JBT002-003	NQ
		Gross Beta	pCi/g	2	0	2	0			329	NA	325	333	333	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Lead-212	pCi/g	17	1	16	2	G	2	1.3917941	2.008	ND	4.06	2.008	JBT002-003	NQ
		Lead-214	pCi/g	17	0	17	2	N	1	1.4737059	1.817	0.371	2.69	1.817	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Non-volatile Beta	pCi/g	11	1	10	4	G	2	18.049545	31.53	ND	39	31.53	JBT004-003	NQ
		Potassium-40	pCi/g	17	5	12	4	X	5	1.9292353	2.706	ND	5.49	2.706	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Radium-226	pCi/g	6	0	6	0	N	1	1.3803333	1.896	0.604	2.12	1.896	JBT002-003	NQ
		Radium-228	pCi/g	1	0	1	0			1.12	NA	1.12	1.12	1.12	JBT005-001	NQ
		Thallium-208	pCi/g	17	1	16	5	X	5	0.4542353	0.583	ND	1.3	0.583	JBT002-003	NQ
		Thorium-228	pCi/g	6	0	6	1	N	1	2.26	2.982	1.02	3.34	2.982	JBT002-003	NQ
		Thorium-230	pCi/g	6	0	6	1	N	1	1.113	1.522	0.476	1.79	1.522	JBT001-003	NQ
		Thorium-232	pCi/g	6	0	6	0	N	1	2.1933333	2.909	1.03	3.22	2.909	JBT004-003	NQ
		Uranium-233 and Uranium-234	pCi/g	6	0	6	1	N	1	1.4231667	1.925	0.399	2.21	1.925	JBT002-003	NQ
		Uranium-235	pCi/g	6	3	3	3	X	5	0.099075	0.14	ND	0.152	0.14	JBT002-003	J
		Uranium-238	pCi/g	6	0	6	1	N	1	1.476	1.981	0.596	2.44	1.981	JBT002-003	NQ
	Volatiles	Acetone	mg/kg	4	1	3	1	X	5	0.2246525	0.555	ND	0.54	0.54	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Carbon disulfide	mg/kg	4	3	1	1			0.0013638	NA	ND	0.00177	0.00177	JBT003-001	J
		Methyl ethyl ketone	mg/kg	4	2	2	0	X	5	0.0134813	0.036	ND	0.0331	0.0331	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Toluene	mg/kg	4	1	3	2	X	5	0.0019674	0.0058	ND	0.00657	0.0058	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.5.1.2__Statistical Summary Table: Exposure Area 5 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
5	Inorganics	Cyanide	mg/kg	3	0	3	0	N	1	0.833333333	1.594	0.516	1.28	1.28	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
	Metals	Aluminum	mg/kg	6	0	6	2	N	1	7,904.50	14,967	478	21,300	14967	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Antimony	mg/kg	6	5	1	1			0.267916667	NA	ND	0.598	0.598	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	J
		Arsenic	mg/kg	6	3	3	0	X	5	0.902833333	1.881	ND	2.9	1.881	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Barium	mg/kg	6	0	6	1	N	1	42.225	80.9	1.31	102	80.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Beryllium	mg/kg	6	2	4	2	X	5	0.400416667	0.738	ND	0.961	0.738	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Cadmium	mg/kg	6	4	2	2	X	5	0.09485	0.172	ND	0.223	0.172	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Calcium	mg/kg	6	0	6	1	X	3	7,299.40	78,347	16.9	43,000	43000	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Chromium	mg/kg	6	0	6	1	N	1	22.75083333	43.01	0.975	56.2	43.01	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Cobalt	mg/kg	6	2	4	0	X	5	4.150333333	7.944	ND	9.9	7.944	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Copper	mg/kg	6	1	5	2	X	5	9.525916667	19.36	ND	28.3	19.36	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Iron	mg/kg	6	0	6	2	N	1	8,747	16,523	542	24,600	16523	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Lead	mg/kg	6	0	6	1	N	1	11.03333333	20.01	1.04	25.6	20.01	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Magnesium	mg/kg	6	1	5	1	X	5	418.9083333	840.2	ND	1,270	840.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Manganese	mg/kg	6	0	6	1	N	1	418.2133333	794.5	2.14	952	794.5	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Mercury	mg/kg	6	3	3	0	X	5	0.0825975	0.174	ND	0.229	0.174	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Nickel	mg/kg	6	0	6	2	N	1	3.237333333	5.93	0.284	8.03	5.93	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Potassium	mg/kg	6	1	5	1	X	5	171.64	335	ND	501	335	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Selenium	mg/kg	6	5	1	1			0.28075	NA	ND	0.596	0.596	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	J
		Sodium	mg/kg	6	5	1	0			9.086666667	NA	ND	37.6	37.6	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Vanadium	mg/kg	6	0	6	1	N	1	16.25833333	30.34	2.16	45.1	30.34	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Zinc	mg/kg	6	0	6	3	N	1	24.115	45.26	1.13	53.4	45.26	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
	Pesticides/PCBs	DDE	mg/kg	5	3	2	2	X	5	0.0014789	0.00375	ND	0.0044	0.00375	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		DDT	mg/kg	5	4	1	0			0.0026619	NA	ND	0.0114	0.0114	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		PCB-1260	mg/kg	5	4	1	0			0.001612	NA	ND	0.0053	0.0053	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
	Radionuclides	Actinium-228	pCi/g	21	0	21	1	N	1	1.786142857	2.307	0.463	6.42	2.307	JBT001-003	NQ
		Americium-241	pCi/g	10	8	2	2	X	5	0.072155	0.151	ND	0.32	0.151	JBT002-003	J
		Americium-243	pCi/g	8	7	1	1			0.0792375	NA	ND	0.341	0.341	JBT002-003	J
		Bismuth-214	pCi/g	23	1	22	1	X	5	1.298304348	1.62	ND	3.66	1.62	JBT001-003	NQ
		Cesium-137	pCi/g	23	0	23	1	G	2	74.05743478	161.5	0.107	405	161.5	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Cobalt-60	pCi/g	23	17	6	0	X	5	0.352247826	0.579	ND	1.83	0.579	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Gross Alpha	pCi/g	19	1	18	5	X	7	24.80605263	40.76	ND	135	40.76	JBT001-003	NQ
		Gross Beta	pCi/g	2	0	2	0			329	NA	325	333	333	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Lead-212	pCi/g	23	1	22	2	G	2	1.615717391	2.296	ND	6.28	2.296	JBT001-003	NQ
		Lead-214	pCi/g	23	0	23	2	N	1	1.509782609	1.859	0.268	4.39	1.859	JBT001-003	NQ
		Non-volatile Beta	pCi/g	17	1	16	4	G	2	18.62676471	28.08	ND	53.5	28.08	JBT001-003	NQ
		Potassium-40	pCi/g	23	6	17	8	X	5	1.707652174	2.323	ND	5.49	2.323	LTR ERDMS IOULTR2 Sampling Event: LTROU-03	NQ
		Radium-226	pCi/g	10	0	10	0	N	1	1.4923	2.024	0.604	3.66	2.024	JBT001-003	NQ
		Radium-228	pCi/g	2	0	2	0			3.77	NA	1.12	6.42	6.42	JBT001-003	NQ
		Thallium-208	pCi/g	23	1	22	5	G	2	0.516869565	0.72	ND	1.95	0.72	JBT001-003	NQ
		Thorium-228	pCi/g	10	1	9	2	X	5	2.2256	3.176	ND	5.83	3.176	JBT001-003	NQ
		Thorium-230	pCi/g	10	0	10	2	N	1	1.1661	1.698	0.163	3.38	1.698	JBT001-003	NQ
		Thorium-232	pCi/g	10	0	10	1	N	1	2.1699	3.102	0.202	5.83	3.102	JBT001-003	NQ
		Uranium-233 and Uranium-234	pCi/g	10	0	10	1	N	1	1.4869	1.977	0.399	3.29	1.977	JBT001-003	NQ
		Uranium-235	pCi/g	10	6	4	4	X	5	0.101795	0.148	ND	0.241	0.148	JBT001-003	J
		Uranium-238	pCi/g	10	0	10	1	N	1	1.4669	1.889	0.543	2.84	1.889	JBT001-003	NQ
	Volatiles	Acetone	mg/kg	5	2	3	1	X	5	0.180176	0.442	ND	0.54	0.442	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Carbon disulfide	mg/kg	5	4	1	1			0.001239	NA	ND	0.0018	0.00177	JBT003-001	J
		Methyl ethyl ketone	mg/kg	5	3	2	0	X	5	0.010933	0.0287	ND	0.0331	0.0287	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
		Toluene	mg/kg	5	1	4	3	X	3	0.0017185	0.00718	ND	0.0066	0.00657	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ

J = Estimated Value
NA = Not Available
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NQ = No Qualfier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.5.2__Statisical Summary Table: Exposure Area 5 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
5	Inorganics	Cyanide	µg/L	2	0	2	0			5	NA	5	5	5	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
	Metals	Aluminum	µg/L	7	3	4	4	X	5	89.1	143.2	ND	157	143.2	JBT002-002	J
		Arsenic	µg/L	7	6	1	1			2.4171429	NA	ND	3.3	3.3	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Barium	µg/L	7	0	7	0	N	1	11.72	13.58	8.64	14.5	13.58	JBT003-002	NQ
		Beryllium	µg/L	7	6	1	1			0.397	NA	ND	0.2	0.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Calcium	µg/L	7	0	7	0	N	1	1657.1429	1987	1260	2420	1987	JBT005-002	NQ
		Copper	µg/L	7	6	1	1			1.4321429	NA	ND	1.83	1.83	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Iron	µg/L	7	0	7	1	N	1	1044.4286	1312	655	1760	1312	JBT001-002	NQ
		Lead	µg/L	7	5	2	2	X	5	1.8057143	2.943	ND	2.58	2.58	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
		Magnesium	µg/L	7	0	7	0	N	1	497.71429	515.2	470	537	515.2	JBT003-002	NQ
		Manganese	µg/L	7	0	7	0	N	1	41.357143	47.59	28.7	49.1	47.59	JBT003-002	NQ
		Potassium	µg/L	7	0	7	0	N	1	310	411.2	180	515	411.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
		Sodium	µg/L	7	0	7	0	N	1	1961.4286	2054	1840	2150	2054	JBT002-002	NQ
		Vanadium	µg/L	7	5	2	2	X	5	0.5665714	0.89	ND	0.814	0.814	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Zinc	µg/L	7	1	6	5	X	5	4.8085714	6.897	ND	9.37	6.897	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	NQ
	Pesticides/PCBs	DDE	µg/L	7	6	1	1			0.0062021	NA	ND	0.0288	0.0288	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
		DDT	µg/L	7	6	1	0			0.01375	NA	ND	0.066	0.066	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	NQ
	Radionuclides	Bismuth-214	pCi/L	7	6	1	1			18.795714	NA	ND	70.2	70.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
		Gross Alpha	pCi/L	2	0	2	2			10.82	NA	9.44	12.2	12.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Lead-214	pCi/L	7	5	2	2	X	5	15.939286	33.9	ND	49.7	33.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
		Non-volatile Beta	pCi/L	2	1	1	1			6.44	NA	ND	9.96	9.96	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Tritium	pCi/L	18	0	18	9	N	1	1317.9444	1615	540	2990	1615	JBSW-01	NQ
	Semivolatiles	2-Chlorophenol	µg/L	7	6	1	1			0.8075714	NA	ND	0.456	0.456	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
	Semivolatiles/Volatiles	Naphthalene	µg/L	7	6	1	1			0.1464286	NA	ND	0.222	0.222	LTR ERDMS IOULTR2 Sampling Event: LTROU-02	J
	Volatiles	Acetone	µg/L	9	7	2	2	X	5	1.3311111	2.503	ND	4.36	2.503	LTR ERDMS IOULTR2 Sampling Event: LTROU-04	J
		Methylene chloride	µg/L	15	12	3	1	X	5	0.6270333	0.477	ND	0.58	0.477	JBSW-01	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.6.1.1__Statistical Summary Table: EA6 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
6	Inorganics	Chloride	mg/kg	44	17	27	25	X	3	2.688068191	4.711	ND	16.5	4.711	PAR Pond Sediment: PPSC-SED27	J
		Chromium VI	mg/kg	3	0	3	2	N	1	0.579666667	0.692	0.503	0.62	0.62	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Cyanide	mg/kg	62	58	4	4	X	3	0.600344355	0.647	ND	3.4	0.647	PAR Pond Sediment: PPSC-SED01	J
		Orthophosphate	mg/kg	45	28	17	17	X	5	8.199422222	6.055	ND	11.9	6.055	PAR Pond Sediment: PPSC-SED03	J
		Phosphate	mg/kg	45	0	45	42	X	3	120.8222223	195.8	15	722	195.8	PAR Pond Sediment: PPSC-SED09	J
		Thallium	mg/kg	60	56	4	4	X	5	6.500975	2.763	ND	6.89	2.763	PAR Pond Sediment: PPSC-SED08	J
	Metals	Aluminum	mg/kg	64	0	64	4	L	6	5,377.03	6,681	1,100	18,200	6681	PAR Pond Sediment: PPSC-SED01	NQ
		Antimony	mg/kg	60	59	1	0			4.037191667	NA	ND	11	11	PAR Pond Sediment: PPSC-SED08	NQ
		Arsenic	mg/kg	58	50	8	8	X	5	6.578612069	3.606	ND	7.67	3.606	PAR Pond Sediment: PPSC-SED01	J
		Barium	mg/kg	64	0	64	3	X	3	21.016875	34.05	4.04	147	34.05	PAR Pond Sediment: PPSC-SED09	NQ
		Beryllium	mg/kg	64	4	60	59	X	3	0.150203125	0.266	ND	1.33	0.266	PAR Pond Sediment: PPSC-SED10	NQ
		Cadmium	mg/kg	60	57	3	2	X	5	0.56315	0.173	ND	0.59	0.173	PAR Pond Sediment: PPSC-SED10	NQ
		Calcium	mg/kg	64	0	64	1	X	3	215.4499999	394.6	14	1,460	394.6	PAR Pond Sediment: PPSC-SED10	NQ
		Chromium	mg/kg	63	8	55	11	G	2	6.857158733	8.461	ND	25.4	8.461	PAR Pond Sediment: PPSC-SED10	NQ
		Cobalt	mg/kg	64	12	52	42	X	7	0.627015625	0.578	ND	7.75	0.578	PAR Pond Sediment: PPSC-SED10	NQ
		Copper	mg/kg	64	10	54	21	G	2	2.2931875	2.726	ND	7.03	2.726	PAR Pond Sediment: PPSC-SED10	NQ
		Iron	mg/kg	64	0	64	35	X	3	4,742.31	8,499	225	27,800	8499	PAR Pond Sediment: PPSC-SED07	NQ
		Lead	mg/kg	63	7	56	41	G	2	4.609111111	5.351	ND	17.9	5.351	PAR Pond Sediment: PPSC-SED10	NQ
		Magnesium	mg/kg	64	0	64	12	G	2	96.66874997	111.1	11.3	303	111.1	PAR Pond Composite Trans 01 Location B3: CS01B3	NQ
		Manganese	mg/kg	64	0	64	5	L	6	49.38875001	78.14	1.58	266	78.14	PAR Pond Transect Composite Hot Aram	NQ
		Mercury	mg/kg	371	206	165	144	X	7	0.065073652	0.0813	ND	0.958	0.0813	PAR Pond Transect 2 Location 5	NQ
		Nickel	mg/kg	64	5	59	33	X	7	1.9549375	2.157	ND	9.15	2.157	PAR Pond Sediment: PPSC-SED10	NQ
		Potassium	mg/kg	64	9	55	48	G	2	103.9555469	95.87	ND	226	95.87	PAR Pond Composite Trans 01 Location B3: CS01B3	J
		Selenium	mg/kg	59	52	7	7	X	5	6.47870339	4.149	ND	7.64	4.149	PAR Pond Sediment: PPSC-SED07	J
		Silver	mg/kg	59	53	6	6	X	5	1.027254237	0.716	ND	0.903	0.716	PAR Pond Sediment: PPSC-SED08	J
		Sodium	mg/kg	61	39	22	22	G	2	22.92983607	15.06	ND	30.7	15.06	PAR Pond Sediment: PPSC-SED10	J
		Vanadium	mg/kg	64	0	64	15	X	3	13.36859377	21.18	1.25	57.1	21.18	PAR Pond Sediment: PPSC-SED07	NQ
		Zinc	mg/kg	64	3	61	9	G	2	4.45375	5.222	ND	31.8	5.222	PAR Pond Sediment: PPSC-SED10	NQ
	Other	Cation exchange capacity	MEQ/100g	45	3	42	1	G	2	66.70644464	85.82	ND	268	85.82	PAR Pond Sediment: PPSC-SED10	NQ
		Nitrogen by Kjeldahl method	mg/kg	45	0	45	3	X	3	135.3266667	273.8	12.6	1,240	273.8	PAR Pond Sediment: PPSC-SED10	NQ
		Nitrogen-Nitrate+Nitrite	mg/kg	45	30	15	10	X	5	0.614588888	0.725	ND	1.27	0.725	PAR Pond Sediment: PPSC-SED04	NQ
		Phenols	mg/kg	43	34	9	9	X	5	0.182025581	0.213	ND	0.315	0.213	PAR Pond Sediment: PPSC-SED26	J
		Total organic carbon	mg/kg	45	0	45	0	X	3	7,547.36	19,107	240	76,300	19107	PAR Pond Sediment: PPSC-SED10	NQ
	Radionuclides	Actinium-228	pCi/g	259	0	259	0	N	1	1.033880308	1.077	0.109	2.35	1.077	PAR Pond Transect 10 Location B7: PP10B7	NQ
		Barium-133	pCi/g	257	255	2	1	X	3	0.010305516	0.0169	ND	0.27	0.0169	PAR Pond Sediment: PPSC-SED26	NQ
		Cesium-134	pCi/g	257	255	2	0	X	3	0.006188977	0.0078	ND	0.13	0.0078	PAR Pond Sediment: PPSC-SED26	NQ
		Cesium-137	pCi/g	540	30	510	1	X	3	6.282413611	8.823	ND	124	8.823	PAR Pond Sediment Fish: PF3-5	NQ
		Cobalt-58	pCi/g	256	253	3	0	X	5	0.005388453	0.0007	ND	0.0323	0.0007	PAR Pond Transect 10 Location B3: PP10B3	NQ
		Cobalt-60	pCi/g	259	127	132	0	X	3	0.035912454	0.0966	ND	1.13	0.0966	PAR Pond Sediment Fish: PF3-5	NQ
		Europium-152	pCi/g	257	255	2	2	X	3	0.023700942	0.0371	ND	0.47	0.0371	PAR Pond Sediment: PPSC-SED26	J
		Europium-155	pCi/g	204	123	81	1	G	2	0.050544485	0.0476	ND	0.33	0.0476	PAR Pond Sediment: PPSC-SED27	NQ
		Gross Alpha	pCi/g	212	10	202	19	X	7	11.31966983	12.24	ND	62.2	12.24	PAR Pond Sediment: PPSC-SED27	NQ
		Lead-212	pCi/g	255	0	255	0	N	1	1.078113725	1.122	0.151	2.4	1.122	PAR Pond Transect 10 Location B7: PP10B7	NQ
		Lead-214	pCi/g	3	0	3	0	N	1	1.001	1.736	0.593	1.46	1.46	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Manganese-54	pCi/g	257	45	212	0	G	2	0.018578658	0.0196	ND	0.0492	0.0196	PAR Pond Sediment Fish: PF3-6	NQ
		Neptunium-239	pCi/g	247	221	26	2	X	3	0.090474979	0.193	ND	3.1	0.193	PAR Pond Sediment: PPSC-SED26	J
		Non-volatile Beta	pCi/g	212	31	181	20	X	3	15.13893868	19.01	ND	71.3	19.01	PAR Pond Transect 11 Location A7: PP11A7	NQ
		Plutonium-238	pCi/g	310	305	5	1	X	5	0.194838548	0.0296	ND	0.69	0.0296	PAR Pond Site No. 5 Elevation 182 ft	NQ
		Plutonium-239	pCi/g	257	256	1	0			0.351264591	NA	ND	0.46	0.46	PAR Pond Site No. 1 Elevation 190 ft	NQ
		Plutonium-239 and Plutonium-240	pCi/g	46	43	3	0	X	5	0.019541087	0.0134	ND	0.11	0.0134	PAR Pond Sediment: PPSC-SED04	NQ
		Potassium-40	pCi/g	260	114	146	0	G	2	0.550963269	0.612	ND	4.38	0.612	PAR Pond Transect 13 Location A9: PP13A9	NQ
		Promethium-146	pCi/g	254	251	3	0	X	5	0.012610073	0.0013	ND	0.0125	0.0013	PAR Pond Sediment Fish: PF4-10	NQ
		Radium-226	pCi/g	3	0	3	0	N	1	0.844666667	1.326	0.559	1.13	1.13	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Radium-228	pCi/g	3	0	3	0	N	1	1.346333333	2.275	0.789	1.89	1.89	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Ruthenium-106	pCi/g	257	256	1	0			0.058172446	NA	ND	0.23	0.23	PAR Pond Transect 08 Location A1: PP08A1	NQ
		Strontium-89 and Strontium-90	pCi/g	242	121	121	0	X	3	0.640206612	1.029	ND	14.5	1.029	PAR Pond Site No. 2 Elevation 190 ft	NQ
		Strontium-90	pCi/g	47	31	16	0	X	3	0.2729	0.511	ND	1.52	0.511	PAR Pond Sediment: PPSC-SED10	NQ
		Thorium-228	pCi/g	3	0	3	2	N	1	0.735333333	1.312	0.466	1.12	1.12	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Thorium-230	pCi/g	3	0	3	3	N	1	0.428333333	0.61	0.328	0.542	0.542	PAR Pond surface water and sediment sampling event LTRPP2Q32	J

Table A.1.6.1.1__Statistical Summary Table: EA6 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Thorium-232	pCi/g	3	1	2	1	X	5	0.624666667	1.375	ND	1.06	1.06	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Thorium-234	pCi/g	257	62	195	0	X	5	1.030175097	0.973	ND	5.59	0.973	PAR Pond Composite Trans 01 Location B9: CS01B9	NQ
		Tin-113	pCi/g	257	256	1	0			0.012099763	NA	ND	0.07	0.07	PAR Pond Sediment: PPSC-SED27	NQ
		Uranium-233 and Uranium-234	pCi/g	3	0	3	3	N	1	0.437	0.891	0.24	0.744	0.744	PAR Pond surface water and sediment sampling event LTRPP2Q32	J
		Uranium-235	pCi/g	3	2	1	1			0.048566667	NA	ND	0.108	0.108	PAR Pond surface water and sediment sampling event LTRPP2Q30	J
		Uranium-238	pCi/g	3	0	3	3	N	1	0.402333333	0.675	0.305	0.589	0.589	PAR Pond surface water and sediment sampling event LTRPP2Q32	J
		Zinc-65	pCi/g	293	286	7	1	G	2	0.010708253	0.0037	ND	0.16	0.0037	PAR Pond Sediment: PPSC-SED26	J
		Zirconium-95	pCi/g	176	125	51	0	X	5	0.019679858	0.0166	ND	0.0701	0.0166	PAR Pond Transect 07 Location B3: PP07B3	NQ
	Semivolatiles	2-Chlorophenol	mg/kg	31	30	1	1			0.026182258	NA	ND	0.0592	0.0592	PAR Pond Composite Trans 01 Location A7: CS01A7	J
		Benzoic acid	mg/kg	31	28	3	0	X	5	0.05185	0.07	ND	0.247	0.07	PAR Pond Composite Trans 01 Location B5: CS01B5	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	32	23	9	9	X	5	0.028915625	0.0272	ND	0.0305	0.0272	PAR Pond Sediment: PPSC-SED04	J
		Butylbenzylphthalate	mg/kg	31	30	1	1			0.028333871	NA	ND	0.0364	0.0364	PAR Pond Sediment: PPSC-SED01	J
		Dibutylphthalate	mg/kg	32	26	6	6	X	5	0.028653125	0.0268	ND	0.0284	0.0268	PAR Pond Sediment: PPSC-SED09	J
		Diethylphthalate	mg/kg	31	28	3	3	X	5	0.026968387	0.0193	ND	0.0207	0.0193	PAR Pond Sediment: PPSC-SED26	J
		Fluoranthene	mg/kg	31	30	1	1			0.028246774	NA	ND	0.0338	0.0338	PAR Pond Composite Trans 01 Location B5: CS01B5	J
		Phenol	mg/kg	31	30	1	1			0.027349355	NA	ND	0.0049	0.0049	PAR Pond Sediment: PPSC-SED27	J
	TIC	Cinnamyl Cinnamate	mg/kg	1	0	1	1			0.25999999	NA	0.26	0.26	0.26	PAR Pond Sediment: PPSC-SED09	J
		Unknown alcohol	mg/kg	3	0	3	3	N	1	0.600000003	0.703	0.56	0.67	0.67	PAR Pond Sediment: PPSC-SED26	J
		Unknown alkane	mg/kg	3	0	3	3	N	1	0.54000001	0.658	0.47	0.61	0.61	PAR Pond Sediment: PPSC-SED09	J
		Unknown hydrocarbon	mg/kg	5	0	5	5	N	1	0.672000006	1.125	0.18	1.3	1.125	PAR Pond Sediment: PPSC-SED09	J
	Volatiles	Acetone	mg/kg	33	15	18	12	X	3	0.017866061	0.0355	ND	0.0933	0.0355	PAR Pond Sediment: PPSC-SED09	NQ
		Carbon disulfide	mg/kg	31	26	5	4	X	3	0.001516774	0.004	ND	0.0192	0.004	PAR Pond Sediment: PPSC-SED26	NQ
		Methyl cyclopentane	mg/kg	6	0	6	6	N	1	0.002511667	0.0028	0.002	0.003	0.0028	PAR Pond Sediment: PPSC-SED01	J
		Methyl ethyl ketone	mg/kg	30	29	1	1			0.001436833	NA	ND	0.0028	0.0028	PAR Pond Composite Trans 01 Location A7: CS01A7	J
		Methyl isobutyl ketone	mg/kg	28	26	2	2	X	3	0.001462286	0.0016	ND	0.0008	0.0008	PAR Pond Sediment: PPSC-SED01	J
		Styrene	mg/kg	28	27	1	0			5.18768E-05	NA	ND	0.0001	0.0001	PAR Pond Sediment: PPSC-SED09	NQ
		Toluene	mg/kg	30	27	3	1	X	5	0.000576533	0.0006	ND	0.0031	0.0006	PAR Pond Sediment: PPSC-SED01	NQ
		Xylenes	mg/kg	28	26	2	2	X	5	0.000163536	0.0002	ND	0.0005	0.0002	PAR Pond Transect Composite Intake Arm: PPIAC	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-PARametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.6.1.2__Statistical Summary Table: Exposure Area 6 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
6	Inorganics	Chloride	mg/kg	44	17	27	25	X	3	2.688068191	4.711	ND	16.5	4.711	PAR Pond Sediment: PPSC-SED27	J
		Chromium VI	mg/kg	3	0	3	2	N	1	0.579666667	0.692	0.503	0.62	0.62	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Cyanide	mg/kg	62	58	4	4	X	3	0.600344355	0.647	ND	3.4	0.647	PAR Pond Sediment: PPSC-SED01	J
		Orthophosphate	mg/kg	45	28	17	17	X	5	8.199422222	6.055	ND	11.9	6.055	PAR Pond Sediment: PPSC-SED03	J
		Phosphate	mg/kg	45	0	45	42	X	3	120.8222223	195.8	15	722	195.8	PAR Pond Sediment: PPSC-SED09	J
		Thallium	mg/kg	60	56	4	4	X	5	6.500975	2.763	ND	6.89	2.763	PAR Pond Sediment: PPSC-SED08	J
	Metals	Aluminum	mg/kg	64	0	64	4	L	6	5377.03125	6,681	1,100	18,200	6681	PAR Pond Sediment: PPSC-SED01	NQ
		Antimony	mg/kg	60	59	1	0			4.037191667	NA	ND	11	11	PAR Pond Sediment: PPSC-SED08	NQ
		Arsenic	mg/kg	58	50	8	8	X	5	6.578612069	3.606	ND	7.67	3.606	PAR Pond Sediment: PPSC-SED01	J
		Barium	mg/kg	64	0	64	3	X	3	21.016875	34.05	4.04	147	34.05	PAR Pond Sediment: PPSC-SED09	NQ
		Beryllium	mg/kg	64	4	60	59	X	3	0.150203125	0.266	ND	1.33	0.266	PAR Pond Sediment: PPSC-SED10	NQ
		Cadmium	mg/kg	60	57	3	2	X	5	0.56315	0.173	ND	0.59	0.173	PAR Pond Sediment: PPSC-SED10	NQ
		Calcium	mg/kg	64	0	64	1	X	3	215.4499999	394.6	14	1,460	394.6	PAR Pond Sediment: PPSC-SED10	NQ
		Chromium	mg/kg	63	8	55	11	G	2	6.857158733	8.461	ND	25.4	8.461	PAR Pond Sediment: PPSC-SED10	NQ
		Cobalt	mg/kg	64	12	52	42	X	7	0.627015625	0.578	ND	7.75	0.578	PAR Pond Sediment: PPSC-SED10	NQ
		Copper	mg/kg	64	10	54	21	G	2	2.2931875	2.726	ND	7.03	2.726	PAR Pond Sediment: PPSC-SED10	NQ
		Iron	mg/kg	64	0	64	35	X	3	4742.3125	8,499	225	27,800	8499	PAR Pond Sediment: PPSC-SED07	NQ
		Lead	mg/kg	63	7	56	41	G	2	4.609111111	5.351	ND	17.9	5.351	PAR Pond Sediment: PPSC-SED10	NQ
		Magnesium	mg/kg	64	0	64	12	G	2	96.66874997	111.1	11.3	303	111.1	PAR Pond Composite Trans 01 Location B3: CS01B3	NQ
		Manganese	mg/kg	64	0	64	5	L	6	49.38875001	78.14	1.58	266	78.14	PAR Pond Transect Composite Hot Aram	NQ
		Mercury	mg/kg	371	206	165	144	X	7	0.065073652	0.0813	ND	0.958	0.0813	PAR Pond Transect 2 Location 5	NQ
		Nickel	mg/kg	64	5	59	33	X	7	1.9549375	2.157	ND	9.15	2.157	PAR Pond Sediment: PPSC-SED10	NQ
		Potassium	mg/kg	64	9	55	48	G	2	103.9555469	95.87	ND	226	95.87	PAR Pond Composite Trans 01 Location B3: CS01B3	J
		Selenium	mg/kg	59	52	7	7	X	5	6.47870339	4.149	ND	7.64	4.149	PAR Pond Sediment: PPSC-SED07	J
		Silver	mg/kg	59	53	6	6	X	5	1.027254237	0.716	ND	0.903	0.716	PAR Pond Sediment: PPSC-SED08	J
		Sodium	mg/kg	61	39	22	22	G	2	22.92983607	15.06	ND	30.7	15.06	PAR Pond Sediment: PPSC-SED10	J
		Vanadium	mg/kg	64	0	64	15	X	3	13.36859377	21.18	1.25	57.1	21.18	PAR Pond Sediment: PPSC-SED07	NQ
		Zinc	mg/kg	64	3	61	9	G	2	4.45375	5.522	ND	31.8	5.522	PAR Pond Sediment: PPSC-SED10	NQ
	Other	Cation exchange capacity	EQ/100	45	3	42	1	G	2	66.70644464	85.82	ND	268	85.82	PAR Pond Sediment: PPSC-SED10	NQ
		Nitrogen by Kjeldahl method	mg/kg	45	0	45	3	X	3	135.3266667	273.8	12.6	1,240	273.8	PAR Pond Sediment: PPSC-SED10	NQ
		Nitrogen-Nitrate+Nitrite	mg/kg	45	30	15	10	X	5	0.614588888	0.725	ND	1.27	0.725	PAR Pond Sediment: PPSC-SED04	NQ
		Phenols	mg/kg	43	34	9	9	X	5	0.182025581	0.213	ND	0.315	0.213	PAR Pond Sediment: PPSC-SED26	J
		Total organic carbon	mg/kg	45	0	45	0	X	3	7,547.36	19,107	240	76,300	19107	PAR Pond Sediment: PPSC-SED10	NQ
	Radionuclides	Actinium-228	pCi/g	259	0	259	0	N	1	1.033880308	1.077	0.109	2.35	1.077	PAR Pond Transect 10 Location B7: PP10B7	NQ
		Barium-133	pCi/g	257	255	2	1	X	3	0.010305516	0.0169	ND	0.27000001	0.0169	PAR Pond Sediment: PPSC-SED26	NQ
		Cesium-134	pCi/g	257	255	2	0	X	3	0.006188977	0.00781	ND	0.13	0.00781	PAR Pond Sediment: PPSC-SED26	NQ
		Cesium-137	pCi/g	540	30	510	1	X	3	6.282413611	8.823	ND	124	8.823	PAR Pond Sediment Fish: PF3-5	NQ
		Cobalt-58	pCi/g	256	253	3	0	X	5	0.005388453	0.000741	ND	0.0323	0.000741	PAR Pond Transect 10 Location B3: PP10B3	NQ
		Cobalt-60	pCi/g	259	127	132	0	X	3	0.035912454	0.0966	ND	1.13	0.0966	PAR Pond Sediment Fish: PF3-5	NQ
		Europium-152	pCi/g	257	255	2	2	X	3	0.023700942	0.0371	ND	0.47	0.0371	PAR Pond Sediment: PPSC-SED26	J
		Europium-155	pCi/g	204	123	81	1	G	2	0.050544485	0.0476	ND	0.33000001	0.0476	PAR Pond Sediment: PPSC-SED27	NQ
		Gross Alpha	pCi/g	212	10	202	19	X	7	11.31966983	12.24	ND	62.200001	12.24	PAR Pond Sediment: PPSC-SED27	NQ
		Lead-212	pCi/g	255	0	255	0	N	1	1.078113725	1.122	0.151	2.4	1.122	PAR Pond Transect 10 Location B7: PP10B7	NQ
		Lead-214	pCi/g	3	0	3	0	N	1	1.001	1.736	0.593	1.46	1.46	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Manganese-54	pCi/g	257	45	212	0	G	2	0.018578658	0.0196	ND	0.0492	0.0196	PAR Pond Sediment Fish: PF3-6	NQ
		Neptunium-239	pCi/g	247	221	26	2	X	3	0.090474979	0.193	ND	3.0999999	0.193	PAR Pond Sediment: PPSC-SED26	J
		Non-volatile Beta	pCi/g	212	31	181	20	X	3	15.13893868	19.01	ND	71.3	19.01	PAR Pond Transect 11 Location A7: PP11A7	NQ
		Plutonium-238	pCi/g	310	305	5	1	X	5	0.194030548	0.0296	ND	0.69	0.0296	PAR Pond Site No. 5 Elevation 102 ft	NQ
		Plutonium-239	pCi/g	257	256	1	0			0.351264591	NA	ND	0.46	0.46	PAR Pond Site No. 1 Elevation 190 ft	NQ
		Plutonium-239 and Plutonium-240	pCi/g	46	43	3	0	X	5	0.019541087	0.0134	ND	0.11	0.0134	PAR Pond Sediment: PPSC-SED04	NQ
		Potassium-40	pCi/g	260	114	146	0	G	2	0.550963269	0.612	ND	4.38	0.612	PAR Pond Transect 13 Location A9: PP13A9	NQ
		Promethium-146	pCi/g	254	251	3	0	X	5	0.012610073	0.00126	ND	0.0125	0.00126	PAR Pond Sediment Fish: PF4-10	NQ
		Radium-226	pCi/g	3	0	3	0	N	1	0.844666667	1.326	0.559	1.13	1.13	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Radium-228	pCi/g	3	0	3	0	N	1	1.346333333	2.275	0.789	1.89	1.89	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Ruthenium-106	pCi/g	257	256	1	0			0.058172446	NA	ND	0.23	0.23	PAR Pond Transect 08 Location A1: PP08A1	NQ
		Strontium-89 and Strontium-90	pCi/g	242	121	121	0	X	3	0.640206612	1.029	ND	14.5	1.029	PAR Pond Site No. 2 Elevation 190 ft	NQ
		Strontium-90	pCi/g	47	31	16	0	X	3	0.2729	0.511	ND	1.52	0.511	PAR Pond Sediment: PPSC-SED10	NQ
		Thorium-228	pCi/g	3	0	3	2	N	1	0.735333333	1.312	0.466	1.12	1.12	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Thorium-230	pCi/g	3	0	3	3	N	1	0.428333333	0.61	0.328	0.542	0.542	PAR Pond surface water and sediment sampling event LTRPP2Q32	J
		Thorium-232	pCi/g	3	1	2	1	X	5	0.624666667	1.375	ND	1.06	1.06	PAR Pond surface water and sediment sampling event LTRPP2Q32	NQ
		Thorium-234	pCi/g	257	62	195	0	X	5	1.030175097	0.973	ND	5.59	0.973	PAR Pond Composite Trans 01 Location B9: CS01B9	NQ
		Tin-113	pCi/g	257	256	1	0			0.012099763	NA	ND	0.07	0.07	PAR Pond Sediment: PPSC-SED27	NQ
		Uranium-233 and Uranium-234	pCi/g	3	0	3	3	N	1	0.437	0.891	0.24	0.744	0.744	PAR Pond surface water and sediment sampling event LTRPP2Q32	J

Table A.1.6.1.2__Statistical Summary Table: Exposure Area 6 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Uranium-235	pCi/g	3	2	1	1			0.048566667	NA	ND	0.108	0.108	PAR Pond surface water and sediment sampling event LTRPP2Q30	J
		Uranium-238	pCi/g	3	0	3	3	N	1	0.402333333	0.675	0.305	0.589	0.589	PAR Pond surface water and sediment sampling event LTRPP2Q32	J
		Zinc-65	pCi/g	293	286	7	1	G	2	0.010708253	0.00372	ND	0.16	0.00372	PAR Pond Sediment: PPSC-SED26	J
		Zirconium-95	pCi/g	176	125	51	0	X	5	0.019679858	0.0166	ND	0.0701	0.0166	PAR Pond Transect 07 Location B3: PP07B3	NQ
	Semivolatiles	2-Chlorophenol	mg/kg	31	30	1	1			0.026182258	NA	ND	0.0592	0.0592	PAR Pond Composite Trans 01 Location A7: CS01A7	J
		Benzoic acid	mg/kg	31	28	3	0	X	5	0.05185	0.07	ND	0.247	0.07	PAR Pond Composite Trans 01 Location B5: CS01B5	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	32	23	9	9	X	5	0.028915625	0.0272	ND	0.0305	0.0272	PAR Pond Sediment: PPSC-SED04	J
		Butylbenzylphthalate	mg/kg	31	30	1	1			0.028333871	NA	ND	0.0364	0.0364	PAR Pond Sediment: PPSC-SED01	J
		Dibutylphthalate	mg/kg	32	26	6	6	X	5	0.028653125	0.0268	ND	0.0284	0.0268	PAR Pond Sediment: PPSC-SED09	J
		Diethylphthalate	mg/kg	31	28	3	3	X	5	0.026968387	0.0193	ND	0.0207	0.0193	PAR Pond Sediment: PPSC-SED26	J
		Fluoranthene	mg/kg	31	30	1	1			0.028246774	NA	ND	0.0338	0.0338	PAR Pond Composite Trans 01 Location B5: CS01B5	J
		Phenol	mg/kg	31	30	1	1			0.027349355	NA	ND	0.00488	0.00488	PAR Pond Sediment: PPSC-SED27	J
	TIC	Cinnamyl Cinnamate	mg/kg	1	0	1	1			0.25999999	NA	0.26	0.25999999	0.26	PAR Pond Sediment: PPSC-SED09	J
		Unknown alcohol	mg/kg	3	0	3	3	N	1	0.600000003	0.703	0.56	0.67000002	0.67	PAR Pond Sediment: PPSC-SED26	J
		Unknown alkane	mg/kg	3	0	3	3	N	1	0.54000001	0.658	0.47	0.61000001	0.61	PAR Pond Sediment: PPSC-SED09	J
		Unknown hydrocarbon	mg/kg	5	0	5	5	N	1	0.672000006	1.125	0.18	1.3	1.125	PAR Pond Sediment: PPSC-SED09	J
	Volatiles	Acetone	mg/kg	33	15	18	12	X	3	0.017866061	0.0355	ND	0.0933	0.0355	PAR Pond Sediment: PPSC-SED09	NQ
		Carbon disulfide	mg/kg	31	26	5	4	X	3	0.001516774	0.00399	ND	0.0192	0.00399	PAR Pond Sediment: PPSC-SED26	NQ
		Methyl cyclopentane	mg/kg	6	0	6	6	N	1	0.002511667	0.00279	0.00219	0.003	0.00279	PAR Pond Sediment: PPSC-SED01	J
		Methyl ethyl ketone	mg/kg	30	29	1	1			0.001436833	NA	ND	0.00275	0.00275	PAR Pond Composite Trans 01 Location A7: CS01A7	J
		Methyl isobutyl ketone	mg/kg	28	26	2	2	X	3	0.001462286	0.00158	ND	0.000841	0.000841	PAR Pond Sediment: PPSC-SED01	J
		Styrene	mg/kg	28	27	1	0			5.18768E-05	NA	ND	0.000138	0.000138	PAR Pond Sediment: PPSC-SED09	NQ
		Toluene	mg/kg	30	27	3	1	X	5	0.000576533	0.000596	ND	0.00305	0.000596	PAR Pond Sediment: PPSC-SED01	NQ
		Xylenes	mg/kg	28	26	2	2	X	5	0.000163536	0.000221	ND	0.000455	0.000221	PAR Pond Transect Composite Intake Arm: PPIAC	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-PARametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

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Table A.1.6.2__Statisical Summary Table: Exposure Area 6 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
6	Inorganics	Thallium	µg/L	30	28	2	2	X	5	2.487333333	2.327	ND	2.32	2.32	PAR Pond Water Sediment Fish PW1-1	J
	Metals	Aluminum	µg/L	31	20	11	3	X	5	32.16774194	38.46	ND	78.6	38.46	PAR Pond Water Sediment Fish PW2-2	NQ
		Antimony	µg/L	30	27	3	3	X	5	2.055666667	1.656	ND	1.62	1.62	PAR Pond Water Sediment Fish PW4-2	J
		Arsenic	µg/L	30	26	4	4	X	5	2.529666667	3.663	ND	4.29	3.663	PAR Pond Water Sediment Fish PW1-2	J
		Barium	µg/L	31	0	31	0	N	1	12.46483871	13.22	7.25	15.8	13.22	PAR Pond Water Fish PW2 21	NQ
		Cadmium	µg/L	31	30	1	1			0.745806452	NA	ND	0.12	0.12	PAR Pond Water Fish PW2 11	J
		Calcium	µg/L	32	0	32	0	N	1	4,063.75	4,291	3,160	5,060	4291	PAR-05-2016	NQ
		Chromium	µg/L	32	31	1	1			1.06125	NA	ND	2.06	2.06	PAR-07-2016	J
		Cobalt	µg/L	30	27	3	3	X	5	1.132033333	0.46	ND	0.469	0.46	PAR Pond Water Sediment Fish PW4-1	J
		Iron	µg/L	32	0	32	1	N	1	248.125	306.3	129	1,090	306.3	PAR-14-2016	NQ
		Lead	µg/L	30	29	1	1			2.172	NA	ND	3.71	3.71	PAR-03-2016	J
		Magnesium	µg/L	32	0	32	0	N	1	602.90625	637.6	432	766	637.6	PAR Pond Water Sediment Fish PW1-2	NQ
		Manganese	µg/L	32	0	32	5	L	6	35.40375	50.7	4.89	200	50.7	PAR Pond Water Fish PW2 21	NQ
		Nickel	µg/L	32	25	7	7	X	5	2.24071875	0.941	ND	0.989	0.941	PAR Pond Water Fish PW2 21	J
		Potassium	µg/L	32	0	32	2	X	3	630.25	869.9	152	965	869.9	PAR Pond Water Sediment Fish PW1-2	NQ
		Selenium	µg/L	30	26	4	4	X	7	3.059	3.191	ND	12.4	3.191	PAR-13-2016	J
		Sodium	µg/L	32	0	32	0	N	1	2,916.56	3,133	1,750	4,120	3133	PAR Pond Water Sediment Fish PW1-2	NQ
		Vanadium	µg/L	30	28	2	2	X	5	1.9641	0.469	ND	0.418	0.418	PAR Pond Water Fish PW1 11	J
		Zinc	µg/L	32	16	16	12	X	5	3.203125	4.147	ND	8.84	4.147	PAR Pond Water Fish PW2 21	NQ
	Other	Turbidity	percent	29	0	29	11	N	1	2.623103448	3.025	1.17	6.03	3.025	PAR Pond Water Fish PW1 21	NQ
	Radionuclides	Cesium-137	pCi/L	51	18	33	0	X	5	4.058235294	5.087	ND	18.1	5.087	PAR Pond Water Fish PW1 21	NQ
		Gross Alpha	pCi/L	52	49	3	0	X	3	0.475294231	1.513	ND	3.62	1.513	PAR Pond Water Fish PW1 21	NQ
		Lead-212	pCi/L	31	28	3	0	X	5	2.748112903	4.305	ND	30.1	4.305	PAR Pond Water Sediment Fish PW2-1	NQ
		Non-volatile Beta	pCi/L	52	21	31	1	X	5	2.512307692	3.041	ND	10	3.041	PAR Pond Water Fish PW1 21	NQ
		Potassium-40	pCi/L	51	46	5	0	X	5	17.24444118	10.89	ND	45.6	10.89	PAR Pond Water Sediment Fish PW2-1	NQ
		Radium-226	pCi/L	14	6	8	8	X	5	0.561785714	0.819	ND	1.5	0.819	PAR-13-2016	J
		Radium-228	pCi/L	14	13	1	1			0.406571429	NA	ND	0.9	0.9	PAR-14-2016	J
		Thorium-232	pCi/L	14	13	1	1			0.224857143	NA	ND	0.678	0.678	PAR-10-2016	J
		Thorium-234	pCi/L	8	3	5	0	X	5	118.91125	184.2	ND	275	184.2	PAR Pond Water Sediment Fish PW2-1	NQ
	Semivolatiles	Benzo[g,h,i]perylene	µg/L	14	13	1	1			0.165714286	NA	ND	0.37	0.37	PAR-13-2016	J
		Dibenz[a,h]anthracene	µg/L	14	13	1	1			0.169285714	NA	ND	0.42	0.42	PAR-13-2016	J
		Indeno[1,2,3-cd]pyrene	µg/L	14	13	1	1			0.162142857	NA	ND	0.32	0.32	PAR-13-2016	J
	Volatiles	Acetone	µg/L	14	9	5	4	X	3	1.825714286	5.325	ND	10.6	5.325	PAR-14-2016	NQ
		Toluene	µg/L	14	12	2	2	X	5	0.190714286	0.366	ND	0.57	0.366	PAR-14-2016	J
		Xylenes	µg/L	14	13	1	1			0.178571429	NA	ND	0.55	0.55	PAR-14-2016	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-PARametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.6.3__Statistical Summary Table: Exposure Area 6 / Fish Media

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
6	Inorganics	Cyanide	mg/kg	47	37	10	10	X	5	0.215293617	0.187	ND	0.276	0.187	PAR Pond Sediment Fish PF1-13 105729	J
	Metals	Aluminum	mg/kg	52	27	25	24	X	3	4.278557692	7.22	ND	35.4	7.22	PAR Pond Sediment Fish PF2-9 105739	J
		Barium	mg/kg	52	1	51	1	X	7	1.845278846	2.433	ND	6.11	2.433	PAR Pond Sediment Fish PF3-9 105735	NQ
		Calcium	mg/kg	52	0	52	0	G	2	15,441.35	17,768	3,260.00	44,200	17768	PAR Pond Sediment Fish PF2-2 105808	NQ
		Chromium	mg/kg	52	50	2	2	X	5	3.097288462	0.242	ND	0.243	0.242	LTR-PAR	J
		Copper	mg/kg	52	27	25	4	X	3	6.967	10.71	ND	12.8	10.71	PAR Pond Sediment Fish PF4-3 105719	NQ
		Iron	mg/kg	52	14	38	38	G	2	21.66019231	27.18	ND	95.5	27.18	PAR Pond Sediment Fish PF1-9 105722	J
		Magnesium	mg/kg	52	0	52	0	N	1	477.5384615	513.7	265.00	958	513.7	PAR Pond Sediment Fish PF2-2 105808	NQ
		Manganese	mg/kg	52	14	38	18	X	3	7.606596154	14.92	ND	81.3	14.92	PAR Pond Sediment Fish PF3-9 105735	NQ
		Mercury	mg/kg	227	3	224	38	G	2	0.621764578	0.689	ND	3.18	0.689	PAR Pond Sediment Fish PF2-2 105808	J
		Potassium	mg/kg	52	0	52	0	N	1	2738.846154	2,828	1,330.00	3,230	2828	PAR Pond Sediment Fish PF1-8 105726	NQ
		Sodium	mg/kg	52	0	52	12	N	1	1,119.15	1,201	742.00	2,360	1201	PAR Pond Sediment Fish PF2-2 105808	NQ
		Zinc	mg/kg	52	9	43	1	G	2	17.41990385	20.28	ND	59.7	20.28	PAR Pond Sediment Fish PF4-11 105748	NQ
	Radionuclides	Cesium-137	pCi/g	165	5	160	1	G	2	5.069583878	5.513	ND	18.435199	5.513	PAR Pond 28055	NQ
		Cobalt-60	pCi/g	148	135	13	0	X	5	0.343075166	0.00354	ND	0.04185	0.00354	PAR Pond (28055)	NQ
		Gross Alpha	pCi/g	158	133	25	0	X	5	0.618431317	0.554	ND	6.16	0.554	PAR Pond Water Fish PF1 108848	NQ
		Lead-212	pCi/g	75	67	8	0	X	5	0.031776693	0.0178	ND	0.131	0.0178	PAR Pond Sediment Fish PF3-8 105730	NQ
		Manganese-54	pCi/g	97	96	1	0			0.004211174	NA	ND	0.0411	0.0411	PAR Pond Sediment Fish PF1-9 105722	NQ
		Non-volatile Beta	pCi/g	164	4	160	1	X	3	13.65945641	16.71	ND	55.9	16.71	PAR Pond Water Fish PF1 108848	NQ
		Potassium-40	pCi/g	155	39	116	0	X	5	2.700501965	3.014	ND	4.99	3.014	PAR Pond Water Fish PF4 108837	NQ
		Sodium-22	pCi/g	97	96	1	0			0.003730218	NA	ND	0.0376	0.0376	PAR Pond Water Fish PF2 108811	NQ
		Thorium-234	pCi/g	49	48	1	0			0.605612245	NA	ND	1.26	1.26	PAR Pond Sediment Fish PF1-7 105868	NQ
		Tin-113	pCi/g	97	96	1	0			0.006184973	NA	ND	0.0505	0.0505	PAR Pond Sediment Fish PF3-11 105750	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-PARametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.7.1.1__Statistical Summary Table: EA7 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
7	Inorganics	Cyanide	mg/kg	5	3	2	1	X	3	0.3206	1.46	ND	1.15	1.15	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Thallium	mg/kg	36	29	7	6	X	3	0.282611111	0.603	ND	3.19	0.603	P2T3-5	NQ
	Metals	Aluminum	mg/kg	36	0	36	11	L	6	6761.666667	8605	1260	30600	8605	PDC010-003	NQ
		Antimony	mg/kg	36	27	9	9			0.150401389		ND	0.69	0.69	P2T3-3	J
		Arsenic	mg/kg	36	1	35	12	X	5	2.141208333	2.566	ND	14.9	2.566	LTROU-42	NQ
		Barium	mg/kg	36	0	36	0			20.62638889		1.61	114	114	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Beryllium	mg/kg	36	6	30	25	X	5	0.273323611	0.848	ND	4.72	0.848	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Cadmium	mg/kg	36	17	19	18	X	3	0.046529167	0.106	ND	0.378	0.106	P2T3-5	J
		Calcium	mg/kg	36	2	34	10	X	5	154.3805556	220	ND	829	220	LTROU-42	NQ
		Chromium	mg/kg	36	0	36	0	L	6	11.77583333	14.58	2.38	70.7	14.58	P2T3-5	NQ
		Cobalt	mg/kg	36	1	35	10	X	3	1.462541667	4.078	ND	18.3	4.078	LTROU-42	NQ
		Copper	mg/kg	36	0	36	2	L	6	4.275694444	5.261	0.768	24.7	5.261	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Iron	mg/kg	36	0	36	1	G	2	8633.888889	10908	1180	36400	10908	LTROU-42	NQ
		Lead	mg/kg	76	0	76	0	X	3	13.07722412	21.85	0.0377	57.99	21.85	P25-010	NQ
		Magnesium	mg/kg	36	3	33	9	L	6	133.6215278	229	ND	813	229	P2T3-5	NQ
		Manganese	mg/kg	36	0	36	1	L	6	70.79666667	109	3.24	993	109	LTROU-42	NQ
		Mercury	mg/kg	76	8	68	14	X	3	0.158660962	0.297	ND	1.146	0.297	P25-005	NQ
		Nickel	mg/kg	36	0	36	2	L	6	1.894194444	2.36	0.462	9.83	2.36	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Potassium	mg/kg	36	0	36	1	L	6	84.08611111	111.1	12.4	429	111.1	P2T3-5	NQ
		Selenium	mg/kg	36	6	30	21	X	5	0.610972222	0.75	ND	3.63	0.75	P2T3-5	J
		Silver	mg/kg	36	32	4	4	X	5	0.041298611	0.0562	ND	0.325	0.0562	P2T3-5	J
		Sodium	mg/kg	36	31	5	3	X	5	8.678472222	11.87	ND	53.6	11.87	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		Vanadium	mg/kg	36	0	36	0	N	1	23.06777778	26.92	3.65	65.2	26.92	PDC003-001	NQ
		Zinc	mg/kg	36	3	33	9	X	5	7.559875	15.01	ND	44.5	15.01	P2T3-5	NQ
	Pesticides/PCBs	DDD	mg/kg	34	32	2	2	X	7	0.000172	2.30E-04	ND	0.00107	0.00023	LTR ERDMS IOULTR2 Sampling Event: LTROU	J
		DDE	mg/kg	34	30	4	1	X	5	0.000573618	8.84E-04	ND	0.0041	0.000884	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		DDT	mg/kg	34	30	4	2	X	5	0.000584294	0.00111	ND	0.00819	0.00111	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ
		PCB-1254	mg/kg	34	33	1	0			0.003917794		ND	0.0204	0.0204	P2T3-3	NQ
		PCB-1260	mg/kg	34	33	1	0			0.003629265		ND	0.0094	0.0094	P2T3-3	NQ
	Radionuclides	Actinium-228	pCi/g	119	3	116	8	G	2	1.29830084	1.469	ND	7.614	1.469	Pond 2 P25-016-01	NQ
		Americium-241	pCi/g	23	21	2	0			0.082276087		ND	0.88	0.88	1995 Pond 2/5 P2-1 30 cm below water (P2-1-3)	NQ
		Americium-243	pCi/g	20	19	1	1			0.0454025		ND	0.047	0.047	PDC015-001	J
		Bismuth-212	pCi/g	87	40	47	5	X	7	0.872689655	1.003	ND	8.802	1.003	Pond 2 P25-016-01	NQ
		Bismuth-214	pCi/g	136	1	135	4	X	3	1.573006618	2.32	ND	12.366	2.32	Pond 2 P25-019-01	NQ
		Cesium-137	pCi/g	138	41	97	4	X	7	10.80107065	139	ND	149.04	139	Pond 2 P25-019-01	NQ
		Cobalt-60	pCi/g	109	91	18	1	G	2	0.348058083	0.802	ND	15.525	0.802	Pond 2 P25-007-01	NQ
		Curium-243 and Curium-244	pCi/g	21	20	1	1			0.048509524		ND	0.098	0.098	PDC010-001	J
		Gross Alpha	pCi/g	103	1	102	21	X	3	37.2842233	65.91	ND	183.33	65.91	Pond 2 P25-004-01	NQ
		Gross Beta	pCi/g	21	2	19	0	X	5	221.1525	257.5	ND	378	257.5	Pond 2 P25-016-01	NQ
		Lead-210	pCi/g	1	0	1	1			1.9		1.9	1.9	1.9	LTROU-43	J
		Lead-212	pCi/g	138	0	138	2	L	6	1.449844203	1.585	0.224	7.155	1.585	Pond 2 P25-019-01	NQ
		Lead-214	pCi/g	137	0	137	11	X	3	1.693391241	2.43	0.28	12.231	2.43	Pond 2 P25-019-01	NQ
		Non-volatile Beta	pCi/g	82	2	80	27	X	3	21.60567073	25.75	ND	46.5	25.75	LTROU-11	NQ
		Plutonium-238	pCi/g	21	16	5	4	X	5	0.062066667	0.05	ND	0.094	0.05	PDC002-001	J
		Potassium-40	pCi/g	129	49	80	5	X	3	4.125833721	6.99	ND	52.92	6.99	Pond 2 P25-019-01	NQ
		Radium-224	pCi/g	11	0	11	0	N	1	18.882	26.14	2.26	45.9	26.14	Pond 2 P25-019-01	NQ
		Radium-226	pCi/g	39	0	39	5	G	2	1.875538462	2.331	0.33	5.99	2.331	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Radium-228	pCi/g	6	0	6	2	N	1	1.023333333	1.703	0.367	2.61	1.703	LTROU-43	NQ
		Thallium-208	pCi/g	135	2	133	6	X	3	0.525751111	0.705	ND	3.213	0.705	Pond 2 P25-019-01	NQ
		Thorium-228	pCi/g	25	3	22	1	L	6	1.43604	2.407	ND	5.11	2.407	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Thorium-230	pCi/g	21	3	18	1	X	5	0.684166667	0.841	ND	1.43	0.841	PDC001-001	NQ
		Thorium-231	pCi/g	4	0	4	0	N	1	0.8375	0.997	0.68	0.96	0.96	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Thorium-232	pCi/g	23	3	20	0	G	2	0.974586957	1.331	ND	2.71	1.331	P2T1-2	NQ
		Thorium-234	pCi/g	7	0	7	1	G	2	2.183857143	4.446	0.88	5.697	4.446	Pond 2 P25-008-01	NQ
		Uranium-233 and Uranium-234	pCi/g	21	2	19	2	G	2	0.588809524	0.781	ND	1.33	0.781	P2T1-2	NQ
		Uranium-235	pCi/g	23	19	4	2	X	5	0.061978261	0.0822	ND	0.36	0.0822	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Uranium-238	pCi/g	22	2	20	3	X	5	0.651522727	0.811	ND	1.8	0.811	LTROU-43	J
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	34	33	1	1			0.024652941		ND	0.059	0.059	PDC009-003	J
	Volatiles	Acetone	mg/kg	34	20	14	5	G	2	0.040560588	0.08	ND	0.38	0.08	LTR ERDMS IOULTR2 Sampling Event: LTROU	NQ

Table A.1.7.1.1__Statistical Summary Table: EA7 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Carbon disulfide	mg/kg	34	32	2	2	X	3	0.00057	7.40E-04	ND	0.0013	0.00074	LTROU-42	J
		Chloroform	mg/kg	34	33	1	1			0.000295559		ND	0.00048	0.000484	P2T3-4	J
		Methyl acetate	mg/kg	34	33	1	0			0.002078235		ND	0.0217	0.0217	P2T3-3	NQ
		Methyl ethyl ketone	mg/kg	34	29	5	3	X	5	0.002893676	0.00527	ND	0.034	0.00527	LTROU-42	NQ
		Toluene	mg/kg	34	28	6	3	G	2	0.000940206	0.0024	ND	0.0143	0.0024	LTROU-11	NQ
		Xylenes	mg/kg	34	33	1	1			0.00034425		ND	0.00052	0.000517	P2T3-5	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.7.1.2__Statistical Summary Table: Exposure Area 7 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
7	Inorganics	Cyanide	mg/kg	5	3	2	1	X	3	0.3206	1.46	ND	1.15	1.15	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Thallium	mg/kg	52	44	8	7	X	3	0.231028846	0.447	ND	3.19	0.447	P2T3-5	NQ
	Metals	Aluminum	mg/kg	52	0	52	16	L	6	6,709.42	7,952	1,260	32,800	7952	PDC003-004	NQ
		Antimony	mg/kg	52	40	12	12	X	5	0.132533654	0.135	ND	0.69	0.135	P2T3-3	J
		Arsenic	mg/kg	52	1	51	20	X	5	1.986605769	2.253	ND	14.9	2.253	LTROU-42	NQ
		Barium	mg/kg	52	0	52	0	L	6	19.52	24.01	1.61	114	24.01	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Beryllium	mg/kg	52	7	45	36	X	3	0.219893269	0.619	ND	4.72	0.619	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Cadmium	mg/kg	52	29	23	22	X	3	0.037620192	0.076	ND	0.378	0.076	P2T3-5	J
		Calcium	mg/kg	52	3	49	18	G	2	126.8903846	171	ND	829	171	LTROU-42	NQ
		Chromium	mg/kg	52	0	52	0	L	6	10.495	12.13	2.03	70.7	12.13	P2T3-5	NQ
		Cobalt	mg/kg	52	2	50	13	X	3	1.148596154	2.978	ND	18.3	2.978	LTROU-42	NQ
		Copper	mg/kg	52	0	52	5	X	3	3.573730769	6.274	0.768	24.7	6.274	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Iron	mg/kg	52	0	52	1	L	6	7,867.31	9,740	1,090	6,N59400	9740	LTROU-42	NQ
		Lead	mg/kg	92	0	92	0	X	3	11.46455471	18.89	0.03775	57.99	18.89	P25-010	NQ
		Magnesium	mg/kg	52	4	48	10	X	3	116.4860577	205.8	ND	813	205.8	P2T3-5	NQ
		Manganese	mg/kg	52	0	52	1	L	6	55.35576923	68	3.24	993	68	LTROU-42	NQ
		Mercury	mg/kg	92	14	78	23	X	3	0.133500088	0.25	ND	1.146	0.25	P25-005	NQ
		Nickel	mg/kg	52	0	52	2	L	6	1.735153846	1.991	0.462	9.83	1.991	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Potassium	mg/kg	52	0	52	2	L	6	75.25769231	88.93	12.4	429	88.93	P2T3-5	NQ
		Selenium	mg/kg	52	9	43	33	X	3	0.559913462	0.907	ND	3.63	0.907	P2T3-5	J
		Silver	mg/kg	52	47	5	5	X	5	0.037418269	0.0482	ND	0.325	0.0482	P2T3-5	J
		Sodium	mg/kg	52	47	5	3	X	5	7.348076923	9.67	ND	53.6	9.67	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Vanadium	mg/kg	52	0	52	0	G	2	21.26326923	24.69	2.68	65.2	24.69	PDC003-001	NQ
		Zinc	mg/kg	52	4	48	12	X	3	6.088086538	11.41	ND	44.5	11.41	P2T3-5	NQ
	Pesticides/PCBs	DDD	mg/kg	50	48	2	2	X	7	0.0001545	2.10E-04	ND	0.00107	0.0002	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	J
		DDE	mg/kg	50	46	4	1	X	5	0.0004547	6.69E-04	ND	0.0041	0.0007	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		DDT	mg/kg	50	46	4	2	X	5	0.00043756	8.21E-04	ND	0.00819	0.0008	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		PCB-1254	mg/kg	50	49	1	0			0.0035069		ND	0.0204	0.0204	P2T3-3	NQ
		PCB-1260	mg/kg	50	49	1	0			0.0033107		ND	0.0094	0.0094	P2T3-3	NQ
	Radionuclides	Actinium-228	pCi/g	161	3	158	10	X	7	1.275936646	1.383	ND	7.614	1.383	Pond 2 P25-016-01	NQ
		Americium-241	pCi/g	32	30	2	0	X	3	0.067782813	0.231	ND	0.88	0.231	1995 Pond 2/5 P2-1 30 cm below water (P2-1-3)	NQ
		Americium-243	pCi/g	29	28	1	1			0.043155172		ND	0.047	0.047	PDC015-001	J
		Bismuth-212	pCi/g	117	60	57	10	X	3	0.789179487	1.232	ND	8.802	1.232	Pond 2 P25-016-01	NQ
		Bismuth-214	pCi/g	178	1	177	5	X	3	1.392572472	1.974	ND	12.366	1.974	Pond 2 P25-019-01	NQ
		Carbon-14	pCi/g	7	6	1	1			1.06		ND	0.63	0.63	PDC009-005	J
		Cesium-137	pCi/g	180	77	103	6	X	7	8.302507222	64.56	ND	149.04	64.56	Pond 2 P25-019-01	NQ
		Cobalt-60	pCi/g	151	133	18	1	G	2	0.263591596	0.58	ND	15.525	0.58	Pond 2 P25-007-01	NQ
		Curium-243 and Curium-244	pCi/g	30	29	1	1			0.044298333		ND	0.098	0.098	PDC010-001	J
		Gross Alpha	pCi/g	145	1	144	31	X	3	35.30093103	56.5	ND	183.33	56.5	Pond 2 P25-004-01	NQ
		Gross Beta	pCi/g	21	2	19	0	X	5	221.1525	257.5	ND	378	257.5	Pond 2 P25-016-01	NQ
		Lead-210	pCi/g	1	0	1	1			1.9		1.9	1.9	1.9	LTROU-43	J
		Lead-212	pCi/g	180	0	180	2	L	6	1.373191667	1.467	0.224	7.155	1.467	Pond 2 P25-019-01	NQ
		Lead-214	pCi/g	179	0	179	18	X	3	1.508997765	2.091	0.28	12.231	2.091	Pond 2 P25-019-01	NQ
		Non-volatile Beta	pCi/g	124	3	121	41	X	3	21.05770161	24.34	ND	46.5	24.34	LTROU-11	NQ
		Plutonium-238	pCi/g	30	25	5	4	X	5	0.057963333	0.0424	ND	0.094	0.0424	PDC002-001	J
		Potassium-40	pCi/g	171	75	96	9	X	3	3.406465205	5.62	ND	52.92	5.62	Pond 2 P25-019-01	NQ
		Radium-224	pCi/g	11	0	11	0	N	1	18.882	26.14	2.26	45.9	26.14	Pond 2 P25-019-01	NQ
		Radium-226	pCi/g	48	0	48	9	L	6	1.692333333	2.13	0.33	5.99	2.13	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Radium-228	pCi/g	9	1	8	3	X	5	0.951111111	1.417	ND	2.61	1.417	LTROU-43	NQ
		Thallium-208	pCi/g	177	2	175	8	X	3	0.496324294	0.636	ND	3.213	0.636	Pond 2 P25-019-01	NQ
		Thorium-228	pCi/g	34	3	31	1	X	3	1.374147059	2.398	ND	5.11	2.398	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Thorium-230	pCi/g	30	3	27	1	X	7	0.684916667	0.908	ND	1.59	0.908	P2T1-4	NQ
		Thorium-231	pCi/g	4	0	4	0	N	1	0.8375	0.997	0.68	0.96	0.96	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ
		Thorium-232	pCi/g	32	3	29	0	X	7	1.032671875	1.437	ND	3.49	1.437	P2T1-4	NQ
		Thorium-234	pCi/g	7	0	7	1	G	2	2.183857143	4.446	0.88	5.697	4.446	Pond 2 P25-008-01	NQ
		Uranium-233 and Uranium-23	pCi/g	30	2	28	2	L	6	0.593	0.766	ND	1.33	0.766	P2T1-2	NQ
		Uranium-235	pCi/g	32	25	7	5	G	2	0.0565	0.0767	ND	0.36	0.0767	1995 Pond 2/5 P2-3 30 cm below water (P2-3-3)	NQ

Table A.1.7.1.2__Statistical Summary Table: Exposure Area 7 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Uranium-238	pCi/g	31	2	29	3	G	2	0.634919355	0.789	ND	1.8	0.789	LTROU-43	J
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	50	49	1	1			0.024138		ND	0.059	0.059	PDC009-003	J
	Volatiles	Acetone	mg/kg	50	34	16	6	G	2	0.0290668	0.059	ND	0.38	0.059	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	NQ
		Carbon disulfide	mg/kg	50	46	4	4	X	5	0.0005706	7.15E-04	ND	0.00282	0.0007	P2T3-3	J
		Chloroform	mg/kg	50	49	1	1			0.00027901		ND	0.00048	0.0005	P2T3-4	J
		Methyl acetate	mg/kg	50	49	1	0			0.0017461		ND	0.0217	0.0217	P2T3-3	NQ
		Methyl ethyl ketone	mg/kg	50	45	5	3	X	5	0.0022819	0.00399	ND	0.034	0.004	LTROU-42	NQ
		Toluene	mg/kg	50	43	7	4	G	2	0.00072583	0.0016	ND	0.0143	0.0016	LTROU-11	NQ
		Xylenes	mg/kg	50	49	1	1			0.00032342		ND	0.00052	0.0005	P2T3-5	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.7.2__Statisical Summary Table: Exposure Area 7 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
7	Inorganics	Cyanide	µg/L	9	7	2	2	X	5	1.795555556	3.173	ND	4.23	3.173	LTROU-20	J
		Thallium	µg/L	24	17	7	7	X	5	1.551666667	0.686	ND	1.4	0.686	PDC010-002	J
	Metals	Aluminum	µg/L	24	1	23	1	X	3	682.5708333	2364	ND	9,360	2364	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Arsenic	µg/L	24	22	2	2	X	5	1.527083333	2.413	ND	3.95	2.413	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
		Barium	µg/L	24	0	24	1	G	2	35.51375	44.27	4.73	90.2	44.27	PDC005-002	NQ
		Beryllium	µg/L	24	18	6	6	X	5	0.124125	0.154	ND	0.32	0.154	PDC013-002	J
		Cadmium	µg/L	24	19	5	5	X	5	0.12275	0.143	ND	0.369	0.143	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
		Calcium	µg/L	24	0	24	0	N	1	3,414.96	4133	979	7,590	4133	PDC001-002	NQ
		Chromium	µg/L	24	16	8	5	X	5	3.557291667	5.253	ND	17.4	5.253	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Cobalt	µg/L	24	6	18	16	G	2	1.213145833	1.862	ND	5.6	1.862	PDC005-002	NQ
		Copper	µg/L	24	10	14	11	G	2	1.318333333	2.041	ND	6.88	2.041	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Iron	µg/L	24	0	24	0	L	6	3996.25	5081	684	36,300	5081	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Lead	µg/L	24	19	5	4	X	5	1.066875	1.812	ND	7.53	1.812	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Magnesium	µg/L	24	0	24	0	N	1	666.0833333	749.9	295	1510	749.9	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Manganese	µg/L	24	0	24	0	X	3	548.8083333	1,280	77.1	3,380	1280	PDC005-002	NQ
		Mercury	µg/L	24	22	2	2	X	5	0.048245833	0.0677	ND	0.15	0.0677	PDC004-002	J
		Nickel	µg/L	24	10	14	14	G	2	0.831708333	1.217	ND	3.4	1.217	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
		Potassium	µg/L	24	1	23	2	X	5	829.6041667	1,060	ND	2,970	1060	PDC001-002	NQ
		Selenium	µg/L	24	20	4	4	X	5	1.391666667	1.872	ND	4	1.872	PDC010-002	J
		Sodium	µg/L	24	0	24	0	N	1	1,737.71	1,981	542	3,990	1981	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Vanadium	µg/L	24	11	13	12	G	2	2.745833333	5.169	ND	19	5.169	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Zinc	µg/L	24	6	18	11	X	7	9.6913125	23.4	ND	30.1	23.4	PDC014-002	NQ
	Pesticides/PCBs	DDE	µg/L	24	22	2	2	X	5	0.003711042	0.00532	ND	0.007	0.00532	LTROU-10	J
		DDT	µg/L	24	21	3	1	X	5	0.0171	0.0208	ND	0.0632	0.0208	LTR ERDMS IOULTR2 Sampling Event: LTROU-24	NQ
		Endrin ketone	µg/L	24	23	1	1			0.00290875	NA	ND	0.00528	0.00528	LTR ERDMS IOULTR2 Sampling Event: LTROU-25	J
	Radionuclides	Bismuth-214	pCi/L	23	22	1	1			18.52391304	NA	ND	80.7	80.7	LTR ERDMS IOULTR2 Sampling Event: LTROU-25	J
		Cesium-137	pCi/L	63	62	1	1			2.971260361	NA	ND	7.6	7.6	LTROU-11	J
		Gross Alpha	pCi/L	180	164	16	1	X	3	0.355284037	0.805	ND	7.27	0.805	LTR ERDMS IOULTR2 Sampling Event: LTROU-09	J
		Gross Beta	pCi/L	39	0	39	0	N	1	4.017745518	4.589	1.809443	11.577546	4.589	P-Area Canal-Par Pond	NQ
		Lead-212	pCi/L	23	22	1	1			13.1826087	NA	ND	17	17	LTROU-19	J
		Lead-214	pCi/L	23	21	2	2	X	3	18.46086957	43.95	ND	110	43.95	LTR ERDMS IOULTR2 Sampling Event: LTROU-25	J
		Non-volatile Beta	pCi/L	141	55	86	1	X	5	1.812329716	1.839	ND	10.5	1.839	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
		Strontium-89 and Strontium-90	pCi/L	69	66	3	0	X	5	0.208089455	0.163	ND	2.967948	0.163	P-Area Canal-Par Pond	NQ
		Tritium	pCi/L	267	61	206	10	X	3	1612.781158	2751	ND	12501	2751	P-Area Canal-Par Pond	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	µg/L	24	21	3	3	X	5	0.561372917	0.414	ND	1.4	0.414	PDC009-002	J
		Caprolactam	µg/L	24	22	2	1	X	3	2.614375	5.958	ND	9.97	5.958	LTROU-19	NQ
		Diethylphthalate	µg/L	24	23	1	1			0.571375	NA	ND	1.6	1.6	PDC015-002	J
		m,p-Cresol	µg/L	24	23	1	1			0.7285625	NA	ND	5.55	5.55	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
		Phenol	µg/L	24	23	1	1			1.388916667	NA	ND	0.764	0.764	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	J
	Volatiles	Acetone	µg/L	24	7	17	8	X	5	2.211041667	2.86	ND	6.76	2.86	LTR ERDMS IOULTR2 Sampling Event: LTROU-08	NQ
		Chloromethane	µg/L	17	16	1	1			0.138647059	NA	ND	0.21	0.21	PDC001-002	J
		Toluene	µg/L	24	11	13	10	X	3	0.525833333	1.575	ND	5.33	1.575	LTROU-11	NQ
		Trichloroethene	µg/L	24	22	2	2	X	5	0.138291667	0.214	ND	0.433	0.214	LTROU-10	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.8.1.1__Statistical Summary Table: EA8 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
8	Inorganics	Cyanide	mg/kg	4	1	3	2	X	5	0.8713875	2.331	ND	2.6	2.331	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Thallium	mg/kg	18	16	2	2	X	3	0.546027778	1.059	ND	2.21	1.059	P4T2-5	J
	Metals	Aluminum	mg/kg	18	0	18	0	G	2	8,661.67	13,888	1,710	36,900	13888	LTROU-05	NQ
		Antimony	mg/kg	18	16	2	2	X	3	0.296111111	0.608	ND	1.29	0.608	LTROU-05	J
		Arsenic	mg/kg	18	2	16	11	G	2	1.708638889	2.888	ND	7.85	2.888	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Barium	mg/kg	18	0	18	2	X	3	27.69722222	63.24	2.72	118	63.24	LTROU-17	J
		Beryllium	mg/kg	18	4	14	12	G	2	0.2872	0.605	ND	1.7	0.605	LTROU-17	NQ
		Cadmium	mg/kg	18	13	5	5	X	5	0.143788889	0.211	ND	0.549	0.211	P5T2-5	J
		Calcium	mg/kg	18	0	18	9	X	3	179.1166667	381.5	13.7	565	381.5	PDC017-001	NQ
		Chromium	mg/kg	18	0	18	0	X	3	14.90888889	49.01	2.07	145	49.01	LTROU-17	NQ
		Cobalt	mg/kg	18	2	16	6	X	3	1.331277778	4.486	ND	13.3	4.486	LTROU-17	NQ
		Copper	mg/kg	18	0	18	6	G	2	4.967833333	8.942	0.639	36.8	8.942	LTROU-17	NQ
		Iron	mg/kg	18	0	18	1	X	3	6,889.39	17,373	969	37,200	17373	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Lead	mg/kg	65	0	65	0	X	3	19.17233231	33.74	0.1566	98.12	33.74	P25-020	NQ
		Magnesium	mg/kg	18	0	18	7	X	3	209.1	612.9	12.1	1,670	612.9	LTROU-17	J
		Manganese	mg/kg	18	0	18	2	G	2	52.285	95.19	2.33	263	95.19	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Mercury	mg/kg	65	7	58	6	X	3	0.1899091	0.367	ND	1.265	0.367	P25-030	NQ
		Nickel	mg/kg	18	0	18	6	X	3	2.599277778	6.88	0.332	17.1	6.88	LTROU-17	NQ
		Potassium	mg/kg	18	0	18	8	X	3	131.8333333	361.4	7.1	916	361.4	LTROU-17	J
		Selenium	mg/kg	18	11	7	7	G	2	0.534	1.017	ND	2.87	1.017	P4T2-5	J
		Silver	mg/kg	18	16	2	2	X	5	0.097961111	0.13	ND	0.439	0.13	P4T2-5	J
		Sodium	mg/kg	18	12	6	2	X	5	14.39083333	23.93	ND	61.4	23.93	LTROU-17	NQ
		Vanadium	mg/kg	18	0	18	0	X	3	20.115	42.88	3.58	73.4	42.88	LTROU-17	NQ
		Zinc	mg/kg	18	0	18	8	X	3	11.51077778	40.32	0.914	121	40.32	LTROU-17	J
	Pesticides/PCBs	DDD	mg/kg	18	17	1	0			0.020774667	NA	ND	0.37	0.37	LTROU-05	NQ
		DDE	mg/kg	18	14	4	3	G	2	0.029234833	0.262	ND	0.511	0.262	LTROU-05	J
		DDT	mg/kg	18	16	2	0	X	3	0.016488306	0.224	ND	0.274	0.224	LTROU-05	NQ
		PCB-1242	mg/kg	18	17	1	1			0.015194444	NA	ND	0.0638	0.0638	P4T2-5	J
		PCB-1254	mg/kg	18	16	2	1	X	3	0.015496111	0.0872	ND	0.101	0.0872	P4T2-5	NQ
	Radionuclides	Actinium-228	pCi/g	57	0	57	8	X	3	1.778789474	2.775	0.254	7.506	2.775	Pond 5 P25-055-01	NQ
		Americium-241	pCi/g	10	9	1	1			0.102855	NA	ND	0.338	0.338	LTROU-17	J
		Bismuth-212	pCi/g	21	10	11	0	X	5	2.286542857	3.249	ND	7.533	3.249	Pond 4 P25-022-01	NQ
		Bismuth-214	pCi/g	72	1	71	3	X	3	2.167940278	3.286	ND	8.1	3.286	Pond 5 P25-055-01	NQ
		Cesium-137	pCi/g	71	12	59	4	X	3	29.34557535	50.31	ND	125.55	50.31	Pond 5 P25-042-01	NQ
		Cobalt-60	pCi/g	73	68	5	1	X	5	0.089395137	0.0564	ND	0.5859	0.0564	Pond 4 P25-022-01	NQ
		Gross Alpha	pCi/g	72	1	71	13	X	3	51.16263889	78.52	ND	207.09	78.52	Pond 4 P25-027-01	NQ
		Gross Beta	pCi/g	27	0	27	0	N	1	390.1166667	436.7	9.9	672.3	436.7	Pond 4 P25-027-01	NQ
		Lead-212	pCi/g	72	0	72	0	L	6	1.942183333	2.375	0.269	6.588	2.375	Pond 4 P25-022-01	NQ
		Lead-214	pCi/g	72	0	72	12	X	3	2.209716667	3.299	0.172	8.154	3.299	Pond 5 P25-055-01	NQ
		Non-volatile Beta	pCi/g	45	3	42	13	G	2	11.90366667	14.63	ND	48.7	14.63	LTROU-17	NQ
		Plutonium-238	pCi/g	10	9	1	1			0.097085	NA	ND	0.035	0.035	PDC016-001	J
		Potassium-40	pCi/g	71	21	50	15	X	3	5.522640845	9.05	ND	22.734	9.05	Pond 5 P25-054-01	NQ
		Radium-224	pCi/g	9	0	9	0	N	1	25.863	29.96	20.898	41.58	29.96	Pond 5 P25-042-01	NQ
		Radium-226	pCi/g	10	0	10	0	N	1	1.0666	1.275	0.724	1.75	1.275	LTROU-17	NQ
		Radium-228	pCi/g	5	0	5	0	N	1	1.814	2.537	1.1	3.07	2.537	LTROU-05	NQ
		Thallium-208	pCi/g	70	1	69	3	X	3	0.713144286	1.063	ND	3.051	1.063	Pond 5 P25-054-01	NQ
		Thorium-228	pCi/g	10	0	10	2	N	1	1.4084	1.714	0.64	2.32	1.714	LTROU-05	NQ
		Thorium-230	pCi/g	10	0	10	3	N	1	0.7429	0.931	0.363	1.37	0.931	LTROU-17	NQ
		Thorium-232	pCi/g	10	0	10	1	N	1	1.2705	1.53	0.724	2.19	1.53	P4T2-3	NQ
		Uranium-233 and Uranium-234	pCi/g	10	0	10	4	N	1	0.8884	1.14	0.522	1.9	1.14	LTROU-17	NQ
		Uranium-238	pCi/g	10	0	10	4	N	1	0.7555	0.972	0.341	1.42	0.972	LTROU-17	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	18	17	1	1			0.046208333	NA	ND	0.22	0.22	LTROU-18	J
	Volatiles	Acetone	mg/kg	18	8	10	1	X	3	0.099401111	0.495	ND	1.05	0.495	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Carbon disulfide	mg/kg	18	16	2	2	X	3	0.001302556	0.0038	ND	0.00877	0.0038	LTROU-17	J
		Methyl ethyl ketone	mg/kg	18	15	3	1	X	5	0.006001639	0.0138	ND	0.0631	0.0138	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Toluene	mg/kg	18	11	7	2	X	5	0.001187444	0.002	ND	0.00764	0.002	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.8.1.2__Statistical Summary Table: Exposure Area 8 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
8	Inorganics	Cyanide	mg/kg	4	1	3	2	X	5	0.8713875	2.331	ND	2.6	2.331	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Thallium	mg/kg	28	26	2	2	X	3	0.435732143	0.708	ND	2.21	0.708	P4T2-5	J
	Metals	Aluminum	mg/kg	28	0	28	0	X	3	7,545	14,619	1,710	36,900	14619	LTROU-05	NQ
		Antimony	mg/kg	28	26	2	2	X	3	0.246169643	0.416	ND	1.29	0.416	LTROU-05	J
		Arsenic	mg/kg	28	3	25	20	X	7	1.469946429	1.88	ND	7.85	1.88	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Barium	mg/kg	28	0	28	2	L	6	23.46321429	37.23	2.72	118	37.23	LTROU-17	J
		Beryllium	mg/kg	28	11	17	15	X	3	0.208332143	0.498	ND	1.7	0.498	LTROU-17	NQ
		Cadmium	mg/kg	28	23	5	5	X	5	0.108817857	0.14	ND	0.549	0.14	P5T2-5	J
		Calcium	mg/kg	28	0	28	15	L	6	131.2392857	264.3	11.3	565	264.3	PDC017-001	NQ
		Chromium	mg/kg	28	0	28	0	L	6	11.85785714	14.29	2.07	145	14.29	LTROU-17	NQ
		Cobalt	mg/kg	28	5	23	11	X	7	0.945017857	1.063	ND	13.3	1.063	LTROU-17	NQ
		Copper	mg/kg	28	0	28	10	L	6	3.755214286	5.184	0.592	36.8	5.184	LTROU-17	NQ
		Iron	mg/kg	28	0	28	1	X	3	5,269.14	12,244	557	37,200	12244	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Lead	mg/kg	75	0	75	0	X	3	17.057488	29.97	0.1566	98.12	29.97	P25-020	NQ
		Magnesium	mg/kg	28	0	28	10	L	6	155.4	223.4	12.1	1,670	223.4	LTROU-17	J
		Manganese	mg/kg	28	0	28	2	L	6	36.86035714	64.15	2.33	263	64.15	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Mercury	mg/kg	75	10	65	9	X	3	0.16690282	0.323	ND	1.265	0.323	P25-030	NQ
		Nickel	mg/kg	28	0	28	8	X	3	2.064535714	4.861	0.332	17.1	4.861	LTROU-17	NQ
		Potassium	mg/kg	28	0	28	11	L	6	99.29285714	145	7.1	916	145	LTROU-17	J
		Selenium	mg/kg	28	18	10	10	G	2	0.474107143	0.746	ND	2.87	0.746	P4T2-5	J
		Silver	mg/kg	28	25	3	3	X	5	0.082392857	0.0915	ND	0.439	0.0915	P4T2-5	J
		Sodium	mg/kg	28	22	6	2	X	5	10.70125	18.09	ND	61.4	18.09	LTROU-17	NQ
		Vanadium	mg/kg	28	0	28	0	X	3	16.59785714	31.99	3.58	73.4	31.99	LTROU-17	NQ
		Zinc	mg/kg	28	0	28	15	X	3	8.130964286	26.85	0.896	121	26.85	LTROU-17	J
	Pesticides/PCBs	DDD	mg/kg	28	27	1	0			0.013417321	NA	ND	0.37	0.37	LTROU-05	NQ
		DDE	mg/kg	28	24	4	3	G	2	0.018863679	0.15	ND	0.511	0.15	LTROU-05	J
		DDT	mg/kg	28	26	2	0	X	3	0.010662518	0.095	ND	0.274	0.095	LTROU-05	NQ
		PCB-1242	mg/kg	28	27	1	1			0.010153214	NA	ND	0.0638	0.0638	P4T2-5	J
		PCB-1254	mg/kg	28	26	2	1	X	3	0.010373929	0.05559	ND	0.101	0.05559	P4T2-5	NQ
	Radionuclides	Actinium-228	pCi/g	87	0	87	9	X	3	1.58608046	2.26	0.254	7.506	2.26	Pond 5 P25-055-01	NQ
		Americium-241	pCi/g	13	12	1	1			0.091934615	NA	ND	0.338	0.338	LTROU-17	J
		Bismuth-212	pCi/g	27	16	11	0	X	5	1.850274074	2.68	ND	7.533	2.68	Pond 4 P25-022-01	NQ
		Bismuth-214	pCi/g	102	1	101	4	X	3	1.740595098	2.58	ND	8.1	2.58	Pond 5 P25-055-01	NQ
		Cesium-137	pCi/g	101	35	66	8	X	3	20.66624059	36.5	ND	125.55	36.5	Pond 5 P25-042-01	NQ
		Cobalt-60	pCi/g	103	98	5	1	X	5	0.070526165	0.0395	ND	0.5859	0.0395	Pond 4 P25-022-01	NQ
		Gross Alpha	pCi/g	102	1	101	19	X	3	40.48931373	61.11	ND	207.09	61.11	Pond 4 P25-027-01	NQ
		Gross Beta	pCi/g	27	0	27	0	N	1	390.1166667	436.7	9.9	672.3	436.7	Pond 4 P25-027-01	NQ
		Lead-212	pCi/g	102	0	102	0	L	6	1.703580392	1.934	0.269	6.588	1.934	Pond 4 P25-022-01	NQ
		Lead-214	pCi/g	102	0	102	16	X	3	1.804094118	2.621	0.172	8.154	2.621	Pond 5 P25-055-01	NQ
		Non-volatile Beta	pCi/g	75	3	72	27	X	7	10.83966667	12.35	ND	48.7	12.35	LTROU-17	NQ
		Plutonium-238	pCi/g	13	12	1	1			0.098488462	NA	ND	0.035	0.035	PDC016-001	J
		Potassium-40	pCi/g	100	30	70	33	X	3	4.177025	6.85	ND	22.734	6.85	Pond 5 P25-054-01	NQ
		Radium-224	pCi/g	9	0	9	0	N	1	25.863	29.96	20.898	41.58	29.96	Pond 5 P25-042-01	NQ
		Radium-226	pCi/g	13	0	13	0	N	1	0.975461538	1.162	0.379	1.75	1.162	LTROU-17	NQ
		Radium-228	pCi/g	5	0	5	0	N	1	1.814	2.537	1.1	3.07	2.537	LTROU-05	NQ
		Thallium-208	pCi/g	100	1	99	4	X	3	0.608581	0.865	ND	3.051	0.865	Pond 5 P25-054-01	NQ
		Thorium-228	pCi/g	13	0	13	4	N	1	1.300461538	1.557	0.562	2.32	1.557	LTROU-05	NQ
		Thorium-230	pCi/g	13	0	13	5	N	1	0.701076923	0.849	0.363	1.37	0.849	LTROU-17	NQ
		Thorium-232	pCi/g	13	0	13	2	N	1	1.205615385	1.42	0.558	2.19	1.42	P4T2-3	NQ
		Uranium-233 and Uranium-234	pCi/g	13	0	13	6	N	1	0.825076923	1.034	0.347	1.9	1.034	LTROU-17	NQ
		Uranium-238	pCi/g	13	0	13	6	N	1	0.717615385	0.886	0.341	1.42	0.886	LTROU-17	NQ
	Semivolatiles	Bis[2-ethylhexyl]phthalate	mg/kg	28	26	2	2	X	5	0.044741071	0.0456	ND	0.22	0.0456	LTROU-18	J
	Volatiles	Acetone	mg/kg	28	15	13	4	X	3	0.065074464	0.245	ND	1.05	0.245	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Carbon disulfide	mg/kg	28	26	2	2	X	3	0.00105825	0.00268	ND	0.00877	0.00268	LTROU-17	J
		Methyl ethyl ketone	mg/kg	28	25	3	1	X	5	0.004133911	0.00922	ND	0.0631	0.00922	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Toluene	mg/kg	28	21	7	2	X	5	0.000830107	0.00142	ND	0.00764	0.00142	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.8.2__Statisical Summary Table: Exposure Area 8 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
8	Inorganics	Cyanide	µg/L	4	3	1	1			1.54625	NA	ND	1.85	1.85	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
		Thallium	µg/L	9	8	1	1			1.943888889	NA	ND	1.1	1.1	PDC017-002	J
	Metals	Aluminum	µg/L	9	2	7	1	X	3	230.2277778	852.6	ND	1,340	852.6	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Barium	µg/L	9	0	9	0	N	1	21.56666667	26.04	11.2	35.4	26.04	PDC016-002	NQ
		Beryllium	µg/L	9	8	1	1			0.199055556	NA	ND	0.32	0.32	PDC017-002	J
		Cadmium	µg/L	9	7	2	2	X	3	0.212722222	0.297	ND	0.27	0.27	PDC017-002	J
		Calcium	µg/L	9	0	9	0	G	2	3112.111111	6,369	459	11,200	6369	LTROU-23	NQ
		Chromium	µg/L	9	8	1	1			0.807	NA	ND	1.14	1.14	P5-SW	J
		Cobalt	µg/L	9	7	2	2	X	5	0.409777778	0.7	ND	1.1	0.7	PDC016-002	J
		Copper	µg/L	9	5	4	4	G	2	1.312777778	2.115	ND	2.92	2.115	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
		Iron	µg/L	9	1	8	0	X	5	2,440.37	3,761	ND	5,990	3761	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Lead	µg/L	9	8	1	1			1.215	NA	ND	1.74	1.74	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
		Magnesium	µg/L	9	0	9	0	N	1	604.6666667	723	359	1,040	723	LTROU-23	NQ
		Manganese	µg/L	9	0	9	0	N	1	153.4444444	252.3	11.7	460	252.3	PDC016-002	NQ
		Nickel	µg/L	9	6	3	3	X	5	0.559277778	0.78	ND	0.92	0.78	PDC016-002	J
		Potassium	µg/L	9	1	8	3	X	5	162.0555556	246.1	ND	397	246.1	PDC018-002	NQ
		Sodium	µg/L	9	0	9	0	N	1	1,444.44	1,973	408	2,860	1973	LTROU-17	NQ
		Vanadium	µg/L	9	6	3	1	X	5	3.522777778	6.904	ND	11.2	6.904	PDC018-002	NQ
		Zinc	µg/L	9	6	3	1	X	5	5.971277778	13.04	ND	31	13.04	PDC016-002	NQ
	Pesticides/PCBs	Atrazine	µg/L	9	8	1	0			1.888888889	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		DDT	µg/L	9	8	1	1			0.009005556	NA	ND	0.0142	0.0142	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
	Radionuclides	Gross Alpha	pCi/L	4	3	1	1			1.401125	NA	ND	1.65	1.65	LTROU-23	J
		Lead-214	pCi/L	9	8	1	1			19.61555556	NA	ND	101	101	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
		Non-volatile Beta	pCi/L	4	1	3	2	X	5	2.07675	3.18	ND	2.95	2.95	LTROU-23	NQ
		Tritium	pCi/L	13	3	10	8	X	5	667.7692308	854.6	ND	1440	854.6	R-Area Burning Rubble Pit Phase 4 Sampling: RBRP-SW-01	J
	Semivolatiles	2-Chloronaphthalene	µg/L	9	8	1	0			0.328	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2-Chlorophenol	µg/L	9	8	1	0			1.66	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2-Methylnaphthalene	µg/L	9	8	1	0			0.331277778	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2-Nitroaniline	µg/L	9	8	1	0			1.964444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2-Nitrophenol	µg/L	9	8	1	0			1.673888889	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4-Dichlorophenol	µg/L	9	8	1	0			1.665555556	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4-Dimethylphenol	µg/L	9	8	1	0			1.667222222	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4-Dinitrophenol	µg/L	9	8	1	0			3.242777778	NA	ND	19.2	19.2	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4-Dinitrotoluene	µg/L	9	8	1	0			1.6155	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4,5-Trichlorophenol	µg/L	9	8	1	0			1.816666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,4,6-Trichlorophenol	µg/L	9	8	1	0			1.806666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		2,6-Dinitrotoluene	µg/L	9	8	1	0			1.635	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		3-Nitroanaline	µg/L	9	8	1	0			1.670555556	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		3,3-Dichlorobenzidine	µg/L	9	8	1	0			1.636666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Bromophenyl phenyl ether	µg/L	9	8	1	0			1.643333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Chloraniline	µg/L	9	8	1	0			1.864444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Chloro-m-cresol	µg/L	9	8	1	0			1.683333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Chlorophenylphenyl ether	µg/L	9	8	1	0			1.65	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Nitroaniline	µg/L	9	8	1	0			1.821111111	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4-Nitrophenol	µg/L	9	8	1	0			1.653666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		4,6-Dinitro-2-Methylphenol	µg/L	9	8	1	0			1.893277778	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Acenaphthene	µg/L	9	8	1	0			0.319377778	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Acenaphthylene	µg/L	9	8	1	0			0.312033333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Acetophenone	µg/L	9	8	1	0			1.695	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Anthracene	µg/L	9	8	1	0			0.316888889	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzaldehyde	µg/L	9	8	1	0			1.797777778	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzo[a]anthracene	µg/L	9	8	1	0			0.312033333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzo[a]pyrene	µg/L	9	8	1	0			0.316888889	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzo[b]fluoranthene	µg/L	9	8	1	0			0.316888889	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzo[g,h,i]perylene	µg/L	9	8	1	0			0.308783333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Benzo[k]fluoranthene	µg/L	9	8	1	0			0.333111111	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Bis[2-chloroethoxy]methane	µg/L	9	8	1	0			1.794444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Bis[2-chloroethyl] ether	µg/L	9	8	1	0			1.685	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Bis[2-chloroisopropyl]ether	µg/L	9	8	1	0			1.672222222	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Bis[2-ethylhexyl]phthalate	µg/L	9	8	1	0			1.464277778	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Butylbenzylphthalate	µg/L	9	8	1	0			1.753333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Caprolactam	µg/L	9	7	2	0	X	5	3.438888889	7.8	ND	10.8	7.8	LTROU-17	NQ
		Carbazole	µg/L	9	8	1	0			1.463333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ

Table A.1.8.2__Statisical Summary Table: Exposure Area 8 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Chrysene	µg/L	9	8	1	0			0.315333333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Dibenz[a,h]anthracene	µg/L	9	8	1	0			0.312033333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Dibenzofuran	µg/L	9	8	1	0			1.618833333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Dibutylphthalate	µg/L	9	8	1	0			1.753333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Diethylphthalate	µg/L	9	8	1	0			1.658333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Dimethylphthalate	µg/L	9	8	1	0			1.655	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Dioctylphthalate	µg/L	9	8	1	0			1.913888889	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Diphenylamine	µg/L	4	3	1	0			2.778250013	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Fluoranthene	µg/L	9	8	1	0			0.315333333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Fluorene	µg/L	9	8	1	0			0.315333333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Hexachlorobenzene	µg/L	9	8	1	0			1.631666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Hexachlorocyclopentadiene	µg/L	9	8	1	0			1.747777778	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Indeno[1,2,3-cd]pyrene	µg/L	9	8	1	0			0.312033333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Isophorone	µg/L	9	8	1	0			1.751111111	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		m,p-Cresol	µg/L	9	8	1	0			1.742777778	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		N-Nitrosodipropylamine	µg/L	9	8	1	0			1.672222222	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		o-Cresol	µg/L	9	8	1	0			1.83	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Pentachlorophenol	µg/L	9	8	1	0			1.881666667	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Phenanthrene	µg/L	9	8	1	0			0.315333333	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Phenol	µg/L	9	8	1	0			1.983333333	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Pyrene	µg/L	9	8	1	0			0.329611111	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
	Semivolatiles/Volatiles	Hexachlorobutadiene	µg/L	9	8	1	0			1.744444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Hexachloroethane	µg/L	9	8	1	0			1.734444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Naphthalene	µg/L	9	8	1	0			0.326444444	NA	ND	0.962	0.962	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Nitrobenzene	µg/L	9	8	1	0			1.799444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
	Volatiles	Acetone	µg/L	13	10	3	3	X	5	1.065384615	1.378	ND	2.33	1.378	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	J
		Biphenyl	µg/L	9	8	1	0			1.789444444	NA	ND	9.62	9.62	LTR ERDMS IOULTR2 Sampling Event: LTROU-06	NQ
		Toluene	µg/L	13	7	6	2	X	5	0.585384615	1.731	ND	3.47	1.731	P4-SW	NQ
		Trichloroethene	µg/L	13	12	1	1			0.121538462	NA	ND	0.38	0.38	P5-SW	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.8.3__Statistical Summary Table: Exposure Area 8 / Fish Media

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
8	Metals	Barium	mg/kg	1	0	1	0			1.21	NA	1.21	1.21	1.21	LTR-P45	NQ
		Calcium	mg/kg	1	0	1	1			25,800	NA	25800.00	25,800	25800	LTR-P45	J
		Chromium	mg/kg	1	0	1	1			0.295	NA	0.295	0.295	0.295	LTR-P45	J
		Copper	mg/kg	1	0	1	1			0.256	NA	0.256	0.256	0.256	LTR-P45	J
		Iron	mg/kg	1	0	1	0			35.1	NA	35.1	35.1	35.1	LTR-P45	NQ
		Magnesium	mg/kg	1	0	1	1			645	NA	645	645	645	LTR-P45	J
		Manganese	mg/kg	1	0	1	0			1.22	NA	1.22	1.22	1.22	LTR-P45	NQ
		Mercury	mg/kg	1	0	1	1			0.854	NA	0.854	0.854	0.854	LTR-P45	J
		Potassium	mg/kg	1	0	1	1			2,420	NA	2420.00	2,420	2420	LTR-P45	J
		Sodium	mg/kg	1	0	1	1			1,630	NA	1630.00	1,630	1630	LTR-P45	J
		Zinc	mg/kg	1	0	1	1			24.7	NA	24.7	24.7	24.7	LTR-P45	J
	Radionuclides	Cesium-137	pCi/g	1	0	1	0			7.84	NA	7.84	7.84	7.84	LTR-P45	NQ
		Non-volatile Beta	pCi/g	1	0	1	0			7.29	NA	7.29	7.29	7.29	LTR-P45	NQ
		Potassium-40	pCi/g	1	0	1	0			2.5	NA	2.5	2.5	2.5	LTR-P45	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.9.1.1__Statistical Summary Table: EA9 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
9	Inorganics	Ammonia	mg/kg	1	0	1	0			64.300003	NA	64.3	64.300003	64.300003	Pond C: PPSC-SED11	NQ
		Chloride	mg/kg	9	3	6	5	X	5	4.067222211	6.982	ND	15.1	6.982	Pond C SED12, Pond C SED28	J
		Cyanide	mg/kg	10	9	1	1			0.6542	NA	ND	0.142	0.142	LTROU-16	J
		Orthophosphate	mg/kg	9	8	1	1			6.172222211	NA	ND	2.6199999	2.6199999	Pond C SED12, Pond C SED28	J
		Phosphate	mg/kg	9	0	9	8	N	1	146.6666662	210.4	60.5	375	210.4	Pond C: PPSC-SED11	J
		Thallium	mg/kg	15	13	2	2	X	5	4.9215	2.634	ND	4.59	2.634	Pond C SED12, Pond C SED28	J
	Metals	Aluminum	mg/kg	15	0	15	0	G	2	6,622	9,627	1,690	18,000	9627	Pond C SED12, Pond C SED28	NQ
		Arsenic	mg/kg	15	10	5	5	X	5	6.117733334	1.595	ND	2.14	1.595	PCT1-5	J
		Barium	mg/kg	15	0	15	0	G	2	29.21866667	45.3	5.52	86.1	45.3	Pond C SED12, Pond C SED28	NQ
		Beryllium	mg/kg	15	1	14	14	G	2	0.263266667	0.429	ND	0.772	0.429	Pond C SED12, Pond C SED28	J
		Cadmium	mg/kg	15	14	1	1			0.214533333	NA	ND	0.0505	0.0505	LTROU-16	J
		Calcium	mg/kg	15	0	15	2	G	2	214.02	411.3	15.8	817	411.3	Pond C SED12, Pond C SED28	NQ
		Chromium	mg/kg	15	0	15	1	G	2	10.63399999	16.49	1.68	32.7	16.49	Pond C: PPSC-SED11	NQ
		Cobalt	mg/kg	15	0	15	7	G	2	1.2768	2.143	0.272	5.5	2.143	Pond C: PPSC-SED11	NQ
		Copper	mg/kg	15	0	15	6	L	6	3.5552	6.455	0.627	14.1	6.455	Pond C: PPSC-SED11	NQ
		Iron	mg/kg	15	0	15	0	N	1	6,272.67	8,551	1,180	17,600	8551	Pond C: PPSC-SED11	NQ
		Lead	mg/kg	15	0	15	5	G	2	7.129333333	10.53	1.04	18.1	10.53	Pond C SED12, Pond C SED28	NQ
		Magnesium	mg/kg	15	0	15	1	N	1	141.4533333	193	36.1	376	193	Pond C SED12, Pond C SED28	NQ
		Manganese	mg/kg	15	0	15	0	G	2	59.00133327	113.7	4.8	181	113.7	Pond C SED12, Pond C SED28	NQ
		Mercury	mg/kg	15	2	13	7	G	2	0.048437333	0.0385	ND	0.076599998	0.0385	Pond C: PPSC-SED11	NQ
		Nickel	mg/kg	15	1	14	5	G	2	2.370866667	3.491	ND	6.29	3.491	Pond C: PPSC-SED11	NQ
		Potassium	mg/kg	15	1	14	7	X	5	137.38	152.7	ND	320	152.7	Pond C SED12, Pond C SED28	NQ
		Selenium	mg/kg	15	14	1	1			6.0132	NA	ND	3.37	3.37	PCT1-5	J
		Sodium	mg/kg	15	9	6	6	X	5	18.315	17.97	ND	27.2	17.97	Pond C: PPSC-SED11	J
		Vanadium	mg/kg	15	0	15	0	N	1	18.57599999	24.81	2.69	42.3	24.81	Pond C SED12, Pond C SED28	NQ
		Zinc	mg/kg	15	0	15	5	G	2	7.588666667	12.65	1.64	31.1	12.65	Pond C: PPSC-SED11	NQ
	Other	Cation exchange capacity	MEQ/100g	5	0	5	1	N	1	38.04600024	58.86	5.53	58.299999	58.299999	Pond C SED12, Pond C SED28	NQ
		Nitrogen by Kjeldahl method	mg/kg	10	0	10	0	N	1	367.3299999	607.5	45.2	1140	607.5	Pond C: PPSC-SED11	NQ
		Nitrogen-Nitrate+Nitrite	mg/kg	9	1	8	7	X	3	0.776000006	1.483	ND	1.92	1.483	Pond C SED12, Pond C SED28	NQ
		Phenols	mg/kg	9	8	1	1			0.215722222	NA	ND	0.215	0.215	Pond C SED12, Pond C SED28	J
		Total organic carbon	mg/kg	9	0	9	0	N	1	8,909.56	15,125	907	31,000	15125	Pond C: PPSC-SED11	NQ
	Pesticides/PCBs	DDE	mg/kg	15	14	1	1			0.0189331	NA	ND	0.000848	0.000848	PCT1-5	J
		PCB-1254	mg/kg	15	14	1	1			0.048951333	NA	ND	0.0019	0.0019	PCT1-2	J
	Radionuclides	Actinium-228	pCi/g	23	1	22	1	X	5	1.314608691	1.526	ND	2.51	1.526	PCT3-2	NQ
		Bismuth-214	pCi/g	16	0	16	1	N	1	0.828375	0.97	0.158	1.47	0.97	PCT3-2	NQ
		Cesium-137	pCi/g	54	3	51	4	X	3	8.636391669	20.87	ND	116.5	20.87	Pond C Site No. 3 Elevation 195 ft	NQ
		Cobalt-60	pCi/g	24	20	4	0	X	5	0.069262292	0.114	ND	0.44800001	0.114	Pond C SED12, Pond C SED28	NQ
		Gross Alpha	pCi/g	25	0	25	7	N	1	15.27599989	17.94	3.6	31	17.94	PCT1-2	NQ
		Lead-212	pCi/g	23	0	23	0	N	1	1.415826081	1.624	0.702	2.59	1.624	PCT3-2	NQ
		Lead-214	pCi/g	16	0	16	1	N	1	0.987375	1.163	0.176	1.72	1.163	PCT3-2	NQ
		Manganese-54	pCi/g	7	2	5	0	X	5	0.026614286	0.0389	ND	0.047600001	0.0389	Pond C: PPSC-SED11	NQ
		Non-volatile Beta	pCi/g	25	1	24	6	G	2	12.17560008	15.66	ND	30.700001	15.66	Pond C SED12, Pond C SED28	NQ
		Plutonium-238	pCi/g	41	40	1	0			0.129849756	NA	ND	0.176	0.176	Pond C SED12, Pond C SED28	NQ
		Plutonium-239 and Plutonium-240	pCi/g	12	8	4	0	X	5	0.076478333	0.0961	ND	0.171	0.0961	Pond C SED12, Pond C SED28	NQ
		Potassium-40	pCi/g	21	5	16	7	X	3	1.018452385	1.828	ND	3.22	1.828	Pond C SED12, Pond C SED28	NQ
		Radium-226	pCi/g	3	0	3	0	N	1	1.144666667	1.812	0.704	1.47	1.47	PCT3-2	NQ
		Radium-228	pCi/g	1	0	1	0			1.17	NA	1.17	1.17	1.17	PCT3-5	NQ
		Strontium-89 and Strontium-90	pCi/g	27	10	17	0	X	5	0.457962963	0.589	ND	1.3	0.589	Pond C Site No. 4 Elevation 195 ft	NQ
		Strontium-90	pCi/g	10	3	7	0	X	5	1.20145	1.625	ND	2.28	1.625	Pond C: PPSC-SED11	NQ
		Thallium-208	pCi/g	16	0	16	1	N	1	0.3937875	0.476	0.0506	0.76	0.476	PCT3-2	NQ
		Thorium-228	pCi/g	3	0	3	0	N	1	1.75	3.064	0.91	2.45	2.45	PCT3-2	NQ
		Thorium-230	pCi/g	3	0	3	1	N	1	0.770333333	1.368	0.403	1.11	1.11	PCT3-2	NQ
		Thorium-232	pCi/g	3	0	3	0	N	1	1.800666667	3.328	0.772	2.48	2.48	PCT3-2	NQ
		Thorium-234	pCi/g	8	5	3	0	X	5	1.430312475	2.728	ND	3.8299999	2.728	Pond C: PPSC-SED11	NQ
		Uranium-233 and Uranium-234	pCi/g	3	0	3	1	N	1	0.925	1.743	0.365	1.22	1.22	PCT1-2	NQ
		Uranium-238	pCi/g	3	0	3	1	N	1	0.83	1.425	0.561	1.23	1.23	PCT1-2	NQ
	Semivolatiles	Benzo[a]pyrene	mg/kg	15	14	1	1			0.003788	NA	ND	0.00529	0.00529	Pond C SED12, Pond C SED28	J
		Benzo[b]fluoranthene	mg/kg	15	14	1	1			0.003813333	NA	ND	0.00545	0.00545	Pond C SED12, Pond C SED28	J
		Benzo[g,h,i]perylene	mg/kg	15	14	1	1			0.015343667	NA	ND	0.00424	0.00424	Pond C SED12, Pond C SED28	J
		Benzoic acid	mg/kg	9	7	2	0	X	3	0.073033333	0.251	ND	0.308	0.251	Pond C SED12, Pond C SED28	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	15	13	2	2	X	3	0.043882667	0.148	ND	0.267	0.148	PCT1-5	J

Table A.1.9.1.1__Statistical Summary Table: EA9 / Sediment and Soil Media (0-1ft)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Camphene	mg/kg	1	0	1	1			0.0025	NA	0.0025	0.0025	0.0025	Pond C SED12, Pond C SED28	J
		Chrysene	mg/kg	15	14	1	1			0.003919	NA	ND	0.00438	0.00438	Pond C SED12, Pond C SED28	J
		Dibutylphthalate	mg/kg	15	13	2	2	X	5	0.029636667	0.0278	ND	0.0277	0.0277	Pond C SED12, Pond C SED28	J
		Diethylphthalate	mg/kg	15	14	1	1			0.027824	NA	ND	0.00601	0.00601	Pond C SED12, Pond C SED28	J
		Fluoranthene	mg/kg	15	14	1	1			0.015462667	NA	ND	0.00713	0.00713	Pond C SED12, Pond C SED28	J
		Phenol	mg/kg	15	14	1	1			0.026996	NA	ND	0.00421	0.00421	Pond C SED12, Pond C SED28	J
		Pyrene	mg/kg	15	14	1	1			0.015668	NA	ND	0.00667	0.00667	Pond C SED12, Pond C SED28	J
	TIC	Aldol condensate	mg/kg	4	3	1	1			0.05	NA	ND	0.2	0.2	Pond C SED12, Pond C SED28	J
		Docosane	mg/kg	1	0	1	1			0.54000002	NA	0.54	0.54000002	0.54000002	Pond C SED12, Pond C SED28	J
		Unknown alcohol	mg/kg	3	0	3	3	N	1	0.347000007	0.853	0.001	0.54000002	0.54000002	Pond C SED12, Pond C SED28	J
		Unknown alkane	mg/kg	1	0	1	1			0.006	NA	0.006	0.006	0.006	Pond C SED12, Pond C SED28	J
	Volatiles	2-Hexanone	mg/kg	15	14	1	1			0.001109133	NA	ND	0.000287	0.000287	Pond C: PPSC-SED11	J
		Acetone	mg/kg	15	7	8	2	G	2	0.051839666	0.142	ND	0.332	0.142	PCT1-1	J
		Benzene	mg/kg	15	8	7	4	X	5	0.0004618	0.0006	ND	0.00106	0.0006	Pond C: PPSC-SED11	NQ
		Carbon disulfide	mg/kg	15	9	6	3	G	2	0.001911267	0.0082	ND	0.0176	0.0082	Pond C: PPSC-SED11	NQ
		Chloroform	mg/kg	15	8	7	2	X	5	0.000395317	0.0005	ND	0.000896	0.0005	Pond C: PPSC-SED11	NQ
		Chloromethane	mg/kg	15	13	2	1	X	5	0.000150167	0.0002	ND	0.000298	0.0002	Pond C SED12, Pond C SED28	J
		Methyl ethyl ketone	mg/kg	15	9	6	4	G	2	0.003341	0.0105	ND	0.0255	0.0105	Pond C SED12, Pond C SED28	NQ
		Methyl isobutyl ketone	mg/kg	15	13	2	2	X	5	0.0010936	0.0006	ND	0.000557	0.000557	Pond C SED12, Pond C SED28	J
		Styrene	mg/kg	15	14	1	0			0.000105533	NA	ND	0.000149	0.000149	Pond C SED12, Pond C SED28	NQ
		Toluene	mg/kg	15	10	5	4	X	5	0.000699967	0.0012	ND	0.0039	0.0012	PCT1-1	J
		Xylenes	mg/kg	15	10	5	4	X	5	0.000220333	0.0002	ND	0.000458	0.0002	Pond C: PPSC-SED11	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.9.1.2__Statistical Summary Table: Exposure Area 9 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
9	Inorganics	Ammonia	mg/kg	1	0	1	0			64.300003	NA	64.3	64.300003	64.3	Pond C: PPSC-SED11	NQ
		Chloride	mg/kg	9	3	6	5	X	5	4.067222211	6.982	ND	15.1	6.982	Pond C SED12, Pond C SED28	J
		Cyanide	mg/kg	10	9	1	1			0.6542	NA	ND	0.142	0.142	LTROU-16	J
		Orthophosphate	mg/kg	9	8	1	1			6.172222211	NA	ND	2.6199999	2.62	Pond C SED12, Pond C SED28	J
		Phosphate	mg/kg	9	0	9	8	N	1	146.6666662	210.4	60.5	375	210.4	Pond C: PPSC-SED11	J
		Thallium	mg/kg	19	17	2	2	X	5	3.947394737	2.001	ND	4.59	2.001	Pond C SED12, Pond C SED28	J
	Metals	Aluminum	mg/kg	19	0	19	0	G	2	6,738.95	9,093	1,690	18,000	9093	Pond C SED12, Pond C SED28	NQ
		Arsenic	mg/kg	19	10	9	9	X	5	5.240473685	1.885	ND	2.85	1.885	PCT1-2	J
		Barium	mg/kg	19	0	19	0	G	2	30.20947368	43.61	5.52	86.1	43.61	Pond C SED12, Pond C SED28	NQ
		Beryllium	mg/kg	19	1	18	18	G	2	0.280684211	0.405	ND	0.772	0.405	Pond C SED12, Pond C SED28	J
		Cadmium	mg/kg	19	18	1	1			0.181763158	NA	ND	0.0505	0.0505	LTROU-16	J
		Calcium	mg/kg	19	0	19	3	X	3	180.0105263	419.6	15.8	817	419.6	Pond C SED12, Pond C SED28	NQ
		Chromium	mg/kg	19	0	19	1	G	2	9.454736832	13.49	1.68	32.7	13.49	Pond C: PPSC-SED11	NQ
		Cobalt	mg/kg	19	0	19	8	G	2	1.271157895	1.88	0.272	5.5	1.88	Pond C: PPSC-SED11	NQ
		Copper	mg/kg	19	0	19	10	L	6	3.338789474	5.251	0.627	14.1	5.251	Pond C: PPSC-SED11	NQ
		Iron	mg/kg	19	0	19	0	N	1	5,960.53	7,784	1,180	17,600	7784	Pond C: PPSC-SED11	NQ
		Lead	mg/kg	19	0	19	5	G	2	6.751578947	9.405	1.04	18.1	9.405	Pond C SED12, Pond C SED28	NQ
		Magnesium	mg/kg	19	0	19	1	G	2	134.3894737	184.1	36.1	376	184.1	Pond C SED12, Pond C SED28	NQ
		Manganese	mg/kg	19	0	19	0	G	2	62.33105258	104.5	4.8	181	104.5	Pond C SED12, Pond C SED28	NQ
		Mercury	mg/kg	19	3	16	7	G	2	0.042958421	0.0344	ND	0.076599998	0.0344	Pond C: PPSC-SED11	NQ
		Nickel	mg/kg	19	1	18	5	G	2	2.300578947	3.078	ND	6.29	3.078	Pond C: PPSC-SED11	NQ
		Potassium	mg/kg	19	1	18	8	G	2	123.5105263	149.6	ND	320	149.6	Pond C SED12, Pond C SED28	NQ
		Selenium	mg/kg	19	18	1	1			4.809263158	NA	ND	3.37	3.37	PCT1-5	J
		Sodium	mg/kg	19	12	7	7	X	5	15.64736842	14.62	ND	27.2	14.62	Pond C: PPSC-SED11	J
		Vanadium	mg/kg	19	0	19	0	G	2	17.09736841	24.16	2.69	42.3	24.16	Pond C SED12, Pond C SED28	NQ
		Zinc	mg/kg	19	0	19	9	L	6	6.828421053	10.12	1.64	31.1	10.12	Pond C: PPSC-SED11	NQ
	Other	Cation exchange capacity	MEQ/100g	5	0	5	1	N	1	38.04600024	58.86	5.53	58.299999	58.3	Pond C SED12, Pond C SED28	NQ
		Nitrogen by Kjeldahl method	mg/kg	10	0	10	0	N	1	367.3299999	607.5	45.2	1,140	607.5	Pond C: PPSC-SED11	NQ
		Nitrogen-Nitrate+Nitrite	mg/kg	9	1	8	7	X	3	0.776000006	1.483	ND	1.92	1.483	Pond C SED12, Pond C SED28	NQ
		Phenols	mg/kg	9	8	1	1			0.215722222	NA	ND	0.215	0.215	Pond C SED12, Pond C SED28	J
		Total organic carbon	mg/kg	9	0	9	0	N	1	8,909.56	15,125	907	31,000	15125	Pond C: PPSC-SED11	NQ
	Pesticides/PCBs	DDE	mg/kg	19	18	1	1			0.014989737	NA	ND	0.000848	0.000848	PCT1-5	J
		PCB-1254	mg/kg	19	18	1	1			0.038787895	NA	ND	0.0019	0.0019	PCT1-2	J
	Radionuclides	Actinium-228	pCi/g	35	1	34	2	X	5	1.331399997	1.522	ND	3.45	1.522	PCT3-2	NQ
		Bismuth-214	pCi/g	28	0	28	2	N	1	0.884214286	1.012	0.158	2.06	1.012	PCT3-2	NQ
		Cesium-137	pCi/g	66	12	54	4	X	3	7.188520456	17.33	ND	116.5	17.33	Pond C Site No. 3 Elevation 195 ft	NQ
		Cobalt-60	pCi/g	36	32	4	0	X	5	0.05337625	0.079	ND	0.44800001	0.079	Pond C SED12, Pond C SED28	NQ
		Gross Alpha	pCi/g	37	0	37	11	N	1	14.71081074	16.72	3.6	31	16.72	PCT1-2	NQ
		Lead-212	pCi/g	35	0	35	0	N	1	1.374828568	1.557	0.295	3.22	1.557	PCT3-2	NQ
		Lead-214	pCi/g	28	0	28	1	N	1	1.026964286	1.161	0.176	1.94	1.161	PCT3-2	NQ
		Manganese-54	pCi/g	7	2	5	0	X	5	0.026614286	0.0389	ND	0.047600001	0.0389	Pond C: PPSC-SED11	NQ
		Non-volatile Beta	pCi/g	37	2	35	11	G	2	11.03540546	13.37	ND	30.700001	13.37	Pond C SED12, Pond C SED28	NQ
		Plutonium-238	pCi/g	43	42	1	0			0.127661395	NA	ND	0.176	0.176	Pond C SED12, Pond C SED28	NQ
		Plutonium-239 and Plutonium-240	pCi/g	14	10	4	0	X	5	0.071620714	0.0832	ND	0.171	0.0832	Pond C SED12, Pond C SED28	NQ
		Potassium-40	pCi/g	32	9	23	12	X	3	0.924093753	1.515	ND	3.22	1.515	Pond C SED12, Pond C SED28	NQ
		Radium-226	pCi/g	5	0	5	0	N	1	1.2748	1.783	0.704	2.06	1.783	PCT3-2	NQ
		Radium-228	pCi/g	1	0	1	0			1.17	NA	1.17	1.17	1.17	PCT3-5	NQ
		Strontium-89 and Strontium-90	pCi/g	27	10	17	0	X	5	0.457962963	0.589	ND	1.3	0.589	Pond C Site No. 4 Elevation 195 ft	NQ
		Strontium-90	pCi/g	10	3	7	0	X	5	1.20145	1.625	ND	2.28	1.625	Pond C: PPSC-SED11	NQ
		Thallium-208	pCi/g	28	0	28	2	N	1	0.402557143	0.469	0.0506	1.04	0.469	PCT3-2	NQ
		Thorium-228	pCi/g	5	0	5	0	N	1	2.004	3.011	0.91	3.56	3.011	PCT3-2	NQ
		Thorium-230	pCi/g	5	0	5	2	N	1	0.902	1.33	0.403	1.56	1.33	PCT3-2	NQ
		Thorium-232	pCi/g	5	0	5	0	N	1	1.9524	2.84	0.772	3.09	2.84	PCT3-2	NQ
		Thorium-234	pCi/g	8	5	3	0	X	5	1.430312475	2.728	ND	3.8299999	2.728	Pond C: PPSC-SED11	NQ
		Uranium-233 and Uranium-234	pCi/g	5	0	5	2	N	1	1.1296	1.843	0.365	2.29	1.843	PCT3-2	NQ
		Uranium-238	pCi/g	5	0	5	1	N	1	1.2536	2.123	0.561	2.82	2.123	PCT3-2	NQ
	Semivolatiles	Benzo[a]pyrene	mg/kg	19	18	1	1			0.004272105	NA	ND	0.00529	0.00529	Pond C SED12, Pond C SED28	J
		Benzo[b]fluoranthene	mg/kg	19	18	1	1			0.004292105	NA	ND	0.00545	0.00545	Pond C SED12, Pond C SED28	J
		Benzo[g,h,i]perylene	mg/kg	19	18	1	1			0.013395	NA	ND	0.00424	0.00424	Pond C SED12, Pond C SED28	J

Table A.1.9.1.2__Statistical Summary Table: Exposure Area 9 / Sediment and Soil Media (All Depths)

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
		Benzoic acid	mg/kg	9	7	2	0	X	3	0.073033333	0.251	ND	0.308	0.251	Pond C SED12, Pond C SED28	NQ
		Bis[2-ethylhexyl]phthalate	mg/kg	19	17	2	2	X	3	0.043173158	0.127	ND	0.267	0.127	PCT1-5	J
		Camphene	mg/kg	1	0	1	1			0.0025	NA	0.0025	0.0025	0.0025	Pond C SED12, Pond C SED28	J
		Chrysene	mg/kg	19	18	1	1			0.004375526	NA	ND	0.00438	0.00438	Pond C SED12, Pond C SED28	J
		Dibutylphthalate	mg/kg	19	17	2	2	X	5	0.031926316	0.0277	ND	0.0277	0.0277	Pond C SED12, Pond C SED28	J
		Diethylphthalate	mg/kg	19	18	1	1			0.030495263	NA	ND	0.00601	0.00601	Pond C SED12, Pond C SED28	J
		Fluoranthene	mg/kg	19	18	1	1			0.013488947	NA	ND	0.00713	0.00713	Pond C SED12, Pond C SED28	J
		Phenol	mg/kg	19	18	1	1			0.029841579	NA	ND	0.00421	0.00421	Pond C SED12, Pond C SED28	J
		Pyrene	mg/kg	19	18	1	1			0.013651053	NA	ND	0.00667	0.00667	Pond C SED12, Pond C SED28	J
	TIC	Aldol condensate	mg/kg	4	3	1	1			0.05	NA	ND	0.2	0.2	Pond C SED12, Pond C SED28	J
		Docosane	mg/kg	1	0	1	1			0.54000002	NA	0.54	0.54000002	0.54	Pond C SED12, Pond C SED28	J
		Unknown alcohol	mg/kg	3	0	3	3	N	1	0.347000007	0.853	0.001	0.54000002	0.54	Pond C SED12, Pond C SED28	J
		Unknown alkane	mg/kg	1	0	1	1			0.006	NA	0.006	0.006	0.006	Pond C SED12, Pond C SED28	J
	Volatiles	2-Hexanone	mg/kg	19	18	1	1			0.001060368	NA	ND	0.000287	0.000287	Pond C: PPSC-SED11	J
		Acetone	mg/kg	19	9	10	2	G	2	0.046070789	0.108	ND	0.332	0.108	PCT1-1	J
		Benzene	mg/kg	19	12	7	4	X	5	0.000401553	0.000503	ND	0.00106	0.000503	Pond C: PPSC-SED11	NQ
		Carbon disulfide	mg/kg	19	13	6	3	G	2	0.001663105	0.00579	ND	0.0176	0.00579	Pond C: PPSC-SED11	NQ
		Chloroform	mg/kg	19	12	7	2	X	5	0.000349066	0.000415	ND	0.000896	0.000415	Pond C: PPSC-SED11	NQ
		Chloromethane	mg/kg	19	16	3	1	X	5	0.000230395	0.000392	ND	0.0016	0.000392	PCT1-3	NQ
		Methyl ethyl ketone	mg/kg	19	11	8	6	G	2	0.003071579	0.00779	ND	0.0255	0.00779	Pond C SED12, Pond C SED28	NQ
		Methyl isobutyl ketone	mg/kg	19	17	2	2	X	5	0.001017579	0.000559	ND	0.000557	0.000557	Pond C SED12, Pond C SED28	J
		Styrene	mg/kg	19	18	1	0			0.000120289	NA	ND	0.000149	0.000149	Pond C SED12, Pond C SED28	NQ
		Toluene	mg/kg	19	12	7	6	G	2	0.000630974	0.00129	ND	0.0039	0.00129	PCT1-1	J
		Xylenes	mg/kg	19	14	5	4	X	5	0.000210921	0.000228	ND	0.000458	0.000228	Pond C: PPSC-SED11	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualfier

Distribution Code:
G Gamma Distribution
L Log Normal
N Normal Distribution
X Non-Parametric

UCL Method Code (as determined by ProUCL):
1 Students-t UCL
2 95% Approximate Gamma UCL
3 95% Chebyshev (Mean, Sd) UCL
4 95% KM (Percentile Bootstrap) UCL
5 95% KM (t) UCL
6 95% H-UCL
7 95% KM H-UCL

Table A.1.9.2__Statisical Summary Table: Exposure Area 9 / Surface Water

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distribution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
9	Metals	Antimony	µg/L	2	1	1	1			2.995	NA	ND	4.49	4.49	LTROU-16	J
		Barium	µg/L	2	0	2	0			20.9	NA	12.7	29.1	29.1	LTROU-16	NQ
		Calcium	µg/L	2	0	2	0			10,305	NA	8,210	12,400	12400	LTROU-16	NQ
		Chromium	µg/L	2	1	1	1			0.845	NA	ND	1.19	1.19	LTROU-16	J
		Iron	µg/L	2	0	2	0			1,165.50	NA	711	1,620	1620	LTROU-16	NQ
		Magnesium	µg/L	2	0	2	0			792.5	NA	455	1,130	1130	LTROU-16	NQ
		Manganese	µg/L	2	0	2	1			56.67	NA	4.34	109	109	LTROU-16	NQ
		Potassium	µg/L	2	0	2	1			229	NA	138	320	320	LTROU-16	NQ
		Silver	µg/L	2	1	1	1			0.384	NA	ND	0.268	0.268	LTROU-16	J
		Sodium	µg/L	2	0	2	0			3,790	NA	1,690	5,890	5890	LTROU-16	NQ
		Zinc	µg/L	2	1	1	1			3.19	NA	ND	4.73	4.73	LTROU-16	J
	Radionuclides	Non-volatile Beta	pCi/L	1	0	1	1			1.9	NA	1.9	1.9	1.9	LTROU-16	J
		Tritium	pCi/L	2	1	1	1			434	NA	ND	601	601	PC-SW	J
	Semivolatiles	Bis[2-ethylhexyl]phthalate	µg/L	2	1	1	1			0.6755	NA	ND	0.351	0.351	LTROU-16	J
	Volatiles	Chloromethane	µg/L	3	2	1	1			0.2053333	NA	ND	0.406	0.406	PC-SW	J
		Toluene	µg/L	3	2	1	1			0.262	NA	ND	0.566	0.566	PC-SW	J

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL):

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.9.3__Statistical Summary Table: Exposure Area 9 / Fish Media

EA	Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Distri-bution	UCL Method	Mean	95% UCL of Mean	Min	Max	RME	Max Location	Qualifier of Max
9	Metals	Barium	mg/kg	2	0	2	0			1.735	NA	1.69	1.78	1.78	LTR-PC	NQ
		Calcium	mg/kg	2	0	2	0			17,850	NA	13,400.00	22,300	22,300.00	LTR-PC	NQ
		Chromium	mg/kg	2	0	2	2			0.211	NA	.156	0.266	0.266	LTR-PC	J
		Copper	mg/kg	2	1	1	1			0.21	NA	ND	0.288	0.288	LTR-PC	J
		Iron	mg/kg	2	0	2	1			17.295	NA	7.39	27.2	27.2	LTR-PC	NQ
		Magnesium	mg/kg	2	0	2	0			547	NA	498	596	596	LTR-PC	NQ
		Manganese	mg/kg	2	0	2	0			2.695	NA	1.77	3.62	3.62	LTR-PC	NQ
		Mercury	mg/kg	2	0	2	1			0.1323	NA	.0206	0.244	0.244	LTR-PC	NQ
		Potassium	mg/kg	2	0	2	0			3115	NA	2,830.00	3,400	3,400.00	LTR-PC	NQ
		Sodium	mg/kg	2	0	2	0			1225	NA	1,090.00	1,360	1,360.00	LTR-PC	NQ
		Zinc	mg/kg	2	0	2	0			18.95	NA	10.6	27.3	27.3	LTR-PC	NQ
	Radionuclides	Cesium-137	pCi/g	2	0	2	0			21.84	NA	1.18	42.5	42.5	LTR-PC	NQ
		Non-volatile Beta	pCi/g	2	0	2	0			17.015	NA	4.23	29.8	29.8	LTR-PC	NQ
		Potassium-40	pCi/g	2	0	2	0			2.67	NA	2.23	3.11	3.11	LTR-PC	NQ

J = Estimated Value
NA = Not Available
ND = No Detect
NQ = No Qualifier

Distribution Code:

G	Gamma Distribution
L	Log Normal
N	Normal Distribution
X	Non-Parametric

UCL Method Code (as determined by ProUCL)**:**

1	Students-t UCL
2	95% Approximate Gamma UCL
3	95% Chebyshev (Mean, Sd) UCL
4	95% KM (Percentile Bootstrap) UCL
5	95% KM (t) UCL
6	95% H-UCL
7	95% KM H-UCL

Table A.1.10.1__Background Sediment/Soil Media (0 - 1 ft)

Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2x Mean	Max-Detects	Min	Max Location	Qualifer of Max
Inorganics	Chloride	mg/kg	9	4	5	2	2.530555549	5.061111098	4.849999905	ND	PPSC-SED22	NQ
	Fluoride	mg/kg	115	114	1	0	3.016260866	6.032521732	11.89999962	ND	Background Meyers Branch 2	NQ
	Nitrate - Nitrite as Nitrogen	mg/kg	2	1	1	1	0.5025	1.005	0.38	ND	Par Pond Sediment Characterization PPSC-2 (Depth 0-1 FT)	J
	Nitrate (as Nitrogen)	mg/kg	60	30	30	0	0.703683333	1.407366667	3.50999999	ND	Background Upper Three Runs 15	NQ
	Orthophosphate	mg/kg	9	7	2	2	10.35333333	20.70666667	2.69	ND	Par Pond Sediment Characterization PPSC-2 (Depth 0-1 FT)	J
	Phosphate	mg/kg	124	7	117	2	87.41370962	174.8274192	826	ND	Background Upper Three Runs 13	NQ
	Silicon	mg/kg	115	0	115	0	410.026087	820.0521739	1,490	30.6000	Background Lower Steel Creek 1	NQ
	Sulfate	mg/kg	115	110	5	0	10.28304346	20.56608693	39	ND	Background Upper Three Runs 11	NQ
	Sulfide	mg/kg	69	68	1	0	20.72611594	41.45223188	0.51700002	ND	Background Upper Three Runs 5	NQ
	Thallium	mg/kg	147	143	4	1	1.887309524	3.774619048	11.2	ND	BKGDSS001	J
	Uranium	mg/kg	13	12	1	0	22.67307692	45.34615385	10	ND	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ
Metals	Aluminum	mg/kg	160	0	160	11	4,896.81	9,793.62	44,100	0.4300	L-Lake-55-02	J
	Antimony	mg/kg	147	139	8	0	2.371197283	4.742394565	8.010000229	ND	Background Meyers Branch 4	NQ
	Arsenic	mg/kg	160	118	42	1	1.7490875	3.498175	6.7	ND	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ
	Barium	mg/kg	160	5	155	3	27.33431244	54.66862488	353	ND	L-Lake-55-02	NQ
	Beryllium	mg/kg	151	88	63	6	0.386566226	0.773132453	4.31	ND	BKGDSS001	NQ
	Cadmium	mg/kg	159	117	42	0	0.184266666	0.368533332	4.199999809	ND	Background Upper Three Runs 9	NQ
	Calcium	mg/kg	147	5	142	4	560.912381	1,121.82	60,700	ND	Background Meyers Branch 2	NQ
	Chromium	mg/kg	162	8	154	3	7.105213704	14.21042741	44.5	ND	BKGDS001	NQ
	Cobalt	mg/kg	147	72	75	14	1.313503404	2.627006808	44	ND	BKGDSS001	NQ
	Copper	mg/kg	160	30	130	6	3.262287489	6.524574978	69	ND	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ
	Iron	mg/kg	160	1	159	18	2,657.90	5,315.79	38,700	ND	BKGDS001	NQ
	Lead	mg/kg	160	21	139	2	5.479571884	10.95914377	59.8	ND	L-Lake-55-02	NQ
	Lithium	mg/kg	115	80	35	0	1.115399996	2.230799992	9.119999886	ND	Background Upper Meyers Branch 1	NQ
	Magnesium	mg/kg	160	22	138	4	137.2677187	274.5354374	2,280	ND	BKGDSS001	NQ
	Manganese	mg/kg	159	2	157	4	67.96185535	135.9237107	3,720	ND	L-Lake-55-02	NQ
	Mercury	mg/kg	158	141	17	8	0.049622152	0.099244304	0.209999993	ND	Background Upper Three Runs 2	J
	Nickel	mg/kg	160	89	71	5	2.238931245	4.477862491	23.8	ND	BKGDS001	NQ
	Potassium	mg/kg	179	124	55	5	119.657514	239.315028	1,170	ND	BKGDS001	NQ
	Selenium	mg/kg	160	107	53	2	1.945993749	3.891987498	5.650000095	ND	Background Upper Three Runs 15	NQ
	Silver	mg/kg	160	129	31	4	0.57985	1.159700001	3.900000095	ND	Background Upper Three Runs 2	NQ
	Sodium	mg/kg	147	43	104	4	36.63431959	73.26863918	202	ND	Background Upper Three Runs 9	NQ
	Tin	mg/kg	115	65	50	0	3.111782608	6.223565215	14.69999981	ND	Background Upper Three Runs 3	NQ
	Vanadium	mg/kg	146	12	134	2	12.41180818	24.82361636	130	ND	BKGDS001	NQ
	Zinc	mg/kg	143	11	132	6	8.493192298	16.9863846	204	ND	BKGDSS001	J
Other	Cation exchange capacity	MEQ/100g	124	0	124	0	13.98145157	27.96290314	107	0.1400	PPSC-SED22	NQ
	Nitrogen by Kjeldahl method	mg/kg	10	0	10	0	26.839	53.678	57.70000076	8.0000	Meyers Branch: PPSC-SED21	NQ
	Percent Solids	percent	127	0	127	0	71.06299234	142.1259847	93.59999847	18.2000	Background Upper Three Runs 9	NQ
	pH	pH	115	0	115	0	4.852695643	9.705391287	8.25	4.1300	Background Meyers Branch 2	NQ
	Total organic carbon	mg/kg	124	2	122	0	297.7669355	595.5338709	8,420	ND	Meyers Branch: PPSC-SED21	NQ
	Total organic halogens	mg/kg	115	111	4	0	14.85478261	29.70956521	38.59999847	ND	Background Upper Three Runs 7	NQ
	Unknown amine	mg/kg	1	0	1	1	0.649999976	1.299999952	0.649999976	0.6500	Meyers Branch: PPSC-SED21	J
Pesticides/PCBs	2,4-Dichlorophenoxyacetic acid	mg/kg	61	59	2	1	0.064931967	0.129863934	0.035999998	ND	Background Upper Three Runs 7	NQ
	2,4,5-Trichlorophenoxyacetic acid	mg/kg	60	54	6	6	0.047343833	0.094687667	0.040099997	ND	Background Upper Three Runs 7	J
	Aldrin	mg/kg	82	81	1	1	0.014568701	0.029137402	0.00588	ND	Background Lower Steel Creek 2	J
	alpha-Chlordane	mg/kg	81	80	1	1	0.139721216	0.279442432	0.00193	ND	MB-02-01	J
	beta Benzene hexachloride	mg/kg	82	81	1	1	0.015345104	0.030690207	0.00650	ND	Background Upper Three Runs 5	J
	Endrin	mg/kg	82	81	1	1	0.028936854	0.057873707	0.00588	ND	Background Lower Steel Creek 2	J
	technical-Chlordane	mg/kg	81	80	1	1	0.13971529	0.27943058	0.00145	ND	MB-02-01	J
Radionuclides	Actinium-228	pCi/g	45	1	44	2	1.343451775	2.68690355	3.83	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Americium-241	pCi/g	21	10	11	0	0.017750479	0.035500959	0.10368	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Bismuth-212	pCi/g	11	1	10	0	1.747103636	3.494207273	2.59	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Bismuth-214	pCi/g	27	0	27	1	2.264300741	4.528601483	8.12	0.1750	U3R-1A Treadway Bridge RD 8-1	NQ
	Californium-244	pCi/g	4	3	1	0	0.001297905	0.002595811	0.00422	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Cesium-137	pCi/g	63	28	35	3	0.094259604	0.188519209	0.623	ND	BKGDSS001	NQ
	Cobalt-60	pCi/g	61	58	3	0	0.010998677	0.021997353	0.010962	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Curium-244	pCi/g	13	9	4	0	0.000947526	0.001895051	0.008748	ND	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ
	Europium-155	pCi/g	20	11	9	0	0.054415	0.10883	0.077	ND	L-Lake-53-02	NQ
	Gross Alpha	pCi/g	32	2	30	7	9.680156251	19.3603125	28.70000076	ND	PPSC-SED22	NQ
	Lead-212	pCi/g	46	0	46	1	1.210159566	2.420319132	3.05	0.1060	U3R-1A Treadway Bridge RD 8-1	NQ
	Lead-214	pCi/g	27	0	27	2	2.317686668	4.635373336	8.42	0.1560	U3R-1A Treadway Bridge RD 8-1	NQ
	Manganese-54	pCi/g	19	13	6	0	0.007209737	0.014419474	0.031199999	ND	Meyers Branch: PPSC-SED21	NQ
	Neptunium-237	pCi/g	10	7	3	0	0.0059916	0.0119832	0.017334	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Neptunium-239	pCi/g	19	16	3	0	0.031913158	0.063826316	0.0674	ND	L-Lake-54-02	NQ
	Non-volatile Beta	pCi/g	32	7	25	3	6.679687526	13.35937505	18.3	ND	BKGDS001	NQ
	Plutonium-238	pCi/g	49	35	14	0	0.014173879	0.028347758	0.02	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Plutonium-239	pCi/g	28	11	17	0	0.006514154	0.013028307	0.04	ND	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ
	Plutonium-239 and Plutonium-240	pCi/g	23	21	2	0	0.025652826	0.051305652	0.175	ND	L-Lake-57-01	NQ
	Potassium-40	pCi/g	46	17	29	3	1.526900867	3.053801734	13	ND	BKGDS001	NQ
	Protactinium-234m	pCi/g	2	0	2	0	23.76	47.52	23.76	23.7600	Tinker Creek 1; also Tinker Creek at Kennedy's Pond Road, SV-2062 or SMSV2062	NQ

Table A.1.10.1__Background Sediment/Soil Media (0 - 1 ft)

Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2x Mean	Max-Detects	Min	Max Location	Qualifer of Max
	Radium-224	pCi/g	5	0	5	0	4.768592	9.537184	6.15	3.9730	U3R-1A Treadway Bridge RD 8-1	NQ
	Radium-226	pCi/g	22	0	22	1	4.567659092	9.135318183	21.62	0.2500	U3R-1A Treadway Bridge RD 8-1	NQ
	Radium-228	pCi/g	18	3	15	1	2.238564443	4.477128886	14.64863	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Strontium-89	pCi/g	5	4	1	1	0.5747	1.1494	1.64	ND	Savannah River And Steel Creek Sediment And Water: MBH-01 & MB-03	J
	Strontium-89 and Strontium-90	pCi/g	37	31	6	0	0.130109857	0.260219715	1.38	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Strontium-90	pCi/g	16	13	3	0	0.377187497	0.754374995	2.539999962	ND	Meyers Branch: PPSC-SED21	NQ
	Thallium-208	pCi/g	27	0	27	5	0.503058889	1.006117778	1.14	0.0267	U3R-1A Treadway Bridge RD 8-1	NQ
	Thorium-228	pCi/g	4	0	4	1	1.353	2.706	2.2	0.7220	BKGDSS001	NQ
	Thorium-230	pCi/g	4	0	4	0	1.09675	2.1935	1.78	0.2620	BKGDS001	NQ
	Thorium-231	pCi/g	2	0	2	0	2.05567	4.11134	2.06	2.0513	U3R-1A Treadway Bridge RD 8-1	NQ
	Thorium-232	pCi/g	4	0	4	0	1.048	2.096	1.86	0.2610	BKGDS001	NQ
	Thorium-234	pCi/g	10	7	3	0	0.434250001	0.868500001	2.09	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-233 and Uranium-234	pCi/g	12	0	12	0	0.637833333	1.275666667	2.27	0.2490	BKGDS001	NQ
	Uranium-234	pCi/g	18	0	18	0	0.682399575	1.36479915	2.4678	0.0255	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-235	pCi/g	30	4	26	0	0.034539563	0.069079126	0.12501	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-238	pCi/g	30	0	30	0	0.657045977	1.314091953	2.5137	0.0172	U3R-1A Treadway Bridge RD 8-1	NQ
Semivolatiles	1,4-Dichlorobenzene	mg/kg	82	81	1	1	0.141867841	0.283735683	0.00111	ND	BKGDSS002	J
	2-(2,4,5-Trichlorophenoxy)propionic acid	mg/kg	61	60	1	1	0.047704918	0.095409836	0.015	ND	Background Upper Three Runs 7	J
	Benzo[a]pyrene	mg/kg	80	73	7	6	0.1545195	0.309038999	0.510999978	ND	Background Upper Three Runs 10	J
	Benzoic acid	mg/kg	9	7	2	2	0.028111111	0.056222222	0.059000001	ND	PPSC-SED22	J
	Bis[2-ethylhexyl]phthalate	mg/kg	82	33	49	37	0.825960373	1.651920746	38.70000076	ND	Background Upper Three Runs 13	NQ
	Dibutylphthalate	mg/kg	82	28	54	54	0.113647561	0.227295122	0.441000015	ND	Background Upper Three Runs 7	J
	Dioctylphthalate	mg/kg	82	80	2	1	0.169040243	0.338080487	1.789999962	ND	Background Upper Three Runs 10	NQ
	Ethyl methacrylate	mg/kg	63	61	2	0	0.191015873	0.382031746	0.920000017	ND	Background Upper Three Runs 10	NQ
	Fluoranthene	mg/kg	82	78	4	4	0.140382927	0.280765854	0.111000001	ND	Background Upper Three Runs 14	J
	Hexachlorodibenzo-p-furans	mg/kg	58	57	1	1	5.17241E-05	0.000103448	0.0001	ND	Background Upper Three Runs 13	J
	Kepone	mg/kg	60	57	3	2	0.037605417	0.075210833	0.031300001	ND	Background Meyers Branch 4	NQ
	m,p-Cresol	mg/kg	42	41	1	1	0.199911905	0.39982381	0.087300003	ND	Background Upper Three Runs 7	J
	p-Cresol	mg/kg	45	42	3	3	0.174966667	0.349933333	0.291999996	ND	Background Meyers Branch 4	J
	Pentachloroethane	mg/kg	63	61	2	0	0.191015873	0.382031746	0.920000017	ND	Background Upper Three Runs 10	NQ
	Phenanthrene	mg/kg	82	81	1	1	0.144008537	0.288017073	0.088500001	ND	PPSC-SED22	J
	Pyrene	mg/kg	82	81	1	1	0.144478049	0.288956098	0.127000004	ND	PPSC-SED22	J
	Pyridine	mg/kg	60	52	8	8	0.203745	0.40749	0.340999991	ND	Background Upper Three Runs 1	J
TIC	Docosane	mg/kg	2	0	2	2	1.085000024	2.170000047	1.700000048	0.4700	Meyers Branch: PPSC-SED21	J
	Unknown alcohol	mg/kg	2	0	2	2	0.325499988	0.650999976	0.649999976	0.0010	Meyers Branch: PPSC-SED21	J
	Unknown hydrocarbon	mg/kg	1	0	1	1	1	2	1	1.0000	Meyers Branch: PPSC-SED21	J
	Cyclotetracosane	mg/kg	1	0	1	1	0.870000005	1.74000001	0.870000005	0.8700	Meyers Branch: PPSC-SED21	J
	Intone	mg/kg	115	8	107	0	1,015.10	2,030.21	7,800	ND	Background Upper Three Runs 3	NQ
Volatiles	1,1,1-Trichloroethane	mg/kg	85	82	3	3	0.002804101	0.005608201	0.0137	ND	Background Upper Three Runs 10	J
	Acetone	mg/kg	89	16	73	16	0.050575449	0.101150898	0.722	ND	BKGDSS001	J
	Carbon disulfide	mg/kg	85	81	4	2	0.003136118	0.006272235	0.0073	ND	BKGDS001	J
	Chlorobenzene	mg/kg	85	84	1	1	0.002778101	0.005556201	0.010600001	ND	Background Upper Three Runs 10	J
	Ethylbenzene	mg/kg	85	83	2	0	0.002715361	0.005430722	0.000494	ND	Meyers Branch: PPSC-SED21	NQ
	Methyl acetate	mg/kg	12	11	1	0	0.006807083	0.013614167	0.0637	ND	BKGDSS002	NQ
	Methyl ethyl ketone	mg/kg	85	75	10	9	0.006539059	0.013078118	0.0578	ND	BKGDSS001	J
	Methyl methacrylate	mg/kg	63	61	2	0	0.191015873	0.382031746	0.920000017	ND	Background Upper Three Runs 10	NQ
	Methylene chloride	mg/kg	88	24	64	5	0.021837619	0.043675239	0.108999997	ND	Background Upper Three Runs 3	NQ
	Tetrachloroethene	mg/kg	85	79	6	1	0.005486393	0.010972787	0.128999993	ND	Background Upper Three Runs 10	NQ
	Toluene	mg/kg	87	73	14	11	0.003342092	0.006684184	0.0239	ND	Background Upper Three Runs 13	NQ
	Trichlorofluoromethane	mg/kg	75	69	6	4	0.00467514	0.00935028	0.066599995	ND	Background Upper Three Runs 10	NQ
	Xylenes	mg/kg	86	84	2	0	0.002911297	0.005822593	0.0175	ND	Background Upper Three Runs 10	NQ

Notes:
J Estimated Value
ND Non-Detects
NQ No Qualifier

Table A.1.10.2__Background Surface Water

Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2x Mean	Max-Detects	Min	Max Location	Qualifer of Max
Inorganics	Alkalinity	µg/L	49	3	46	0	2,612.24	5,224.49	24,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Ammonia	µg/L	44	26	18	0	64.43181818	128.8636364	790	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Cadmium-Water	µg/L	26	21	5	5	0.888155769	1.776311538	0.47227	ND	U3R-1A Treadway Bridge RD 8-1	J
	Chloride	µg/L	50	0	50	0	2531.2	5062.4	8,050	1470	Background Wetland 3	NQ
	Nitrate (as Nitrogen)	µg/L	247	25	222	5	141.9595142	283.9190283	1,600	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Nitrite	µg/L	366	226	140	4	424.3770492	848.7540984	450	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Orthophosphate	µg/L	191	18	173	0	72.53403141	145.0680628	1,600	ND	Tinker Creek 1	NQ
	Phosphate	µg/L	120	65	55	0	116.7916667	233.5833333	490	ND	Tinker Creek at Kennedy Pond	NQ
	Phosphorus	µg/L	72	7	65	0	57.27777778	114.5555556	200	ND	Tinker Creek 1	NQ
	Sulfate	µg/L	50	3	47	0	1182.2	2364.4	5,100	ND	Background Wetland 3	NQ
	Thallium	µg/L	273	256	17	0	6.755311355	13.51062271	16.3	ND	Tinker Creek 1	NQ
	Total Hardness	µg/L	291	192	99	0	8,650.41	17,300.82	150,000	ND	Tinker Creek 1	NQ
Metals	Aluminum	µg/L	427	96	331	3	138.6261782	277.2523564	6,060	ND	Background Wetland 2	NQ
	Arsenic	µg/L	16	14	2	0	5.01875	10.0375	11.4	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	NQ
	Barium	µg/L	17	6	11	0	53.05176482	106.1035296	72.400002	ND	MB-02-02	NQ
	Beryllium	µg/L	289	253	36	0	0.28301128	0.566022561	0.7	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Cadmium	µg/L	306	295	11	0	0.858660131	1.717320261	4	ND	Tinker Creek at Kennedy Pond	NQ
	Calcium	µg/L	32	6	26	0	2215.9375	4431.875	6,740	ND	BKGDSW003	NQ
	Chromium	µg/L	349	335	14	6	1.411459112	2.822918223	2.33	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	J
	Cobalt	µg/L	16	13	3	1	12.418125	24.83625	13.1	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	NQ
	Copper	µg/L	363	269	94	13	3.290459229	6.580918457	70	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Iron	µg/L	427	4	423	1	572.4033138	1,144.81	12,400	ND	Background Wetland 2	NQ
	Lead	µg/L	333	306	27	2	1.924216216	3.848432432	20	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Magnesium	µg/L	32	7	25	1	859.21875	1718.4375	1,360	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	NQ
	Manganese	µg/L	401	16	385	0	34.4288481	68.85769621	2,690	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	NQ
	Mercury	µg/L	359	284	75	0	0.12692549	0.253850981	0.242285	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Nickel	µg/L	419	335	84	10	3.218925322	6.437850644	30	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Potassium	µg/L	17	6	11	1	1,412.82	2,825.65	2,090	ND	MB-02-02	NQ
	Sodium	µg/L	32	7	25	0	1,863.28	3,726.56	4,920	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Vanadium	µg/L	15	12	3	1	12.47133333	24.94266667	13.1	ND	Savannah River And Steel Creek Sediment And Water MBH-01 & MB-03	NQ
	Zinc	µg/L	377	113	264	1	14.17809019	28.35618037	166.9	ND	U3R-1A Treadway Bridge RD 8-1	NQ
Other	Chemical oxygen demand	µg/L	214	201	13	0	9,897.20	19,794.39	31,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Fixed Residue	µg/L	44	8	36	0	3,181.82	6,363.64	9,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Nitrogen-Nitrate+Nitrite	µg/L	12	0	12	0	202.5	405	290	150	U3R-1A Treadway Bridge RD 8-1	NQ
	Oxygen, Dissolved	µg/L	437	0	437	0	8,305.90	16,611.81	49,000	3180	Tinker Creek 1	NQ
	pH	pH	439	0	439	0	6.059544419	12.11908884	7.9	3.5	U3R-1A Treadway Bridge RD 8-1	NQ
	Specific conductance	USIEMEN/cm	151	0	151	0	25.22582781	50.45165563	140	12	U3R-1A Treadway Bridge RD 8-1	NQ
	Temperature	deg/c	367	0	367	0	16.4319346	32.86386921	25.9	3	Tinker Creek 1	NQ
	Total Dissolved Solids	µg/L	128	1	127	0	12,261.72	24,523.44	49,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Total organic carbon	µg/L	333	1	332	0	4,132.31	8,264.62	35,500	ND	Background Wetland 2	NQ
	Total Suspended Solids	µg/L	360	19	341	0	9,744.22	19,488.44	280,000	ND	Tinker Creek at Kennedy Pond	NQ
	Turbidity	NTU	44	0	44	3	11.40113636	22.80227273	126	1.4	Background Wetland 2	J
	Volatile Solids	µg/L	44	2	42	0	2,954.55	5,909.09	8,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ
Pesticides/PCBs	beta-Benzene hexachloride	µg/L	124	122	2	0	0.36897121	0.737942419	44	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	DDT	µg/L	124	123	1	0	0.01459879	0.029197581	0.033	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Oxadiazon	µg/L	118	65	53	0	64.22337151	128.446743	280	ND	U3R-1A Treadway Bridge RD 8-1	NQ
Radionuclides	Americium-241	pCi/L	16	14	2	0	0.050475449	0.100950897	0.015068781	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Cesium-137	pCi/L	487	430	57	0	0.850557205	1.70111441	25.13513511	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Cobalt-60	pCi/L	478	421	57	0	0.811699641	1.623399282	6.940728	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Curium-244	pCi/L	7	6	1	0	0.000446937	0.000893874	0.001911597	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Gross Alpha	pCi/L	1511	32	1479	0	5.658369051	11.3167381	345.6162	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Gross Beta	pCi/L	248	106	142	0	8.264054407	16.52810881	215.55882	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Non-volatile Beta	pCi/L	1258	406	852	0	2.154973573	4.309947146	67.3	ND	Background Wetland 2	NQ
	Plutonium-238	pCi/L	17	13	4	0	0.039271265	0.078542531	0.13230648	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Plutonium-239	pCi/L	14	11	3	0	0.001392104	0.002784208	0.005114448	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Potassium-40	pCi/L	254	237	17	0	11.06830493	22.13660986	275.4	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Strontium-89 and Strontium-90	pCi/L	20	13	7	0	0.230477565	0.460955131	1.2243447	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Technetium-99	pCi/L	15	13	2	0	2.016448763	4.032897527	0.81	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Tritium	pCi/L	1523	608	915	0	455.3771618	910.7543237	2,729.73	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-234	pCi/L	15	2	13	0	0.100733567	0.201467135	0.9761391	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-235	pCi/L	15	12	3	0	0.028168989	0.056337979	0.04461345	ND	U3R-1A Treadway Bridge RD 8-1	NQ
	Uranium-238	pCi/L	17	6	11	0	0.126669946	0.253339893	1.1805453	ND	U3R-1A Treadway Bridge RD 8-1	NQ
Semivolatiles	Tetracosane	µg/L	25	8	17	0	2680	5360	8,000	ND	U3R-1A Treadway Bridge RD 8-1	NQ

Table A.1.10.2__Background Surface Water

Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2x Mean	Max-Detects	Min	Max Location	Qualifer of Max
TIC	4-Methyldiphenylmethane-3,4-di	µg/L	6	0	6	0	51,833.33	103,666.67	84,000	8000	Background Wetland 2	NQ
Unknown	Methylmercury, Total	µg/L	23	1	22	0	0.000309887	0.000619774	0.00089	ND	Meyers Branch At Road 9 (LLHg51)	NQ
	Water Temperature	deg/c	48	0	48	0	16.10604167	32.21208333	25.3	3.5	Tinker Creek 1	NQ
Volatiles	Acetone	µg/L	16	10	6	2	5.498125	10.99625	15.9	ND	MB-02-02	NQ
	Dichlorodifluoromethane	µg/L	16	13	3	3	3.06875	6.1375	3.76	ND	Background Wetland 2	J
	Toluene	µg/L	16	15	1	1	1.080625	2.16125	1.29	ND	Background Wetland 3	J

Notes:
J Estimated Value
ND No Detects
NQ No Qualifier

Table A.1.10.3__Background Fish Media

Fraction	Analyte	Units	Samples	Non-Detects	Detects	J-Detects	Mean	2x Mean	Max-Detects	Min	Max Location	Qualifer of Max
Metals	Aluminum	mg/kg	14	7	7	4	9.270714286	18.54142857	31.9	ND	UTR-TC	NQ
	Antimony	mg/kg	16	14	2	1	0.26015625	0.5203125	1.2	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Barium	mg/kg	19	3	16	2	5.490526316	10.98105263	19.9	ND	Upper Three Runs near SRS Rd F (UTR-01)	J
	Cadmium	mg/kg	19	17	2	2	0.084868421	0.169736842	0.06	ND	Tinker Creek below Hywy 278	J
	Calcium	mg/kg	11	0	11	0	7,607.82	15,215.64	19,000	326	SC-MB	NQ
	Chromium	mg/kg	19	10	9	9	0.1945	0.389	0.466	ND	SC-MB	J
	Cobalt	mg/kg	11	9	2	2	0.110727273	0.221454545	0.402	ND	SC-MB	J
	Copper	mg/kg	16	8	8	2	0.49903125	0.9980625	1.19	ND	LTR-UP	NQ
	Iron	mg/kg	14	0	14	7	41.07142857	82.14285714	287	8.36	SC-MB	NQ
	Magnesium	mg/kg	11	0	11	0	308.0909091	616.1818182	537	217	SC-MB	NQ
	Manganese	mg/kg	16	1	15	2	10.860375	21.72075	66.8	ND	SC-MB	NQ
	Mercury	mg/kg	16	0	16	4	0.09800625	0.1960125	0.24	.02	Upper Three Runs near SRS Rd F (UTR-01)	J
	Potassium	mg/kg	11	0	11	1	2,373.64	4,747.27	3,550	1340	UTR-TC	NQ
	Selenium	mg/kg	19	11	8	3	1.847868421	3.695736842	13.1	ND	Meyers Branch	J
	Silver	mg/kg	19	18	1	1	0.166684211	0.333368421	0.06	ND	Tinker Creek below Hywy 278	J
	Sodium	mg/kg	11	0	11	0	804	1608	1020	478	SC-MB	NQ
	Vanadium	mg/kg	11	9	2	2	0.064027273	0.128054545	0.167	ND	SR-CKNK	J
	Zinc	mg/kg	16	0	16	1	23.616875	47.23375	60.8	8.02	SC-MB	NQ
Radionuclides	Actinium-228	pCi/g	18	17	1	0	0.090102778	0.180205556	0.27	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Bismuth-214	pCi/g	6	5	1	1	0.053391667	0.106783333	0.112	ND	LTR-UP	J
	Cesium-137	pCi/g	19	2	17	4	0.133647368	0.267294737	0.488	ND	LTR-UP	NQ
	Gross Alpha	pCi/g	19	16	3	0	1.073789474	2.147578947	5.67	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Lead-212	pCi/g	19	16	3	0	0.043102632	0.086205263	0.18	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Lead-214	pCi/g	9	6	3	1	0.081127778	0.162255556	0.223	ND	UTR-TC	NQ
	Non-volatile Beta	pCi/g	19	3	16	1	2.682	5.364	6.42	ND	Tinker Creek below Hywy 278	NQ
	Potassium-40	pCi/g	19	0	19	1	2.751578947	5.503157895	3.8	1.24	Meyers Branch	NQ
	Strontium-89 and Strontium-90	pCi/g	5	3	2	0	0.209	0.418	0.2	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Tritium	pCi/g	19	13	6	0	1.608626316	3.217252632	1.29	ND	Upper Three Runs near SRS Rd F (UTR-01)	NQ
	Uranium-235	pCi/g	8	7	1	0	0.0093	0.0186	0.0121	ND	Meyers Branch	NQ
	Uranium-238	pCi/g	8	7	1	0	0.008354375	0.01670875	0.0067	ND	Meyers Branch	NQ
Volatiles	Acetone	mg/kg	8	0	8	7	0.368375	0.73675	0.57	.231	Tinker Creek below Hywy 278	J
	Benzene	mg/kg	8	7	1	1	0.01096375	0.0219275	0.00071	ND	Meyers Branch	J
	Bromomethane	mg/kg	8	5	3	3	0.020375	0.04075	0.07	ND	Upper Three Runs near SRS Rd F (UTR-01)	J
	Chloroform	mg/kg	8	2	6	5	0.0126175	0.025235	0.03	ND	Upper Three Runs near SRS Rd F (UTR-01)	J
	Chloromethane	mg/kg	8	5	3	3	0.011625	0.02325	0.03	ND	Upper Three Runs near SRS Rd F (UTR-01)	J
	Ethylbenzene	mg/kg	8	5	3	2	0.0126125	0.025225	0.00878	ND	Meyers Branch	NQ
	Methyl ethyl ketone	mg/kg	8	1	7	6	0.06783125	0.135662501	0.18	ND	Upper Three Runs near SRS Rd F (UTR-01)	J
	Methylene chloride	mg/kg	8	0	8	7	0.099125	0.19825	0.3	.017	Upper Three Runs near SRS Rd F (UTR-01)	J
	Tetrachloroethene	mg/kg	8	7	1	1	0.0111525	0.022305	0.00222	ND	Meyers Branch	J
	Toluene	mg/kg	8	2	6	5	0.027545	0.05509	0.06	ND	Tinker Creek below Hywy 278	J
	Xylenes	mg/kg	8	5	3	2	0.0214125	0.042825001	0.045700001	ND	Meyers Branch	NQ

Notes:
Value
ND No Detects
NQ No Qualifier

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Lower Three Runs Integrator Operable Unit Upper Exposure Area #1 Data Sets
Revision 1

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	March 23 - May 20, 2010	IOU LTR2009 - (1)'LTR ERDMS: Sampling Event IOULTR2009-DC' & (2)'LTR ERDMS: Sampling Event IOULTR2009-P'	23	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 4 and **Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters**, SRNS-RP-2010-01379, October 2010	YES - QA reported in: **Field Summary Report & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters**, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Sed & Sed/ Soil	Sept. 13, 2001 - April 28, 2004	IOU - (1)'LTR ERDMS IOULTR Sediment', (2)'LTR ERDMS IOULTR2 Sediment/Soils'	3	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #1; **Field Summary Report for the Lower Three Runs IOU**; WSRC-RP-2004-4015, February 2004	2003 - 2004 Data As reported in **Field Summary Report for the Lower Three Runs IOU**; WSRC-RP-2004-4015, February 2004	Medium
3	Sed	August 13, 1997 - April 23, 2013	EMS Data -(1) 'EMS SEDIMENT DATA' (2) 'LTR EMS EMCAP' (3) 'LTR EMS Rad Sediment' (4) 'LTR EMS SEDIMENT' (5) 'LTR EMS Rad Data' (6) 'LTR WSRC/EMCAP Sediment' (7) 'LTR WSRC/EMS EMCAP Sediment' (8)'LTR EMS Sediment Rad Data'	1	Radionuclides	Periodic Reports 1 -4; SRS Annual Environment Reports	EMS Lab Procedures	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #1 Data Sets
Revision 1

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	April 12-13 and May 19, 2010	IOULTR2009: (1)'ERDMS: Sampling Event IOULTR2009-DC' & (2) 'LTR ERDMS: Sampling Event IOULTR2009-P'	3	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 and **Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters**, SRNS-RP-2010-01379, October 2010	QA reported in: **Field Summary Report & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters**, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Surface Water	Sept 13, 20, 2001 & Nov. 10, 2003	IOU: (1) 'LTR ERDMS IOULTR Surface Water' (2) 'LTR ERDMS IOULTR2 Surface Water'	3	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #1 and **Field Summary Report for the Lower Three Runs IOU**, WSRC-RP-2001-4015	**Field Summary Report for the Lower Three Runs IOU**, WSRC-RP-2001-4015	Medium
3	Surface Water	Oct. 1, 2010	R-Area Groundwater: 'LTR ERDMS: Sampling Event 3Q1ORAG'	1	Tritium	Sampling Event for the R-Area Groundwater 3Q10RAG	EMS Laboratory Procedures followed	Medium
4	Surface Water	Jan. 5, 1991 - Jan. 4, 2011	EMS: (1) 'EMS SURFACE WATER DATA', (2) 'LTR EMS Rad Surface Water' (3) 'LTR EMS SURFACE WATER'; (4) 'LTR WSRC EMCAP' (5) 'WSRC/EMCAP Surface Water'; (6) 'LTR WSRC/EMCAP Water'; (7) 'LTR WSRC/EMS Water Quality'; (8) 'LTR EMS Surface Water Rad Data'	1	Rads	SRS Annual Environmental Reports and Remedial Investigation Work Plan for the Lower Three Runs IOU, WSRC-RP-2001-4061 and Lower Three Runs PR #1 through #4	EMS Laboratory Procedures followed	Medium

Lower Three Runs Upper Subunit Exposure Area #1 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Biota (Fish)	Aug. 19-25, 2010	SREL 2011	2	Metals	"Trace Element Concentrations of Aquatic Biota from Selected SRS Aquatic Systems - Support of th SRS Trophic Transfer Modeling Effort - Phase 2"	None noted	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #2 Data Sets
Revision 1

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	April 12 - 20, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-DC'	44	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 4 and **Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters**, SRNS-RP-2010-01379, October 2010	QA reported in: **Field Summary Report** & **SAP for the Lower Three Runs Stream, Floodplain, and Headwaters**, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High

Lower Three Runs Integrator Operable Unit Upper Exposure Area #2 Data Sets
Revision 1

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	April 12-20, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-DC'	10	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 4 and **Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters**, SRNS-RP-2010-01379, October 2010	QA reported in: **Field Summary Report & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters**, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Surface Water	October 18, 2001	IOU: 'LTR ERDMS IOULTR Surface Water'	2	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 1	EMS Laboratory Procedures	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #3 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	March 18 - May 15, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-P'	15	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 4 and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Sed & Sed/ Soil	Sept 12 and 27, 2001	IOU: (1) 'FMB ERDMS IOUFMB2 Sediment Data' (2) 'LTR ERDMS IOULTR Sediment'	2	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 1; Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	As reported in Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	Medium
3	Sed & Sed/ Soil	Sept. 13 - 21, 1994	SREL: 'LTR Pond B Cesium Sediment Data	28	Radionuclides	Lower Three Runs PR #1; Temproal Trend of Cesium-137 in an Abandoned Reactor Cooling Reservoir. Journal of Environmental Radioactivity Vol 37(3):251-268	Temproal Trend of Cesium-137 in an Abandoned Reactor Cooling Reservoir. Journal of Environmental Radioactivity Vol 37(3):251-268	High

Lower Three Runs Integrator Operable Unit Upper Exposure Area #3 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	May 14, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-P'	1	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Surface Water	Aug. 27 & Oct. 16, 2001	IOU: 'LTR ERDMS IOULTR Surface Water'	2	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 1 (WSRC-RP-2003-4151)	None	Medium

Lower Three Runs Integrator Operable Unit Exposure Area #3 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Biota (Fish)	April 14 and June 7, 2010	'LTR ERDMS: Sampling Event IOULTR2009-FISH'	1	Inorganics, Metals, Radionuclides	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)		High
2	Biota (Fish)	Jan. 1, 1993 – June 12, 2002	(1) 'LTR WSRC EMS EMCAP Fish' (2) 'LTR WSRC EMS Mercury Fish' (3) 'LTR WSRC/EMS EMCAP Fish' (4) 'LTR WSRC/EMS Fish Mercury'	1	Metals (Mercury), Radionuclides	SRS Annual Environmental Reports		Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #4 Data Sets

	Media	Dates of Sampling	Data Sets Names (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	April 19 -22, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-DC'	36	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535) and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High

Lower Three Runs Integrator Operable Unit Upper Exposure Area #5 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	April 19 - 22, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-DC'	9	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535) and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters, SRNS-RP-2009-00763 Rev. 1 (SGCP-SAP-00003)	High
2	Surface Water	Oct. 17, 2001	IOU: 'LTR ERDMS IOULTR Surface Water'	1	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR 1 (WSRC-RP-2003-4151)	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #5 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	March 16 - 29, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-JB'	10	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535) and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters (SGCP-SAP-00003)	High
2	Sed & Sed/ Soil	Oct. 30, Nov. 10, 2003 & April 28, 2004	IOU: (1) 'LTR ERDMS IOULTR2 Sediment/Soils'; (2) 'LTR ERDMS: Sampling Event IOULTR2'	3	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs Periodic Report 1 (WSRC-RP-2003-4151)	QA/QC samples reported in Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #5 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	March 16 - 18, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-JB'	5	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535) and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters (SGCP-SAP-00003)	High
2	Surface Water	Oct. 30, 2003	IOU: 'LTR ERDMS IOULTR2 Surface Water'	2	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #1 (WSRC-RP-2003-4151)	QA/QC Samples reported in: Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	Medium
3	Surface Water	June 15, 2010 - Nov. 5, 2013	RAG: (1) 'LTR ERDMS: Sampling Event 2Q10RAG'; (2) 'LTR ERDMS: Sampling Event 4Q11RAG'; (3) 'LTR ERDMS: Sampling Event 4Q12RAG'; (4) 'LTR ERDMS:Sampling Event 4Q11RAG'; (5) 'LTR ERDMS:Sampling Event 4Q12RAG'; (6) 'LTR ERDMS:Sampling Event 4Q13RAG'	4	Radionuclides, Semivolatiles, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535)	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #6 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	June 6, 2016	LTR ERDMS: SEDIMENT subset of Sampling Event LTRPP2Q16	3	Suites of: Inorganics, Metals, Radionuclides	Sampling collected following the Addendum to the Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters - PAR Pond (SGCP-SAP-2009-00003, Rev.1), SRNS-RP-2016-00006 July 2016	Lower Three Runs Integrator Operable Unit Data Usability Report, SRNS-RP-2012-00729, Rev. 0, 2017	High
2	Sed	July 7 - 14, 1995	IOU: 'LTR PAR L-Lake EIS'	10	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Submerged Sediment Core samples taken at PAR Pond, Pond C, and L Lake (WSRC-TR-96-0238) and Quality Control Summary Report for the RFI/RI Assessment of the Submerged Sedimetn Cores taken at PAR Pond, Pond C, and L Lake (WSRC-RP-91-1197)	As reported in Quality Control Summary Report for the RFI/RI Assessment of the Submerged Sediment Cores taken at Par Pond, Pond C, and L Lake (WSRC-RP-91-1197)	Medium
3	Sed	Jan 26 - March 13, 1995	IOU: 'LTR PAR Pond Risk Assessment Phase 1'	152	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Potential Ecological Effect of Contaminants in the Exposed PAR Pond Sediments (WSRC-TR-96-0292) and Quality Control Summary Report for the Par Pond Ecological Risk Assessment (ESH-EMS-950548 and ESH-EMS-950903) unavailable	As reported in Quality Control Summary Report For the PAR Pond Ecological Risk Assessment (ESH-EMS-950548) and (ESH-ESM-950903)	Medium
4	Sed	Sept 14 - 20, 1995	IOU: 'LTR PAR Pond Refill Sediment, Fish & Water'	44	Radionuclides, Metals	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
5	Sed	July 25 and 26, 1995	IOU: 'LTR Refill Sediment'	42	Metals	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
6	Sed	July 28 - Oct 3, 1991	IOU: 'LTR EMS PAR-C Pond Sediment'	9	Radionuclides	SRS Environmental Report for 1991 (WSRC-TR-92-186)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #6 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	May 18-31, 2016	LTR ERDMS: SURFACE WATER subset of Sampling Event LTRPP2Q16	14	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semi-volatiles. Volatiles	Sampling collected following the Addendum to the Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters - PAR Pond (SGCP-SAP-2009-00003, Rev.1), SRNS-RP-2016-00006 July 2016	Lower Three Runs Integrator Operable Unit Data Usability Report, SRNS-RP-2012-00729, Rev. 0, 2017	High
2	Surface Water	Sept 14 - 20, 1995	SRTC: 'LTR PAR Pond Refill Sediment, Fish & Water'	4	Inorganics, Metals, Radionuclides	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium
3	Surface Water	May 7, Sept 18, and Nov 12, 1996	SRTC: 'LTR PAR Pond Water & Fish'	4	Inorganics, Metals, Radionuclides	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #6 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Biota (Fish)	April 14, June 7 and 8, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-FISH'	1	Inorganics, Metals, Radionuclides	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High
2	Biota (Fish)	Sept 12-27, 1995	IOU: 'LTR PAR Pond Refill Sediment, Fish & Water'	47	Inorganics, Metals, Radionuclides	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
3	Biota (Fish)	August 14 and 15, 1996	IOU: 'LTR PAR Pond Water & Fish'	4	Metals, Radionuclides	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
4	Biota (Fish)	Sept 15, 1995	IOU: 'LTR Refill Fish'	1	Metals	PAR Pond Fish, Water, and Sediment Chemistry (WSRC-TR-96-0208)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
5	Biota (Fish)	Sept 2, 1993 - October 29, 1999	IOU: 'LTR WSRC EMS EMCAP Fish'	1	Radionuclides	SRS Annual Environmental Reports	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium
6	Biota (Fish)	Jan 1, 1993 - Jan 1, 1999	IOU: 'LTR WSRC EMS Mercury Fish'	2	Metals	SRS Annual Environmental Reports	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium
7	Biota (Fish)	Jan 26, 2000 - June 19, 2002	LTR WSRC/EMS EMCAP Fish	1	Radionuclides	SRS Annual Environmental Reports	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium
8	Biota (Fish)	Jan 1, 2000 - June 19, 2002	LTR WSRC/EMS Fish Mercury	1	Radionuclides	SRS Annual Environmental Reports	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #7 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	March 24 - May 24, 2010	IOULTR2009: (1) 'LTR ERDMS: Sampling Event IOULTR2009-DC'; (2) 'LTR ERDMS: Sampling Event IOULTR2009-P'	75	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 (SRNS-RP-2011-01535) and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters (SGCP-SAP-00003)	High
2	Sed & Sed/ Soil	Sept. 13, 2001 - Feb. 25, 2005	IOU: (1) 'LTR ERDMS IOULTR Sediment'; (2) 'LTR ERDMS IOULTR2 Sediment/Soils'; (3) 'LTR ERDMS: Sampling Event IOUFY05'; (4) 'LTR ERDMS: Sampling Event IOULTR2'	6	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs Periodic Report 1 (WSRC-RP-2003-4151) and Lower Three Runs Periodic Report 2 (WSRC-RP-2006-4016)	QA/QC samples reported in: Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	Medium
3	Sed	July 26 & Nov. 13, 2006; May 12 & 13, 2008	PAOU: 'LTR ERDMS: Sampling Event PAOU-06D'	1	Inorganics, Metals, and Radionuclides	Lower Three Runs Periodic Report 3 (SRNS-RP-2009-00763) and Lower Three Runs Periodic Report 4 (SRNS-RP-2011-01535); RFI/RI with BRA and CMS/FS for the P-Area Operable Unit (WSRC-RP-20074032)	QA/QC samples and plan reported in: RI Work Plan for the P-Area Operable Unit, WSRC-RP-2005-4081 Rev. 1.1 Sept. 2006	Medium
4	Sed	Aug. 1, 1995 & April 1, 1996	'LTR Pond 2/5 P-Canal Sediments'	5	Radionuclides	Sampling and Analysis of Pond2, Pond 5, and the P-Reactor Canal Sediments (WSRC-TR-96-0175, Rev. 1, 1996); RI Work Plan for the Lower Three Runs IOU (WSRC-RP-2001-4061)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium
5	Sed	March 9, 2000	'LTR ERDMS: Sampling Event PRECOOLPOND'	22	Metals, Radionuclides	Surface Sediments in Precooler Ponds 2,4, and 5; March 2000, WSRC-TR-2000-00162; Lower Three Runs Periodic Report 2	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium
6	Sed	March 9, 2000	'LTR Ponds 2,4&5'	21	Metals	Surface Sediments in Precooler Ponds 2,4, and 5; March 2000, WSRC-TR-2000-00162; Lower Three Runs Periodic Report 1	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #7 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	April 22 - May 24, 2010	IOULTR2009: (1) 'LTR ERDMS: Sampling Event IOULTR2009-P'; (2) 'LTR ERDMS: Sampling Event IOULTR2009-DC'	16	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs PR #4 and Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters, SRNS-RP-2010-01379, October 2010	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain, and Headwaters (SGCP-SAP-00003)	High
2	Surface Water	Sept. 13 & 19, 2001; Nov. 4,5 & 10, 2003	IOU: (1) 'LTR ERDMS IOULTR Surface Water'; (2) 'LTR ERDMS IOULTR2 Surface Water'	8	Suites of: Metals, Inorganics, Rads, Semi-Volatiles, Semi-volatile/Volatile, Pesticide/PCBs, Volatiles	Lower Three Runs Periodic Report 1 (WSRC-RP-2003-4151)	QA/QC samples reported in Field Summary Report for the Lower Three Runs IOU; WSRC-RP-2004-4015, February 2004	Medium
3	Surface Water	Jan. 5, 1991 - May 3, 2011	EMS: (1) 'EMS SURFACE WATER DATA'; (2) 'LTR EMS SURFACE WATER'; (3) 'LTR EMS SURFACE WATER RAD DATA'; (4) ' LTR WSRC EMCAP'	1	Radionuclides	Work Plan for the Lower Three Runs IOU (WSRC-RP-2001-4061); SRS Annual Environmental Reports; Lower Three Runs PR #3, #4	QA/QC Program through EMS Laboratory Procedures & Calibrations (Manual L3.25 - QA Procedures)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #7 Data Sets

	Media	Dates of Sampling	Data Set Name (Identifier)	# of Sample Locations	Analytical	Reported	QA/QC	Pedigree Rating
1	Biota (Fish)	Aug. 19-25, 2010	SREL 2011	2	Metals	"Trace Element Concentrations of Aquatic Biota from Selected SRS Aquatic Systems - Support of th SRS Trophic Transfer Modeling Effort - Phase 2"	None noted	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #8 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/Soil	March 25 - May 21, 2010	IOULTR2009: (1) 'LTR ERDMS: Sampling event IOULTR2009-DC' (2) 'LTR ERDMS: Sampling Event IOULTR2009-P'	42	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High
2	Sed & Sed/Soil	Sept 27, 2001 - April 21, 2004	IOU: (1) 'LTR ERDMS IOULTR Sediment' (2) 'LTR ERDMS IOULTR2 Sediment/Soils' (3) 'LTR ERDMS: Sampling Event IOULTR2'	4	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Field Summary Report for the Lower Three Runs IOU (WSRC-RP-2004-4015) and Periodic Report 1 for the Lower Three Runs IOU (WSRC-RP-2003-4151)	QA/QC samples reported in: Field Summary Report for the Lower Three Runs IOU (WSRC-RP-2004-4015, February 2004	Medium
3	Sed	March 2 and 27, 2000	PRECOOL: 'LTR ERDMS: Sampling Event PRECOOLPOND (20000003)'	26	Metals, Radionuclides	Surface Sediments in Precooler Ponds 2, 4 and 5: March 2000 (WSRC-TR-2000-00164, Dunn et al) and Periodic Report 2 for the Lower Three Runs IOU (WSRC-RP-2006-4016)	QA/QC Program through SRTC Laboratory procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium
4	Sed	March 2 and 27, 2000	LTR Ponds 2,4&5	26	Metals	Remedial Investigation Work Plan for the Lower Three Runs IOU (WSRC-RP-2001-4061)	QA/QC Program through SRTC Laboratory procedures & Calibrations (i.e., Manual L10.1 & L10.4, ERTS Work Instructions)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #8 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	April 29, May 20 & 21, 2010	IOULTR2009: (1) 'LTR ERDMS: Sampling Event IOULTR2009-DC' (2) 'LTR ERDMS: Sampling Event IOULTR2009-P'	5	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semivolatiles, Semivolatiles/Volatiles, Volatiles	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High
2	Surface Water	Sept 20 and Oct 17, 2001; Nov 4, 2003	IOU: (1) 'LTR ERDMS IOULTR Surface Water' (2) 'LTR ERDMS IOULTR2 Surface Water'	4	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semivolatiles, Semivolatiles/Volatiles, Volatiles	Field Summary Report for the Lower Three Runs IOU (WSRC-RP-2004-4015) (2003 data) and Periodic Report 1 for the Lower Three Runs IOU (WSRC-RP-2003-4151)	QA/QC samples reported in: Field Summary Report for the Lower Three Runs IOU (WSRC-RP-2004-4015), February 2004	Medium
3	Surface Water	Sept 27 and Oct 18, 2001	RBP: 'LTR ERDMS RBRP4 Surface Water'	4	Radionuclides, Volatiles	Periodic Report 1 for the Lower Three Runs IOU (WSRC-RP-2003-4151)	QA/QC samples reported in Field Summary Report for the Lower Three Runs IOU (WSRC-RP-2004-4015) February 2004	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #8 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Biota (Fish)	June, 10 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-FISH'	1	Inorganics, Metals, Radionuclides	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High

Lower Three Runs Integrator Operable Unit Upper Exposure Area #9 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Sed & Sed/ Soil	March 22, 23 & May 18, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-P'	15	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High
2	Sed	July 7 - 14, 1995	IOU: 'LTR PAR L-Lake EIS'	2	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Submerged Sediment Core samples taken at PAR Pond, Pond C, and L Lake (WSRC-TR-96-0238) and Quality Control Summary Report for the RFI/RI Assessment of the Submerged Sedimetn Cores taken at PAR Pond, Pond C, and L Lake (WSRC-RP-91-1197)	As reported in Quality Control Summary Report for the RFI/RI Assessment of the Submerged Sediment Cores taken at Par Pond, Pond C, and L Lake (WSRC-RP-91-1197)	Medium
3	Sed	Sept 27, 2001	IOU: 'LTR ERDMS IOULTR Sediment'	1	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Periodic Report 1 for the Lower Three Runs IOU, (WSRC-RP-2003-4151)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium
4	Sed	July 30, 1991	IOU: 'LTR EMS PAR-C Pond Sediment'	5	Radionuclides	SRS Environmental Report for 1991 (WSRC-TR-92-186)	QA/QC Program through SRTC Laboratory Procedures & Calibrations (i.e., Manual L10.1 &L10.4, ERTS Work Instructions)	Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #9 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Surface Water	May 18, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-P'	1	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High
2	Surface Water	Sept 27, 2001	IOU: 'LTR ERDMS IOULTR Surface Water'	1	Suites of: Inorganics, Metals, Pesticides/PCBs, Radionuclides, Semiviolatiles, Semiviolatiles/Volatiles, Volatiles	Remedial Investigation Work Plan For the Lower Three Runs IOU (WSRC-RP-2001-4061) and Periodic Report 1 for the Lower Three Runs IOU (WSRC-RP-2003-4151)		Medium

Lower Three Runs Integrator Operable Unit Upper Exposure Area #9 Data Sets

	Media	Dates of Sampling	Data Sets Name (Identifier)	# Sample Locations	Analytical	Reported	QA/QC Report	Pedigree Rating
1	Biota (Fish)	April 14, June 7, 2010	IOULTR2009: 'LTR ERDMS: Sampling Event IOULTR2009-FISH'	1	Inorganics, Metals, Radionuclides	Periodic Report 4 for the Lower Three Runs IOU (SRNS-RP-2011-01535); Field Summary Report for the Characterization of LTR Stream, Floodplain, and Headwaters (SRNS-RP-2010-01379); Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters (SRNS-RP-2009-00763)	QA reported in: Field Summary Report (SRNS-RP-2010-01379) & SAP for the Lower Three Runs Stream, Floodplain and Headwaters (SGCP-SAP-2009-00003)	High

APPENDIX B

Human Health Risk Assessment

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B.1 INTRODUCTION

The human health risk assessment (HHRA) in support of the Lower Three Runs (LTR) Integrator Operable Unit (IOU) is presented in this appendix. The LTR IOU is defined as the LTR stream and its tributaries and impoundments, including surface water, sediment, floodplain/wetland soils (sediment/soil), and related biota in these water bodies and associated floodplains. For purposes of the RI/BRA, sediment and sediment/soil sample results were combined as a single media referred to as "sediment/soil." The LTR IOU is downgradient from the major industrial areas R Area and P Area that include the R Area Operable Unit (OU) [RAOU] and P Area OU [PAOU]), both of which have previously undergone the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 Remedial Investigation/Feasibility Study process and subsequent remedial action as described in the Records of Decision (RODs) for these OUs (Savannah River Nuclear Solutions [SRNS] 2010a and SRNS 2010b, respectively).

The basis for this evaluation is the preliminary conceptual site model (CSM) as presented in Chapter 2. The CSM is a graphical representation of the LTR IOU sources of contamination and potential impacts to human health and the environment that serves in facilitating cleanup decisions during a remedial investigation. The CSM is a planning tool that organizes information known about a site and identifies the additional information necessary to support decisions that will achieve the goals of the project. The preliminary CSM establishes the focus for the risk assessment, identifying the sources of contamination, the release mechanisms into exposure media, the exposure routes associated with media, and the potential receptors evaluated in the risk assessment. Figure 2-7 in Chapter 2 presents the preliminary CSM for the LTR IOU HHRA. The CSM includes the following elements:

- Primary sources of contamination,
- Primary environmental release mechanisms,
- Secondary sources of contamination,
- Secondary release mechanisms,
- Exposure media,
- Exposure routes, and
- Human receptors.

The HHRA is conducted and presented for each of nine exposure areas (EAs). EAs represent geographically distinct locations within the upper subunit of the LTR IOU, each of which contains environmental media to which a receptor may be exposed. Exposure is assessed by screening

environmental data from the LTR IOU BRA database and evaluating the potential for exposure. This approach allows for remedial decisions to be made on a smaller scale within the larger IOU area. The EAs are comprised of the following:

- Pond A and R Discharge Canal,
- Canal between Pond A and Pond B,
- Pond B,
- Canal between Pond B and PAR Pond,
- Joyce Branch/Old Discharge Canal,
- PAR Pond,
- Pond 2 and associated canals,
- Ponds 4 and 5 and Canal to Pond C, and
- Pond C.

Various datasets exist for each EA. Much of the characterization data were collected in 2009-2010, but are supplemented by historical data for development of the risk assessment. Media include sediment/soil, surface water, and biota (i.e., fish). For purposes of the RI/BRA, sediment and sediment/soil sample results were combined as a single media referred to as "sediment/soil." More recently, a 2016 Sampling and Analysis Plan Addendum called for the collection and analysis of additional surface water and sediment samples from PAR Pond (SRNS 2016). All data used in the HHRA is presented in Appendix A.

B.1.1 Background

The LTR IOU represents the integration of potential contamination discharged to surface water or migrating through groundwater from upgradient source OUs, EAs, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure. The LTR IOU consists of natural and manmade water bodies, including ponds and streams, and man-made canals that transmitted and temporarily stored reactor cooling water obtained from the Savannah River Site (SRS) after circulating through the P Reactor and R Reactor, with discharge into the lower arm of LTR IOU tail section, and eventual discharge back into the Savannah River via the LTR stream system. The water bodies and canals are segregated into EAs for investigation, evaluation, and potential remediation purposes based on the primary source of contamination (i.e., R Reactor or P Reactor). The focus is the contaminants that have settled and/or remained in environmental media within the upper portion of the LTR IOU. Figure B-1 illustrates the LTR IOU and the associated EAs.

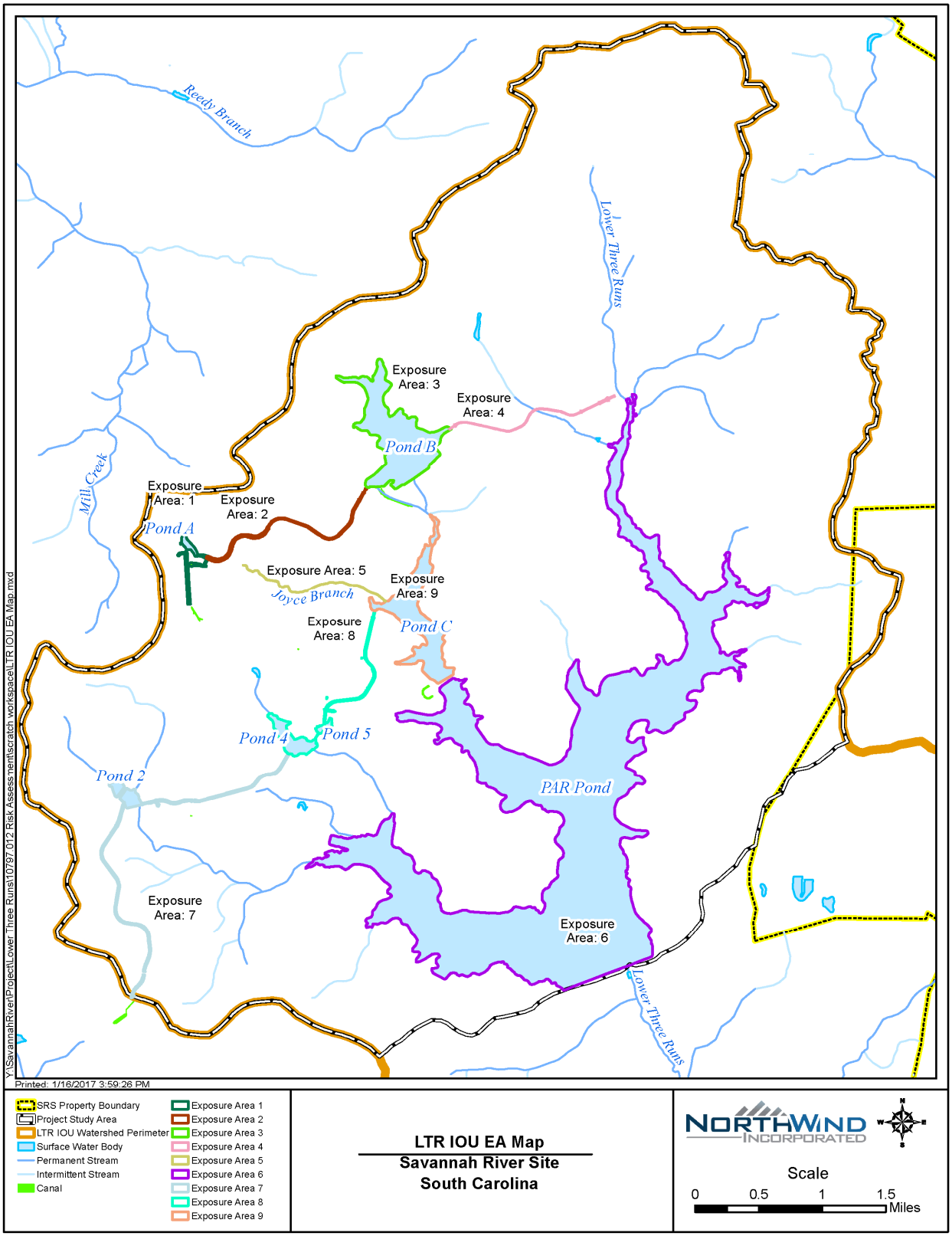


Figure B-1. Lower Three Runs Operable Unit and Associated Exposure Areas

The EAs, having received reactor water from R Reactor and/or P Reactor, are described below.

- EA 1 includes Pond A and the R-Reactor Area Discharge Canal. Pond A is approximately (~) 2.6 hectares [ha] (6.4 acres [ac]) and received water from the R-Area Discharge Canal and subsequently discharged to Pond B. Initially, the Discharge Canal effluent flowed into Pond C via Joyce Branch (EA 5) prior to construction of the canal to Pond B. Water levels in Pond A fluctuate from year to year based on precipitation amounts. The canal from R-Reactor to Pond A is ~645-meters (m [2,116.1-feet {ft}]) long. The canal from the R-Discharge Canal to Joyce Branch is 233-m (764.4-ft) long.
- EA 2 includes the canal from Pond A to Pond B, which is ~2,837 m (9,307.7 ft) long. It received water from Pond A, which flowed to and discharged into Pond B. Water levels fluctuate from year to year based on precipitation amounts.
- EA 3 includes Pond B and the overflow canal connecting Pond B to Pond C. Pond B is ~82.1 ha (202.8 ac) and discharged water into the canal, which flowed to discharged to Pond C. The canal from Pond B to Pond C is ~547-m (1,794.6-ft) long. Pond B generally maintains its water level from year to year.
- EA 4 includes the canal from Pond B to the North Arm of PAR Pond and is ~2,305-m (7,562.3-ft) long. It received water from Pond B, which flowed to and discharged into the North Arm of PAR Pond. Water levels within the canal fluctuate from year to year based on precipitation amounts.
- EA 5 includes the natural stream (i.e., Joyce Branch) that flows into Pond C, which was initially used to transmit reactor water from R Reactor directly to the Lower Three Runs stream system prior to the construction of the canal system to Pond B. Joyce branch is ~2,533-m (8,310.3-ft) long.
- EA 6 includes PAR Pond from below the dam on the north end at the downgradient side of Pond C to the dam on the downgradient end of PAR Pond, as well as the north and south arms of PAR Pond. PAR Pond is ~1,068.3 ha (2,640 ac) and received water from the R Area and P Area discharges via Pond B and Pond C, respectively. Water levels in PAR Pond naturally fluctuate above the 59.4-m (195-ft) mean sea level.

- EA 7 includes the P effluent canal, Pond 2, and the canal from Pond 2 to Pond 4. Pond 2 is ~7.9 ha (19.6 ac) and received water from the P effluent canal. Pond 2 discharged water into Pond 4. The canal from P-Area is ~3,582-m (11,751.9-ft) long. The canal from Pond 2 to Ponds 4/5 is ~2,081-m (6,827.4-ft) long. Water levels fluctuate from year to year in Pond 2 and the canal system based on precipitation amounts.
- EA 8 includes Ponds 4 and 5 and the canal from Pond 5 to Pond C. Pond 4 is ~14.3 ha (35.3 ac) and received water from the P-Area and subsequently discharged to Pond 5. Pond 5 is ~4.0 ha (9.9 ac) and received water from Pond 4 and subsequently discharged to Pond C via a 1,887-m (6,190.9-ft) long canal. Water levels fluctuate from year to year in Pond 4, Pond 5, and the canal.
- EA 9 includes Pond C. Pond C is ~53.5 ha (132.4 ac) and received water from the R-Area and P-Area via Joyce Branch and the Pond 5 discharge canal, respectively. Pond C and PAR Pond are separated by an earthen barrier that is hydraulically connected and allows flow between the two bodies of water. In general, the Pond C water level is naturally maintained from year to year.

All waste units located within the LTR IOU have been closed, remediated, or are currently under remediation, therefore, the risk assessment considers environmental media within the canals and ponds only, including sediments and immediately adjacent floodplain/wetland soils (collectively referred herein as sediment/soil), surface water in the ponds and canals, and biota (i.e., fish) where habitat is sufficient to support fish populations (i.e., limited to EAs 3, 6, 8, and 9).

B.1.2 Data

For the IOU program, previous characterization efforts have focused on determining the nature of contamination and identifying the areas where Phase II early actions were required as described in the *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (SRNS 2002). Past characterization efforts within the LTR IOU have indicated that cesium-137 is the major contaminant in the former reactor cooling water system. For the IOU program, previous characterization efforts have focused primarily on determining the nature of contamination and identifying areas where IOU Phase II early actions were required. Several

characterization efforts were performed for the LTR RI/BRA, from the initial RI Work Plan through the data evaluation/culling process that resulted in the final dataset supporting this document. The RI Work Plan (WSRC 2002) compiled exiting data for the LTR IOU (including sediment, sediment/soil, surface water, and fish) from sampling and monitoring efforts conducted by various investigators that established the LTR IOU database (Phase I). A detailed discussion of these efforts is provided in Chapter 3. The previous studies performed and summarized in the RI Work Plan are summarized below:

- Surface Sediments in Pre-Cooler Ponds 2, 4 and 5 were collected in March 2000 (WSRC-TR-2000-00164) to determine the levels of radioactive lead and mercury in sediments that could be exposed if the precooler dams were eliminated or allowed to fail. The results indicated evidence of radioisotope (namely cobalt-60 and cesium [Cs]-137), lead, and mercury contamination exceeding background levels.
- Sediment cores from shallow- and deep-water locations in PAR Pond, Pond C, and L Lake were collected in July 1995 (WSRC-TR-96-0238) to develop a defensible characterization of contaminants found in sediments in these water bodies. The results indicated mercury and radioisotope contamination exceeding concentrations from the reference sites.
- Sediments where collected in August 1995 (Phase I) and April 1996 (Phase 2) at four sites in Pond 2, eight sites in or near Pond 5, and one site along the canal between Pond 2 and Pond 5 (WSRC-TR-96-0175) to identify the maximum levels of contamination that could be exposed by fluctuating water levels in ponds as a result of shutting down the river water distribution system. The results indicated that radioisotope activity levels were comparable to activities measured during other studies of the PAR Pond cooling system.
- Sediment and small mammal samples were collected in 1995 from exposed sediments of PAR Pond before the reservoir was refilled following a 4-year drawdown. Samples were analyzed for radionuclides and metals to determine if contaminant levels in the PAR Pond sediments were high enough to cause deleterious ecological effects. The results indicated that mercury was slightly elevated and Cs-137 was present at levels well in excess of levels at control sites. Also, levels of Cs-137 detected in small mammals were elevated, while no evidence of mercury bioaccumulation was seen.

Upon completion of the Work Plan, the LTR IOU entered Phase II of the IOU program (investigation process). Phase II included the ongoing monitoring and assessment of the IOU (with periodic reporting) prior to the onset of Phase III final action determinations. A summary of the monitoring presented in periodic reports is presented below.

- Areas targeted for additional sampling included the unnamed tributary south of R-Area in the Ponds 4/5 subunit and the unnamed tributary northeast of P-Area of the Pond 2 subunit. Sediment/soil samples were collected in Ponds 4/5 subunit for definitive level data (i.e., full suite of analytes, including target compound list, target analyte list, gross alpha, nonvolatile beta, gamma spectroscopy). Additionally, samples collected in the Pond 2 subunit were analyzed for metals and gamma emitters, primarily Cs-137, along the reach of the tributary for definitive level data.
- A third round of LTR IOU sampling was performed that consisted of follow-on speciation for alpha spectroscopy and nonvolatile beta-emitting radionuclides in sediment/soil samples south of R-Area.

Following analysis of data collected from these sampling efforts, additional sampling was defined in *Sampling and Analysis Plan (SAP) for the Lower Three Runs Stream, Floodplain, and Headwaters – PAR Pond* (SRNS 2009). This SAP included characterization of all subunits (Upper, Middle, and Lower) of the LTR IOU, which were targeted for further characterization based on gaps in definitive characterization data from the previous investigations.

In 2009 and 2010, extensive sampling of the LTR IOU was performed to augment prior data collected to ensure that sufficient information was available for evaluating risks to human health and ecological receptors. This sampling was performed as outlined in an approved SAP (SRNS 2012) and included sampling within three types of systems: canals, pre-cooler ponds/PAR Pond, and stream/channel/floodplain. Within each system, the sample design involved an even spacing of transects to collect an unbiased population of data. The data consisted of field gamma readings along transects that were supplemented with the collection of sediment, sediment/soil, and surface water samples for laboratory analyses. The sampling effort included collection of both filtered and unfiltered surface water samples, composite and two depth intervals for sediment/soil,

and biological data (primarily fish) from Lower Three Runs Exposure Areas as well as several background locations for all media.

In 2016, additional sediment and surface water samples were collected in PAR Pond in accordance with the SAP (SRNS 2009). The identification and definition of problems warranting action and the associated extent of contamination is based on the final data set, which includes both high- and medium-level pedigree historic data as well as data collected from the 2009 and 2010 characterization effort. Historical data sets were assigned a high, medium, or low pedigree rating based on availability of published reports, level of quality assurance/quality control documentation, etc. A summary of the number of analytical data supporting the Phase III evaluation is shown below.

Data summaries for each media by EA are presented in Appendix A. For discussion of the nature and extent of contamination, see Chapter 3 of the Remedial Investigation.

Summary of LTR IOU Analytical Records

Media	LTR IOU Analytical Record Types		
	Ponds and Canal System 2009/2010 Data	**Medium/High Pedigree Historical Data**	**2009/2010 Background Data**
Sediment	5,539	53,822	564
Sediment/Soil	26,750		1,040
Surface Water	15,455	33,124	855
Fish	504	4,945	268

B.1.3 Receptors

The purpose of the HHRA is to evaluate the potential for adverse effects associated with exposure to constituents present in the LTR IOU. The assessment estimates the risk potential in the absence of any remedial action and provides a basis for determining whether or not remedial actions are necessary to reduce or eliminate risks to human health. A streamlined approach that considers both standardized and site-specific receptor scenarios/exposure assumptions has been used for this evaluation.

The receptors evaluated for the HHRA are described below. Initially, maximum concentrations of constituents detected in exposure media are compared to risk-based threshold values applicable

to the receptors included in the HHRA. The receptors evaluated include future resident, future industrial worker, onsite worker, and recreational fisherman. A description of each receptor is presented below.

The **future resident** receptor scenario evaluates long-term risks to individuals assumed to have unrestricted use of the unit. This scenario considers residents (adults and children) that hypothetically live on the unit and are exposed chronically, both indoors and outdoors, to unit contaminants. Exposure routes associated with sediment/soil include inhalation of particulates and vapors, external exposure to radiation, dermal absorption, and incidental ingestion. This receptor is routinely evaluated in OU program risk assessments performed by Area Completion Projects (ACPs).

The future resident receptor scenario is also evaluated for the surface water media. This includes a comparison of constituents to surface water threshold levels based on regulatory-based limits (i.e., maximum contaminant levels) or risk-based threshold values, as appropriate.

The **future industrial worker** scenario is a standard United States Environmental Protection Agency (USEPA) exposure scenario, which addresses long-term risks to workers who are exposed to unit contaminants within an industrial setting. The standard exposure assumptions are 25 years, 250 days per year, and 8 hours per day. The future industrial worker scenario considers an adult who hypothetically works on-unit in an outdoor setting for the majority of time. Exposure routes include inhalation, external exposure to radiation, dermal absorption, and incidental ingestion to sediment/soil. This receptor is routinely evaluated in OU program risk assessments performed by ACPs.

The **onsite worker** receptor scenario is site specific and describes a worker who is performing maintenance, collecting site samples, or conducting research within the LTR IOU. The exposure assumptions for the onsite worker are 20 years, 150 days/year, and 8 hours per day. These site-specific assumptions are based on input provided by the Savanna River Ecology Laboratory and describe a typical wetlands researcher. Exposure routes associated with sediment/soil include inhalation, external exposure to radiation, dermal absorption, and incidental ingestion. This receptor is routinely evaluated in the IOU program risk screening exercises (i.e., benchmark

comparisons) performed by the ACPs. This is the most likely receptor exposure scenario for the LTR IOU. This receptor is also considered for the principal threat source material evaluation and assumes the same exposure routes as described above (see Appendix D).

The **recreational fisherman** receptor scenario is site specific and describes a person who fishes in the LTR IOU infrequently (26 years, 20 days/year, 6 hours/day). This exposure scenario is evaluated by comparing fish tissue concentrations to receptor-based threshold levels for fish based on ingestion of fillets. The exposure assumptions for fish ingestion are 26 years, 350 days/year, and 54 grams (1.7 ounces) of fish fillet ingested per day. Risk estimated for sediment/soil media for this receptor is not presented herein since the onsite worker exposure assumptions are more conservative (i.e., results in higher risk) and bounds the risk for exposure to this media.

B.1.4 Sources of Risk-Based Threshold Values

The USEPA publishes regional screening levels (RSLs) for nonradiological constituents and preliminary remediation goals (PRGs) for radiological constituents that are risk-based concentrations (or activity concentrations) and can be used to evaluate potentially contaminated waste sites. Both RSLs and PRGs combine current USEPA toxicity values with standard exposure factors that represent reasonable maximum exposure (RME) conditions to estimate contaminant concentrations in exposure media that the agency considers protective of humans over a lifetime. The concentrations are based on direct exposure pathways for which generally accepted methods, models, and assumptions have been developed for specific land use conditions.

The source of RSLs used in this assessment, *USEPA Regional Screening Levels* website (USEPA 2016), consists of generic exposure scenario summary tables and a calculator function to derive site-specific RSLs in which user-specific exposure parameters are exchanged for the generic scenario parameters. The website was accessed in October 2016. The generic table, published in May 2016, uses all default parameters for both the residential and industrial worker scenarios. A copy of the RSL table used in this evaluation for these standard receptors is provided in Attachment B-1 to this appendix. The RSLs for the onsite worker scenario were obtained using the website calculator function using the exposure parameters previously described (Attachment B-2).

The source of the PRGs used in this assessment is the *USEPA Radionuclide Preliminary Remediation Goals for Superfund* website (USEPA 2014). Like the RSL website, the PRG website consists of both generic exposure scenario tables and a calculator function. The website was accessed in October 2016. The PRGs for a residential scenario are obtained by using the website calculator function to derive site-specific PRGs. These site-specific PRG values are calculated by eliminating the fruit and vegetable consumption pathways as standard input assumptions and using all other default parameters. The residential PRG output from the calculator is provided as Attachment B-3 to this appendix. The PRGs for an industrial worker scenario are obtained from the generic table that assumes all default parameters. A copy of the PRG table is provided in Attachment B-4 to this appendix. The PRGs for the onsite worker were obtained by using the website calculator function to derive site-specific PRGs. The PRGs for this scenario are provided in Attachment B-5.

Site-specific fish ingestion RSLs and PRGs for the recreational fisherman scenario are derived using the requisite calculator functions for nonradiological constituents and radiological constituents, respectively. The fish ingestion RSLs and PRGs are presented in Attachments B-6 and B-7, respectively, to this appendix.

For surface water, maximum contaminant levels (MCLs) are used, where available for constituents, to screen against maximum detected concentrations and activity concentrations in water. Where MCLs are not available, the lesser of tapwater RSLs or PRGs available on generic table or ambient water quality criteria (AWQC) published in *R.61-68, Water Classification & Standards, South Carolina Department of Health and Environmental Control, Bureau of Water* (SCDHEC 2014), are used. Surface water screening levels for nonradiological constituents and radiological constituents are presented in Attachments B-8 and B-9, respectively.

B.2 HUMAN HEALTH RISK ASSESSMENT PROCESS

B.2.1 Sediment/Soil Media

As previously described, canal, stream, and pond sediments as well as adjacent floodplain soils, are comingled into a collective media called sediment/soil. The primary dataset used for the human health screening and risk/hazard calculations is the 0- to 0.3-m (0- to 1-ft) depth sample interval.

Concentrations of detected constituents include both the maximum and the 95 percent upper confidence limit (UCL) on the mean concentration for screening and risk/hazard calculations, respectively.

A summary of the processes undertaken to evaluate human health associated with the various exposure media is described below.

B.2.1.1 Constituents of Potential Concern

The process used to identify constituents of potential concern (COPCs) for sediment/soil in each EA within the LTR IOU is described below. For this initial step, maximum detected concentrations (for nonradiological constituents) and maximum detected activity concentrations (for radionuclides) from the 0- to 0.3-m (0- to 1-ft) sampling interval were compared to residential soil RSLs (0.1 × RSL for noncarcinogens, RSL for carcinogens) and residential soil PRGs (for radiological carcinogens), from Attachments B-1 and B-3. For naturally-occurring non-anthropogenic constituents, maximum concentrations from the 0- to 0.3-m (0- to 1-ft) sampling interval were also compared to two times the IOU average background concentrations. Constituents exceeding the both the RSL/PRG residential screening thresholds and the IOU background values are identified as sediment/soil COPCs. COPCs are carried forward to the risk/hazard calculation (Section B.2.1.2). Appendix A presents the sediment/soil datasets for each EA as well as the IOU sediment/soil background data set (see Table A.1.10.1).

Constituents that are recognized as essential human nutrients (calcium, magnesium, potassium, and sodium) are identified as such and are not subject to further evaluation since these constituents are deemed necessary for health and are consumed in normal diets.

Section B.2.4 presents the results of the sediment/soil COPC screening step, including the output tables showing the maximum detected concentrations and activity concentrations of constituents, applicable RSLs and PRGs, and whether such constituents are identified as COPCs.

B.2.1.2 Risk/Hazard Calculation

The next step in the HHRA for each LTR IOU EA includes calculating the risk or hazard for each of the three receptor scenarios included in the CSM (i.e., resident, industrial worker, and onsite

worker). The process used to identify contaminants of concern (COCs) for each EA within the LTR IOU is described below. For this step, constituents are segregated by overall health effect into carcinogens and noncarcinogens to calculate risk and hazard index, respectively. Risk and hazard estimate calculations are based on the RME exposure point concentrations (EPC), which is defined as the lesser of the maximum detected concentration and the 95% UCL on the mean concentration. Appendix A presents the sediment/soil datasets for each EA, indicating the respective EPCs for the COPCs for each EA identified in the previous step.

For carcinogens, constituents grouped into chemicals and radionuclides and the risk estimate for a single constituent is calculated using RSLs and PRGs (presented tin Attachment B-1 through B-5, as appropriate) and the following equation:

$$\text{risk estimate} = \left(\frac{[EPC]}{[RSLorPRG]} \right) \text{X 1E-06}$$

Individual constituent risk estimated by grouping are then summed to provide the chemical constituent-specific risk and the radiological constituent-specific risk. The total medial risk is the sum of the chemical constituent risk and the radiological-specific risk. Constituents with an individual cancer risk that is greater than (>) 1E-06 are identified as COCs and are further evaluated in the refinement of COCs step (see Section B.2.4).

For noncarcinogens, hazard estimated are calculated individually, called hazard quotients (HQs), using the following equation:

$$\text{hazard estimate} = \frac{[EPC]}{[RSL]}$$

Individual constituent HQs are summed to provide the total hazard index (HI). If the total HI is less than 1, then no COCs are identified. IF the total HI is >1, then the constituents are segregated based on relevant target organ or system toxicity and the grouped constituent HQs are summed. Constituents are identified as COCs if the total organ/system HQ is >0.1 and the total organ HI is >1. Constituents identified as COCs are further evaluated in the refinement of COCs step (see B.2.4).

B.2.2 Surface Water Media

For surface water media, maximum detected surface water concentrations within each EA (see Appendix A) are compared to threshold levels from Attachments B-8 and B-9 as described below.

B.2.2.1 Comparison of MCL/(PRG/RSL or AWQC)

Maximum detected concentrations of each constituent are conservatively compared to drinking water MCLs. In the absence of a MCL, the lowest value for the tapwater RSL/PRG or promulgated AWQC (Federal/State) is used as a screening threshold. Attachments B-8 and B-9 contain the surface water screening thresholds for nonradionuclides and radionuclides, respectively, used in this evaluation. Constituents that exceed the MCL/(PRG/RSL or AWQC) thresholds are further evaluated in the refinement of COCs step (see B.2.4).

B.2.3 Fish Media

For fish media, maximum detected concentrations from fish collected from EAs 3, 6, 8, and 9 are compared to RSLs and PRGs based on fish ingestion from Attachments B-6 and B-7 as described below. Because no fish samples were collected from EAs 1, 2, 4, 5, and 7, results of the screening for EAs 3, 6, 8, and 9 are used as surrogate results for EAs 1, 2, 4, 5, and 7.

B.2.3.1 Comparison to PRGs/RSLs

Maximum detected concentrations of each constituent detected in fish samples for the EAs in which fish were collected are compared to PRGs and RSLs for the recreational fisherman scenario. Constituents that exceed PRG/RSL thresholds are further evaluated in the refinement of COCs step (see B.2.4).

B.2.4 Refinement of Constituents of Concern/Results

The process used to identify human health refined COCs (RCOCs) for each EA within the LTR IOU is described below. For this final step, an uncertainty analysis is performed for each individual COC. This includes an interpretive discussion of the applicable uncertainty factors (lines of evidence) and a recommendation of whether the constituent should or should not be carried

forward for further remedial evaluation. The major categories of uncertainty used in this evaluation and the major emphasis include:

- unit-related uncertainty, which includes uncertainties related to the nature and extent of contamination, consistency with history of use, and presence in background;
- data quality uncertainty and risk assessment uncertainties, which includes uncertainties related to data quality and physical characteristics; and
- risk assessment uncertainty, which includes uncertainties related to toxicity data and changes in constituent concentrations due to radioactive decay.

Using the three-step process described above, results of the HHRA are presented below for each exposure medium by EA.

In the uncertainty evaluation, exposure area concentrations are compared to background concentrations as one line of evidence to assist in the identification of RCOCs. A brief description of the primary sources of background information is provided below.

The IOU background dataset provided in Appendix A identifies minimum, mean, and maximum concentrations (activities) for sediment/soil, surface water, and fish tissue media. A more thorough description of the IOU background dataset is provided in Chapter 3.

The *Background Soils Statistical Summary Report for the Savannah River Site* (WSRC 2006) is used routinely in OU risk assessments performed by ACPs. The document provides statistical summaries for many naturally-occurring constituents at SRS. Appendix B-2 (all depth intervals) is the primary source of information used in this evaluation; an exception is that Appendix B-1 (0- to 0.3-m [0 to 1 ft]) was used for the Cs-137 background comparisons.

The *Geochemical and Physical Properties of Wetland Soils at the Savannah River Site* (SRTC 1997) is used routinely in the IOU Periodic Reports to assist in data evaluation. This report focuses primarily on metals and is referred to as the "Wetland Study" in this evaluation.

Note that for the background comparisons involving a particular decay chain, activities of the parent and its daughter products are considered. For example, the thorium series [Th-232(+D)]

evaluation includes the measured concentration of Th-232 specifically, and also includes any analytical results from its daughter products (e.g., radium- [Ra]-228, actinium-228, Th-228, Ra-224, lead- [Pb]-212, bismuth- [Bi]-212, thallium- [Tl]-208) since these isotopes are assumed to be in secular equilibrium. Therefore, background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The same approach was applied to the Ra-226(+D) evaluation (i.e., includes Pb-214 and Bi-214).

An additional risk calculation is also presented in the refinement step that considers radioactive decay for short-lived isotopes cobalt- (Co)-60 (half-life = 5.3 years) and Cs-137 (half-life = 30.2 years). The Co-60 and Cs-137 datasets were decay-corrected to January 1, 2017, as appropriate.

B.2.4.1 Exposure Area 1

B.2.4.1.1 Sediment/Soil Media

Table B-1 presents the results of the sediment/soil screening for EA 1. Human health COPCs for sediment/soil include chromium, iron, vanadium, americium- (Am)-243(+D), Cs-137(+D), Co-60(+D), potassium- (K)-40, Th-232(+D) and uranium- (U)-238(+D), as these constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times mean IOU background concentrations.

Table B-2 presents the total HI (0.23) and total media risk (2.6E-03) for the resident exposure scenario, and the associated COCs: chromium, Am-234(+D), Cs-137(+D), Co-60, K-40, Th-232(+D), and U-238(+D).

Table B-3 presents the total HI (0.015) and total media risk (1.7E-03) for the industrial worker exposure scenario and the associated COCs: chromium, Am-234(+D), Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-4 presents the total HI (0.009) and total media risk (8.6E-04) for the onsite worker exposure scenario and the associated COCs: Cs-137(+D), Co-60, K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is identified as a COC for the resident (risk = 3.3E-05) and industrial worker (risk =1.6E-06) scenarios. The risk to the onsite worker was <1E-06. It was detected in 12/12 samples, with no results being estimated values (i.e., "J" qualified). Concentrations ranged from 1.43 to 15 mg/kg. Sample location PAT1-5 (see Figure 3-1 in Chapter 3), Collected on May 19, 2010, had the highest detected concentration. The EPC used in the risk calculations is 9.79 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. Sediment/soil concentrations from this EA are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds in the Cr+3 or Cr+6 forms are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at the SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined, the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for

Cr+3 are 120,000 mg/kg for the residential exposure scenario and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a human health refined constituents of concern (HH RCOC) in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined; the analytical result was for total chromium.
- The risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Am-243(+D) is identified as a COC for the resident (risk = 1.7E-06) and industrial worker (risk = 1.1E-06) scenarios. The risk to the onsite worker was <1E-06 and was detected in 2/5 samples, with no results being estimated values ("J" qualified). Concentrations range from nondetect (ND) to 0.277 pCi/g. Sample location RDC002-001 (see Figure 3-1 in Chapter 3), collected on April 13, 2010, had the highest detected concentration. The EPC used in the risk calculations was 0.277 pCi/g, which is the maximum concentration. Using the maximum detected concentration tends to bias the risk calculation high. The mean activity concentration, 0.126 pCi/g, is below the residential PRG of 0.167 pCi/g and industrial worker PRG of 0.26 pCi/g.

There are no background results for Am-243.

Am-243 (half-life of 7,370 years) and Am-241 (half-life of 432 years) are produced together in reactors and both behave the same in the environment. Am-243(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- The risk estimate is biased high because the maximum detected concentration was used.
- The mean concentration is less than the PRG.

Cs-137(+D) is identified as a COC for the resident (risk = 2.4E-03), the industrial worker (risk = 1.6 E-03) and the onsite worker (risk = 8.2E-04) scenarios. It was detected in 44/45 samples, with 4 results being estimated values ("J" qualified). Concentrations range from ND to 686 pCi/g. Sample location R-Area Downstream of R-1 (see Figure 3-1 in Chapter 3), collected on April 11, 2005, had the highest detected concentration. The EPC used in the risk calculations is 148 pCi/g.

Cs-137 is a result of nuclear fission, it does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 1 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 115.6 pCi/g. Using this adjusted value results in residential risk = 1.9E-03, industrial worker risk = 1.3E-03, and onsite worker risk = 6.4E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 44/45 samples, indicating widespread contamination.
- The risk is >1E-06.

Cobalt- (Co)-60 is identified as a COC for the resident (risk = 4.4E-06), industrial worker (risk = 3.0E-06), and onsite worker (risk = 1.7E-06) scenarios. It was detected in 15/45 samples, with 2 results being estimated values ("J" qualified). Concentrations range from ND to 0.648 pCi/g.

Sample location R-Area Downstream of R-1 (see Figure 3-1 in Chapter 3), collected on June 13, 2001, had the highest detected concentration. The EPC used in the risk calculations is 0.144 pCi/g. Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors.

There are no background results for Co-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Co-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.032 pCi/g. Using this adjusted value results in residential risk = 9.7E-07, industrial worker risk = 6.7E-07, and onsite worker risk = 3.8E-07.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- The risk is >1E-06.

Potassium- (K-)40 is a COC for the resident (risk = 2.7E-05), industrial worker (risk = 1.8E-05), and onsite worker (risk = 8.6E-06) scenarios. It was detected in 20/32 samples, with 8 results being estimated values ("J" qualified). Concentrations range from ND to 4.15 pCi/g. Sample location PAT3-2 (see Figure 3-1 in Chapter 3), collected on March 24, 2010, had the highest detected concentration. The EPC used in the risk calculations is 3.9 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half- life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- K-40 is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 8.2E-05), industrial worker (risk = 5.2E-05), and onsite worker (risk = 2.5E-05) scenarios. The thorium series [thorium-232(+D)] evaluation includes the measured concentration of Th-232 specifically and also considers any analytical results from its daughter products (e.g., Ra-228, actinium (Ac)-228, Th-228, Ra-224, Pb-212, Bi-212 and Ti-208) since these isotopes are assumed to be in secular equilibrium. Data screening is performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, Th-228 had the highest detected concentration (3.7 pCi/g) as well as the highest EPC (2.21 pCi/g). This is from sample location R-Area Downstream of R-1 (see Figure 3-1 in Chapter 3) collected on April 23, 2013. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (Ra-224 result) and the SRS Soil background maximum detected activity concentration is 6.75 pCi/g (Ra-224 result). (Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment.) Sediment/soil concentrations from EA 1 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout

history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P-Area and R-Area waste units and EA1 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

U-238(+D) is a COC for the resident scenario only (risk = 1.5E-06). It was detected in 17/18 samples, with 2 results being estimated values ("J" qualified). Concentrations range from ND to 2.73 pCi/g. Sample location R-Area Downstream of R-1 (see Figure 3-1 in Chapter 3), collected on April 23, 2013, had the highest detected concentration. The EPC used in the risk calculations is 1.2 pCi/g.

Uranium is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 2.51 pCi/g, and the maximum detected concentration in the SRS Soil background data set is 1.9 pCi/g. One sediment/soil sample result from EA 1 is slightly greater than background.

U-238 is a naturally-occurring constituent of primordial origin with a half-life of 4.5 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

The uranium isotopes U-238, U-235, and U-233/234 were used in SRS reactor operations, but also occur naturally and are widespread in Coastal Plain soils and sediments. Isotopic concentration ratios (e.g., U-238/[U-233/234]) are very close to unity, which is expected for natural uranium,

and is not consistent with reactor uranium. Isotopic considerations conclusively demonstrate that EA 1 sediment/soil samples are natural uranium.

U-238(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for the resident receptor scenario based on the following lines-of-evidence:

- Unit activities are consistent with the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- Isotopic ratios demonstrate natural uranium (not reactor waste).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA1 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr		X	X		X	X	
Am-243(+D)	X			X			
Cs-137(+D)*							
Co-60*							
K-40		X	X				
Th-232(+D)		X	X		X		
U-238(+D)			X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.1.2 Surface Water Media

Table B-5 identifies manganese, K-40, Th-234, and tritium as human health surface water COCs because these constituents maximum detected concentrations and activity concentrations exceeded surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Manganese is a COC based on an exceedance of the tapwater RSL (430 µg/L). It was detected in 6/6 samples, with 1 result being an estimated value ("J" qualified). Concentrations range from 26.3 µg/L to 1,180 µg/L. Sample location LTR Environmental Restoration Data Management System (ERDMS) IOULTR2 Sampling Event LTROU-01 (see Figure 3-1 in Chapter 3), collected on November 10, 2001, had the highest detected concentration. The average concentration (375 µg/L) is less than the tapwater RSL (430 µg/L).

Manganese is a naturally-occurring constituent that is common in the environment. In IOU Background surface water, it was detected in 385/401 sample results with a maximum detected concentration of 2,690 µg/L. Surface water results from EA 1 are less than background surface water concentrations. Manganese is not associated with any reactor processes at SRS. Manganese is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- Unit concentrations are less than the background surface water concentration.
- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any reactor processes at SRS.
- The mean concentration is less than the tapwater RSL.

K-40 is a COC based on an exceedance of the tapwater PRG (0.83 pCi/L). It was detected in 21/139 samples, with no results being estimated values ("J" qualified). Concentrations range from ND to 464 pCi/L, with a mean concentration of 29.9 pCi/L. Sample location R-Area Downstream of R-1 (see Figure 3-1 in Chapter 3), collected on November 11, 1997, had the highest detected concentration.

K-40 is a naturally-occurring constituent that is common in the environment. In IOU Background surface water, it was detected in 17/254 sample results with a maximum detected concentration of 275.4 pCi/L. Surface water mean from EA 1 is within the background surface water concentration.

K-40 can be found wherever potassium is found. Potassium is a constituent of natural clay minerals and surface water often contains suspended clay. The reported concentration of 464 pCi/L corresponds to about 550 mg/L total potassium that, if accurate, would indicate the sample was very turbid. Since K-40 was not used in any process at SRS, these detections are regarded as non-United States Department of Energy (USDOE) related.

K-40 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- Unit average concentrations are consistent with background surface water concentration.
- It is a naturally-occurring constituent that is common in the environment.
- It is not associated with any reactor processes at SRS.
- The maximum result from the sample collected in 1997 likely had high turbidity.

Th-234 is a COC based on an exceedance of the tapwater PRG (1.9 pCi/L). It was detected in 1/1 samples that was not "J" qualified. Sample location R-Area Downstream of R-1 (28034) (see Figure 3-1 in Chapter 3), collected on May 7, 2002, had detected result of 710 pCi/g.

Th-234 is a naturally-occurring constituent with a half-life of 24 days and is a daughter product of U-238. There are no surface water background results for Th-234. Th-234 occurs naturally, but as the daughter product of U-238 it can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples because: 1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty, and 2) gamma peak overlap with actinium-228 causes falsely elevated reported concentrations and additional uncertainty.

Because of its extremely low solubility and short half-life (24 days), Th-234 would not be expected to occur in surface water at these concentrations unless local U-238 concentrations were extremely high in either surface water or sediment. However, observed U-238 levels are very low in both sediment/soil and surface water in EA 1. The measured U-238 concentrations provide a much more reliable guide to reactor waste than Th-234. Therefore, the reported Th-234 detection of 710 pCi/L is not USDOE related. The U-238 maximum detected concentration (0.181 pCi/L) does not exceed the MCL (10.1 pCi/L).

Th-234 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- There are issues associated with the Th-234 analysis.
- All U-238 analytical results, which are much more reliable, are below the MCL.

Tritium is a COC based on exceedance of the MCL (20,000 pCi/L). It was detected in 504/505 samples, with 4 results being estimated values ("J" qualified). Activities range from ND to

314,412 pCi/L, with a mean activity of 13,342 pCi/L. Sample location R-Area Downstream of R-1 (28034) (see Figure 3-1 in Chapter 3), collected on May 8, 2001, had the highest detected concentration.

Tritium is a known groundwater contaminant associated with the RAOU (R-Reactor). The maximum detected activity concentration was collected in the R-discharge canal downstream of R-1, a presumed discharge point for shallow groundwater. Thus, the tritium likely is associated with groundwater (which is not addressed under the LTR IOU) rather than EA 1 surface water.

The maximum concentration was from a sample collected in 2001, which pre-dates the early actions in R Area. A more recent surface water sample, collected in 2010 after the early actions taken in the R Area, indicated a maximum activity concentration of 976 pCi/L. No results are greater than the MCL following the early action taken in the R Area (samples collected between February and May 2010).

Tritium is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- Results above the MCL are from the 2001 to 2008 time frame and could be decay corrected to some degree.
- There are no exceedances of the MCL following the early action in 2010.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA 1 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Mn	X	X	X				
K-40	X	X	X		X		
Th-234					X		X
H-3	X						X

B.2.4.1.3 Fish Media

No fish samples were collected within EA 1. However, results for samples collected within other EAs (i.e., 3, 6, 8, and 9) are used as a proxy for EA 1. Considering the results of the risk assessments performed for EAs 3, 6, 8, and 9 and the associated lines of evidence, Cs-137 and mercury are considered HH RCOCs for fish media for the recreational fisherman scenario.

B.2.4.1.4 HHRA Conclusion for EA 1

Sediment/Soil Media

- Resident scenario: Cs-137(+D) (risk = 2.4E-03) and Co-60 (risk = 4.4E-06) identified as RCOCs with a total cumulative risk (TCR) = 2.4E-03. Decay-adjusted Cs-137(+D) risk = 1.9E-03, decay-adjusted Co-60 risk = 9.7E-07, and decay adjusted TCR = 1.9E-03.
- Industrial Worker scenario: Cs-137(+D) (risk = 1.6E-03) and Co-60 (risk = 3.0E-06) identified as RCOCs with a TCR = 1.6E-03. Decay-adjusted Cs-137(+D) risk = 1.3E-03, decay-adjusted Co-60 risk = 6.7E-07, and decay adjusted TCR = 1.3E-03.
- Onsite Worker scenario: Cs-137(+D) (risk = 8.2E-04) and Co-60 (risk = 1.7E-06) identified as RCOCs with a TCR = 8.2E-04. Decay-adjusted Cs-137(+D) risk = 6.4E-04, decay-adjusted Co-60 risk = 3.8E-07, and decay adjusted TCR = 6.4E-04.

Surface Water Media

- No surface water RCOCs.

Fish Media

- Cs-137and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.2 Exposure Area 2

B.2.4.2.1 Sediment/Soil Media

Table B-6 presents the results of the sediment/soil screening for EA 2. Human health COPCs for sediment/soil include aluminum, arsenic, chromium, iron, vanadium, bis[2-chloroethyl]ether, cesium-137(+D), K-40, Th-232(+D), and U-238(+D). These constituents had maximum detected

concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times IOU background concentrations.

Table B-7 presents the total HI (0.84) and total media risk (9.2E-04) for the resident exposure scenario and the associated COCs: arsenic, chromium, bis[2-chloroethyl]ether, Cs-137(+D), K-40, and Th-232(+D).

Table B-8 presents the total HI (0.057) and total media risk (5.8E-04) for the industrial worker exposure scenario and the associated COCs: arsenic, chromium, Cs-137(+D), K-40, and Th-232(+D).

Table B-9 presents the total HI (0.034) and the total media risk (2.9E-04) for the onsite worker exposure scenario and the associated COCs: chromium, Cs-137(+D), K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident (risk = 8.1E-06) and industrial worker (risk = 1.8E-06) scenarios. The risk to the onsite worker is <1E-06. It was detected in 15/16 samples, with 3 of these results being estimated values (i.e., "J" qualified). Concentrations range from ND to 11.8 mg/kg. Sample location RDC010-003 (see Figure 3-2 in Chapter 3), collected on April 15, 2010, had the highest detected concentration. The EPC used in the risk calculations is 5.53 mg/kg.

Arsenic is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 6.7 mg/kg, the maximum concentration in the SRS Soil background dataset is 22.9 mg/kg, and the maximum concentration in the Wetland Study is 3.7 mg/kg. Sediment/soil concentrations from the EA are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and fruit orchards. However, no significant quantities

of pressure treated wood were used in buildings within the LTR IOU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- Arsenic products where either not used or where of limited use at SRS.

Chromium is identified as a COC for the resident (risk = 5.2E-05), the industrial worker (risk = 2.5E-06), and the onsite worker (risk = 1.2E-06) scenarios. It was detected in 16/16 samples, with no results being estimated values (i.e., "J" qualified). Concentrations range from 2.02 to 32 mg/kg. Sample location RDC010-001 (see Figure 3-2 in Chapter 3), collected on April 15, 2010, had the highest detected concentration. The EPC used in the risk calculations is 15.6 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg, and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. Sediment/soil concentrations from this EA are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered cancerous. Chromium compounds in the Cr+3 or Cr+6 forms are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected

when chromium is likely to be an important contaminant at the site. Since this is not the case for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined; the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines-of-evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined; analytical result was for total chromium.
- Risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Bis[2-chloroethyl]ether is identified as a residential COC only (risk = 3.5E-06). The risk to the industrial worker and onsite worker are <1E-06. It was detected in only 1/16 samples, which was not estimated (i.e., "J" qualified). The single result (0.8 mg/kg) is from RDC010-001 (see Figure 3-2 in Chapter 3), collected on April 15, 2010, and represents the maximum concentration. The EPC used in the risk calculation is 0.8 mg/kg.

Bis[2-chloroethyl]ether is used in the production of pesticides and other chemicals and is unlikely to have been associated with operations within the LTR IOU. Further, bis[2-chloroethyl]ether, if present, is broken down by bacteria in soil and water and by chemical reactions in the air, so it

does not tend to persist for long periods in the environment. There are no background values for bis[2-chloroethyl]ether in sediment/soil for SRS.

Bis[2-chloroethyl]ether is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor based on the following lines of evidence.

- It is limited to a single detection, which is uncertain.
- Its use at SRS in unlikely.
- It is not persistent in the environment and is readily broken down by normally present bacteria.
- Use of the maximum detected concentration as the EPC biases the risk estimate high.

Cs-137(+D) is identified as a COC for the resident (risk = 8.1E-04), industrial worker (risk = 5.4E-04), and onsite worker (risk = 2.7E-04) scenarios. It was detected in 21/44 samples, with 1 being an estimated value (i.e., "J" qualified). Concentrations range from ND to 180 pCi/g. Sample location RDC007-001 (see Figure 3-2 in Chapter 3), collected on April 14, 2010, had the highest detected concentration. The EPC used in the risk calculations is 48.8 pCi/g.

Cs-137 is a result of nuclear fission, it does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 2 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 41.9 pCi/g. Using this adjusted value results in residential risk = 6.9E-04, industrial worker risk = 4.6E-04, and onsite worker risk = 2.3E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).

- It was detected in 21/44 samples, which indicates widespread contamination.
- Risk was >1E-06.

K-40 is a COC for the resident (risk = 8.4E-06), industrial worker (risk = 5.4E-06), and onsite worker (risk = 2.6E-06) scenarios. It was detected in 11/44 samples, with 3 results being estimated (i.e., "J" qualified). Concentrations range from ND to 4.6 pCi/g. Sample location RDC006-001 (see Figure 3-2 in Chapter 3), collected on April 14, 2010, had the highest detected concentration. The EPC used in the risk calculations is 3.9 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half- life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products). K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 4.4E-05), industrial worker (risk = 2.8E-05), and onsite worker (risk = 1.3E-05) scenarios. The thorium series (Th-232[+D]) evaluation includes the measured concentration of Th-232 specifically, and also considers any analytical results from its daughter products (e.g., Ac-228, Th-228, Pb-212, Bi-212, and Tl-208) since these isotopes are assumed to be present in secular equilibrium. Data screening performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, Ac-228 had the highest detected concentration (3.13 pCi/g) and

the highest EPC (3.13 pCi/g). This is from sample location PBT1-2 (see Figure 3-2 in Chapter 3) collected on March 18, 2010. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (Ra-224 result) and the SRS Soil background maximum detected activity concentration is 6.75 pCi/g (Ra-224 result). (Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment.) Sediment/soil concentrations from EA 2 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half- life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units, and EA 2 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA2 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
As		X	X				
Cr		X	X		X	X	
Bis[2-chloroethyl]ether	X	X		X	X		
Cs-137(+D)*							
K-40		X	X				
Th-232(+D)		X	X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.2.2 Surface Water Media

Table B-10 identifies manganese, bis[2-ethylhexyl]phthalate, naphthalene, and Bi-214 as human health surface water COCs because these constituent maximum detected concentrations exceeded surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Manganese is a COC based on an exceedance of the tapwater RSL (430 µg/L). It was detected in 12/12 samples, with no results being estimated (i.e., "J" qualified). Concentrations range from 19.2 µg/L to 910 µg/L. Sample location RDC012-002 (see Figure 3-2 in Chapter 3), collected on April 19, 2010, had the highest detected concentration. The average concentration (340 µg/L) is less than the tapwater RSL (430 µg/L).

Manganese is a naturally-occurring constituent that is common in the environment. In IOU Background surface water, it was detected in 385/401 sample results with a maximum detected concentration of 2,690 µg/L. Surface water results from EA 2 are less than background surface water concentrations.

Manganese is not associated with any reactor processes at SRS.

Manganese is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- Unit concentrations are less than the background surface water concentration.
- It is a naturally-occurring constituent that is common in the environment.

- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any reactor processes at SRS

Bis[2-ethylhexyl]phthalate is a COC based on an exceedance of the MCL (6 µg/L). It was detected in only 1/12 samples, with this result not being estimated (i.e., "J" qualified). The concentration of 16 µg/L is the maximum detected, which is from sample location RDC010-002 (see Figure 3-2 in Chapter 3) collected on April 15, 2010. The average concentration (1.7 µg/L) is less than the tapwater MCL.

Bis[2-ethylhexyl]phthalate is a common laboratory artifact because it is associated with plastics, which are part of the sampling and analytical processes. However, it was a ND in the SRS background surface water samples. Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a common laboratory contaminant that is frequently detected and thus not site related.
- It was only detected in one sample for the EA surface water.
- It is not associated with any reactor processes at SRS.
- The mean concentration is less than the tapwater MCL.

Naphthalene is a COC based on an exceedance of the tapwater RSL (0.17 µg/L). It was detected in 1/12 samples, with this result being estimated (i.e., "J" qualified). The maximum detected concentration is 0.368 µg/L, which is from sample location LTROU-14 (see Figure 3-2 in Chapter 3) collected on October 18, 2001.

Naphthalene is a ubiquitous polycyclic aromatic hydrocarbon (PAH), being a component of crude oil. It is also produced from the combustion of organic materials, including from car exhaust and smoke from forest fires.

Naphthalene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection was an estimated ("J"-qualified) result.

Bi-214 is a COC based on an exceedance of the tapwater MCL of 15 pCi/L. It was detected in 1 of 13 samples at a maximum activity concentration of 48 pCi/L. The maximum concentration is from sample location RDC009-002 (see Figure 3-2 in Chapter 3), collected on April 15, 2010. The mean concentration is 15 pCi/L.

Bi-214 is a naturally-occurring daughter of radon and radium and was not used at SRS. Due to the high solubility and mobility of radium, and especially radon, there are many examples of elevated levels of Bi-214 in SRS groundwater, with concentrations as high as 500 pCi/L not unknown. Bodies of surface water that are fed by groundwater, such as the small creeks, can inherit these high Bi-214 concentrations. Because Bi-214 and its parent's radon and radium were not used at SRS, and because elevated levels of Bi-214 are well known in SRS groundwater, the detections of Bi-214 are accepted as real and are believed to be natural. Bi-214 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a daughter of naturally-occurring radium.
- It has a very short half-life (19.9 minutes).
- It has no historical use at SRS.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA 2 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Mn	X	X	X				
Bis[2-ethylhexyl]phthalate	X	X			X		
Naphthalene	X		X	X			
Bi-214	X	X	X		X		

B.2.4.2.3 Fish Media

No fish samples were collected within EA 2. However, results for samples collected within other EAs (i.e., 3, 6, 8, and 9) are used as a proxy for EA 2. Considering the results of the risk

assessments performed for EAs 3, 6, 8, and 9 and the associated uncertainties, Cs-137(+D) and mercury are considered fish HH RCOCs.

B.2.4.2.4 HHRA Conclusion for EA 2

Sediment/soil Media

- Resident scenario: Cs-137(+D) (risk = 8.1E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 6.9E-04.

Industrial Worker Scenario

- Cs-137(+D) (risk = 5.4E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 4.6E-04.

Onsite Worker Scenario

- Cs-137(+D) (risk = 2.7E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 2.3E-04.

Surface Water Media

- No surface water RCOCs.

Fish Media

- Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.3 Exposure Area 3

B.2.4.3.1 Sediment/Soil Media

Table B-11 presents the results of the sediment/soil screening for EA 3. Human health COPCs or sediment/soil include aluminum, arsenic, chromium, cobalt, iron, vanadium, Cs-137(+D), Th-232(+D) and U-238(+D). These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times IOU background concentrations.

Table B-12 presents the total HI (1.6) and total media risk (1.9E-03) for the resident exposure scenario and the associated COCs: arsenic, chromium, cobalt, Cs-137(+D), Th-232(+D), and U-238(+D).

Table B-13 presents the total HI (0.11) and the total media risk (1.2E-03) for the industrial worker exposure scenario and the associated COCs: arsenic, chromium, Cs-137(+D), Th-232(+D), and U-238(+D).

Table B-14 presents the total HI (0.07) and the total media risk (5.9E-04) for the onsite worker exposure scenario and the associated COCs: chromium, Cs-137(+D), and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident (risk = 6.0E-05) and the industrial worker (risk = 1.4E-06). It was detected in 5/6 samples, with 4 of these results being estimated values (i.e., "J" qualified). Concentrations range from ND to 5.3 mg/kg. Sample location PBT3-23 (see Figure 3-3 in Chapter 3) had the highest detected concentration and was collected on March 22, 2010. The EPC used in the risk calculations is 4.1 mg/kg.

Arsenic is a naturally-occurring constituent that is common in the environment. The IOU Background dataset is 6.7 mg/kg, the maximum concentration in the SRS Soil background dataset is 22.9 mg/kg, and the maximum concentration in the Wetland Study is 3.7 mg/kg. Sediment/soil concentrations from the EA are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust, being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and fruit orchards. However, no significant quantities of pressure-treated wood were used in buildings within the LTR IOU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as HH RCOC in sediment/soil for any receptor scenario based on the following lines-of-evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- Its products where either not used or where of limited use at SRS.

Chromium is identified as a COC for the resident (risk = 2.0E-04), the industrial worker (risk = 9.8E-06) and the onsite worker (risk = 2.6E-06). It was detected in 6/6 samples, with no results being estimated values (i.e., "J" qualified). Concentrations range from 1.88 mg/kg to 61.4 mg/kg. Sample location LTROU-15 (see Figure 3-3 in Chapter 3) had the highest detected concentration; it was collected on September 27, 2001. The EPC used in the risk calculations is 61.4 = mg/kg, which is the maximum detected concentration since the 95% UCL value exceeds the maximum detected concentration. This indicates high variability in the sample results and biases the risk calculation high. The mean concentration is 16.24 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg, and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. The mean concentration for chromium from this EA is within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium. The trivalent form is considered noncancerous, whereas the hexavalent form is considered cancerous. Chromium compounds in the Cr+3 or Cr+6 forms are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case for

the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined and the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined and the analytical result was for total chromium.
- Risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Cs-137(+D) is identified as a COC for the resident (risk = 1.6E-03), the industrial worker (risk = 1.1E-03) and the onsite worker (risk = 5.5E-04) scenarios. It was detected in 44/44 samples, with none being an estimated value (i.e., "J" qualified). Concentrations range from 0.093 pCi/g to 456.8 pCi/g. Sample location Pond B-Main Body near Mouth of Outlet: SCB-29 (see Figure 3-3 in Chapter 3) had the highest detected concentration and was collected on September 14, 1994. The EPC used in the risk calculations is 98.3 pCi/g.

Cs-137 is a result of nuclear fission and does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The

maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 3 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 59.16 pCi/g. Using this adjusted value, results in residential risk = 9.8E-04, industrial worker risk = 6.5E-04, and onsite worker risk = 3.3E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 44/44 samples, indicating widespread contamination.
- Its risk is >1E-06.

Th-232(+D) is a COC for the resident (risk = 1.2E-04), the industrial worker (risk = 7.4E-05), and onsite worker (risk = 3.5E-05) scenarios. The thorium series [Th-232(+D)] evaluation includes the measured concentration of Th-232 specifically, and considers any analytical results from its daughter products (e.g., Ac-228, Th-228, Pb-212, Bi-212, and Tl-208) since these isotopes are assumed to be present in secular equilibrium. Data screening performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, Th-228 (from 1/1 samples) had the highest detected concentration (3.13 pCi/g) and the highest RME concentration (3.13 pCi/g). This is from sample location PBT1-2 (see Figure 3-3 in Chapter 3) collected on March 18, 2010. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (Ra-224 result) and the SRS Soil background maximum detected activity concentration is

6.75 pCi/g (Ra-224 result). (Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment.) Sediment/soil concentrations from EA 3 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238, and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units and EA 3 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines-of-evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

Uranium-238(+D) is a COC for the resident (risk = 2.1E-06) and industrial worker (1.2E-06) scenarios. It was detected in only 1/1 samples, with the result not being an estimated value ("J" qualified). Sample location PBT1-2 (see Figure 3-3 in Chapter 3), collected on March 18, 2010, had the highest detected concentration (1.68 pCi/g). The EPC used in the risk calculations is 1.68 pCi/g.

Uranium is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 2.51 pCi/g and the maximum detected concentration in the SRS Soil background data set is 1.9 pCi/g. The result for the one sediment/soil sample collected in EA 3 is less than background.

U-238 is a naturally-occurring constituent of primordial origin with a half-life of 4.5 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout

history. The main contributors to external exposure from primordial nuclides are K-40, U-238, and Th-232 (and their daughter products).

The uranium isotopes U-238, U-235, and U-233/234 were used in SRS reactor operations, but also occur naturally and are widespread in Coastal Plain soils and sediments. Isotopic concentration ratios (e.g., U-238/U-233/-234) are very close to unity, which is expected for natural uranium, and are not consistent with reactor uranium. Isotopic considerations conclusively demonstrate that EA 3 sediment/soil samples are natural uranium.

U-238(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenarios based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range.
- It is a naturally-occurring constituent common in SRS background soils.
- Isotopic ratios demonstrate natural uranium (not reactor waste).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 3 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
As		X	X				
Cr		X	X		X	X	
Cs-137(+D)*							
Th-232(+D)		X	X		X		
U-238(+D)			X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.3.2 Surface Water Media

Table B-15 identifies naphthalene as a human health surface water COC because this constituent maximum detected concentration exceeds its surface water comparison value. The refinement/uncertainty evaluation is presented for this COC.

Naphthalene is a COC based on an exceedance of the tapwater RSL (0.17 µg/L). It was detected in only 1/12 samples, with the result being estimated (i.e., "J" qualified). The maximum detected concentration is 0.368 µg/L from sample location LTROU-14 (see Figure 3-3 in Chapter 3), which was collected on October 18, 2001.

Naphthalene is a ubiquitous PAH, being a component of crude oil. It is also produced from the combustion of organic materials, including from car exhaust and smoke from forest fires.

Naphthalene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection is an estimated value ("J" qualified).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 3 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Naphthalene	X		X	X			

B.2.4.3.3 Fish Media

Table B-16 identifies chromium, mercury, Cs-137(+D), K-40, and strontium- (Sr)-89/-90 as COCs for fish media because the maximum detected concentrations and activity concentrations from fish samples collected from Pond B exceed their respective human health RSLs or PRGs. The refinement/ uncertainty evaluation is presented for each of these COCs.

Chromium is a COC based on an exceedance of the fish RSL (0.00832 mg/kg). It was detected in 1 of 2 fish samples at a concentration of 0.37 mg/kg, with this result being estimated (i.e., "J" qualified). It was from sample LTR-PB collected on June 7, 2010. This result is below the IOU maximum background concentration for fish at 0.47 mg/kg.

The hexavalent chromium fish RSL (0.243 mg/kg) was used to perform the data screening. This overly conservative approach tends to bias the calculation high. The RSL for the chromium +3 is 2,320 mg/kg. Therefore, if chromium is actually present in the +3 valence state, chromium would not be identified as a COC for fish media.

Chromium is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- The fish concentration is below the background fish concentration.
- It is a naturally-occurring constituent that is an essential nutrient.
- It does not appear to be unit related since it is indistinguishable from background in fish.
- The valence state of chromium was not determined and the analytical result was for total chromium.
- The most conservative RSL (Cr+6) was used for data screening.
- Fish concentrations are much less than the trivalent chromium RSL (i.e., no risk/hazard).

Mercury is a COC based on exceedance of the fish RSL (0.154 mg/kg). It was detected in 77 out of 81 samples, with 1 result being estimated (i.e., "J" qualified). Concentrations range from ND to 1.83 mg/kg. Sample location Pond B-32081, collected on January 1, 1998, had the highest detected concentration. Both the mean concentration (0.64 mg/kg) and maximum concentration (0.734 mg/kg) exceed the RSL.

Mercury is a naturally-occurring constituent in rocks and soil that is common in the environment and enters the environment from natural deposits and disposal of wastes within water bodies. It can be taken up by animals (i.e., fish) and plants. Mercury combines with chlorine, sulfur, or oxygen to form inorganic mercury compounds or "salts." Mercury also combines with carbon to make organic mercury compounds (i.e., methylmercury). The maximum concentration in the IOU Fish Background dataset is 0.24 mg/kg.

Inorganic mercury compounds are much less toxic than methylmercury, which is considered more bioavailable and thus has a higher toxicity. Methylmercury may be formed in water and soil by bacteria, which leads to increased concentrations in tissues of fish. Mercury compounds were not

used in the PAOU or RAOU and are not part of the reactor operation. However, copious amounts of river water from the Savannah River where used in both reactors as cooling water. High concentrations of mercury in Savannah River samples have been observed, which indicates other sources may have released mercury into the river. Given the differences in mercury compounds, the USEPA generally recommends that both total mercury and methyl mercury data be collected when mercury is likely to be an important contaminant at the site. However, only total mercury was collected in the LTR IOU.

To be conservative, the fish screening was performed for methylmercury rather than for mercury salts. Based on unit history and the environmental conditions (likely presence of mercury in the source for reactor cooling water and the presence of methylating bacteria in the IOU water bodies), it is likely the methylated form of mercury is present in the LTR IOU.

Mercury is recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- It was detected in 77 of 81 samples, indicating widespread contamination.
- Fish concentrations exceed the background fish maximum concentration.

Cs-137(+D) is a COC based on exceedance of the fish PRG (0.0544 pCi/g). It was detected in all 54 samples collected from Pond B. Concentrations range from 9.35 pCi/g to 113 pCi/g. Sample Pond B 28054, collected on March 4, 1998, had the highest concentration. Both the mean activity concentration (60.34 pCi/g) and the 95% UCL on the mean activity concentration (79.2 pCi/g) exceed the PRG.

Cs-137 is a result of nuclear fission and does not occur naturally in in the environment. However, Cs-137 is common in SRS background soils, surface water, and fish media. The maximum detected concentration in the background fish media dataset is 0.49 pCi/g, with a mean of 0.13 pCi/g. Both the maximum concentration and mean concentration in EA 3 fish media are greater than background fish concentration.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Both the maximum detected concentration and the mean concentration exceeds the fish PRG.
- It was detected in 54 samples, indicating widespread contamination

K-40 is a COC based on exceedance of the fish PRG (0.0595 pCi/g). It was detected in all 48 samples collected from Pond B. Activity concentrations range from 2.03 pCi/g to 3.89 pCi/g. Sample Pond B 28054, collected on March 4, 1998, had the highest detected activity concentration.

K-40 is a naturally-occurring constituent that is common in the environment. The background fish media activity concentrations range from 1.24 pCi/g to 3.8 pCi/g. The average activity concentration for EA 3 fish (2.75 pCi/g) is less than the background fish media maximum activity concentration.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238, and Th-232 (and their daughter products). Potassium is an essential nutrient, therefore, some amount of normally present potassium in biological tissue is likely K-40. K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- Average fish activity is within the SRS background fish media activity range.
- It is a natural component occurring in biological tissues.
- It does not appear to be unit related since it is indistinguishable from background.

Sr-89/-90 is a COC based on an exceedance of the fish PRG (0.0296 pCi/g). It was detected in the only sample collected from Pond B at an activity concentration of 0.0939 pCi/g. Sample Pond B 28054, collected on August 17, 1995, had the highest concentration. While these are separate isotopes of strontium, the analysis was not specific to identify the predominant isotope. The most conservative (lowest) fish PRG for Sr-90 was used for screening. However, if the

predominant isotope is Sr-89, the detected activity would not exceed the Sr-89 fish PRG (0.111 pCi/g).

Sr-89/-90 is a result of nuclear fission and these radioactive isotopes of strontium do not occur naturally in the environment. These isotopes may also be present as a result of fallout from nuclear weapons testing. Sr-90 has limited use and is considered a waste product. Conversely, Sr-89 is used as a cancer therapeutic agent. However, Sr-89/-90 is detected in background fish samples at a maximum activity concentration of 0.2 pCi/g.

The fish media screening does not take into account radioactive decay. The half-life of Sr-90, the more hazardous isotope, is 29 years.

Sr-89/-90 is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman receptor scenario based on the following lines of evidence:

- The maximum detected activity concentration is less than the background maximum activity concentration.
- It has a short half-life.
- The lowest (most conservative) PRG was used for screening

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 3 – Fish Tissue	**UNCERTAINTY CATEGORY**						
	Unit Related			**Data Quality Related**		**Risk Assessment Related**	
Constituent	**Nature and Extent**	**History of Use**	**Presence in Background**	**Analytical Data Quality**	**Physical Characteristics**	**Toxicity**	**Radioactive Decay**
Cr			X	X	X	X	
Hg*							
Cs-137(+D)*							
K-40		X	X		X		
Sr-89/90			X		X	X	

* Identified as a RCOC for further remedial evaluation.

B.2.4.3.4 HHRA Conclusion for EA 3

Sediment/soil Media

- Resident scenario: Cs-137(+D) (risk = 1.6E-03) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 9.8E-04.
- Industrial worker scenario: Cs-137(+D) (risk = 1.1E-03) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 6.5E-04.
- Onsite worker scenario: Cs-137(+D) (risk = 5.5E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 3.3E-04.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.4 Exposure Area 4

B.2.4.4.1 Sediment/Soil Media

Table B-17 presents the results of the sediment/soil screening for EA 4. Human health COPCs for sediment/soil include iron, vanadium, and Cs-137(+D). These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times IOU background concentrations.

Table B-18 presents the total HI (0.26) and total media risk (3.0E-04) for the resident exposure scenario. Table B-19 presents the total HI (0.017) and total media risk (2.0E-04) for the industrial worker exposure scenario. Table B-20 presents the total HI (0.01) and total media risk (1.0E-04) for the onsite worker exposure scenario. Cs-137(+D) is identified as a COC for the resident, industrial worker, and onsite worker exposure scenarios, respectively.

The refinement/uncertainty evaluation is presented for this COC.

Cs-137(+D) is identified as a COC for the resident (risk = 3.0E-04), industrial worker (risk = 2.0E-04), and onsite worker (risk = 1.0E-04) scenarios. It was detected in 24/36 samples, with five of these being an estimated value (i.e., "J" qualified). Concentrations range from ND to

50 pCi/g. The sample identified as RDC015-001(see Figure 3-4 in Chapter 3), collected on April 20, 2010, had the highest detected concentration. The EPC used in the risk calculations is 18.3 pCi/g.

Cs-137 is a result of nuclear fission and does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration of Cs-137 in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 4 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation presented in this refinement step considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected is EPC = 15.8 pCi/g. Using this adjusted value results in residential risk = 2.6E-04; industrial worker risk = 1.7E-04, and onsite worker risk = 8.8E-05.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 24/36 samples, indicating widespread contamination.
- Risk is >1E-06.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA 4 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cs-137(+D)*							

* Identified as a RCOC for further remedial evaluation.

B.2.4.4.2 Surface Water Media

Table B-21 identifies benzo(a)anthracene and bis[2-ethylhexl]phthalate as human health surface water COCs because these constituents maximum detected concentrations exceed their surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Benzo(a)anthracene is a COC based on an exceedance of the tapwater RSL (0.012 µg/L). It was detected in only 1/11 samples, with this result being estimated (i.e., "J" qualified). The maximum detected concentration is 0.309 µg/L from sample location LTROU-22 (see Figure 3-4 in Chapter 3) collected on January 17, 2001.

Benzo(a)anthracene is a ubiquitous PAH, being a component of crude oil. It is also produced from the combustion of organic materials, including from car exhaust and smoke from forest fires.

Benzo(a)anthracene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection is an estimated value ("J" qualified).

Bis[2-ethylhexyl]phthalate is a COC based on an exceedance of the MCL (6 µg/L). It was detected in only 4/11 samples, with two results being estimated (i.e., "J" qualified). Concentrations range from ND to 12 µg/L. The maximum detected concentration is from sample location RDC015-002 (see Figure 3-4 in Chapter 3) collected on April 20, 2010. The mean concentration (2.5 µg/L) is less than the tapwater MCL (6 µg/L). Bis[2-ethylhexyl]phthalate is a common laboratory artifact associated with plastics, which are part of the sampling and analytical processes. However, it was not detected in the SRS background surface water samples.

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a common laboratory contaminant that is frequently detected and, thus, not site related.
- It is not associated with any reactor processes at SRS.

- The mean concentration is less than the tapwater MCL.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 4 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Benzo(a)anthracene	X		X	X			
Bis[2-ethylhexyl]phthalate	X	X			X		

B.2.4.4.3 Fish Media

No fish samples were collected within EA 4. However, results for samples collected within other EAs (i.e., 3, 6, 8, and 9) are used as a proxy for EA 4. Considering the results of the risk assessments performed for EAs 3, 6, 8, and 9 and the associated lines-of-evidence, Cs-137 and mercury are considered HH RCOCs for fish media for the recreational fisherman scenario.

B.2.4.4.4 HHRA Conclusion for EA 4

Sediment/soil Media

- Resident scenario: Cs-137(+D) (risk = 3.0E-04) is identified as RCOC; decay-adjusted Cs-137(+D) risk = 2.6E-04.
- Industrial Worker scenario: Cs-137(+D) (risk = 2.0E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 1.7E-04.
- Onsite Worker scenario: Cs-137(+D) (risk = 1.0E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 8.8E-05.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.5 Exposure Area 5

B.2.4.5.1 Sediment/Soil Media

Table B-22 presents the results of the sediment/soil screening for EA 5. Human health COPCs for sediment/soil include aluminum, chromium, cobalt, iron, manganese, vanadium, Am-243(+D), Cs-137(+D), Co-60, K-40, Th-232(+D), and U-238(+D). These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential), risk-based screening levels and exceeded two times IOU background concentrations.

Table B-23 presents the total HI (0.61) and total media risk (4.1E-03) for the resident exposure scenario and the associated COCs chromium, Am-243(+D), Cs-137(+D), Co-60, potassium-40, Th-232(+D), and U-238(+D).

Table B-24 presents the total HI (0.1) and total media risk (2.6E-03) for the industrial worker exposure scenario and the associated COCs chromium, Am-243(+D), Cs-137(+D), Co-60, K-40, Th-232(+D), and U-238(+D).

Table B-25 presents the total HI (0.06) and the total media risk (1.3E-03) for the onsite worker exposure scenario and the associated COCs chromium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is identified as a COC for the resident (risk = 1.7E-04), the industrial worker (risk = 8.1E-06), and the onsite worker (3.8E-06) scenarios. It was detected in 5/5 samples, with no results being estimated values (i.e., "J" qualified). Concentrations range from 1.06 mg/kg to 56.2 mg/kg. Sample location LTR ERDMS IOULTR2 Sampling Event: LTROU-03 (see Figure 3-5 in Chapter 3), collected on November 10, 2003, had the highest detected concentration. The EPC used in the risk calculations is 50.8 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS soil background dataset is 53.3 mg/kg, and the maximum concentration in the Wetland Study

dataset is 58.1 mg/kg. The concentration for chromium from this EA is within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered cancerous. Chromium compounds, in the Cr+3 or Cr+6 forms, are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case at for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined; the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario, and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined and the analytical result was for total chromium.

- The risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Americium-243(+D) is identified as a COC for the resident (risk = 2.0E-06) and the industrial worker (risk = 1.3E-06) scenarios. The risk to the onsite worker is <1E-06. It was detected in 1/5 samples, with this result being estimated (i.e., "J" qualified). Sample location JBT002-003 (see Figure 3-5 in Chapter 3), collected on March 16, 2010, had the highest detected concentration. The EPC used in the risk calculation is 0.341 pCi/g, which is the maximum concentration.

Using the maximum detected concentration tends to bias the risk calculation high. The mean activity concentration, 0.097 pCi/g, is below the residential PRG of 0.67 pCi/g and industrial worker PRG of 0.26 pCi/g. There are no background results for Am-243.

Am-243 (half-life of 7,370 years) and americium-241 (half-life of 432 years) are produced together in reactors and both behave the same in the environment.

Am-243(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- The risk estimate is biased high because maximum detected concentration was used.
- The mean concentration is less than the PRG.

Cs-137(+D) is identified as a COC for the resident (risk = 3.8E-03), the industrial worker (risk = 2.5E-03), and the onsite worker (risk = 1.3E-03) scenarios. It was detected in 17/17 samples, with none of these results being an estimated value (i.e., "J" qualified). Concentrations range from 1.7 pCi/g to 405 pCi/g. Sample location LTR ERDMS IOULTR2 Sampling Event LTROU-02 (see Figure 3-5 in Chapter 3), collected on April 28, 2004, had the highest detected concentration. The EPC used in the risk calculations is 228 pCi/g.

Cs-137 is a result of nuclear fission and does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g with a mean of

0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 5 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the cesium-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 168.3 pCi/g. Using this adjusted value results in residential risk = 2.8E-03; industrial worker risk = 1.8E-03, and onsite worker risk = 9.4E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 17/17 samples, indicating widespread contamination.
- Its risk >1E-06.

Co-60 is a COC for the resident (risk = 2.3E-05), the industrial worker (risk = 1.6E-05), and the onsite worker (risk = 9.1E-06) scenarios. It was detected in 6/17 samples, with no results being estimated values ("J" qualified). Concentrations range from ND to 1.83 pCi/g. Sample location LTR ERDMS IOULTR2 Sampling Event LTROU-02 (see Figure 3-5 in Chapter 3), collected on April 28, 2004 had the highest detected concentration. The EPC used in the risk calculations is 0.76 pCi/g.

Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors. There are no background results for cobalt-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the cobalt-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.143 pCi/g. Using this adjusted value results in residential risk = 4.3E-06, industrial worker risk = 3.0E-06, and onsite worker risk = 1.7E-06.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Its risk >1E-06

K-40 is a COC for the resident (risk = 1.9E-05), the industrial worker (risk = 1.2E-05), and the onsite worker (risk = 5.9E-06) scenarios. It was detected in 12/17 samples, with 4 results being estimated (i.e., "J" qualified). Concentrations range from ND to 5.49 pCi/g. Sample location LTR ERDMS IOULTR2 Sampling Event LTROU-03 (see Figure 3-5 in Chapter 3), collected on April 28, 2004, had the highest detected concentration. The EPC used in the risk calculations is 2.71 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half- life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- K-40 is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 1.1E-04), the industrial worker (risk = 7.1E-05), and onsite worker (risk = 3.4E-05) scenarios. The Thorium Series [thorium-232(+D)] evaluation

includes not only the measured concentration of Th-232, specifically, but also considers any analytical results from its daughter products (e.g., Ac-228, Th-228, Pb-212, Bi-212, and Tl-208) since these isotopes are assumed to be present in secular equilibrium. Data screening performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, lead-212 had the highest detected concentration (4.06 pCi/g), however, Th-228 had the highest EPC (2.98 pCi/g). These results are both from sample location JBT002-003 (see Figure 3-5 in Chapter 3) collected on March 16, 2010. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (Ra-224 result) and the SRS Soil background maximum detected activity concentration is 6.75 pCi/g (Ra-224 result). (Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment.) Sediment/soil concentrations from EA 5 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P-Area and R-Area waste units and EA 5 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

U-238(+D) is a COC for the resident (risk = 2.5E-06) and the industrial worker (risk = 1.4E-06) scenarios. The risk for the onsite worker is <1E-06. It was detected in 6/6 samples, with one result being an estimated value (i.e., "J" qualified). Sample location JBT002-003 (see Figure 3-5 in Chapter 3), collected on March 16, 2010, had the highest detected concentration (i.e., 2.44 pCi/g). The EPC used in the risk calculations was 1.98 pCi/g.

Uranium is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 2.51 pCi/g, and the maximum detected concentration in the SRS Soil background data set is 1.9 pCi/g. The mean for sediment/soil collected in EA 5 is less than background.

U-238 is naturally-occurring constituent of primordial origin with a half-life of 4.5 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

The uranium isotopes U-238, U-235, and U-233/234 were used in SRS reactor operations, but also occur naturally and are widespread in Coastal Plain soils and sediments. Isotopic concentration ratios (e.g., U-238/[U233/234]) are very close to unity, which is expected for natural uranium, and are not consistent with reactor uranium. Isotopic considerations conclusively demonstrate that EA 5 sediment/soil samples are natural uranium.

U-238(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- Isotopic ratios demonstrate natural uranium (not reactor waste).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 5 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr		X	X		X	X	
Am-243(+D)	X			X			
Cs-137(+D)*							
Co-60*							
K-40		X	X				
Th-232(+D)		X	X		X		
U-238(+D)			X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.5.2 Surface Water Media

Table B-26 identifies naphthalene and Bi-214 as human health surface water COCs because these constituents' maximum detected concentrations exceed their surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Naphthalene is a COC based on an exceedance of the tapwater RSL (0.17 µg/L). It was detected in only 1/7 samples, with this result being estimated (i.e., "J" qualified). The maximum detected concentration is 0.222 µg/L from sample location LTR ERDMS IOULTR2 Sampling Event LTROU-02 (see Figure 3-5 in Chapter 3) collected on October 30, 2003.

Naphthalene is a ubiquitous PAH, being a component of crude oil. It is also produced from the combustion of organic materials, including from car exhaust and smoke from forest fires.

Naphthalene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection is an estimated value ("J" qualified).

Bi-214 is a COC based on an exceedance of the tapwater MCL of 15 pCi/L. It was detected in 1 of 7 samples, with this result being estimated (i.e., "J" qualified). The maximum activity concentration is 70.2 pCi/L. The maximum concentration is from sample location LTR ERDMS IOULTR2 Sampling Event LTROU-02 (see Figure 3-5 in Chapter 3) collected on October 30, 2003.

Bi-214 is a naturally-occurring daughter of radon and radium and was not used at SRS. Due to the high solubility and mobility of radium, and especially radon, there are many examples of elevated levels of Bi-214 in SRS groundwater, with concentrations as high as 500 pCi/L not unknown. Bodies of surface water that are fed by groundwater, such as the small creeks, can inherit these high Bi-214 concentrations. Because Bi-214 and its parent's radon and radium were not used at SRS, and because elevated levels Bi-214 are well known in SRS groundwater, the detections of Bi-214 are accepted as real and believed to be natural.

Bi-214 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines-of-evidence:

- It is a daughter of naturally-occurring radium.
- It has a very short half-life (19.9 minutes).
- It had no historical use at SRS.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 5 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Naphthalene	X		X	X			
Bi-214	X	X	X		X		

B.2.4.5.3 Fish Media

No fish samples were collected within EA 5. However, results for samples collected within other EAs (i.e., 3, 6, 8, and 9) are used as a proxy for EA 5. Considering the results of the risk assessments performed for EAs 3, 6, 8, and 9 and the associated uncertainties, Cs-137(+D) and mercury are considered fish HH RCOCs.

B.2.4.5.4 HHRA Conclusion for EA 5

Sediment/soil media

- Resident scenario: Cs-137(+D) (risk = 3.8E-03) and Co-60 (risk = 2.3E-05) are identified as RCOCs with a TCR = 3.8E-03. Decay-adjusted Cs-137(+D) risk = 2.8E-03 and decay-adjusted Co-60 risk = 4.3E-06 with a decay-adjusted TCR = 2.8E-03.
- Industrial Worker scenario: Cs-137(+D) (risk = 2.5E-03) and Co-60 (risk = 1.6E-05) are identified as RCOCs with a TCR = 2.5E-03. Decay-adjusted cesium-137(+D) risk = 1.8E-03 and decay-adjusted Co-60 risk = 3.0E-06, with a decay adjusted TCR = 1.9E-03.
- Onsite Worker scenario: Cs-137(+D) (risk = 1.3E-03) and Co-60 (risk = 9.1E-06) are identified as RCOCs with a TCR = 1.3E-03. Decay-adjusted Cs-137(+D) risk = 9.4E-04 and decay-adjusted Co-60 risk = 1.7E-06, with a TCR = 9.4E-04.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.6 Exposure Area 6

B.2.4.6.1 Sediment/Soil Media

Table B-27 presents the results of the sediment/soil screening for EA 6. Human health COPCs for sediment/soil include aluminum, antimony, arsenic, chromium, hexavalent chromium, cobalt, cyanide, iron, manganese, mercury, thallium, vanadium, barium- (Ba)-133, Cs-137(+D), Co-60, europium- (Eu)-152, K-40, strontium- (Sr-)89/-90, and Th-232(+D) as these constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times IOU background concentrations.

Table B-28 presents the total HI (4.4) and the total media risk (2.3E-04) for the resident exposure scenario and the associated COCs: arsenic, chromium, hexavalent chromium, thallium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-29 presents the total HI (0.29) and the total media risk (1.3E-04) for the industrial worker exposure scenario and the associated COCs: arsenic, chromium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-30 presents the total HI (0.18) and the total media risk (6.6E-05) for onsite worker exposure scenario and the associated COCs: Cs-137(+D), Co-60, K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident (HQ = 0.1 and risk = 5.3E-06) and industrial worker (risk = 1.2E-06) scenarios. Risk to the onsite worker is <1E-06. It was detected in 8/58 samples, with the 8 results being estimated values (i.e., "J" qualified). Concentrations range from ND to 7.67 mg/kg. Sample location PAR Pond Sediment PPSC-SED01 (see Figure 3-6 in Chapter 3), collected on July 7, 1995, had the highest detected concentration. The EPC used in the risk calculations is 3.61 mg/kg.

Arsenic is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 6.7 mg/kg, the maximum concentration in the SRS Soil background dataset is 22.9 mg/kg, and the maximum concentration in the Wetland Study is 3.7 mg/kg. Sediment/soil concentrations from the EA are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and in fruit orchards. However, no significant quantities of pressure treated wood were used in buildings within the LTR IOU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- Arsenic products were either not used or were of limited use at SRS.

Chromium is identified as a COC for the resident (risk = 2.8E-05) and the industrial worker (risk = 1.3E-06) scenarios. It was detected in 55/63 samples, with 11 results being estimated (i.e., "J" qualified). Concentrations range from not detected to 25.4mg/kg. Sample location PAR Pond Sediment PPSC-SED10 (see Figure 3-6 in Chapter 3), collected on July 10, 1995, had the highest detected concentration. The EPC used in the risk calculations is 8.46 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. Only 1 sample out of 36 exceeds these background concentrations. Sediment/soil concentrations for all samples, but one, from this EA are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds, in the Cr+3 or Cr+6 forms, are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined and the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario, and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined and the analytical result was for total chromium.
- The risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard)

Hexavalent Chromium is identified as a COC for the resident (risk = 2.0E-06) scenario only; the risk estimates were <1E-06 for the industrial worker and the onsite worker receptor scenarios. Hexavalent chromium was detected in 3/3 samples sampled in 2016, with 2 results being estimated (i.e., "J" qualified). Concentrations range from 0.503 to 0.62 mg/kg. Since the 95% UCL was calculated to be greater than the maximum detected concentration due to a small number of samples, the maximum detected concentration of 0.62 mg/kg was used in the risk calculation. Use of maximum detected concentration tends to bias the risk estimate high.

There is not a SRS background value for hexavalent chromium. Hexavalent chromium occurs naturally in the environment from the erosion of natural chromium deposits found in rock and soil. Depending on conditions, hexavalent and trivalent forms of chromium can convert back and forth in the environment (and the human body). The transformations of chromium in the environment

involve complicated geochemical processes that are dependent on a variety of conditions/factors. Oxidation and reduction reactions can convert trivalent chromium to hexavalent chromium and vice versa. Naturally-occurring chromium is likely to be oxidized to hexavalent chromium in the presence of abundant manganese oxides. The occurrence of non-anthropogenic hexavalent chromium in soil and groundwater is a recognized phenomenon. Detections of hexavalent chromium in the PAR Pond samples are not related to disposal practices or industrial activities, but are more likely due to changes in the valence state of the naturally-occurring chromium in the environment (and the laboratory).

Hexavalent chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for the residential scenario based on the following lines of evidence:

- The risk estimation of 2.0E-06 for the residential scenario is biased high due to use of the maximum detected concentration in the calculation. The risk estimate for the industrial worker and on-site worker are <1E-06.
- The USEPA 7196A colorimetric method is known to be prone to interferences and false-positives.
- Detections of hexavalent chromium are likely due to changes in the valence state of the naturally-occurring chromium in the environment (and the laboratory).
- Analysis of hexavalent chromium is a very complicated issue due to its vicissitude. Complex geochemical relationships, including interactions with other minerals (such as aluminum, iron, manganese), presence of organic matter, as well as biota (such as microbes in the soil), all influence reduction and oxidation of naturally-occurring chromium in the soil. The occurrence of non-anthropogenic hexavalent chromium in soil and groundwater is a documented phenomenon.

Thallium is identified as a COC for the resident only (HQ = 3.5), risks for the industrial worker and onsite worker are less than HQ = 1. It was detected in 4/60 samples, with all 4 of these being estimated (i.e., "J" qualified). Concentrations range from ND to 6.89 mg/kg. Sample location PAR Pond Sediment PPSC-SED08 (see Figure 3-6 in Chapter 3), collected on July 10, 1995, had the highest detected concentration. The EPC used in the risk calculation is 2.76 mg/kg.

Thallium is a naturally-occurring constituent that is widely distributed in trace amounts in the earth's crust. The maximum concentration in the IOU Background dataset is 11.2 mg/kg, the maximum concentration in the SRS Soil background dataset is 8.13 mg/kg, and the maximum detected concentration from the Wetland Study is 2.1 mg/kg. Sediment/soil concentrations from this EA are within the range of concentrations found in background soil.

Thallium can be found in pure form or mixed with other metals in the form of alloys. It can also be found combined with other substances such as bromine, chlorine, fluorine, and iodine to form salts. Thallium remains in the environment since it is a metal and cannot be broken down to simpler substances.

Thallium is used mostly in the manufacture of electronic devices, switches, and closures. It also has limited use in the manufacture of special glasses and for medical procedures that evaluate heart disease. Up until 1972 thallium was used as a rat poison. However, it has banned because of its potential harm to human health. Thallium is no longer produced in the United States.

Thallium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for the resident receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It was not used at SRS.

Cs-137(+D) is identified as a COC for the resident (risk = 1.5E-04), the industrial worker (risk = 9.7E-05), and the onsite worker (risk = 4.9E-05) scenarios. It was detected in 510/540 samples, with one of these results being an estimated value (i.e., "J" qualified). Concentrations range from ND to 124 pCi/g. Sample location PAR Pond Sediment Fish PF3-5 (see Figure 3-6 in Chapter 3), collected on September 16, 1995, had the highest detected concentration. The EPC used in the risk calculations is 8.82 pCi/g.

Cs-137 is a result of nuclear fission and it does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The

maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 6 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 5.23 pCi/g. Using this adjusted value results in residential risk = 8.6E-05, industrial worker risk =5.8E-05, and onsite worker risk = 2.9E-05.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 510/540 samples, indicating widespread contamination.
- Its risk >1E-06.

Co-60 is a COC for the resident (risk = 2.9E-06), the industrial worker (risk = 2.0E-06), and the onsite worker (1.2E-06) scenarios. It was detected in 132/259 samples, with no results being estimated values ("J" qualified). Concentrations range from ND to 1.13 pCi/g. Sample location PAR Pond Sediment Fish PF3-5 (see Figure 3-6 in Chapter 3), collected on September 16, 1995, had the highest detected concentration. The EPC used in the risk calculations is 0.097 pCi/g.

Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors. There are no background results for Co-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Co-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.0063 pCi/g. Using this adjusted value, results in risks to the resident risk = 1.8E-07, industrial worker risk = 1.3E-07, and onsite worker risk = 7.2E-08.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Its risk >1E-06.

K-40 is a COC for the resident (risk = 4.3E-06), the industrial worker (risk = 2.8E-06), and the onsite worker (risk = 1.3E-06) scenarios. It was detected in 146/260 samples, with no results being estimated (i.e., "J" qualified). Concentrations range from ND to 4.38 pCi/g. Sample location PAR Pond Transect 13 Location A9 PP13A9 (see Figure 3-6 in Chapter 3), collected on February 8, 1995, had the highest detected concentration. The EPC used in the risk calculations is 0.612 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half- life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes. K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- K-40 is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 4.2E-05), the industrial worker (risk = 2.7E-05), and the onsite worker (risk = 1.3E-05) scenarios. The Thorium Series [Th-232(+D)] evaluation

includes not only the measured concentration of Th-232, specifically, but also considers any analytical results from its daughter products (e.g., Ac-228, Th-228, Pb-212, Bi-212, and Tl-208) since these isotopes are assumed to be present in secular equilibrium. Data screening performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, Pb-212 had the highest detected concentration (2.40 pCi/g) and the highest EPC (1.12 pCi/g). These results are both from sample location PAR Pond Transect 10 Location B7 PP10B7 (see Figure 3-6 in Chapter 3) collected on February 24, 1995. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (Ra-224 result) and the SRS Soil background maximum detected activity concentration is 6.75 pCi/g (Ra-224 result) (Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment.) Sediment/soil concentrations from EA 6 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium had a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units and EA 6 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines-of-evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA 6 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
As		X	X				
Cr		X	X		X	X	
Cr+6		X		X	X	X	
Tl		X	X	X			
Cs-137(+D)*							
Co-60*							
K-40		X	X				
Th-232(+D)		X	X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.6.2 Surface Water Media

Table B-31 identifies thallium, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, Pb-212, K-40, and Th-234 as human health surface water COCs because these constituents maximum detected concentrations exceed their surface water comparison values.

The refinement/uncertainty evaluation is presented for each of these COCs.

Thallium is a COC based on an exceedance of the tapwater RSL (0.002 µg/L). It was detected in only 2 of 30 samples, both of which are estimated (i.e., "J" qualified). The maximum detected concentration collected from sample PAR Pond Water Sediment Fish PW1-1 (see Figure 3-6 in Chapter 3) on September 20, 1995 is 2.32 µg/L.

Thallium is naturally-occurring widely distributed in trace amounts in the earth's crust. It is present in surface water due to desolution from rock, soil, and sediments. Thallium is produced or used in power plants, cement factories, and smelters. Emissions into the air can deposit into soil and surface water bodies. Thallium mixes easily with water.

The IOU background maximum concentration is 16.3 µg/L, with a mean concentration of 6.75 µg/L. The maximum detected concentration is within the maximum and mean background concentrations. Further, more recent samples collected in 2016 that were filtered prior to analysis resulted in NDs for thallium.

Thallium is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a naturally-occurring constituent in the environment.
- It is within SRS background surface water concentrations.
- It was not used at SRS.

Dibenz[a,h]anthracene is a COC based on an exceedance of the tapwater RSL (0.0034 µg/L). It was detected in only 1 of 14 samples, which is estimated (i.e., "J" qualified). Sample location PAR-13-2016 (see Figure 3-6 in Chapter 3), collected on May 31, 2016, had a maximum detected concentration of 0.42 µg/L. Dibenz[a,h]anthracene is a ubiquitous PAH, being a component of coal tar..

Dibenz[a,h]anthracene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection is an estimated value ("J" qualified)

Indeno[1,2,3-cd]pyrene is a COC based on an exceedance of the tapwater RSL (0. 034 µg/L). It was detected in only 1 of 14 samples, which is estimated (i.e., "J" qualified). Sample PAR-13-2016 (see Figure 3-6 in Chapter 3), collected on May 31, 2016, had a maximum detected concentration of 0.32 µg/L. Indeno[1,2,3-cd]pyrene is a ubiquitous PAH because it is a component of coal tar.

Indeno[1,2,3-cd]pyrene is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a ubiquitous PAH with multiple man-made and natural sources.
- The single detection is an estimated value ("J" qualified).

Pb-212 is a COC based on an exceedance of the tapwater PRG (1.8 pCi/L). It was detected in 3 of 31 samples with no results being estimated (i.e., "J" qualified). Concentrations range from ND to 30.1 pCi/L. Sample PAR Pond Water Sediment Fish PW2-1 (see Figure 3-6 in Chapter 3),

collected on September 14, 1995, had the highest activity concentration. The mean activity concentration of Pb-212 is 2.75 pCi/L, which is below the IOU background mean activity concentration of 7 pCi/L.

Pb-212 is a daughter of the naturally-occurring Ra-224, Ra-228 and Th-232. In surface water, it may be in secular equilibrium with Ra-224. Pb-212 probably exists in SRS waters, but because of its short half-life (10 hours), and the short half-life of Ra-224 (3.6 days) a sample would have to be analyzed very quickly after being taken for it to be detected at a laboratory. It is rarely detected at SRS, because most samples are analyzed a week or more after collection.

If Pb-212 were due to SRS processes, it would need to have decayed from Th-232, which had a very limited use at SRS. Th-232 concentrations in EA 6 sediment/soils are consistent with natural levels. Therefore, the Pb-212 detections in EA 6 surface waters are regarded as natural.

Pb-212 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a daughter of naturally-occurring radioisotopes in the environment.
- The mean activity concentration is within the SRS mean background concentration.
- It was not used in any SRS process.

K-40 is a COC based on an exceedance of the tapwater PRG (0.83pCi/L). It was detected in 5/51 samples, with no results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 45.6 pCi/L. The maximum detected activity concentration is from sample PAR Pond Water Sediment Fish PW2-1(see Figure 3-6 in Chapter 3) collected on September 14, 1995. The maximum activity concentration of K-40 is below the IOU background maximum activity concentration of 275 pCi/L.

K-40 is a naturally-occurring radionuclide, and can be found wherever potassium is found. Potassium is a constituent of natural clay minerals, and surface water often contains suspended clay. K-40 was not used in any SRS process and SRS regards this detection as non-USDOE related.

K-40 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring in the environment.
- It is within the SRS background concentration.
- It was not used in any SRS process.

Th-234 is a COC based on an exceedance of the tapwater PRG (1.9 pCi/L). It was detected in 5/8 samples, with no results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 275 pCi/L. It was detected from PAR Pond Water Sediment Fish PW2-1 (see Figure 3-6 in Chapter 3) collected on September 14, 1995).

Thorium-234 occurs naturally, but as the daughter product of uranium-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples because 1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty, and 2) gamma peak overlap with Ac-228 causes falsely elevated reported concentrations and additional uncertainty.

Because of its extremely low solubility and short half-life (24 days), Th-234 would not be expected to occur in surface water at these concentrations unless local U-238 concentrations were extremely high in either surface water or sediment. However, observed U-238 levels are very low in both sediment/soil and surface water in EA 6. Furthermore, U-234/U-238 isotopic ratios in EA 6 sediment/soils are consistent with natural uranium, but are not consistent with either enriched or depleted uranium. SRS believes that measured U-238 concentrations and uranium isotopic ratios provide a much more reliable guide to reactor waste than Th-234, and therefore, the reported Th-234 detection of 275 pCi/L is not believed to be USDOE-related, but are perhaps spurious.

Th-234 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a daughter of naturally-occurring radioisotopes in the environment.
- It has an extremely short half-life and not expected to occur in surface water.
- It is consistent with natural uranium.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 6– Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Tl	X	X	X	X			
Dibenz[a,h]anthracene	X		X	X			
Indeno[1,2,3-cd]pyrene	X		X	X			
Pb-212	X	X	X		X		
K-40		X	X				
Th-234					X		X

B.2.4.6.3 Fish Media

Table B-32 identifies chromium, mercury, Cs-137(+D), Pb-212, K-40, and Th-234(+D) are human health COCs for fish, as maximum detected concentrations of these constituents exceed respective human health RSLs or PRGs. The refinement/ uncertainty evaluation is presented for each of these COCs.

Chromium is a COC based on an exceedance of the fish RSL (0.00832 mg/kg). It was detected in 2 of 52 fish samples, in which both results are estimated (i.e., "J" qualified). The maximum concentration is 0.243 mg/kg, which was from sample LTR-PAR collected on June 8, 2010. The maximum detected concentration is below the IOU maximum background concentration for fish at 0.47 mg/kg.

The hexavalent chromium RSL was used to perform the data screening. This overly conservative approach tends to bias the comparison high. The RSL for the chromium +3 is 2,320 mg/kg. Therefore, if chromium is actually present in the +3 valence state, chromium would not be identified as a COC for fish media.

Chromium is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines-of-evidence:

- Fish concentration is below the background fish concentration.

- It is a naturally-occurring constituent that is an essential nutrient.
- It does not appear to be unit related since it is indistinguishable from background in fish.
- The valence state of chromium was not determined analytical result was for total chromium.
- The Cr+6 RSL was used in the comparison; fish tissue concentrations <Cr+3 RSL.

Mercury is a COC based on an exceedance of the fish RSL (0.154 mg/kg). It was detected in 224/227 fish samples in which 38 if these results were estimated (i.e., "J" qualified). Concentrations range from ND to 3.18 mg/kg. Sample PAR Pond Sediment Fish PF2-2 105808, collected September 226, 1995, had the maximum detected fish concentration. Both the mean concentration (0.627 mg/kg) and the 95% UCL on the mean concentration (0.689 mg/kg) exceed the RSL.

Mercury is a naturally-occurring constituent in rocks and soil that is common in the environment and enters the environment from natural deposits and disposal of wastes within water bodies. It can be taken up by animals (i.e., fish) and plants. Mercury combines with chlorine, sulfur or oxygen to form inorganic mercury compounds or "salts." Mercury also combines with carbon to make organic mercury compounds (i.e., methylmercury). The maximum concentration in the IOU Fish Background dataset is 0.24 mg/kg.

Inorganic mercury compounds are much less toxic than methylmercury, which is considered more bioavailable and thus has a higher toxicity. Methylmercury may be formed in water and soil by bacteria which leads to increased concentrations in tissues of fish. Mercury compounds were not used in the PAOU or RAOU and they are not part of the reactor operation. However, copious amounts of river water from the Savannah River were used in both reactors as cooling water. High concentrations of mercury in Savannah River samples have been observed indicating other sources that may have release mercury into the river. Given the differences in mercury compounds, the USEPA generally recommends that both total mercury and methyl mercury data be collected when mercury is likely to be an important contaminant at the site. However, only total mercury was collected in the LTR IOU.

To be conservative, the fish screening is performed for methylmercury rather than for mercury salts. Based on unit history and the environmental conditions (likely presence of mercury in the source for reactor cooling water and the presence of methylating bacteria in the IOU water bodies), it is likely the methylated form of mercury is present LTR IOU.

Mercury is recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman scenario based on the following lines-of-evidence:

- It was detected in 224 of 227 samples.
- Fish concentrations exceed the background fish maximum concentration.

Cs-137(+D) is a COC based on an exceedance of the fish PRG (0.054 pCi/g). It was detected in 160/165 fish samples, with one result being estimated (i.e., "J" qualified). Concentrations range from ND to 18.4 pCi/g. Sample PAR Pond 28055, collected on September 2, 1993, had the highest activity concentration. Both the mean activity concentration (5.07 pCi/g) and the 95% UCL on the mean activity concentration (5.51 pCi/g) exceed the PRG.

Cs-137 is a result of nuclear fission it does not occur naturally in in the environment. However, Cs-137 is common in SRS background soils, surface water, and fish media. The maximum detected concentration in the background fish media dataset is 0.49 pCi/g, with a mean of 0.13 pCi/g. Both the maximum activity concentration (18.4 pCi/g) and the mean activity concentration (5.51 pCi/g) in EA 6 fish media are greater than background fish concentrations.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Both the maximum detected concentration and the mean concentration exceeds the fish PRG.
- It was detected with a high frequency, indicating widespread contamination in this media.

Pb-212 is a COC based on an exceedance of the fish PRG (0.057 pCi/g). It was detected in 8/75 samples collected from PAR Pond, with no results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 0.131 pCi/L. Sample PAR Pond Sediment Fish PF3-8 105730,

collected on September 26, 1995, had the highest activity concentration. The IOU background maximum activity concentration is 0.18 pCi/g.

Pb-212 is a daughter of the naturally-occurring Ra-224, Ra-228 and Th-232. In surface water, it may be in secular equilibrium with Ra-224. Given the moderate fish bioconcentration factor for Pb-212 (25 L/kg), it can be taken up into fish tissue. Pb-212 probably exists in SRS waters, but because of its short half-life (10 hours) and the short half-life of Ra-224 (3.6 days), a sample would need to be analyzed very quickly after being taken for it to be detected at a laboratory. It is rarely detected at SRS, because most samples are analyzed a week or more after collection.

If Pb-212 were due to SRS processes, it would have to have decayed from Th-232, which had a very limited use at SRS. Th-232 concentrations in EA 6 sediment/soils are consistent with natural levels. Therefore, the Pb-212 detections in EA 6 surface waters are regarded as natural.

Pb-212 is not recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- It is considered naturally-occurring in SRS surface waters.
- It has a very short half-life.
- Concentrations are within background for fish tissue.

K-40 is a COC based on an exceedance of the fish PRG (0.0595 pCi/g). It was detected in all 48 samples collected from PAR Pond, with no results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 4.99 pCi/g. Sample PAR Pond Water Fish PF4 108837, collected on August 15, 1996, had the highest activity concentration.

K-40 is a naturally-occurring constituent that is common in the environment. The background fish media activity concentration ranges from 1.24 pCi/g to 3.8 pCi/g. The average activity concentration for EA 6 fish (2.70 pCi/g) is less than the background fish media maximum activity concentration.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout

history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products). Potassium is an essential nutrient therefore some amount of normally present potassium in biological tissue is likely K-40.

K-40 is not associated with any of the reactor processes. K-40 is not recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Average fish activity is within the SRS background fish media activity range.
- It is a natural component occurring in biological tissues.
- It does not appear to be unit related since it is indistinguishable from background.

Th-234(+D) is a COC based on an exceedance of the fish PRG (0.06 pCi/g). It was detected in only 1 out of 49 samples collected from PAR Pond at an activity concentration of 1.26 pCi/g. Sample PAR Pond Sediment Fish PF1-7 105868, collected on September 19, 1995, had the highest activity concentration.

Th-234 occurs naturally, but as the daughter product of U-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples because 1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty, and 2) gamma peak overlap with Ac-228 causes falsely elevated reported concentrations and additional uncertainty.

Because of its extremely low solubility and short half-life (24 days), Th-234 would not be expected to occur in surface water unless local U-238 concentrations were extremely high in either surface water or sediment. However, observed U-238 levels are very low in both sediment/soil and surface water in EA6. Furthermore, U-234/U-238 isotopic ratios in EA 6 sediment/soils are consistent with natural uranium, but are not consistent with either enriched or depleted uranium. SRS believes that measured U-238 concentrations and uranium isotopic ratios provide a much more reliable guide to reactor waste than Th-234.

Th-234 is not recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman scenario based on the following lines of evidence:

- It is a daughter of naturally-occurring radioisotopes in the environment.
- It has an extremely short half-life and not expected to occur in surface water and, therefore, fish.
- It is consistent with natural uranium.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 6 – Fish Tissue	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr	X		X	X	X	X	
Hg*							
Cs-137(+D)*							
Pb-212			X		X		
K-40	X	X	X		X		
Th-234	X		X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.6.4 HHRA Conclusion for EA 6

Sediment/soil media

- Resident scenario: Cs-137(+D) (risk = 1.5E-04) and Co-60 (risk = 2.9E-06) are identified as RCOCs with a TCR = 1.5E-04. Decay-adjusted cesium-137(+D) risk = 8.6E-05 and decay-adjusted Co-60 risk = 1.8E-07 with a decay-adjusted TCR = 8.7E-05.
- Industrial Worker scenario: Cs-137(+D) (risk = 9.7E-05) and Co-60 (risk = 2.0E-06) are identified as RCOCs with a TCR = 9.9E-05. Decay-adjusted Cs-137(+D) risk = 5.8E-05 and decay-adjusted Co-60 risk = 1.3E-07, with a decay adjusted TCR = 5.8E-05.
- Onsite Worker scenario: Cs-137(+D) (risk = 4.9E-05) and Co-60 (risk = 1.2E-06) are identified as RCOCs with a TCR = 5.0E-05. Decay-adjusted Cs-137(+D) risk = 2.9E-05 and decay - adjusted Co-60 risk = 7.2E-08, with a TCR = 2.9E-05.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.7 Exposure Area 7

B.2.4.7.1 Sediment/Soil Media

Table B-33 presents the results of the sediment/soil screening for EA 7. Human health COPCs for sediment/soil include aluminum, arsenic, chromium, cobalt, iron, lead, manganese, mercury, vanadium, Cs-137(+D), Co-60, K-40, radium-226(+D), Th-232(+D), U-235(+D), and U-238(+D) as these constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential) risk-based screening levels and exceeded two times mean IOU background concentrations.

Table B-34 presents the total HI (0.9) and the total media risk (3.6E-03) for the resident exposure scenario and the associated COCs: arsenic, chromium, Cs-137(+D), Co-60, K-40, Ra-226(+D), Th-232(+D), and U-238(+D).

Table B-35 presents the total HI (0.09) and the total media risk (2.2E-03) for the industrial worker exposure scenario and the associated COCs: chromium, Cs-137(+D), Co-60, K-40, Ra-226(+D), and Th-232(+D).

Table B-36 presents the total HI (0.06) and the total media risk (1.2E-03) for the onsite worker exposure scenario and the associated COCs chromium, Cs-137(+D), Co-60, K-40, Ra-226(+D), and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident only (risk = 3.8E-06). Risks to the industrial worker and onsite worker are <1E-06. Arsenic was detected in 35/36 samples, with 12 of these results being estimated (i.e., "J" qualified). Concentrations range from ND to 14.9 pCi/g. Sample location LTROU-42 (see Figure 3-7 in Chapter 3), collected on February 25, 2005, had the highest concentration. The EPC used in the risk calculation is 2.57mg/kg.

Arsenic is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 6.7 mg/kg, the maximum concentration in the SRS Soil background dataset is 22.9 mg/kg, and the maximum concentration in the Wetland

Study is 3.7 mg/kg. Sediment/soil concentrations from the EA 7 are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and in fruit orchards. However, no significant quantities of pressure treated wood were used in buildings within the LTR IOU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- Arsenic products were either not used or were of limited use at SRS.

Chromium is identified as a COC for the resident (risk = 4.9E-05), the industrial worker (risk = 2.3E-06), and the onsite worker (risk = 1.1E-06) scenarios. It was detected in 36/36 samples, with no results being estimated (i.e., "J" qualified). Concentrations range from 2.38 mg/kg to 70.7 mg/kg. Sample location P2T3-5 (see Figure 3-7 in Chapter 3), collected on May 24, 2010, had the highest detected concentration. The EPC used in the risk calculations is 14.6 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg, and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. Only 1 sample out of 36 exceeds these background concentrations. Sediment/soil concentrations for all samples, but one, from this EA are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds, in the Cr+3 or Cr+6 forms, are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case at for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined- the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario, and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined- analytical result was for total chromium.
- Risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Cs-137(+D) is identified as a COC for the resident (risk = 2.3E-03), the industrial worker, (risk = 1.5E-03), and the onsite worker (risk = 7.7E-04) scenarios. It was detected in 97/138 samples, with 4 of these results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 149 pCi/g. Sample location Pond 2 P25-019-01 (see Figure 3-7 in Chapter 3), collected on March 9, 2000, had the highest activity concentration. The EPC used in the risk calculations is 139 pCi/g.

Cs-137 is a result of nuclear fission and does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 7 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 80.6 pCi/g. Using this adjusted value results in residential risk = 1.3E-03; industrial worker risk = 8.9E-04, and onsite worker risk = 4.5E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 97/138 samples, indicating widespread contamination.
- Its risk >1E-06.

Co-60 is a COC for the resident (risk = 2.4E-05), the industrial worker (risk = 1.7E-05), and the onsite worker (risk = 9.6E-06) scenarios. It was detected in 18/109 samples, with 1 result being estimated (i.e., "J" qualified). Activity concentrations range from ND to 15.5 pCi/g. Sample Pond 2 P25-007-01 (see Figure 3-7 in Chapter 3), collected on March 9, 2000, had the highest activity concentration. The EPC used in the risk calculations is 0.802 pCi/g.

Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors. There are no background results for Co-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Co-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.087 pCi/g. Using this adjusted value results in residential risk = 2.6E-06; industrial worker risk = 1.8E-06, and onsite worker risk = 1.0E-06.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Its risk >1E-06.

K-40 is a COC for the resident (risk = 4.9E-05), the industrial worker (risk = 3.2E-05), and the onsite worker (risk = 1.5E-05) scenarios. It was detected in 80/129 samples, with 5 results being estimated (i.e., "J" qualified). Concentrations range from ND to 52.9 pCi/g. Sample location Pond 2 P25-019-01 (see Figure 3-7 in Chapter 3), collected on March 9, 2000, had the highest detected concentration. The EPC used in the risk calculations is 6.99 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations (mean and EPC) are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any of the reactor processes.

Ra-226(+D) is a COC for the resident (risk = 1.7E-04), the industrial worker (risk = 4.5E-05), and the onsite worker (risk = 5.4E-05) scenarios. The Radium Series [Ra-226(+D)] evaluation includes not only the measured concentration of Ra-226 specifically, but also considers any analytical results from its daughter products (e.g., Pb-210, Pb-214 and, Bi-214) since these isotopes are assumed to be present in secular equilibrium for data screening. Data screening performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, Bi-214 had the highest detected concentration (12.4 pCi/g) and Pb-214 had the highest EPC (2.43 pCi/g). It was detected 137/137 samples, with 11 results being estimated (i.e., "J" qualified). Sample Pond 2 P25-019-01 (see Figure 3-7 in Chapter 3), collected on March 9, 2000, had the highest activity concentration.

Secular equilibrium is a valid assumption for rocks and vadose zone soils, but should not be applied to natural waters or to sediment in contact with natural waters. The sediments in EA 7 with elevated Bi-214 (up to 12.4 pCi/g) and Ra-226 (up to 5.99 pCi/g) are in contact with percolating groundwater, which may be enriched with naturally-occurring radium and its daughter radon. Bi-214, being a product of both radium and radon, can have very high natural concentrations in groundwater and can impart those concentrations to sediment that is exposed to such groundwater.

Because Bi-214 and its parent's radon and radium were not used at SRS. Because elevated levels of naturally-occurring Bi-214 and Ra-226 are well known in SRS groundwater, the detections of Bi-214 and Ra-226 are accepted as real and are regarded as natural. The IOU background maximum activity concentration is 21.62 pCi/g.

Ra-226(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

Th-232(+D) is a COC for the resident (risk = 9.8E-04), the industrial worker (risk = 6.2E-04), and onsite worker (risk = 3.0E-04) scenarios. The Thorium Series [Th-232(+D)] evaluation includes not only the measured concentration of Th-232 specifically, but also considers any analytical results from its daughter products (e.g., Ra-228, Ac-228, Th-228, Ra-224, Pb-212, Bi-212 and Tl-208) because these isotopes are assumed to be in secular equilibrium. Data screening is performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. Th-232(+D) was conservatively assumed to be present at the activity concentration of Ra-224, a daughter of Th-232. Ra-224 had the highest detected concentration (45.9 pCi/g) as well as the highest EPC (26.1 pCi/g). This is from sample location Pond 2 P25-019-01 (see Figure 3-7 in Chapter 3) collected on March 9, 2000. The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Ra-224 is a short-lived daughter of the thorium series decay chain. Secular equilibrium should not be assumed for sediment in contact with natural waters.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units and EA 7 concentrations (3.5 pCi/g or less) are typical of natural thorium. The probable origin for the daughter product Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater and Ra-228, although not often analyzed for, is known to be elevated in some SRS monitoring wells. Sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- It is a naturally-occurring constituent of primordial origin that is common in SRS background soils.
- It is not a COC for the P Area and R Area waste units and the concentrations are typical of natural thorium.
- Conservative risk screening assumed the Th-232 concentration to be equal to the highest concentration of the daughter products (Ra-224). This is an overly conservative approach since secular equilibrium should not be assumed for sediment in contact with natural waters.
- The probable origin for Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater and sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides.

U-238(+D) is a COC for the resident only (risk = 1.02E-06), the risk for the industrial worker and onsite worker scenarios are <1E-06. It was detected in 20/22 samples, with 3 results being estimated values ("J" qualified). Concentrations range from ND to 1.8 pCi/g. Sample location LTROU-43 (see Figure 3-7 in Chapter 3), collected on February 25, 2005, had the highest detected concentration. The EPC used in the risk calculation is 0.0811 pCi/g.

Uranium is naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 2.51 pCi/g and the maximum detected concentration in the SRS Soil background data set is 1.9 pCi/g.

U-238 is naturally-occurring constituent of primordial origin with a half-life of 4.5 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238, and Th-232 (and their daughter products).

The uranium isotopes U-238, U-235, and U-233/234 were used in SRS reactor operations, but also occur naturally and are widespread in Coastal Plain soils and sediments. Isotopic concentration ratios (e.g., U-238/U-233/234) are very close to unity, which is expected for natural uranium and

is not consistent with reactor uranium. Isotopic considerations conclusively demonstrate that EA 7 sediment/soil samples are natural uranium.

U-238(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for the resident receptor scenario based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- Isotopic ratios demonstrate natural uranium (not reactor waste).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 7 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
As		X	X				
Cr		X	X		X	X	
Cs-137(+D)*		X	X				
Co-60*			X		X		
K-40		X	X		X		X
Ra-226(+D)			X		X		
Th-232(+D)			X		X		
U-238(+D)			X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.7.2 Surface Water Media

Table B-37 identifies iron, manganese, Bi-214, and Pb-212, as human health surface water COCs because the maximum detected concentrations of these constituents exceed their surface water comparison values. The refinement/uncertainty evaluation is presented for each of these COCs.

Iron is a COC based on an exceedance of the tapwater RSL (14,000 µg/L). It was detected in 24/24 samples, with none being estimated (i.e., "J" qualified). Concentrations range from ND to 36,300 µg/L. The maximum concentration of 36,300 µg/L is the only sample result that exceeds the RSL (and may be due to high turbidity). The mean concentration (4,000 µg/L) is less than the

RSL. This result is from sample location LTR ERDMS IOULTR2 Sampling Event LTROU-08 (see Figure 3-7 in Chapter 3) and was collected on November 4, 2003.

Iron is a naturally-occurring metal in the environment, being the tenth most abundant element in the universe. Most of the iron on earth is found in various iron oxides. Iron is essential to almost all living things from microorganisms to humans.

Iron can enter waterbodies as a result of dissolution of rocks and soil. The background maximum concentrations in surface water is 12,400 µg/L.

Iron is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- Unit concentrations are consistent with the SRS background range for surface water.
- It is a naturally-occurring constituent that is an essential human nutrient.
- Other than a material of construction, it had no other use as a raw material at SRS.
- Mean concentration is less than the RSL.

Manganese is a COC based on an exceedance of the tapwater RSL (430 µg/L). It was detected 24/24 samples, with none of the results being estimated (i.e., "J" qualified). Concentrations range from 77.1 µg/L to 910 µg/L. Sample location PDC005-002 (see Figure 3-7 in Chapter 3), collected on April22, 2010, had the highest detected concentration. The average concentration (340 µg/L) is less than the tapwater RSL (430 µg/L).

Manganese is a naturally-occurring constituent that is common in the environment. In IOU Background surface water, it was detected in 385/401 sample results with a maximum detected concentration of 2,690 µg/L. Surface water results from EA 7 are less than background surface water concentrations.

Manganese is not associated with any reactor processes at SRS.

Manganese is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines-of-evidence:

- Unit concentrations are less than the background surface water concentration.
- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any reactor processes at SRS.
- The mean concentration is less than the tapwater RSL.

Bi-214 is a COC based on an exceedance of the tapwater MCL (15 pCi/L). It was detected in 22/23 samples, with one result being estimated (i.e., "J" qualified). Activity concentrations range from ND to 80.7 pCi/L. Sample location LTR ERDMS IOULTR2 Sampling Event LTROU-25 (see Figure 3-7 in Chapter 3), collected on November 10, 2003, had the highest concentration.

Bi-214 is a naturally-occurring daughter of radon and radium and was not used at SRS. Due to the high solubility and mobility of radium, and especially radon, there are many examples of elevated levels of Bi-214 in SRS groundwaters, with concentrations as high as 500 pCi/L. Bodies of surface water that are fed by groundwater, such as the small creeks in EA 7, can inherit these high Bi-214 concentrations. Because Bi-214 and its parent's radon and radium were not used at SRS, and because elevated levels of Bi-214 are well known in SRS groundwater, the detections of Bi-214 are accepted as real and believed to be natural.

Bi-214 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines of evidence:

- It is a daughter of naturally-occurring radium.
- It has a very short half-life (19.9 minutes).
- It had no historical use at SRS.

Pb-212 is a COC based on an exceedance of the tapwater PRG (1.8 pCi/L). It was detected in 1/23 samples at a concentration of 17 pCi/L, which is estimated (i.e., "J" qualified). Sample location LTROU-19 (see Figure 3-7 in Chapter 3), collected on September 19, 2010, had this activity concentration.

Pb-212 is a daughter of the naturally-occurring Ra-224, Ra-228 and Th-232. In surface water, it may be in secular equilibrium with Ra-224. Pb-212 probably exists in SRS waters, but because of its short half-life (10 hours) and the short half-life of Ra-224 (3.6 days), a sample would need to be analyzed very quickly after being taken for it to be detected at a laboratory. It is rarely detected at SRS because most samples are analyzed a week or more after collection.

If Pb-212 were due to SRS processes, it would need to have decayed from Th-232, which had a very limited use at SRS. Th-232 concentrations in EA 7 sediment/soils are consistent with natural levels. Therefore, the Pb-212 detections in EA 7 surface waters are regarded as natural.

Pb-212 is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines-of-evidence:

- It is a daughter of naturally-occurring radioisotopes in the environment.
- It was not used in any SRS process.
- It is considered naturally-occurring in SRS surface waters.
- It has a very short half-life.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 7 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Fe	X	X	X		X		
Mn	X	X	X				
Bi-214		X	X		X		
Pb-212	X	X	X	X	X		

B.2.4.7.3 Fish Media

No fish samples were collected within EA 7. However, results for samples collected within other EAs (i.e., 3, 6, 8, and 9) are used as a proxy for EA 7. Considering the results of the risk assessments performed for EAs 3, 6, 8, and 9 and the associated uncertainties, Cs-137(+D) and mercury are considered fish HH RCOCs.

B.2.4.7.4 HHRA Conclusion for EA 7

Sediment/soil media

- Resident scenario: Cws-137(+D) (risk = 2.3E-03) and Co-60 (risk = 2.4E-05) are identified as RCOCs with a TCR = 2.3E-03. Decay-adjusted Cs-137(+D) risk = 1.3E-03 and decay-adjusted Co-60 risk = 2.6E-06 with a decay-adjusted TCR = 1.3E-03.
- Industrial Worker scenario: Cs-137(+D) (risk = 1.5E-03) and Co-60 (risk = 1.7E-05) are identified as RCOCs with a TCR = 1.5E-03. Decay-adjusted Cs-137(+D) risk = 8.9E-04 and decay-adjusted Co-60 risk = 1.8E-06, with a decay adjusted TCR = 8.9E-04.
- Onsite Worker scenario: Cs-137(+D) (risk = 7.7E-04) and Co-60 (risk = 9.6E-06) are identified as RCOCs with a TCR = 7.8E-04. Decay-adjusted Cs-137(+D) risk = 4.5E-04 and decay-adjusted Co-60 risk = 1.0E-06, with a decay adjusted TCR = 4.5E-04.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.8 Exposure Area 8

B.2.4.8.1 Sediment/Soil Media

Table B-38 presents the results of the sediment/soil screening for EA 8. Human health COPCs for sediment/soil include aluminum, arsenic, chromium, cobalt, cyanide, iron, lead, manganese, mercury, vanadium, Cs-137(+D), Co-60, K-40, Th-232(+D), and U-238(+D), as these constituents had maximum detected concentrations or activity concentrations that exceeded human (residential) risk-based screening levels and exceeded two times mean IOU background concentrations.

Table B-39 presents the total HI (1.4) and the total media risk (2.2E-03) for the resident exposure scenario and the associated COCs arsenic, chromium, Cs-137(+D), Co-60, K-40, Th-232(+D), and U-238(+D).

Table B-40 presents the total HI (0.14) and the total media risk (1.3E-03) for the industrial worker exposure scenario and the associated COCs chromium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-41 presents the total HI (0.1) and the total media risk (6.4E-04) for the onsite worker exposure scenario and the associated COCs chromium, Cs-137(+D), K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Arsenic is identified as a COC for the resident only (risk = 4.2E-06); risk for the industrial worker and onsite worker scenarios is <1E-06. It was detected in 16/18 samples, with 11 results being estimated (i.e., "J" qualified). Concentrations range from ND to 7.85 mg/kg. Sample location LTR ERDMS IOULTR2 Sampling Event LTROU-06 (see Figure 3-8 in Chapter 3), collected on November 4, 2003, had the highest concentration. The EPC used in the risk calculation is 2.89 mg/kg.

Arsenic is a naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 6.7 mg/kg, the maximum concentration in the SRS Soil background dataset is 22.9 mg/kg, and the maximum concentration in the Wetland Study is 3.7 mg/kg. Sediment/soil concentrations from the EA are within the range of concentrations found in background soil at SRS.

Arsenic is widely distributed in the earth's crust being present in soil and minerals. It combines with oxygen, chlorine, and sulfur to form inorganic arsenic compounds, primarily present in wind-blown dust. Inorganic arsenic compounds are mainly used to preserve wood, with copper chromate arsenate being used to make pressure treated wood. Organic arsenic compounds are used as pesticides, primarily in cotton fields and in fruit orchards. However, no significant quantities of pressure-treated wood were used in buildings within the LTR IOU and no arsenic pesticides were used at SRS. Arsenic pesticides were commonly used to combat the boll weevil by local cotton farmers prior to the establishment of SRS.

Arsenic is not recommended for further remedial evaluation as HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

- Arsenic products were either not used or were of limited use at SRS.

Chromium is identified as a COC for the resident (risk = 1.6E-04), the industrial worker (risk = 7.8E-06), and the onsite worker (risk = 3.7E-06) scenarios. It was detected in 18/18 samples, with no results being estimated (i.e., "J" qualified). Concentrations range from 2.07 mg/kg to 145 mg/kg. Sample location LTROU-17 (see Figure 3-8 in Chapter 3), collected on November 17, 2001, had the highest detected concentration. The EPC used in the risk calculations is 49.0 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg, and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. One sample result out of 18 exceeds these background concentrations. Sediment/soil concentrations for all samples, but one, from this EA are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds, in the Cr+3 or Cr+6 forms, are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case at the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined and the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for

Cr+3 are 120,000 mg/kg for the residential exposure scenario and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations (mean and EPC) are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined and the analytical result was for total chromium.
- Risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Cs-137(+D) is identified as a COC for the resident (risk = 8.3E-04), the industrial worker (risk = 5.5E-04), and the onsite worker (risk = 2.8E-04) scenarios. It was detected in 59/71 samples, with 4 of these results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 125.6 pCi/g. Sample location Pond 5 P25-042-01 (see Figure 3-8 in Chapter 3), collected on March 27, 2000, had the highest activity concentration. The EPC used in the risk calculations is 50.31 pCi/g.

Cs-137 is a result of nuclear fission and does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 8 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC =

34.5 pCi/g. Using this adjusted value results in residential risk = 5.7E-04, industrial worker risk = 3.8E-04, and onsite worker risk = 1.9E-04.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product)
- It was detected in 59/71 samples, indicating widespread contamination
- Its risk >1E-06.

Co-60 is a COC for the resident (risk = 1.7E-06) and industrial worker (risk = 1.2E-06) scenarios and risk to the onsite worker is <1E-06. It was detected in 5/73, samples with 1 result being estimated (i.e., "J" qualified). Activity concentrations range from ND to 0.586 pCi/g. Sample Pond 4 P25-022-01 (see Figure 3-8 in Chapter 3), collected on March 2, 2000, had the highest activity concentration. The EPC used in the risk calculations is 0.0564 pCi/g.

Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors. There are no background results for Co-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Co-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.007 pCi/g. Using this adjusted value results in residential risk of 2.1E-07 and industrial worker risk of 1.5E-07.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for the resident and industrial worker receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Its risk >1E-06.

K-40 is a COC for the resident (risk = 6.3E-05), the industrial worker (risk = 4.1E-05), and the onsite worker (risk = 1.9E-05) scenarios. It was detected in 50/71 samples, with 15 results being estimated (i.e., "J" qualified). Concentrations range from ND to 22.7 pCi/g. Sample location Pond

5 P25-054-01 (see Figure 3-8 in Chapter 3), collected on March 27, 2000, had the highest detected concentration. The EPC used in the risk calculations is 9.05 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity mean and EPC concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit mean and EPC activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- K-40 is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 1.1E-03), the industrial worker (risk = 7.1E-04), and onsite worker (risk = 3.4E-04) scenarios. The Thorium Series [Th-232(+D)] evaluation includes not only the measured concentration of Th-232 specifically, but also considers any analytical results from its daughter products (e.g., Ra-228, Ac-228, Th-228, Ra-224, Pb-212, Bi-212 and Tl-208) because these isotopes are assumed to be in secular equilibrium for data screening. Data screening is performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. Th-232(+D) was conservatively assumed to be present at the activity concentration of Ra-224, a daughter product of Th-232. Ra-224 had the highest detected concentration (41.58 pCi/g) as well as the highest EPC (30.0 pCi/g). This is from sample location Pond 5 P25-042-01 collected on March 37, 2000.

The daughter products are not evaluated separately since they are considered in the Th-232(+D) PRG.

Ra-224 is a short-lived daughter of the thorium series decay chain. Secular equilibrium should not be assumed for sediment in contact with natural waters.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units and EA 8 concentrations are typical of natural thorium. The probable origin for the daughter product Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater and Ra-228, although not often analyzed for, is known to be elevated in some SRS monitoring wells. Sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- It is a naturally-occurring constituent of primordial origin that is common in SRS background soils.
- It is not a COC on the P Area and R Area waste units and the concentrations are typical of natural thorium.
- Conservative risk screening assumed the Th-232 concentration to be equal to the highest concentration of the daughter products (Ra-224). This is an overly conservative approach since secular equilibrium should not be assumed for sediment in contact with natural waters.
- The probable origin for Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater and sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides.

U-238(+D) is a COC for the resident only (risk = 1.2E-06); risk for the industrial worker and onsite worker are <1E-06. It was detected in 10/10 samples, with 4 results being estimated values ("J" qualified). Concentrations range from 0.341 pCi/g to 1.42 pCi/g. Sample location LTROU-17 (see Figure 3-8 in Chapter 3), collected on November 17, 2001, had the highest detected concentration. The EPC used in the risk calculation is 0.972 pCi/g.

Uranium is naturally-occurring constituent that is common in the environment. The maximum detected concentration in the IOU Background dataset is 2.51 pCi/g and the maximum detected concentration in the SRS Soil background data set is 1.9 pCi/g.

U-238 is naturally-occurring constituent of primordial origin with a half-life of 4.5 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

The uranium isotopes U-238, U-235, and U-233/234 were used in SRS reactor operations, but also occur naturally and are widespread in Coastal Plain soils and sediments. Isotopic concentration ratios (e.g., U-238/[U-233/234]) are very close to unity, which is expected for natural uranium and is not consistent with reactor uranium. Isotopic considerations conclusively demonstrate that EA 8 sediment/soil samples are natural uranium.

U-238(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil the resident receptor scenario based on the following lines of evidence:

- Unit activities are consistent with the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- Isotopic ratios demonstrate natural uranium (not reactor waste).

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 8 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
As		X	X				
Cr		X	X		X	X	
Cs-137(+D)*							
Co-60*							
K-40		X	X				
Th-232(+D)		X	X		X		X
U-238(+D)			X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.8.2 Surface Water Media

Table B-42 identifies manganese and various organic compounds (2,4-dinitrophenol, 2,4-dinitrotoluene, 2,4,6-trichlorophenol, 2,6-dinitrotoluene, 3-nitroaniline, 3,3-dichlorobenzidine, 4-chloraniline, 4-nitroaniline, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethyl]ether, bis[2-ethylhexlyphthalate], dibenz[a,h]anthracene, dioctylphthalate, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, indeno[1,2,3-cd]pyrene, n-nitrosodipropylamine, pentachlorophenol, naphthalene, nitrobenzene, and atrazine) as human health surface water COCs because the maximum detected concentrations of these constituents exceed their surface water comparison values.

During the analysis of the data for EA 8, it was determined that several organic constituents were reported as detects in the LTR IOU database. All of the compounds in question were reported as detected in 1 of 9 samples, with the same maximum concentration (i.e., 0.00962 µg/L). These results are from the same sample location, LTR ERDMS IOULTR2 Sampling Event LTROU-06, collected on November 4, 2003 and all results had the "not qualified" (i.e., "NQ") data quality label. However, all of these results should have been identified as non-detect (i.e., flagged "U") and, therefore, should not be carried forward into the surface water screening step. As a result, all of the results for these compounds are considered "false positives" and are not carried forward as RCOPCs.

The refinement/uncertainty evaluation is presented for each of these COCs.

Manganese is a COC based on an exceedance of the tapwater RSL (430 µg/L). It was detected 9/9 samples with none of the results being estimated (i.e., "J" qualified). Concentrations range from 11.7 µg/L to 460 µg/L. Sample location PDC016-002 (see Figure 3-8 in Chapter 3), collected on April 29, 2010, had the highest detected concentration. The average concentration (153 µg/L) is less than the tapwater RSL (430 µg/L).

Manganese is a naturally-occurring constituent that is common in the environment. In IOU Background surface water, it was detected in 385/401 sample results, with a maximum detected concentration of 2,690 µg/L. Surface water results from EA 8 are less than background surface water concentrations.

Manganese is not associated with any reactor processes at SRS.

Manganese is not recommended for further remedial evaluation as a HH RCOC in surface water based on the following lines-of-evidence:

- Unit concentrations are less than the background surface water concentration.
- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is indistinguishable from background.
- It is not associated with any reactor processes at SRS
- The mean concentration is less than the tapwater RSL.

The organic compounds 2,4-dinitrophenol, 2,4-dinitrotoluene, 2,4,6-trichlorophenol, 2,6-dinitrotoluene, 3-nitroaniline, 3,3-dichlorobenzidine, 4-chloraniline, 4-nitroaniline, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethyl]ether, bis[2-ethylhexlyphthalate], dibenz[a,h]anthracene, dioctylphthalate, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, indeno[1,2,3-cd]pyrene, n-nitrosodipropylamine, pentachlorophenol, naphthalene, nitrobenzene, and atrazine are COCs based on exceedances of their respective tapwater MCL, RSL, or AWQC. All of the compounds were detected in 1 of 9 samples, with the same maximum concentration (i.e., 0.00962 µg/L). These results are all from the same sample location, LTR ERDMS IOULTR2 Sampling Event LTROU-06, collected on November 4, 2003, and all had the "not qualified" (i.e., "NQ") data

quality label. However, all these results should have been identified as non-detect (i.e., flagged "ND") and, therefore, should not carried into the surface water screening step. As a result, none of the above organic compounds are recommended for further remedial evaluation as HH RCOCs.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the table below:

EA 8 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Mn	X	X	X				
Organic Compounds[#]		X		X			

Organic compounds include: 2,4-dinitrophenol, 2,4-dinitrotoluene, 2,4,6-trichlorophenol, 2,6-dinitrotoluene, 3-nitroaniline, 3,3-dichlorobenzidine, 4-chloraniline, 4-nitroaniline, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethyl]ether, bis[2-ethylhexlyphthalate], dibenz[a,h]anthracene, dioctylphthalate, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, indeno[1,2,3-cd]pyrene, n-nitrosodipropylamine, pentachlorophenol, naphthalene, nitrobenzene, and atrazine.

B.2.4.8.3 Fish Media

Table B-43 identifies chromium, mercury, Cs-137(+D), and K-40 as fish tissue COCs as these constituents exceed their respective RSLs or PRGs. The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is a COC based on an exceedance of the fish RSL (0 .00832 mg/kg). It was detected in 1/1 fish samples, with this result being estimated (i.e., "J" qualified). The maximum concentration for sample LTR-P45, collected on June 10, 2010, is 0.295 mg/kg. The maximum detected concentration is below the IOU maximum background concentration for fish at 0.47 mg/kg.

The hexavalent chromium RSL was used to perform the data screening. This overly conservative approach tends to bias the comparison high. The RSL for the chromium +3 is 2,320 mg/kg. Therefore, if chromium is actually present in the +3 valence state, chromium would not be identified as a COC for fish media.

Chromium is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- Fish concentration is below the background fish concentration.

- It is a naturally-occurring constituent that is an essential nutrient.
- It does not appear to be unit related since it is indistinguishable from background in fish.
- The valence state of chromium was not determined and analytical result was for total chromium.

Mercury is a COC based on an exceedance of the fish RSL (0.154 mg/kg). It was detected in 1/1 fish samples at a concentration of 0.854 mg/kg, which is "J" qualified (i.e. estimated). Sample LTR-P45, collected on June 10, 2010, had the detected fish concentration. This concentration exceeds the RSL.

Mercury is a naturally-occurring constituent in rocks and soil that is common in the environment and enters the environment from natural deposits and disposal of wastes within water bodies. It can be taken up by animals (i.e., fish) and plants. Mercury combines with chlorine, sulfur or oxygen to form inorganic mercury compounds or "salts." Mercury also combines with carbon to make organic mercury compounds (i.e., methylmercury). The maximum concentration in the IOU Fish Background dataset is 0.24 mg/kg.

Inorganic mercury compounds are much less toxic than methylmercury which is considered more bioavailable and thus has a higher toxicity. Methylmercury may be formed in water and soil by bacteria, which leads to increased concentrations in fish tissues. Mercury compounds were not used in the PAOU or RAOU and are not part of the reactor operation. However, copious amounts of river water from the Savannah River were used in both reactors as cooling water. High concentrations of mercury in Savannah River samples have been observed, which indicates other sources may have released mercury into the river. Given the differences in mercury compounds, the USEPA generally recommends that both total mercury and methyl mercury data be collected when mercury is likely to be an important contaminant at the site. However, only total mercury was collected in the LTR IOU.

To be conservative, the fish screening is performed for methylmercury rather than for mercury salts. Based on unit history and the environmental conditions (likely presence of mercury in the source for reactor cooling water and the presence of methylating bacteria in the IOU water bodies), it is likely the methylated form of mercury is present LTR IOU.

Mercury is recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- Fish concentrations exceed the background fish maximum concentration.
- The maximum detected concentration exceeds the fish RSL.
- It was detected in 1/1 samples, indicating contamination that is consistent with conclusion of other EAs for fish tissue.

Cs-137(+D) is a COC based on an exceedance of the fish PRG (0.054 pCi/g). It was detected in 1/1 fish samples, with a maximum activity concentration of 7.84 pCi/g. Sample LTR-P45, collected June 10, 2010, had the highest activity concentration.

Cs-137 is a result of nuclear fission and it does not occur naturally in the environment. However, Cs-137 is common in SRS background soils, surface water, and fish media. The maximum detected concentration in the background fish media dataset is 0.49 pCi/g, with a mean of 0.13 pCi/g.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- The maximum detected concentration exceeds the fish PRG.
- It was detected in 1/1 samples, indicating contamination consistent with the conclusion of other EAs for fish tissue.

K-40 is a COC based on an exceedance of the fish PRG (0.0595 pCi/g). It was detected in 1/1 samples. Sample LTR-P45, collected on June 10, 2010, a maximum activity concentration of 2.5 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The background fish media activity concentration ranges from 1.24 pCi/g to 3.8 pCi/g. The maximum activity concentration for EA 8 fish (2.5 pCi/g) is less than the background fish media maximum activity concentration.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products). Potassium is an essential nutrient therefore some amount of normally present potassium in biological tissue is likely K-40.

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Fish activity is within the SRS background fish media activity range.
- It is a natural component occurring in biological tissues.
- It does not appear to be unit related since it is indistinguishable from background.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 8 – Fish Tissue	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr			X	X	X	X	
Hg*							
Cs-137(+D)*							
K-40		X	X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.8.4 HHRA Conclusion for EA 8

Sediment/soil media

- Resident scenario: Cs-137(+D) (risk = 8.3E-04) and Co-60 (risk = 1.7E-06) are identified as RCOCs with a TCR = 8.3E-04. Decay-adjusted Cs-137(+D) risk = 5.7E-04 and decay-adjusted risk for Co-60 = 2.1E-08 with a decay-adjusted TCR = 5.7E-04.

- Industrial Worker scenario: Cs-137(+D) (risk = 5.5E-04) and Co-60 (risk = 1.2E-06) are identified as RCOCs with a TCR = 5.5E-04. Decay-adjusted cesium-137(+D) risk = 3.8E-04 and decay-adjusted Co-60 risk = 1.5E-07 with a decay adjusted TCR = 3.8E-04.
- Onsite Worker scenario: Cs-137(+D) (risk = 2.8E-04) is identified as a RCOC; decay-adjusted Cs-137(+D) risk = 1.9E-04.
- Surface water media: No surface water RCOCs.
- Fish media: Cesium-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.4.9 Exposure Area 9

B.2.4.9.1 Sediment/Soil Media

Table B-44 presents the results of the sediment/soil screening for EA 9. Human health COPCs for sediment/soil include aluminum, chromium, cobalt, iron, manganese, thallium, vanadium, Cs-137(+D), Co-60, K-40, and Th-232(+D). These constituents had maximum detected concentrations or activity concentrations that exceeded human health (residential), risk-based screening levels and exceeded two times mean IOU background concentrations.

Table B-45 presents the total HI (4.0) and the total media risk (5.1E-04) for the resident exposure scenario and the associated COCs chromium, thallium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-46 presents the total HI (0.26) and the total media risk (3.0E-04) for the industrial worker exposure scenario and the associated COCs chromium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

Table B-47 presents the total HI (0.16) and the total media risk (1.5E-04) for the onsite worker exposure scenario and the associated COCs chromium, Cs-137(+D), Co-60, K-40, and Th-232(+D).

The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is identified as a COC for the resident (risk = 5.5E-05), the industrial worker (risk = 2.6E-06), and the onsite worker (risk = 1.3E-06) scenarios. It was detected in 15/15 samples, with 1 result being estimated (i.e., "J" qualified). Concentrations range from 1.68 mg/kg to 32.7 mg/kg. Sample location Pond C: PPSC-SED11 (see Figure 3-9 in Chapter 3), collected on July 14, 1995, had the highest detected concentration. The EPC used in the risk calculations is 16.5 mg/kg.

Chromium is a naturally-occurring constituent that is common in the environment. The maximum concentration in the IOU Background dataset is 44.5 mg/kg, the maximum concentration in the SRS Soil background dataset is 53.3 mg/kg and the maximum concentration in the Wetland Study dataset is 58.1 mg/kg. Sediment/soil concentrations are within the range of concentrations found in background soil.

Chromium occurs in the environment primarily in two valence states, trivalent chromium (Cr+3), and hexavalent chromium (Cr+6). Exposure may occur from natural or industrial sources of chromium. Trivalent chromium is much less toxic than hexavalent chromium; the trivalent form is considered noncancerous, whereas the hexavalent form is considered a carcinogen. Chromium compounds, in the Cr+3 or Cr+6 forms, are used for chrome plating, the manufacture of dyes and pigments, and leather and wood preservation. Chromate (CrO_4^{2-}), which is an oxyanion of chromium in the oxidation state of +6, was never used in reactor coolant water as an anti-fouling agent at SRS. The USEPA recommends that valence-specific state data for chromium be collected when chromium is likely to be an important contaminant at the site. Since this is not the case at for the LTR IOU (i.e., chromium is not a significant contaminant or risk driver), the valence state of chromium was not determined, the chemical analysis was for total chromium.

The risk estimate used the hexavalent chromium RSL (residential RSL = 0.30 mg/kg, industrial worker RSL = 6.3 mg/kg, and onsite worker RSL = 13.2 mg/kg) to perform the data screening. This overly conservative approach tends to bias the calculation high. Based on unit history and the environmental conditions (reducing environment associated with hydric soils and sediments), it is likely the trivalent form of chromium is most prevalent at the LTR IOU. In addition, the RSLs for Cr+3 are 120,000 mg/kg for the residential exposure scenario and 1,800,000 mg/kg for the industrial worker exposure scenario.

Chromium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- The valence state of chromium was not determined and analytical result was for total chromium.
- Risk estimate is biased high because the most conservative RSL (Cr+6) was used, but this form is not expected to be present based on unit history and environmental conditions.
- Unit concentrations are much less than the trivalent chromium RSLs (i.e., no risk/hazard).

Thallium is identified as a COC of the resident only (HQ = 3.4), risk for both the industrial worker and onsite worker scenarios are less than HQ = 1. It was detected in 2/15 samples, with both results estimated (i.e., "J" qualified). Concentrations range from ND to 4.59 mg/kg. Sample location Pond C SED12, Pond C SED28 (see Figure 3-9 in Chapter 3), collected on July 14, 1995, had the highest detected concentration. The EPC used in the risk calculation is 2.63 mg/kg.

Thallium is a naturally-occurring constituent that is widely distributed in trace amounts in the earth's crust. The maximum concentration in the IOU Background dataset is 11.2 mg/kg, the maximum concentration in the SRS Soil background dataset is 8.13 mg/kg, and maximum detected concentration in the Wetland Study is 2.1 mg/kg

Sediment/soil concentrations from this EA are within the range of concentrations found in background soil.

Thallium can be found in pure form or mixed with other metals in the form of alloys. It can also be found combined with other substances such as bromine, chlorine, fluorine, and iodine to form salts. Thallium remains in the environment since it is a metal and cannot be broken down to simpler substances.

Thallium is used mostly in the manufacture of electronic devices, switches, and closures. It also has limited use in the manufacture of special glasses and for medical procedures that evaluate heart disease. Up until 1972 thallium was used as a rat poison. However, it has banned because of its potential harm to human health. Thallium is no longer produced in the United States.

Thallium is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for the resident receptor scenario based on the following lines of evidence:

- Unit concentrations are within the background soil concentration range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It was not used at SRS.

Cs-137(+D) is identified as a COC for the resident (risk = 3.4E-04), the industrial worker (risk = 2.3E-04), and the onsite worker (risk = 1.2E-04) scenarios. It was detected in 51/54 samples, with 4 of these results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 116.5 pCi/g. Sample location Pond C Site No. 3 Elevation 195 ft (see Figure 3-9 in Chapter 3), collected on July 30, 1991, had the highest activity concentration. The EPC used in the risk calculations is 20.9 pCi/g.

Cs-137 is a result of nuclear fission- it does not occur naturally in soil. However, Cs-137 is common in SRS background soils as a result of fallout from nuclear weapons testing. The maximum detected concentration in the IOU background dataset is 0.623 pCi/g, with a mean of 0.09 pCi/g. Maximum concentration in SRS soils (WSRC 2006, Appendix B-1) is 3.3 pCi/g and the mean concentration is 0.142 pCi/g. Sediment/soil concentrations from EA 9 are greater than SRS background concentrations.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Cs-137 half-life of 30.2 years. The Cs-137 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 11.98 pCi/g. Using this adjusted value results in residential risk = 2.0E-04, industrial worker risk = 1.3E-04, and onsite worker risk = 6.7E-05.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- It was detected in 51/54 samples, indicating widespread contamination.
- Its risk >1E-06.

Co-60 is identified as a COC for the resident (risk = 3.5E-06), the industrial worker (risk = 2.4E-06), and the onsite worker (risk = 1.4E-06) scenarios. It was detected in 4/24 samples, with none of these results being estimated (i.e., "J" qualified). Activity concentrations range from ND to 0.448 pCi/g. Sample location Pond C SED12, Pond C SED 28 (see Figure 3-9 in Chapter 3), collected on July 14, 1995, had the highest activity concentration. The EPC used in the risk calculations is 0.114 pCi/g.

Co-60 is a synthetic radioactive isotope of cobalt with a half-life of 5.3 years. It is produced artificially in nuclear reactors. There are no background results for Co-60.

The risk estimate does not take into account radioactive decay. An additional risk calculation is presented in this refinement step that considers the Co-60 half-life of 5.3 years. The Co-60 dataset was decay-corrected to January 1, 2017, as appropriate. The decay-corrected EPC = 0.008 pCi/g. Using this adjusted value results in resident risk = 2.4E-07, industrial worker risk = 1.7E-07, and onsite worker risk = 9.6E-08.

Co-60 is recommended for further remedial evaluation as a HH RCOC in sediment/soil for all three receptor scenarios based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Its risk >1E-06.

K-40 is a COC for the resident (risk = 1.3E-05), the industrial worker (risk = 8.3E-06), and the onsite worker (risk = 4.0E-06) scenarios. It was detected in 16/21samples, with 7 results being estimated (i.e., "J" qualified). Concentrations range from ND to 3.22 pCi/g. Sample location Pond C SED12, Pond C SED28 (see Figure 3-9 in Chapter 3), collected on July 14, 1995, had the highest detected concentration. The EPC used in the risk calculations is 1.83 pCi/g.

K-40 is a naturally-occurring constituent that is common in the environment. The IOU background maximum activity concentration is 13 pCi/g and the SRS background maximum activity concentration is 8.53 pCi/g. Unit activity concentrations are within the background soil range.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

K-40 is not associated with any of the reactor processes. K-40 is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- K-40 is not associated with any of the reactor processes.

Th-232(+D) is a COC for the resident (risk = 9.3E-05), the industrial worker (risk = 5.9E-05), and onsite worker (risk = 2.8E-05) scenarios. The Thorium Series (Th-232[+D]) evaluation includes the measured concentration of Th-232 specifically, and also considers any analytical results from its daughter products (e.g., Ra-228, Ac-228, Th-228, Ra-224, Pb-212, Bi-212 and Tl-208) because these isotopes are assumed to be in secular equilibrium. Data screening is performed using the highest detected concentration in the entire series and the risk calculation is performed using the highest EPC of the entire series. For this dataset, the Pb-212 had the highest detected concentration (2.59 pCi/g) and Th-232 had the highest EPC (2.48 pCi/g). This is from sample location PCT3-2 (see Figure 3-9 in Chapter 3) collected on March 22, 2010. The daughter products are not evaluated separately because they are considered in the Th-232(+D) PRG.

Background comparisons for the Th-232 series includes consideration of the range of concentrations for the entire decay chain (i.e., includes daughter products). The IOU Background maximum activity concentration of the constituents in the Th-232 decay chain is 6.15 pCi/g (based

on the Ra-224 result) and the SRS Soil background maximum detected activity concentration is 6.75 pCi/g (based on the Ra-224 result). Note that the Ra-228 result of 14.64 pCi/g from the IOU Background dataset was not used based on professional judgment. Sediment/soil concentrations from EA 9 are within the range of activity concentrations found in background soil.

Th-232 is a naturally-occurring constituent of primordial origin with a half-life of 14 billion years. Primordial nuclides are those that are long lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and Th-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in the P Area and R Area waste units and EA 9 concentrations are typical of natural thorium.

Th-232(+D) is not recommended for further remedial evaluation as a HH RCOC in sediment/soil for any of the receptor scenarios based on the following lines of evidence:

- Unit activities are within the SRS soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented below:

EA 9 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr		X	X		X	X	
Tl	X	X	X	X			
Cs-137(+D)*							
Co-60*							
K-40		X	X				
Th-232(+D)		X	X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.9.2 Surface Water Media

Table B-48 presents the results of the surface water comparison to screening limits for EA 9. No surface water analytes analyzed from samples from EA 9 exceeded their respective comparison values. Therefore, there are no surface water RCOCs

B.2.4.9.3 Fish Media

Table B-49 identifies chromium, mercury, Cs-137(+D), and K-40 as human health COCs for fish media, as maximum detected concentrations exceed their respective RSLs or PRGs.

The refinement/uncertainty evaluation is presented for each of these COCs.

Chromium is a COC based on an exceedance of the fish RSL (0 .00832 mg/kg). It was detected in 2/2 fish samples, with both of these results being estimated (i.e., "J" qualified). The maximum concentration is 0.266 mg/kg, which was from sample LTR-PC collected on June 7, 2010. The maximum detected concentration is below the IOU maximum background concentration for fish at 0.47 mg/kg.

The hexavalent chromium RSL was used to perform the data screening. This overly conservative approach tends to bias the comparison high. The RSL for the chromium +3 is 2,320 mg/kg. Therefore, if chromium is actually present in the +3 valence state, chromium would not be identified as a COC for fish media.

Chromium is not recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- Fish concentration is below the background fish concentration.
- It is a naturally-occurring constituent that is an essential nutrient.
- It does not appear to be unit related since it is indistinguishable from background in fish.
- The valence state of chromium was not determined- analytical result was for total chromium.

Mercury is a COC based on an exceedance of the fish RSL (0.154 mg/kg). It was detected in 2/2 fish samples, with 1 result being estimated (i.e., "J" qualified). Concentrations range from 0.0206 mg/kg to 0.854 mg/kg. Sample LTR-PC, collected on April 14, 2010, had the maximum

detected fish concentration. While the mean concentration (0.132 mg/kg) does not exceed the RSL, the maximum detection (0.244 mg/kg) does exceed the RSL.

Mercury is a naturally-occurring constituent in rocks and soil that is common in the environment and enters the environment from natural deposits and disposal of wastes within water bodies. It can be taken up by animals (i.e., fish) and plants. Mercury combines with chlorine, sulfur or oxygen to form inorganic mercury compounds or "salts." Mercury also combines with carbon to make organic mercury compounds (i.e., methylmercury). The maximum concentration in the IOU Fish Background dataset is 0.24 mg/kg.

Inorganic mercury compounds are much less toxic than methylmercury which is considered more bioavailable and thus has a higher toxicity. Methylmercury may be formed in water and soil by bacteria which leads to increased concentrations in tissues of fish. Mercury compounds were not used in the PAOU or RAOU and they are not part of the reactor operation. However, copious amounts of river water from the Savannah River were used in both reactors as cooling water. High concentrations of mercury in Savannah River samples have been observed indicating other sources that may have release mercury into the river. Given the differences in mercury compounds, the USEPA generally recommends that both total mercury and methyl mercury data be collected when mercury is likely to be an important contaminant at the site. However, only total mercury was collected in the LTR IOU.

To be conservative, the fish screening is performed for methylmercury rather than for mercury salts. Based on unit history and the environmental conditions (likely presence of mercury in the source for reactor cooling water and the presence of methylating bacteria in the IOU water bodies), it is likely the methylated form of mercury is present LTR IOU.

Mercury is recommended for further remedial evaluation as a HH RCOC in fish tissue for the recreational fisherman scenario based on the following lines of evidence:

- The maximum detected concentration exceeds the fish RSL.
- It was detected in 2/2 samples, which indicates contamination consistent with the conclusion of other EAs for fish tissue.

Cs-137(+D) is a COC based on an exceedance of the fish PRG (0.054 pCi/g). It was detected in 2/2 fish samples, with no result being estimated (i.e., "J" qualified). Concentrations range from 1.18 pCi/g to 42.5 mg/kg pCi/g. Sample LTR-PC, collected on April 14, 2010, had the highest activity concentration.

Cs-137 is a result of nuclear fission and it does not occur naturally in in the environment. However, Cs-137 is common in SRS background soils, surface water, as well as in fish media. The maximum detected concentration in the background fish media dataset is 0.49 pCi/g with a mean of 0.13 pCi/g.

Cs-137(+D) is recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Its presence is consistent with historical use (i.e., reactor product).
- Both the minimum-detected activity concentration and the maximum-detected activity concentration exceed the fish PRG.
- It was detected in both fish samples collected in EA 9, indicating contamination consistent with conclusions of other EAs.

K-40 is a COC based on an exceedance of the fish PRG (0.0595 pCi/g). It was detected in 2/2 samples, with neither result being estimated (i.e., "J" qualified). Activity concentrations range from 2.23 pCi/g to 3.11 pCi/G. Sample LTR-PC, collected on April 14, 2010, had this activity concentration.

K-40 is a naturally-occurring constituent that is common in the environment. The background fish media activity concentration ranges from 1.24 pCi/g to 3.8 pCi/g. The maximum activity concentration for EA 9 fish (3.11 pCi/g) is less than the background fish media maximum activity concentration.

K-40 is a naturally-occurring constituent of primordial origin with a half-life of 1.2 billion years. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are K-40, U-238 and

Th-232 (and their daughter products). Potassium is an essential nutrient therefore some amount of normally present potassium in biological tissue is likely K-40.

K-40 is not associated with any of the reactor processes.

K-40 is not recommended for further remedial evaluation as a HH RCOC in fish for the recreational fisherman receptor scenario based on the following lines of evidence:

- Fish activity is within the SRS background fish media activity range.
- It is a natural component occurring in biological tissues.
- It does not appear to be unit related since it is indistinguishable from background.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section B.2.4, is presented in the following table:

EA 9 – Fish Tissue	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Cr			X	X	X	X	
Hg*							
Cs-137(+D)*							
K-40		X	X		X		

* Identified as a RCOC for further remedial evaluation.

B.2.4.9.4 HHRA Conclusion for EA 9

Sediment/soil media

- Resident scenario: Cs-137(+D) (risk = 3.4E-04) and Co-60 (risk = 3.5E-06) are identified as RCOCs with a TCR = 3.5E-04. Decay-adjusted Cs-137(+D) risk = 2.0E-04 and decay-adjusted Co-60 risk = 2.4E-07 with a decay-adjusted TCR = 2.0E-04.
- Industrial Worker scenario: Cs-137(+D) (risk = 2.3E-04) and Co-60 (risk = 2.4E-06) are identified as RCOCs with a TCR = 2.3E-04. Decay-adjusted Cs-137(+D) risk = 1.3E-04 and decay-adjusted Co-60 risk = 1.7E-07 with a decay adjusted TCR = 1.3E-04.

- Onsite Worker scenario: Cs-137(+D) (risk = 1.2E-04) and Co-60 (risk = 1.4E-06) are identified as RCOCs with a TCR = 1.2E-04. Decay-adjusted Cs-137(+D) risk = 6.7E-05 and decay adjusted Co-60 risk = 9.6E-08 with a decay adjusted TCR = 6.7E-05.
- Surface water media: No surface water RCOCs.
- Fish media: Cs-137 and mercury identified as RCOCs in fish tissue for the recreational fisherman scenario.

B.2.5 Summary/Conclusion of the HHRA

The table presented below shows the overall summary of the HHRA by EA. The revised CSM is presented in Chapter 3.

Summary of the LTR IOU Human Health Risk Assessment

Upper Exposure Area	HH Residential RCOCs	HH Industrial Worker RCOCs	HH Onsite Worker RCOCs	HH Recreational Fisherman RCOCs
1. Pond A, including R Discharge Canal	Sediment/Soil (0-1 ft) Cs-137(+D) = 2.4E-03 (Decayed = 1.9E-03) Co-60 = 4.4E-06 (Decayed = 9.7E-07) TCR = 2.4E-03 (Decayed = 1.9E-03) Surface Water None	Sediment/Soil (0-1 ft) Cs-137(+D) = 1.6E-03 (Decayed = 1.3E-03) Co-60 = 3.0E-06 (Decayed = 6.7E-07) TCR = 1.6E-03 (Decayed = 1.3E-03)	Sediment /Soil (0-1 ft) Cs-137(+D) = 8.2E-04 (Decayed = 6.4E-04) Co-60 = 1.7E-06 (Decayed = 3.8E-07) TCR = 8.2E-04 (Decayed = 6.4E-04)	Fish Tissue Not sampled: assume Cs-137 and Hg (from EAs 3,6,8,9)
2. Canal from Pond A to Pond B	Sediment /Soil (0-1 ft) Cs-137(+D) = 8.1E-04 (Decayed = 6.9E-04) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 5.4E-04 (Decayed = 4.6E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.7E-04 Decayed = 2.3E-04	Fish Tissue Not sampled: assume Cs-137 and Hg (from EAs 3,6,8,9)
3. Pond B	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.6E-03 (Decayed = 9.8E-04) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.1E-03 (Decayed = 6.5E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 5.5E-04 (Decayed = 3.3E-04)	Fish Tissue Cs-137(+D) Hg
4. Canal from Pond B to North Arm of PAR Pond	Sediment /Soil (0-1 ft) Cs-137(+D) = 3.0E-04 (Decayed = 2.6E-04) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.0E-04 (Decayed = 1.7E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.0E-04 (Decayed = 8.8E-05)	Fish Tissue Not sampled: assume Cs-137 and Hg (from EAs 3,6,8,9)
5. Joyce Branch (Old Discharge Canal)	Sediment /Soil (0-1 ft) Cs-137(+D) = 3.8E-03 (Decayed = 2.8E-03) Co-60 = 2.3E-05 (Decayed = 4.3E-06) TCR = 3.8E-03 (Decayed = 2.8E-03) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.5E-03 (Decayed = 1.8E-03) Co-60 = 1.6E-05 (Decayed = 3.0E-06) TCR = 2.5E-03) (Decayed = 1.9E-03)	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.3E-03 (Decayed = 9.4E-04) Co-60 = 9.1E-06 (Decayed = 1.7E-06) TCR = 1.3E-03 (Decayed = 9.4E-04)	Fish Tissue Not sampled: assume Cs-137 and Hg (from EAs 3,6,8,9)
6. PAR Pond	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.5E-04 (Decayed = 8.6E-05) Co-60 = 2.9E-06 (Decayed = 1.8E-07) TCR = 1.5E-04 (Decayed = 8.7E-05) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 9.7E-05 (Decayed = 5.8E-05) Co-60 = 2.0E-06 (Decayed = 1.3E-07) TCR = 9.9E-05 (Decayed = 5.8E-05	Sediment /Soil (0-1 ft) Cs-137(+D) = 4.9E-05 (Decayed = 2.9E-05) Co-60 = 1.2E-06 (Decayed = 7.2E-08) TCR = 5.0E-05 (Decayed = 2.9E-05)	Fish Tissue Cs-137(+D) Hg

Upper Exposure Area	HH Residential RCOCs	HH Industrial Worker RCOCs	HH Onsite Worker RCOCs	HH Recreational Fisherman RCOCs
7. Canal from P-Area to Ponds 4 and 5, including Pond 2	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.3E-03 (Decayed = 1.3E-03) Co-60 = 2.4E-05 (Decayed = 2.6E-06) TCR = 2.3E-03 (Decayed = 1.3E-03) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.5E-03 (Decayed = 8.9E-04) Co-60 = 1.7E-05 (Decayed = 1.8E-06) TCR = 1.5E-03 (Decayed = 8.9E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 7.7E-04 (Decayed = 4.5E-04) Co-60 = 9.6E-06 (Decayed = 1.0E-06)TCR = 7.8E-04 (Decayed = 4.5E-04)	Fish Tissue Not sampled: assume Cs-137 and Hg (from EAs 3,6,8,9)
8. Ponds 4 and 5, including Canal from Ponds 4 and 5 to Pond C	Sediment /Soil (0-1 ft) Cs-137(+D) = 8.3E-04 (Decayed = 5.7E-04 Co-60 = 1.7E-06 (Decayed = 2.1E-07 TCR = 8.3E-04 (Decayed = 5.7E-04 Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 5.5E-04 (Decayed = 3.8E-04) Co-60 = 1.2E-06 (Decayed = 1.5E-07) TCR = 5.5E-04 (Decayed = 3.8E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.8E-04 (Decayed = 1.9E-04)	Fish Tissue Cs-137(+D) Hg
9. Pond C	Sediment /Soil (0-1 ft) Cs-137(+D) = 3.4E-04 (Decayed = 2.0E-04) Co-60 = 3.5E-06 (Decayed = 2.4E-07) TCR = 3.5E-04 (Decayed = 2.0E-04) Surface Water None	Sediment /Soil (0-1 ft) Cs-137(+D) = 2.3E-04 (Decayed = 1.3E-04) Co-60 = 2.4E-06 (Decayed = 1.7E-07) TCR = 2.3E-04 (Decayed = 1.3E-04)	Sediment /Soil (0-1 ft) Cs-137(+D) = 1.2E-04 (Decayed = 6.7E-05) Co-60 = 1.4E-06 (Decayed = 9.6E-08) TCR = 1.2E-04 (Decayed = 6.7E-05)	Fish Tissue Cs-137(+D) Hg

HH = human health
RCOC = refinement of constituents of concern
TCR = total cumulative risk

B.2.6 Additional Uncertainty

In December 2016, a revision to the approach for calculating PRGs was announced on the USEPA PRG website. The primary change was that the plus daughters (+D) option had been removed from the selection list and secular equilibrium (SE) PRGs are now the preferred (default) option. Later in December 2016, USEPA acknowledged that an unexpected error had occurred in the SE PRG calculations. In January 2017, another update was announced due to new risk and dose coefficients for a handful of constituents.

The PRG website currently indicates that the default tables do not reflect current changes and will be replaced soon. The calculator function appears to be working, but the new approach for calculating SE PRGs seems to be a work in progress that still needs to be verified by USEPA before project implementation.

Using the calculator function, the revised Cs-137 SE PRG is 0.144 pCi/g (current = 0.18 pCi/g) and the revised Co-60 SE PRG is 0.0295 pCi/g (current = 0.0832 pCi/g) for the onsite worker. These activities correspond to a 1E-06 risk. The revised approach will be re-evaluated in the FS phase of the project upon finalization of the SE PRG methodology.

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Table B-1. Human Health COPC Screening for Exposure Area 1 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	9.02E+03	7.70E+03	0.1xRSL	YES	9.79E+03	no	no
Antimony	5.56E-01	3.10E+00	0.1xRSL	no	4.74E+00	no	no
Arsenic	2.34E+00	6.80E-01	RSL	YES	3.50E+00	no	no
Barium	5.09E+01	1.50E+03	0.1xRSL	no	5.47E+01	no	no
Beryllium	3.72E-01	1.60E+01	0.1xRSL	no	7.73E-01	no	no
Cadmium	6.16E-02	7.10E+00	0.1xRSL	no	3.69E-01	no	no
Calcium	4.46E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	1.50E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	1.99E+00	2.30E+00	0.1xRSL	no	2.63E+00	no	no
Copper	6.69E+00	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Cyanide	2.23E-01	2.30E+00	0.1xRSL	no	NA[8]	---	no
Iron	1.33E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	8.54E+00	4.00E+01	0.1xRSL	no	1.10E+01	no	no
Magnesium	4.67E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	1.77E+02	1.80E+02	0.1xRSL	no	1.36E+02	YES	no
Mercury[9]	3.58E-02	7.80E-01	0.1xRSL	no	9.92E-02	no	no
Nickel	2.92E+00	1.50E+02	0.1xRSL	no	4.48E+00	no	no
Potassium	2.18E+02	EN[6]	Nutrient	no	2.39E+02	no	no
Selenium	1.89E+00	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Sodium	2.19E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Vanadium	6.14E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	2.68E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics *(mg/kg)*							
Acetone	4.00E-01	6.10E+03	0.1xRSL	no	---	---	no
Bis[2-ethylhexyl]phthalate	3.57E+00	3.90E+01	RSL	no	---	---	no
Ethylbenzene	6.47E-04	5.80E+00	RSL	no	---	---	no
Isopropylbenzene	2.59E-03	1.95E+03	0.1xRSL	no	---	---	no
Methyl acetate	3.91E-03	7.80E+03	0.1xRSL	no	---	---	no
Methyl ethyl ketone	2.42E-02	2.70E+03	0.1xRSL	no	---	---	no
Toluene	1.24E-02	4.90E+02	0.1xRSL	no	---	---	no
Pesticides/PCBs *(mg/kg)*							
DDD	6.32E-04	2.30E+00	RSL	no	---	---	no
DDE	3.80E-03	2.00E+00	RSL	no	---	---	no
DDT	2.50E-03	1.90E+00	RSL	no	---	---	no
PCB-1260	3.50E-03	2.40E-01	RSL	no	---	---	no
Radionuclides *(pCi/g)*							
Americium-241	1.84E+00	2.27E+00	PRG	no	3.55E-02	YES	no
Americium-243(+D)	2.77E-01	1.67E-01	PRG	YES	NA[8]	---	YES
Californium-244	1.74E-01	5.85E+08	PRG	no	NA[8]	---	no
Carbon-14	2.69E+00	3.16E+02	PRG	no	NA[8]	---	no
Cesium-137(+D)	6.86E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-60	6.48E-01	3.29E-02	PRG	YES	NA[8]	---	YES
Curium-244	4.46E-02	8.77E+00	PRG	no	NA[8]	---	no
Curium-245/Curium-246	2.69E-01	3.88E-01	PRG	no	NA[8]	---	no
Plutonium-238	4.86E-01	4.27E+00	PRG	no	2.83E-02	YES	no
Plutonium-239(+D)	2.16E+00	3.79E+00	PRG	no	NA[8]	YES	no
Plutonium-239(+D)/ Plutonium-240	1.18E+00	3.79E+00	PRG	no	5.13E-02	YES	no
Potassium-40	4.15E+00	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	3.71E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	3.71E+00	NA[11]	---	---	---	---	---
Bismuth-214	3.41E+00	NA[11]	---	---	---	---	---
Strontium-89/Strontium-90(+D)	1.54E+00	1.34E+01	PRG	no	NA[8]	---	no
Thorium-230	1.60E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	3.70E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-228	1.48E+00	NA[11]	---	---	---	---	---
Actinium-228	2.50E+00	NA[11]	---	---	---	---	---
Thorium-228	3.70E+00	NA[11]	---	---	---	---	---
Lead-212	2.16E+00	NA[11]	---	---	---	---	---

Table B-1. Human Health COPC Screening for Exposure Area 1 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Radionuclides *(pCi/g) – cont'd*							
Bismuth-212	1.31E+00	NA[11]	---	---	---	---	---
Thallium-208	7.30E-01	NA[11]	---	---	---	---	---
Uranium-233 and Uranium-234	1.64E+00	5.63E+00	PRG	no	1.28E+00	YES	no
Uranium-234	2.78E+00	5.84E+00	PRG	no	1.36E+00	YES	no
Uranium-235(+D)	1.37E-01	1.94E-01	PRG	no	6.91E-02	YES	no
Uranium-238(+D)	2.73E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0 to 1 ft) (see Table A.1.1.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.[VS1]

Table B-2. Human Health Risk/Hazard Calculation for Exposure Area 1 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Chromium[7]	9.79E+00	2.30E+02	0.04	---	No
Iron	5.81E+03	5.50E+04	0.11	---	No
Vanadium	3.21E+01	3.90E+02	0.08	---	No
		Total Hazard Index (HI) =	**0.23**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Chromium[7]	9.79E+00	3.00E-01	---	3.26E-05	Yes
			Total Inorganic Risk =	**3.26E-05**	
Radionuclides					
Americium-243(+D)	2.77E-01	1.67E-01	---	1.66E-06	Yes
Cesium-137(+D)	1.48E+02	6.06E-02	---	2.44E-03	Yes
Cobalt-60	1.44E-01	3.29E-02	---	4.38E-06	Yes
Potassium-40	3.90E+00	1.43E-01	---	2.73E-05	Yes
Thorium-232(+D)[8]	2.21E+00	2.68E-02	---	8.23E-05	Yes
Actininum-228	1.31E+00	---	---	---	---
Thorium--228	2.21E+00	---	---	---	---
Lead-212	1.21E+00	---	---	---	---
Bismuth-212	9.87E-01	---	---	---	---
Thallium-208	4.37E-01	---	---	---	---
Uranium-238(+D)	1.20E+00	7.99E-01	---	1.50E-06	Yes
			Total Radionuclide Risk =	**2.56E-03**	
			Total Media Risk =	**2.59E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-1hat were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.
5. Residential Risk Estimate = EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Thorium-232 is assumed to be in secular equilibrium with its daughter products; therefore, EPC is the highest of the daughters detected.

Table B-3. Human Health Risk/Hazard Calculation for Exposure Area 1 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Chromium[7]	9.79E+00	3.50E+03	0.0028	---	No
Iron	5.81E+03	8.20E+05	0.0071	---	No
Vanadium	3.21E+01	5.80E+03	0.0055	---	No
		Total Hazard Index (HI) =	**0.015**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Chromium	9.79E+00	6.30E+00	---	1.55E-06	Yes
			Total Inorganic Risk =	**1.55E-06**	
Radionuclides					
Americium-243(+D)	2.77E-01	2.60E-01	---	1.07E-06	Yes
Cesium-137(+D)	1.48E+02	9.10E-02	---	1.63E-03	Yes
Cobalt-60	1.44E-01	4.80E-02	---	3.00E-06	Yes
Potassium-40	3.90E+00	2.20E-01	---	1.77E-05	Yes
Thorium-232(+D)[8]	2.21E+00	4.20E-02	---	5.25E-05	Yes
Actininum-228	1.31E+00	---	---	---	---
Thorium--228	2.21E+00	---	---	---	---
Lead-212	1.21E+00	---	---	---	---
Bismuth-212	9.87E-01	---	---	---	---
Thallium-208	4.37E-01	---	---	---	---
Uranium-238(+D)	1.20E+00	1.40E+00	---	8.56E-07	No
			Total Radionuclide Risk =	**1.70E-03**	
			Total Media Risk =	**1.70E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-1 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are industrial worker soil default values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Thorium-232 is assumed to be in secular equilibrium with its daughter products; therefore, EPC is the highest of the daughters detected.

Table B-4. Human Health Risk/Hazard Calculation for Exposure Area 1 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	9.79E+00	5.81E+03	0.0017	---	No
Iron	5.81E+03	1.36E+06	0.0043	---	No
Vanadium	3.21E+01	9.72E+03	0.0033	---	No
		Total Hazard Index (HI) =	**0.009**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	9.79E+00	1.32E+01	---	7.42E-07	No
			Total Inorganic Risk =	**7.42E-07**	
Radionuclides					
Americium-243(+D)	2.77E-01	5.39E-01	---	5.14E-07	No
Cesium-137(+D)	1.48E+02	1.80E-01	---	8.22E-04	Yes
Cobalt-60	1.44E-01	8.32E-02	---	1.73E-06	Yes
Potassium-40	3.90E+00	4.56E-01	---	8.55E-06	Yes
Thorium-232(+D)[8]	2.21E+00	8.85E-02	---	2.49E-05	Yes
Actininum-228	1.31E+00	---	---	---	---
Thorium--228	2.21E+00	---	---	---	---
Lead-212	1.21E+00	---	---	---	---
Bismuth-212	9.87E-01	---	---	---	---
Thallium-208	4.37E-01	---	---	---	---
Uranium-238(+D)	1.20E+00	2.91E+00	---	4.12E-07	No
			Total Radionuclide Risk =	**8.58E-04**	
			Total Media Risk =	**8.59E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-1 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-5. Surface Water Comparison to MCLs/(RSLs/PRGs or AWQC) for Exposure Area 1

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	1.06E+03	µg/L	---	---	2.00E+04	NA	no
Barium	3.77E+01	µg/L	2.00E+03	no			
Calcium[3]	1.27E+04	µg/L	NA	---	NA	NA	---
Chromium	1.32E+00	µg/L	1.00E+02	no			
Cobalt	3.03E+00	µg/L	---	---	6.00E+00	NA	no
Copper	9.80E-01	µg/L	1.30E+03	no			
Cyanide	3.02E+00	µg/L	2.00E+02	no			
Iron	1.26E+04	µg/L	---	---	1.40E+04	NA	no
Lead	6.70E-01	µg/L	1.50E+01	no			
Magnesium[3]	1.90E+03	µg/L	NA	---	NA	NA	---
Manganese	1.18E+03	µg/L	---	---	4.30E+02	NA	YES
Nickel	6.40E-01	µg/L	---	---	3.90E+02	6.10E+02	no
Potassium[3]	8.13E+03	µg/L	NA	---	NA	NA	---
Sodium[3]	2.31E+03	µg/L	NA	---	NA	NA	---
Thallium	1.50E+00	µg/L	2.00E+00	no			
Vanadium	3.80E+00	µg/L	---	---	8.60E+01	NA	no
Zinc	2.69E+01	µg/L	---	---	6.00E+03	7.40E+04	no
Organics							
Acetone	9.63E+00	µg/L	---	---	1.40E+04	NA	no
Bis[2-ethylhexyl]phthalate	2.68E+00	µg/L	6.00E+00	no			
Chloromethane	5.62E-01	µg/L	---	---	1.90E+02	NA	no
Toluene	7.25E-01	µg/L	1.00E+03	no			
Pesticides/PCBs							
DDE	9.34E-03	µg/L	---	---	4.60E-02	NA	no
DDT	1.37E-01	µg/L	---	---	2.30E-01	NA	no
Radionuclides							
Americium-241	4.02E-02	pCi/L	1.50E+01	no			
Cesium-137	1.76E+02	pCi/L	2.00E+02	no			
Cobalt-60	7.58E+00	pCi/L	1.00E+02	no			
Curium-244	1.00E-02	pCi/L	1.50E+01	no			
Iodine-129	3.23E+01	pCi/L	---	---	NA	NA	---
Plutonium-238	3.73E-02	pCi/L	1.50E+01	no			
Plutonium-239	1.11E-02	pCi/L	1.50E+01	no			
Plutonium-239 and Plutonium-240	1.00E-02	pCi/L	1.50E+01	no			
Potassium-40	4.64E+02	pCi/L	---	---	8.30E-01	NA	YES
Strontium-89 and Strontium-90	3.01E+00	pCi/L	8.00E+00	no			
Technetium-99	5.66E-01	pCi/L	9.00E+02	no			
Thorium-234	7.10E+02	pCi/L	---	---	1.90E+00	NA	YES
Tritium	3.14E+05	pCi/L	2.00E+04	YES			
Uranium-234	2.03E-01	pCi/L	1.87E+05	no			
Uranium-235	8.20E-03	pCi/L	6.47E+01	no			
Uranium-238	1.81E-01	pCi/L	1.01E+01	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.1.2)
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-6. Human Health COPC Screening for Exposure Area 2 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	2.18E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Antimony	2.00E-01	3.10E+00	0.1xRSL	no	4.74E+00	no	no
Arsenic	1.18E+01	6.80E-01	RSL	YES	3.50E+00	YES	YES
Barium	2.11E+01	1.50E+03	0.1xRSL	no	5.47E+01	no	no
Beryllium	3.15E-01	1.60E+01	0.1xRSL	no	7.73E-01	no	no
Cadmium	6.13E-02	7.10E+00	0.1xRSL	no	3.69E-01	no	no
Calcium	5.18E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	3.20E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	1.59E+00	2.30E+00	0.1xRSL	no	2.63E+00	no	no
Copper	1.31E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Iron	4.90E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	2.58E+01	4.00E+01	0.1xRSL	no	1.10E+01	YES	no
Magnesium	3.00E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	5.99E+01	1.80E+02	0.1xRSL	no	1.36E+02	no	no
Mercury[8]	3.52E-02	7.80E-01	0.1xRSL	no	9.92E-02	no	no
Nickel	3.91E+00	1.50E+02	0.1xRSL	no	4.48E+00	no	no
Potassium	1.98E+02	EN[6]	Nutrient	no	2.39E+02	no	no
Selenium	2.06E+00	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Thallium	5.14E-01	7.80E-02	0.1xRSL	YES	3.77E+00	no	no
Vanadium	1.12E+02	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	1.96E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics (mg/kg)							
Acetone	4.60E-02	6.10E+03	0.1xRSL	no	---	---	no
Bis[2-chloroethyl] ether	8.00E-01	2.3E-01	RSL	YES	---	---	YES
Bis[2-ethylhexyl]phthalate	4.40E-02	3.90E+01	RSL	no	---	---	no
Toluene	1.90E-01	4.90E+02	0.1xRSL	no	---	---	no
Radionuclides (pCi/g)							
Americium-241	8.70E-02	2.27E+00	PRG	no	3.55E-02	YES	no
Americium-243(+D)	1.26E-01	1.67E-01	PRG	no	NA[9]	---	no
Carbon-14	7.00E-01	3.16E+02	PRG	no	NA[9]	---	no
Cesium-137(+D)	1.80E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Curium-243/Curium-244	5.70E-02	5.90E-02	PRG	no	1.85E-01	no	no
Curium-245/Curium-246	7.60E-02	3.88E-01	PRG	no	NA[9]	---	no
Neptunium-237(+D)	2.30E-02	1.32E-01	PRG	no	NA[9]	---	no
Plutonium-238	4.40E-02	4.27E+00	PRG	no	2.83E-02	YES	no
Plutonium-239(+D)/ Plutonium-240	1.19E-01	3.79E+00	PRG	no	5.13E-02	YES	no
Potassium-40	4.60E+00	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	2.33E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	2.33E+00	NA[11]	---	---	---	---	---
Bismuth-214	1.71E+00	NA[11]	---	---	---	---	---
Strontium-90(+D)	4.60E-01	4.21E+00	PRG	no	7.54E-01	no	no
Thorium-230	1.00E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	2.84E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-228	2.27E+00	NA[11]	---	---	---	---	---
Actinium-228	2.84E+00	NA[11]	---	---	---	---	---
Thorium-228	1.56E+00	NA[11]	---	---	---	---	---
Lead-212	2.59E+00	NA[11]	---	---	---	---	---
Bismuth-212	2.70E+00	NA[11]	---	---	---	---	---
Thallium-208	1.02E+00	NA[11]	---	---	---	---	---
Uranium-233/ Uranium-234	1.17E+00	5.63E+00	PRG	no	1.28E+00	no	no
Uranium-235(+D)	5.70E-02	1.94E-01	PRG	no	6.91E-02	no	no
Uranium-238(+D)	1.35E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

Table B-6. Human Health COPC Screening for Exposure Area 2 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.2.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for methyl mercury (most conservative) used.
9. NA = not available (a background value is not available for this constituent).
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-7. Human Health Risk/Hazard Calculation for Exposure Area 2 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.12E+04	7.70E+04	0.15	---	No
Arsenic	5.53E+00	3.50E+01	0.16	---	No
Chromium[7]	1.56E+01	2.30E+02	0.07	---	No
Iron	1.94E+04	5.50E+04	0.35	---	No
Vanadium	4.38E+01	3.90E+02	0.11	---	No
			Total Hazard Index (HI) =	**0.84**	
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	5.53E+00	6.80E-01	---	8.13E-06	Yes
Chromium[7]	1.56E+01	3.00E-01	---	5.18E-05	Yes
Organics *(mg/kg)*					
Bis[2-chloroethyl]ether	8.00E-01	2.30E-01	---	3.48E-06	No
			Total Inorganic/Organic Risk =	**6.34E-05**	
Radionuclides					
Cesium-137(+D)	4.88E+01	6.06E-02	---	8.05E-04	Yes
Potassium-40	1.20E+00	1.43E-01	---	8.36E-06	Yes
Thorium-232(+D)[8]	1.18E+00	2.68E-02	---	4.39E-05	Yes
Actinium-228	1.18E+00	---	---	---	---
Thorium-228	1.04E+00	---	---	---	---
Lead-212	1.16E+00	---	---	---	---
Bismuth-212	8.86E-01	---	---	---	---
Thallium-208	4.58E-01	---	---	---	---
Uranium-238(+D)	7.01E-01	7.99E-01	---	8.77E-07	No
			Total Radionuclide Risk =	**8.58E-04**	
			Total Media Risk =	**9.22E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-6 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.2.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-8. Human Health Risk/Hazard Calculation for Exposure Area 2 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.12E+04	1.10E+06	0.010	---	No
Arsenic	5.53E+00	4.80E+02	0.012	---	No
Chromium[7]	1.56E+01	3.50E+03	0.004	---	No
Iron	1.94E+04	8.20E+05	0.024	---	No
Vanadium	4.38E+01	5.80E+03	0.008	---	No
		Total Hazard Index (HI) =	**0.057**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	5.53E+00	3.00E+00	---	1.84E-06	Yes
Chromium[7]	1.56E+01	6.30E+00	---	2.47E-06	Yes
Organics *(mg/kg)*					
Bis[2-chloroethyl]ether	8.00E-01	1.00E+00	---	8.00E-07	No
			Total Inorganic Risk =	**5.11E-06**	
Radionuclides					
Cesium-137(+D)	4.88E+01	9.10E-02	---	5.36E-04	Yes
Potassium-40	1.20E+00	2.20E-01	---	5.43E-06	Yes
Thorium-232(+D)[8]	1.18E+00	4.20E-02	---	2.80E-05	Yes
Actinium-228	1.18E+00	---	---	---	---
Thorium-228	1.04E+00	---	---	---	---
Lead-212	1.16E+00	---	---	---	---
Bismuth-212	8.86E-01	---	---	---	---
Thallium-208	4.58E-01	---	---	---	---
Uranium-238(+D)	7.01E-01	1.60E+00	---	5.01E-07	No
			Total Radionuclide Risk =	**5.70E-04**	
			Total Media Risk =	**5.75E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-6 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.2.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Appendix B-1). Radiological PRGs are industrial worker soil default values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-9. Human Health Risk/Hazard Calculation for Exposure Area 2 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.12E+04	1.87E+06	0.006	---	No
Arsenic	5.53E+00	7.99E+02	0.007	---	No
Chromium[7]	1.56E+01	5.81E+03	0.003	---	No
Iron	1.94E+04	1.36E+06	0.014	---	No
Vanadium	4.38E+01	9.72E+03	0.005	---	No
		Total Hazard Index (HI) =	**0.034**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	5.53E+00	6.24E+00	---	8.86E-07	No
Chromium[7]	8.00E-01	1.32E+01	---	1.18E-06	Yes
Organics *(mg/kg)*					
Bis[2-chloroethyl]ether	8.00E-01	2.15E+00	---	3.72E-07	No
			Total Inorganic Risk =	**2.44E-06**	
Radionuclides					
Cesium-137(+D)	4.88E+01	1.80E-01	---	2.71E-04	Yes
Potassium-40	1.20E+00	4.56E-01	---	2.62E-06	Yes
Thorium-232(+D)[8]	1.18E+00	8.85E-02	---	1.33E-05	Yes
Actinium-228	1.18E+00	---	---	---	---
Thorium-228	1.04E+00	---	---	---	---
Lead-212	1.16E+00	---	---	---	---
Bismuth-212	8.86E-01	---	---	---	---
Thallium-208	4.58E-01	---	---	---	---
Uranium-238(+D)	1.20E+00	2.91E+00	---	2.41E-07	No
			Total Radionuclide Risk =	**2.87E-04**	
			Total Media Risk =	**2.90E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-6 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.2.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-10. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 2

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	4.54E+02	µg/L	---	---	2.00E+04	NA	no
Antimony	1.50E+00	µg/L	6.00E+00	no			
Arsenic	2.10E+00	µg/L	1.00E+01	no			
Barium	7.28E+01	µg/L	2.00E+03	no			
Calcium[3]	4.32E+04	µg/L	NA	---	NA	NA	---
Chromium	9.49E+00	µg/L	1.00E+02	no			
Cobalt	2.20E+00	µg/L	---	---	6.00E+00	1.30E+03	no
Copper	1.10E+00	µg/L	1.30E+03	no			
Iron	6.89E+03	µg/L	---	---	1.40E+04	NA	no
Magnesium[3]	3.41E+03	µg/L	NA	---	NA	NA	
Manganese	9.10E+02	µg/L	---	---	4.30E+02	NA	YES
Mercury	4.49E-01	µg/L	2.00E+00	no			
Nickel	8.50E-01	µg/L	---	---	3.90E+02	6.10E+02	no
Potassium[3]	5.23E+03	µg/L	NA	---	NA	NA	---
Sodium[3]	6.30E+03	µg/L	NA	---	NA	NA	---
Thallium	1.90E+00	µg/L	2.00E+00	no			
Vanadium	1.21E+00	µg/L	---	---	8.60E+01	NA	no
Zinc	6.88E+01	µg/L	---	---	6.00E+03	7.40E+04	no
Organics							
2-Methylnaphthalene	2.91E-01	µg/L	---	---	3.60E+01	NA	no
Acenaphthene	3.95E-01	µg/L	---	---	5.30E+02	NA	no
Acenaphthylene	3.30E-01	µg/L	---	---	---	---	---
Acetone	6.80E+00	µg/L	---	---	1.40E+04	NA	no
Anthracene	4.05E-01	µg/L	---	---	1.80E+03	8.30E+03	no
Bis[2-ethylhexyl]phthalate	1.60E+01	µg/L	6.00E+00	YES			
Fluoranthene	3.35E-01	µg/L	---	---	8.00E+02	1.30E+02	no
Pyrene	3.02E-01	µg/L	---	---	1.20E+02	8.30E+02	no
Naphthalene	3.68E-01	µg/L	---	---	1.70E-01	NA	YES
Styrene	3.20E-01	µg/L	1.00E+02	no			
Toluene	2.20E+00	µg/L	1.00E+03	no			
Radionuclides							
Bismuth-214	4.80E+01	pCi/L	1.50E+01	YES			
Tritium	8.66E+02	pCi/L	2.00E+04	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.2.2)
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-11. Human Health COPC Screening for Exposure Area 3 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	3.17E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Arsenic	5.30E+00	6.80E-01	RSL	YES	3.50E+00	YES	YES
Barium	6.47E+01	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	7.96E-01	1.60E+01	0.1xRSL	no	7.73E-01	YES	no
Cadmium	6.05E-01	7.10E+00	0.1xRSL	no	3.69E-01	YES	no
Calcium	4.86E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	6.14E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	5.63E+00	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	2.09E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Iron	3.26E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	2.33E+01	4.00E+01	0.1xRSL	no	1.10E+01	YES	no
Magnesium	7.44E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	1.76E+02	1.80E+02	0.1xRSL	no	1.36E+02	YES	no
Mercury[9]	7.31E-02	7.80E-01	0.1xRSL	no	9.92E-02	no	no
Nickel	1.19E+01	1.50E+02	0.1xRSL	no	4.48E+00	YES	no
Potassium	5.52E+02	EN[6]	Nutrient	no	2.39E+02	YES	no
Selenium	1.23E+00	3.90E+01	0.1xRSL	no	3.89E+00	YES	no
Sodium	5.85E+01	EN[6]	Nutrient	no	7.33E+01	YES	no
Thallium	9.44E-01	7.80E-02	0.1xRSL	YES	3.77E+00	no	no
Vanadium	5.78E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	5.66E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics (mg/kg)							
Acetone	4.07E-01	6.10E+03	0.1xRSL	no	---	---	no
Carbon disulfide	1.11E-02	7.70E+01	0.1xRSL	no	---	---	no
Methyl ethyl ketone	6.04E-02	2.70E+03	0.1xRSL	no	---	---	no
Toluene	2.93E-03	4.90E+02	0.1xRSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDE	3.28E-03	2.00E+00	RSL	no	---	---	no
Radionuclides (pCi/g)							
Cesium-137(+D)	4.57E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Potassium-40	3.04E+00	1.43E-01	PRG	YES	3.05E+00	no	no
Radium-226(+D)[10]	1.79E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	1.79E+00	NA[11]	---	---	---	---	---
Bismuth-214	1.57E+00	NA[11]	---	---	---	---	---
Thorium-230	1.35E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	3.13E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Actinium-228	2.55E+00	NA[11]	---	---	---	---	---
Thorium-228	3.13E+00	NA[11]	---	---	---	---	---
Lead-212	2.24E+00	NA[11]	---	---	---	---	---
Thallium-208	6.89E-01	NA[11]	---	---	---	---	---
Uranium-233 and Uranium-234	1.88E+00	5.63E+00	PRG	no	1.28E+00	YES	no
Uranium-238(+D)	1.68E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.3.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived *using USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways, all other inputs are default values (see Attachment B-3). Websites accessed October 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.

Table B-11. Human Health COPC Screening for Exposure Area 3 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]

11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.

Table B-12. Human Health Risk/Hazard Calculation for Exposure Area 3 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	3.17E+04	7.70E+04	0.412	---	No
Arsenic	4.10E+00	3.50E+01	0.117	---	No
Chromium[7]	6.14E+01	2.30E+02	0.267	---	No
Cobalt	5.63E+00	2.30E+01	0.245	---	No
Iron	2.59E+04	5.50E+04	0.470	---	No
Vanadium	5.40E+01	3.90E+02	0.138	---	No
		Total Hazard Index (HI) =	**1.65**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	4.10E+00	6.80E-01	---	6.03E-06	Yes
Chromium[7]	6.14E+01	3.00E-01	---	2.05E-04	Yes
Cobalt	5.63E+00	4.20E+02	---	1.34E-08	No
			Total Inorganic Risk =	**2.11E-04**	
Radionuclides					
Cesium-137(+D)	9.83E+01	6.06E-02	---	1.62E-03	Yes
Thorium-232(+D)[8]	3.13E+00	2.68E-02	---	1.17E-04	Yes
Actinium-228	1.58E+00	---	---	---	---
Thorium-228	3.13E+00	---	---	---	---
Lead-212	1.50E+00	---	---	---	---
Thallium-208	4.66E-01	---	---	---	---
Uranium-238(+D)	1.68E+00	7.99E-01	---	2.10E-06	Yes
			Total Radionuclide Risk =	**1.74E-03**	
			Total Media Risk =	**1.95E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-11 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.3.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculated and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. If the total media HI ≥1, then the constituents are segregated based on relevant target organs. HQs are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ ≥1 and the total organ HI >1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Constituent	Target Organ	Residential HQ	
Aluminum	Neurological	0.4.12	
		0.4.12	Total neurological target organ hazard index
Arsenic	Skin and blood	0.117	Total skin target organ hazard index
Chromium[7]	Gastrointestinal	0.267	
Iron	Gastrointestinal	0.470	
		0.737	Total gastrointestinal target organ hazard index
Vanadium	Kidney	0.138	Total kidney target organ hazard index
Cobalt	Thyroid	0.245	Total thyroid target organ hazard index

Table B-13. Human Health Risk/Hazard Calculation for Exposure Area 3 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	3.17E+04	1.10E+06	0.029	---	No
Arsenic	4.10E+00	4.80E+02	0.009	---	No
Chromium[7]	6.14E+01	3.50E+03	0.018	---	No
Cobalt	5.63E+00	3.50E+02	0.016	---	No
Iron	2.59E+04	8.20E+05	0.032	---	No
Vanadium	5.40E+01	5.80E+03	0.009	---	No
		Total Hazard Index (HI) =	**0.11**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	4.10E+00	3.00E+00	---	1.37E-05	Yes
Chromium[7]	6.14E+01	6.30E+00	---	9.75E-06	Yes
Cobalt	5.63E+00	1.90E+03	---	2.96E-09	No
			Total Inorganic Risk =	**1.11E-05**	
Radionuclides					
Cesium-137(+D)	9.83E+01	9.10E-02	---	1.08E-03	Yes
Thorium-232(+D)[8]	3.13E+00	4.20E-02	---	5.83E-05	Yes
Actinium-228	1.58E+00	---	---	---	---
Thorium-228	3.13E+00	---	---	---	---
Lead-212	1.50E+00	---	---	---	---
Thallium-208	4.66E-01	---	---	---	---
Uranium-238(+D)	1.68E+00	1.40E+00	---	1.20E-06	Yes
			Total Radionuclide Risk =	**1.14E-03**	
			Total Media Risk =	**1.15E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-11 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.3.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Work Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-14. Human Health Risk/Hazard Calculation for Exposure Area 3 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	3.17E+04	1.87E+06	0.017	---	No
Arsenic	4.10E+00	7.99E+02	0.005	---	No
Chromium[7]	6.14E+01	5.81E+03	0.011	---	No
Cobalt	5.63E+00	5.78E+02	0.010	---	No
Iron	2.59E+04	1.36E+06	0.019	---	No
Vanadium	5.40E+01	9.72E+03	0.006	---	No
		Total Hazard Index (HI) =	**0.0.07**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	4.10E+00	6.24E+00	---	6.57E-07	No
Chromium[7]	6.14E+01	1.32E+01	---	4.65E-06	Yes
Cobalt	5.63E+00	3.86E+03	---	1.46E-09	No
			Total Inorganic Risk =	**5.31E-06**	
Radionuclides					
Cesium-137(+D)[8]	9.83E+01	1.80E-01	---	5.46E-04	Yes
Thorium-232(+D)	3.13E+00	8.85E-02	---	3.54E-05	Yes
Actinium-228	1.58E+00	---	---	---	---
Thorium-228	3.13E+00	---	---	---	---
Lead-212	1.50E+00	---	---	---	---
Thallium-208	4.66E-01	---	---	---	---
Uranium-238(+D)	1.68E+00	2.91E+00	---	5.77E-07	No
			Total Radionuclide Risk =	**5.82E-04**	
			Total Media Risk =	**5.87E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-11 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.3.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-15. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 3

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL /PRG or AWQC?
Inorganics							
Aluminum	4.94E+01	µg/L	---	---	2.00E+04	NA	no
Barium	2.66E+01	µg/L	2.00E+03	no			
Calcium[3]	1.09E+04	µg/L	NA	---	NA	NA	---
Chromium	9.49E+00	µg/L	1.00E+02	no			
Iron	9.17E+02	µg/L	---	---	1.40E+04	NA	no
Lead	3.67E+00	µg/L	1.50E+01	no			
Magnesium[3]	1.11E+03	µg/L	NA	---	NA	NA	---
Manganese	4.02E+01	µg/L	---	---	4.30E+02	NA	no
Mercury	4.49E-01	µg/L	2.00E+00	no			
Nickel	9.50E-01	µg/L	---	---	3.90E+02	6.10E+02	no
Potassium[3]	4.65E+02	µg/L	NA	---	NA	NA	---
Sodium[3]	6.21E+03	µg/L	NA	---	NA	NA	---
Vanadium	1.21E+00	µg/L	---	---	8.60E+01	NA	no
Zinc	6.71E+00	µg/L	---	---	6.00E+03	7.40E+04	no
Organics							
2-Methylnaphthalene	2.91E-01	µg/L	---	---	3.60E+01	NA	no
Acenaphthene	3.95E-01	µg/L	---	---	5.30E+02	NA	no
Acenaphthylene	3.30E-01	µg/L	---	---	NA	NA	---
Anthracene	4.05E-01	µg/L	---	---	1.80E+03	8.30E+03	no
Bis[2-ethylhexyl]phthalate	3.26E-01	µg/L	6.00E+00	no			
Fluoranthene	3.35E-01	µg/L	---	---	8.00E+02	1.30E+02	no
Pyrene	3.02E-01	µg/L	---	---	1.20E+02	8.30E+02	no
Naphthalene	3.68E-01	µg/L	---	---	1.70E-01	NA	YES
Radionuclides							
Cesium-137	8.30E+00	pCi/L	2.00E+02	no			
Tritium	8.66E+02	pCi/L	2.00E+04	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.3.2)
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-16. Human Health Fish Ingestion Screening for Exposure Area 3 – Recreational Fisherman

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?
Inorganics (mg/kg)				
Aluminum	1.65E+01	1.54E+03	RSL	no
Barium	8.07E+00	3.09E+02	RSL	no
Calcium	2.17E+04	EN[3]	---	no
Chromium[4]	3.70E-01	8.32E-03	RSL	YES
Copper	3.37E-01	6.18E+01	RSL	no
Iron	4.54E+01	1.08E+03	RSL	no
Magnesium	5.73E+02	EN[3]	---	no
Manganese	3.13E+01	2.16E+02	RSL	no
Mercury[5]	1.83E+00	1.54E-01	RSL	YES
Potassium	2.77E+04	EN[3]	---	no
Sodium	1.43E+03	EN[3]	---	no
Zinc	2.44E+01	4.63E+02	RSL	no
Radionuclides (pCi/g)				
Cesium-137(+D)	1.13E+02	5.44E-02	PRG	YES
Cobalt-60	4.05E-02	9.13E-02	PRG	no
Plutonium-238	5.08E-05	1.20E-02	PRG	no
Potassium-40	3.89E+00	5.95E-02	PRG	YES
Strontium-89 and Strontium-90(+D)	9.39E-02	2.14E-02	PRG	YES

PRG = preliminary remediation goal
RSL = regional screening level

1. Maximum detected fish tissue concentration (see Table A.1.1.3)
2. Nonradiological RSLs for ingestion of fish are default residential values from *USEPA Regional Screening Levels calculator.* Radiological PRGs for ingestion of fish are values from *USEPA Radionuclide Preliminary Remediation Goals for Superfund* calculator. Websites accessed October 23, 2016.
3. EN = essential nutrient, RSL is not available.
4. RSL for hexavalent chromium used.
5. RSL for methyl mercury used.

Table B-17. Human Health COPC Screening for Exposure Area 4 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	9.49E+03	7.70E+03	0.1xRSL	YES	9.79E+03	no	no
Arsenic	2.80E+00	6.80E-01	RSL	YES	3.50E+00	no	no
Barium	3.01E+01	1.50E+03	0.1xRSL	no	5.47E+01	no	no
Beryllium	1.76E-01	1.60E+01	0.1xRSL	no	7.73E-01	no	no
Cadmium	1.33E-02	7.10E+00	0.1xRSL	no	3.69E-01	no	no
Calcium	1.28E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	1.30E+01	3.00E-01	RSL	YES	1.42E+01	no	no
Cobalt	8.10E-01	2.30E+00	0.1xRSL	no	2.63E+00	no	no
Copper	3.96E+00	3.10E+02	0.1xRSL	no	6.52E+00	no	no
Iron	1.39E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	8.84E+00	4.00E+01	0.1xRSL	no	1.10E+01	no	no
Magnesium	1.18E+02	EN[6]	Nutrient	no	2.75E+02	no	no
Manganese	1.04E+02	1.80E+02	0.1xRSL	no	1.36E+02	no	no
Mercury[8]	1.96E-02	7.80E-01	0.1xRSL	no	9.92E-02	no	no
Nickel	2.84E+00	1.50E+02	0.1xRSL	no	4.48E+00	no	no
Potassium	1.09E+02	EN[6]	Nutrient	no	2.39E+02	no	no
Selenium	7.25E-01	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Vanadium	5.11E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	5.46E+00	2.30E+03	0.1xRSL	no	1.70E+01	no	no
Organics (mg/kg)							
Acetone	2.30E-02	6.10E+03	0.1xRSL	no	---	---	no
Bis[2-ethylhexyl]phthalate	5.20E-02	3.90E+01	RSL	no	---	---	no
Carbon disulfide	2.40E-03	7.70E+01	0.1xRSL	no	---	---	no
Chrysene	4.20E-02	1.60E+01	RSL	no	---	---	no
Chloroform	1.10E-03	3.20E-01	RSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDT	4.90E-03	1.90E+00	RSL	no	---	---	no
Radionuclides (pCi/g)							
Americium-241	3.20E-02	2.27E+00	PRG	no	3.55E-02	no	no
Americium-243(+D)	6.70E-02	1.67E-01	PRG	no	NA[9]	---	no
Carbon-14	6.30E-01	3.16E+00	PRG	no	NA[9]	---	no
Cesium-137(+D)	5.00E+01	6.06E-02	PRG	YES	1.89E-01	YES	YES
Curium-243 and Curium-244	4.00E-02	5.90E-02	PRG	no	1.85E-01	no	no
Plutonium-238	1.08E-01	4.27E+00	PRG	no	2.83E-02	YES	no
Plutonium-239(+D)/Plutonium-240	2.60E-02	3.79E+00	PRG	no	5.13E-02	no	no
Potassium-40	2.83E+00	1.43E-01	PRG	YES	3.05E+00	no	no
Radium-226(+D)[10]	1.80E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	1.80E+00	NA[11]	---	---	---	---	---
Bismuth-214	1.61E+00	NA[11]	---	---	---	---	---
Thorium-230	1.11E+00	5.07E+00	PRG	YES	2.19E+00	no	no
Thorium-232(+D)[12]	1.98E+00	2.68E-02	PRG	YES	2.10E+00	no	no
Radium-228	1.48E+00	NA[11]	---	---	---	---	---
Actinium-228	1.93E+00	NA[11]	---	---	---	---	---
Thorium-228	1.68E+00	NA[11]	---	---	---	---	---
Lead-212	1.66E+00	NA[11]	---	---	---	---	---
Bismuth-212	1.98E+00	NA[11]	---	---	---	---	---
Thallium-208	7.30E-01	NA[11]	---	---	---	---	---
Uranium-233 and Uranium-234	8.80E-01	5.63E+00	PRG	no	1.28E+00	no	no
Uranium-235(+D)	3.50E-02	1.94E-01	PRG	no	6.91E-02	no	no
Uranium-238(+D)	9.50E-01	7.99E-01	PRG	YES	1.31E+00	no	no

Table B-17. Human Health COPC Screening for Exposure Area 4 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.4.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for methyl mercury (most conservative) used.
9. NA = not available (a background value is not available for this constituent).
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-18. Human Health Risk/Hazard Calculation for Exposure Area 4 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Iron	9.67E+03	5.50E+04	0.176	---	No
Vanadium	3.10E+01	3.90E+02	0.080	---	No
		Total Hazard Index (HI) =	**0.26**		
Carcinogenic Risk Estimate					
Radionuclides					
Cesium-137(+D)	1.83E+01	6.06E-02	---	3.02E-04	Yes
			Total Radionuclide Risk =	**3.02E-04**	
			Total Media Risk =	**3.02E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-17 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.4.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituent are identified as COCs if the individual cancer risk is ≥1E-06.

Table B-19. Human Health Risk/Hazard Calculation for Exposure Area 4 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Iron	9.67E+03	8.20E+05	0.012	---	No
Vanadium	3.10E+01	5.80E+03	0.005	---	No
		Total Hazard Index (HI) =	**0.017**		
Carcinogenic Risk Estimate					
Radionuclides					
Cesium-137(+D)	1.83E+01	9.10E-02	---	2.01E-04	Yes
			Total Radionuclide Risk =	**2.01E-04**	
			Total Media Risk =	**2.01E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-17 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.4.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.

Table B-20. Human Health Risk/Hazard Calculation for Exposure Area 4 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Iron	9.67E+03	1.36E+06	0.007	---	No
Vanadium	3.10E+01	9.72E+03	0.003	---	No
		Total Hazard Index (HI) =	**0.010**		
Carcinogenic Risk Estimate					
Radionuclides					
Cesium-137(+D)	1.83E+01	1.80E-01	---	1.02E-04	Yes
			Total Radionuclide Risk =	**1.02E-04**	
			Total Media Risk =	**1.02E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-17 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.4.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.

Table B-21. Surface Water Comparison to MCLs/(RSLs/PRGs or AWQC) for Exposure Area 4

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	3.64E+02	µg/L	---	---	2.00E+04	NA	no
Antimony	5.30E-01	µg/L	6.00E+00	no			
Barium	2.69E+01	µg/L	2.00E+03	no			
Beryllium	1.20E-01	µg/L	4.00E+00	no			
Cadmium	9.00E-02	µg/L	5.00E+00	no			
Calcium[3]	5.10E+03	µg/L	NA	---	NA	NA	---
Chromium	3.60E+00	µg/L	1.00E+02	no			
Cobalt	9.50E-01	µg/L	---	---	6.00E+00	1.30E+03	no
Copper	1.50E+00	µg/L	1.30E+03	no			
Iron	5.26E+03	µg/L	---	---	1.40E+04	NA	no
Lead	8.10E-01	µg/L	1.50E+01	no			
Magnesium[3]	7.93E+02	µg/L	NA	---	NA	NA	---
Manganese	2.37E+02	µg/L	---	---	4.30E+02	NA	no
Mercury	9.70E-02	µg/L	2.00E+00	no			
Potassium[3]	2.65E+03	µg/L	NA	---	NA	NA	---
Sodium[3]	2.76E+03	µg/L	NA	---	NA	NA	---
Thallium	2.00E+00	µg/L	2.00E+00	no			
Vanadium	1.09E+00	µg/L	---	---	8.60E+01	NA	no
Zinc	1.11E+01	µg/L	---	---	NA	7.40E+04	no
Organics							
1,4-Dichlorobenzene	5.25E-01	µg/L	7.50E+01	no			
Anthracene	2.31E-01	µg/L	---	---	1.80E+03	8.30E+03	no
Benzo[a]anthracene	3.09E-01	µg/L	---	---	1.20E-02	3.80E-03	YES
Bis[2-ethylhexyl]phthalate	1.20E+01	µg/L	6.00E+00	YES			
Bromoform	9.40E-01	µg/L	8.00E+01	no			
Dibromochloromethane	3.90E-01	µg/L	8.00E+01	no			
Caprolactam	1.28E+00	µg/L	---	---	9.90E+03	NA	no
Fluoranthene	2.59E-01	µg/L	---	---	8.00E+02	1.30E+02	no
Fluorene	1.85E-01	µg/L	---	---	2.90E+02	1.10E+03	no
Pyrene	3.05E-01	µg/L	---	---	1.20E+02	8.30E+02	no
Toluene	5.30E-01	µg/L	1.00E+03	no			
Radionuclides							
Non-volatile Beta	2.27E+00	pCi/L	---	---	---	---	---
Tritium	6.80E+02	pCi/L	2.00E+04	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.4.2).
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-22. Human Health COPC Screening for Exposure Area 5 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	2.13E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Antimony	5.98E-01	3.10E+00	0.1xRSL	no	4.74E+00	no	no
Arsenic	2.90E+00	6.80E-01	RSL	YES	3.50E+00	no	no
Barium	1.02E+02	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	9.61E-01	1.60E+01	0.1xRSL	no	7.73E-01	YES	no
Cadmium	2.23E-01	7.10E+00	0.1xRSL	no	3.69E-01	no	no
Calcium	4.30E+04	EN[6]	Nutrient	no	1.12E+03	YES	no
Chromium[7]	5.62E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	9.90E+00	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	2.83E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Cyanide	1.28E+00	2.30E+00	0.1xRSL	no	NA[8]	---	no
Iron	2.46E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	2.56E+01	4.00E+01	0.1xRSL	no	1.10E+01	YES	no
Magnesium	1.27E+03	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	9.52E+02	1.80E+02	0.1xRSL	YES	1.36E+02	YES	YES
Mercury[9]	2.29E-01	7.80E-01	0.1xRSL	no	9.92E-02	YES	No
Nickel	8.03E+00	1.50E+02	0.1xRSL	no	4.48E+00	YES	No
Potassium	5.01E+02	EN[6]	Nutrient	no	2.39E+02	YES	No
Selenium	5.96E-01	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Sodium	3.76E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Vanadium	4.51E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	5.34E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics (mg/kg)							
Acetone	5.40E-01	6.10E+03	0.1xRSL	no	---	---	no
Carbon disulfide	1.77E-03	7.70E+01	0.1xRSL	no	---	---	no
Methyl ethyl ketone	3.31E-02	2.70E+03	0.1xRSL	no	---	---	no
Toluene	6.57E-03	4.90E+02	0.1xRSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDE	4.41E-03	2.30E+00	RSL	no	---	---	no
DDT	1.14E-02	1.90E+00	RSL	no	---	---	no
PCB-1260	5.30E-03	2.40E-01	RSL	no	---	---	no
Radionuclides (pCi/g)							
Americium-241	2.12E-01	2.27E+00	PRG	no	3.55E-02	YES	no
Americium-243(+D)	3.41E-01	1.67E-01	PRG	YES	NA[8]	---	YES
Cesium-137(+D)	4.05E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-60	1.83E+00	3.29E-02	PRG	YES	NA[8]	---	YES
Potassium-40	5.49E+00	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	2.99E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	2.69E+00	NA[11]	---	---	---	---	---
Bismuth-214(+D)	2.99E+00	NA[11]	---	---	---	---	---
Radium-228(+D)	1.12E+00	8.85E-02	PRG	YES	4.48E+00	no	no
Thorium-230	1.79E+00	5.07E+00	PRG	No	2.19E+00	no	no
Thorium-232(+D)[12]	4.06E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-228	1.12E+00	NA[11]	---	---	---	---	---
Actinium-228	3.99E+00	NA[11]	---	---	---	---	---
Thorium-228	3.34E+00	NA[11]	---	---	---	---	---
Lead-212	4.06E+00	NA[11]	---	---	---	---	---
Thallium-208	1.30E+00	NA[11]	---	---	---	---	---
Uranium-233 and Uranium-234	2.21E+00	5.63E+00	PRG	No	1.28E+00	YES	no
Uranium-235(+D)	1.52E-01	1.94E-01	PRG	No	6.91E-02	YES	no
Uranium-238(+D)	2.44E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.5.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1)

Table B-22. Human Health COPC Screening for Exposure Area 5 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]

4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-23. Human Health Risk/Hazard Calculation for Exposure Area 5 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.77E+04	7.70E+04	0.230	---	No
Chromium[7]	5.08E+01	2.30E+02	0.221	---	No
Cobalt	9.24E+00	2.30E+01	0.402	---	No
Manganese	9.38E+02	1.80E+03	0.521	---	No
Vanadium	3.58E+01	3.90E+02	0.092	---	No
		Total Hazard Index (HI) =	**0.61**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	5.08E+01	3.00E-01	---	1.69E-04	Yes
Cobalt	9.24E+00	4.20E+02	---	2.20E-08	No
			Total Inorganic Risk =	**1.69E-04**	
Radionuclides					
Americium-243(+D)	3.41E-01	1.67E-01	---	2.04E-06	Yes
Cesium-137(+D)	2.28E+02	6.06E-02	---	3.76E-03	Yes
Cobalt-60	7.60E-01	3.29E-02	---	2.31E-05	Yes
Potassium-40	2.71E+00	1.43E-01	---	1.89E-05	Yes
Thorium-232(+D)[8]	2.98E+00	2.68E-02	---	1.11E-04	Yes
Actinium-228	2.19E+00	---	---	---	---
Thorium-228	2.98E+00	---	---	---	---
Lead-212	2.01E+00	---	---	---	---
Thallium-208	5.83E-01	---	---	---	---
Uranium-238(+D)	1.98E+00	7.99E-01	---	2.48E-06	Yes
			Total Radionuclide Risk =	**3.92E-03**	
			Total Media Risk =	**4.09E-03**	

RSL = regional screening value
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-22 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.5.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.
5. Residential Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-24. Human Health Risk/Hazard Calculation for Exposure Area 5 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.77E+04	1.10E+06	0.016	---	No
Chromium[7]	5.08E+01	3.50E+03	0.015	---	No
Cobalt	9.24E+00	3.50E+02	0.026	---	No
Manganese	9.38E+02	2.60E+04	0.036	---	No
Vanadium	3.58E+01	5.80E+03	0.006	---	No
			Total Hazard Index (HI) =	**0.10**	
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	5.08E+01	6.30E+00	---	8.06E-06	Yes
Cobalt	9.24E+00	1.90E+03	---	4.87E-09	No
			Total Inorganic Risk =	**8.06E-06**	
Radionuclides					
Americium-243(+D)	3.41E-01	2.60E-01	---	1.31E-06	Yes
Cesium-137(+D)	2.28E+02	9.10E-02	---	2.50E-03	Yes
Cobalt-60	7.60E-01	4.80E-02	---	1.58E-05	Yes
Potassium-40	2.71E+00	2.20E-01	---	1.23E-05	Yes
Thorium-232(+D)[8]	2.98E+00	4.20E-02	---	7.10E-05	Yes
Actinium-228	2.19E+00	---	---	---	---
Thorium-228	2.98E+00	---	---	---	---
Lead-212	2.01E+00	---	---	---	---
Thallium-208	5.83E-01	---	---	---	---
Uranium-238(+D)	1.98E+00	1.40E+00	---	1.42E-06	Yes
			Total Radionuclide Risk =	**2.61E-03**	
			Total Media Risk =	**2.61E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-22 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.5.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-25. Human Health Risk/Hazard Calculation for E Exposure Area A 5 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.77E+04	1.87E+06	0.009	---	No
Chromium[7]	5.08E+01	5.81E+03	0.009	---	No
Cobalt	9.24E+00	5.78E+02	0.016	---	No
Manganese	9.38E+02	4.27E+04	0.022	---	No
Vanadium	3.58E+01	9.72E+03	0.004	---	No
		Total Hazard Index (HI) =	**0.06**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	5.08E+01	1.32E+01	---	3.85E-06	Yes
Cobalt	9.24E+00	3.86E+03	---	2.39E-09	No
			Total Inorganic Risk =	**3.85E-06**	
Radionuclides					
Americium-243(+D)	3.41E-01	5.39E-01	---	6.33E-07	No
Cesium-137(+D)	2.28E+02	1.80E-01	---	1.27E-03	Yes
Cobalt-60	7.60E-01	8.32E-02	---	9.13E-06	Yes
Potassium-40	2.71E+00	4.56E-01	---	5.93E-06	Yes
Thorium-232(+D)[8]	2.98E+00	8.85E-02	---	3.37E-05	Yes
Actinium-228	2.19E+00	---	---	---	---
Thorium-228	2.98E+00	---	---	---	---
Lead-212	2.01E+00	---	---	---	---
Thallium-208	5.83E-01	---	---	---	---
Uranium-238(+D)	1.98E+00	2.91E+00	---	6.81E-07	No
			Total Radionuclide Risk =	**1.32E-03**	
			Total Media Risk =	**1.32E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-22 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.5.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-26. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 5

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	1.57E+02	µg/L	---	---	2.00E+04	NA	no
Arsenic	3.30E+00	µg/L	1.00E+01	no			
Barium	1.45E+01	µg/L	2.00E+03	no			
Beryllium	2.00E-01	µg/L	4.00E+00	no			
Calcium[3]	2.42E+03	µg/L	NA	---	NA	NA	---
Copper	1.83E+00	µg/L	1.30E+03	no			
Cyanide	5.00E+00	µg/L	2.00E+02	no			
Iron	1.76E+03	µg/L	---	---	1.40E+04	NA	no
Lead	2.58E+00	µg/L	1.50E+01	no			
Magnesium[3]	5.37E+02	µg/L	NA	---	NA	NA	---
Manganese	4.91E+01	µg/L	---	---	4.30E+02	NA	no
Potassium[3]	5.15E+02	µg/L	NA	---	NA	NA	---
Sodium[3]	2.15E+03	µg/L	NA	---	NA	NA	---
Vanadium	8.14E-01	µg/L	---	---	8.60E+01	NA	no
Zinc	9.37E+00	µg/L	---	---	6.00E+03	7.40E+04	no
Organics							
2-Chlorophenol	4.56E-01	µg/L	---	---	9.10E+01	8.10E+01	no
Acetone	4.36E+00	µg/L	---	---	1.40E+04	NA	no
Naphthalene	2.22E-01	µg/L	---	---	1.70E-01	NA	YES
Methylene chloride	5.80E-01	µg/L	5.00E+00	no			
Pesticides/PCBs							
DDE	2.88E-02	µg/L	---	---	4.60E-02	2.20E-04	no
DDT	6.60E-02	µg/L	---	---	2.30E-01	2.20E-03	no
Radionuclides							
Bismuth-214	7.02E+01	pCi/L	1.50E+01	YES			
Gross Alpha	1.22E+01	pCi/L	---	---	NA	NA	---
Lead-214	4.97E+01	pCi/L	---	---	1.30E+02	NA	no
Non-volatile Beta	9.96E+00	pCi/L	---	---	NA	NA	---
Tritium	2.99E+03	pCi/L	2.00E+04	no			

AWQC = ambient water quality criteria
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.5.2).
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-27. Human Health COPC Screening for Exposure Area 6 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	1.82E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Antimony	1.10E+01	3.10E+00	0.1xRSL	YES	4.74E+00	YES	YES
Arsenic	7.67E+00	6.80E-01	RSL	YES	3.50E+00	YES	YES
Barium	1.47E+02	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	1.33E+00	1.60E+01	0.1xRSL	no	7.73E-01	YES	no
Cadmium	5.90E-01	7.10E+00	0.1xRSL	no	3.69E-01	YES	no
Calcium	1.46E+03	EN[6]	Nutrient	no	1.12E+03	YES	no
Chromium[7]	2.51E+01	3.0E-01	RSL	YES	1.42E+01	YES	YES
Chromium VI	6.20E-01	3.0E-01	RSL	YES	NA[8]	---	YES
Chloride	1.65E+01	---	---	---	5.06E+00	YES	no
Cobalt	7.75E+00	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	7.03E+00	3.10E+02	0.1xRSL	No	6.52E+00	YES	no
Cyanide	3.40E+00	2.30E+00	0.1XRSL	YES	NA[8]	---	YES
Iron	2.78E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	1.79E+01	4.00E+01	0.1xRSL	no	1.10E+01	Yes	no
Magnesium	3.03E+02	EN[6]	Nutrient	no	2.75E+02	Yes	no
Manganese	2.66E+02	1.80E+02	0.1xRSL	YES	1.36E+02	YES	YES
Mercury[9]	9.58E-01	7.80E-01	0.1xRSL	YES	9.92E-02	YES	YES
Nickel	9.15E+00	1.50E+02	0.1xRSL	no	4.48E+00	Yes	no
Nitrogen-Nitrate+Nitrite	1.27E+00	7.80E+02	0.1xRSL	no	1.25E+00	Yes	no
Orthophosphate	1.19E+01	---	---	---	2.07E+01	no	no
Phosphate	7.22E+02	---	---	---	1.75E+02	Yes	no
Potassium	2.26E+02	EN[6]	Nutrient	no	2.39E+02	No	no
Selenium	7.64E+00	3.90E+01	0.1xRSL	no	3.89E+00	Yes	no
Silver	9.03E-01	3.90E+01	0.1xRSL	no	1.16E+00	no	no
Sodium	3.07E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Thallium	6.89E+00	7.80E-02	0.1xRSL	YES	3.77E+00	YES	YES
Vanadium	5.71E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	3.18E+01	2.30E+03	0.1xRSL	No	1.70E+01	Yes	no
Organics (mg/kg)							
2-Chlorophenol	5.92E-02	3.90E+01	0.1xRSL	no	NA[8]	---	no
Benzoic acid	2.47E-01	2.50E+04	0.1xRSL	no	NA[8]	---	no
Bis[2-ethylhexyl]phthalate	3.05E-02	3.90E+01	RSL	no	NA[8]	---	no
Butylbenzylphthalate	3.64E-02	2.90E+02	RSL	no	NA[8]	---	no
Dibutylphthalate	2.84E-02	6.30E+02	0.1xRSL	no	NA[8]	---	no
Diethylphthalate	2.07E-02	5.10E+03	0.1xRSL	no	NA[8]	---	no
Fluoranthene	3.38E-02	2.40E+02	0.1xRSL	no	NA[8]	---	no
Phenol	4.88E-03	1.90E+03	0.1xRSL	no	NA[8]	---	no
CinnamylCinnamate	2.60E-01	---	---	---	NA[8]	---	no
Acetone	9.33E-02	6.10E+03	0.1xRSL	no	NA[8]	---	no
Carbon disulfide	1.92E-02	7.70E+01	0.1xRSL	no	NA[8]	---	no
Methyl cyclopentane	3.00E-03	---	---	no	NA[8]	---	no
Methyl ethyl ketone	2.75E-03	2.70E+03	0.1xRSL	no	NA[8]	---	no
Methyl isobutyl ketone	8.41E-04	3.30E+03	0.1xRSL	no	NA[8]	---	no
Phenols	3.15E-01	1.90E+03	0.1xRSL	no	NA[8]	---	no
Styrene	1.38E-04	6.00E+02	0.1xRSL	no	NA[8]	---	no
Toluene	3.05E-03	4.90E+02	0.1xRSL	no	NA[8]	---	no
Xylenes	4.55E-04	5.80E+01	0.1xRSL	no	NA[8]	---	no
Radionuclides (pCi/g)							
Barium-133	2.70E-01	1.68E-01	PRG	YES	NA[8]	---	YES
Cesium-134	1.30E-01	1.42E-01	PRG	no	NA[8]	---	no
Cesium-137(+D)	1.24E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-58	3.23E-02	2.40E+00	PRG	no	NA[8]	---	no
Cobalt-60	1.13E+00	3.29E-02	PRG	YES	NA[8]	---	YES
Europium-152	4.70E-01	3.87E-02	PRG	YES	NA[8]	---	YES
Europium-155	3.30E-01	3.58E+00	PRG	no	NA[8]	---	no
Manganese-54	4.92E-02	6.26E-01	PRG	no	NA[8]	---	no
Neptunium-239	3.10E+00	5.64E+02	PRG	no	NA[8]	---	no

Table B-27. Human Health COPC Screening for Exposure Area 6 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Radionuclides (pCi/g) cont'd							
Plutonium-238	6.90E-01	4.27E+02	PRG	no	2.83E-02	YES	no
Plutonium-239(+D)	4.60E-01	3.79E+00	PRG	no	NA[8]	---	no
Plutonium-239(+D)/ Plutonium-240	1.10E-01	3.79E+00	PRG	no	5.13E-02	YES	no
Potassium-40	4.38E+00	1.43E-01	PRG	YES	3.05E+00	YES	YES
Promethium-146	1.25E-02	1.20E-01	PRG	no	NA[8]	---	no
Radium-226(+D)[10]	1.46E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	1.46E+00	na[11]	---	---	---	---	---
Ruthenium-106(+D)	2.30E-01	2.07E+00	PRG	no	NA[8]	---	no
Strontium-89 and Strontium-90(+D)	1.45E+01	1.34E+01	PRG	YES	NA[8]	---	Yes
Strontium-90(+D)	1.52E+00	4.21E+00	PRG	no	7.54E-01	YES	no
Thorium-230	5.42E-01	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	2.40E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-228	1.89E+00	na[11]	---	---	---	---	---
Actinium-228	2.35E+00	na[11]	---	---	---	---	---
Thorium-228	1.12E+00	na[11]	---	---	---	---	---
Lead-212	2.40E+00	na[11]	---	---	---	---	---
Thorium-234(+D)	5.59E+00	2.72E+02	PRG	no	8.69E-01	YES	no
Tin-113	7.00E-02	2.72E+02	PRG	no	NA[8]	---	no
Uranium-233 and Uranium-234	7.44E-01	5.63E+00	PRG	no	1.28E+00	no	no
Uranium-235(+D)	1.08E-01	1.94E-01	PRG	no	6.91E-02	YES	no
Uranium-238(+D)	5.89E-01	7.99E-01	PRG	no	1.31E+00	no	no
Zinc-65	1.60E-01	1.12E+00	PRG	no	NA[8]	---	no
Zirconium-95	7.01E-02	3.54E+02	PRG	no	NA[8]	---	no

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.6.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1)
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-28. Human Health Risk/Hazard Calculation for Exposure Area 6 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	6.68E+03	7.70E+04	0.087	---	No
Antimony	1.10E+01	3.10E+01	0.355	---	No
Arsenic	3.61E+00	3.50E+01	0.103	---	Yes
Chromium[7]	8.46E+00	2.30E+02	0.037	---	No
Cobalt	5.78E-01	2.30E+01	0.025	---	No
Cyanide	6.47E-01	2.30E+01	0.028	---	No
Iron	8.50E+03	5.50E+04	0.155	---	No
Manganese	7.81E+01	1.80E+03	0.043	---	No
Mercury[8]	8.13E-02	7.80E+00	0.010	---	No
Thallium	2.76E+00	7.80E-01	3.542	---	Yes
Vanadium	2.12E+01	3.90E+02	0.054	---	No
		Total Hazard Index (HI) =	**4.4**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	3.61E+00	6.80E-01	---	5.30E-06	Yes
Chromium[7]	8.46E+00	3.00E-01	---	2.82E-05	Yes
Cobalt	5.78E-01	4.20E+02	---	1.38E-09	No
Chromium VI	6.20E-01	3.00E-01	---	2.06E-06	YES
			Total Inorganic Risk =	**3.56E-05**	
Radionuclides					
Barium-133	1.69E-02	1.68E-01	---	1.01E-07	No
Cesium-137(+D)	8.82E+00	6.06E-02	---	1.46E-04	Yes
Cobalt-60	9.66E-02	3.29E-02	---	2.94E-06	Yes
Europium-152	3.71E-02	3.87E-02	---	9.59E-07	No
Potassium-40	6.12E-01	1.43E-01	---	4.28E-06	Yes
Strontium-89 and Strontium-90(+D)	1.03E+00	4.21E+00	---	2.44E-07	No
Thorium-232(+D)[9]	1.12E+00	2.68E-02	---	4.19E-05	Yes
Actinium-228	1.08E+00	---	---	---	---
Thorium-228	1.12E+00	---	---	---	---
Lead-212	1.12E+00	---	---	---	---
			Total Radionuclide Risk =	**1.96E-04**	
			Total Media Risk =	**2.32E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-27 that were identified as constituents of potential concern from Table B-27.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.1.1.).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC / RSL.

Table B-28. Human Health Risk/Hazard Calculation for Exposure Area 6–– Sediment/Soil Media Residential Scenario *(Continued/End)*

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]

5 - Residential Risk Estimate - (EPC / RSL or PRG) x 1E-06.
6 - For noncarcinogens, no constituents are identified as COCs if the total media HI <1. If the total media HI ≥1, then the constituents are segregated based on relevant target organs. HQs are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ ≥1 and the total organ HI >1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7 - RSL for hexavalent chromium (most conservative) used.
8 - RSL for methyl mercury (most conservative) used.
9 – Ac-228, Th-228, and Pb-212, are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Constituent	Target Organ	Residential HQ	
Aluminum	Neurological	0.087	
Manganese	Neurological	0.043	
Mercury	Neurological	0.010	
		0.141	Total neurological target organ hazard index
Antimony	Whole body	0.355	Total whole body target organ hazard index
Arsenic	Skin and blood	0.103	
Thallium	Skin	3.542	Total skin target organ hazard index
Chromium	Gastrointestinal	0.037	
Iron	Gastrointestinal	0.155	
		0.191	Total gastrointestinal target organ hazard index
Vanadium	Kidney	0.054	Total kidney target organ hazard index
Cobalt	Thyroid	0.025	Total thyroid target organ hazard index
Cyanide	Testes	0.028	Total testes target organ hazard index

Table B-29. Human Health Risk/Hazard Calculation for Exposure Area 6 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	6.68E+03	1.10E+06	0.006	---	No
Antimony	1.10E+01	4.70E+02	0.023	---	No
Arsenic	3.61E+00	4.80E+02	0.008	---	No
Chromium[7]	8.46E+00	3.50E+03	0.002	---	No
Cobalt	5.78E-01	3.50E+02	0.002	---	No
Cyanide	6.47E-01	1.50E+02	0.004	---	No
Iron	8.50E+03	8.20E+05	0.010	---	No
Manganese	7.81E+01	2.60E+04	0.003	---	No
Mercury[8]	8.13E-02	1.2E+02	0.002	---	No
Thallium	2.76E+00	1.20E+01	0.230	---	No
Vanadium	2.12E+01	5.80E+03	0.004	---	No
			Total Hazard Index (HI) =	**0.29**	
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	3.61E+00	3.00E+00	---	1.20E-06	Yes
Chromium[7]	8.46E+00	6.30E+00	---	1.34E-06	Yes
Chromium VI	6.20E-01	6.60E+00	---	9.84E-08	No
Cobalt	5.78E-01	1.90E+03	---	3.04E-10	No
			Total Inorganic Risk =	**2.64E-06**	
Radionuclides					
Barium-133	1.69E-02	2.50E-01	---	6.76E-08	No
Cesium-137(+D)	8.82E+00	9.10E-02	---	9.70E-05	Yes
Cobalt-60	9.66E-02	4.80E-02	---	2.01E-06	Yes
Europium-152	3.71E-02	5.70E-02	---	6.51E-07	No
Potassium-40	6.12E-01	2.20E-01	---	2.78E-06	Yes
Strontium-89 and Strontium-90(+D)	1.03E+00	9.00E+00	---	1.14E-07	No
Thorium-232(+D)[9]	1.12E+00	4.20E-02	---	2.67E-05	Yes
Actinium-228	1.08E+00	---	---	---	---
Thorium-228	1.12E+00	---	---	---	---
Lead-212	1.12E+00	---	---	---	---
			Total Radionuclide Risk =	**1.29E-04**	
			Total Media Risk =	**1.32E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-27 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.6.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil default values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC / RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for elemental mercury (most conservative) used.
9. Ac-228, Th-228, and Pb-212, are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-30. Human Health Risk/Hazard Calculation for Exposure Area 6 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	6.68E+03	1.87E+06	0.004	---	No
Antimony	1.10E+01	7.79E+02	0.014	---	No
Arsenic	3.61E+00	7.99E+02	0.005	---	No
Chromium[7]	8.46E+00	5.81E+03	0.001	---	No
Cobalt	5.78E-01	5.78E+02	0.001	---	No
Cyanide	6.47E-01	2.46E+02	0.003	---	No
Iron	8.50E+03	1.36E+06	0.006	---	No
Manganese	7.81E+01	4.27E+04	0.002	---	No
Mercury[8]	8.13E-02	7.6E+01	0.001	---	No
Thallium	2.76E+00	1.95E+01	0.142	---	No
Vanadium	2.12E+01	9.72E+03	0.002	---	No
		Total Hazard Index (HI) =	**0.18**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	3.61E+00	6.24E+00	---	5.78E-07	No
Chromium[7]	8.46E+00	1.32E+01	---	6.41E-07	No
Chromium VI	6.20E-01	1.32E+01	---	4.70E-08	No
Cobalt	5.78E-01	3.86E+03	---	1.50E-10	No
			Total Inorganic Risk =	**1.27E-06**	
Radionuclides					
Barium-133	1.69E-02	4.56E-01	---	3.71E-08	No
Cesium-137(+D)	8.82E+00	1.80E-01	---	4.90E-05	Yes
Cobalt-60	9.66E-02	8.32E-02	---	1.16E-06	Yes
Europium-152	3.71E-02	1.08E-01	---	3.44E-07	No
Potassium-40	6.12E-01	4.56E-01	---	1.34E-06	Yes
Strontium-89 and Strontium-90(+D)	1.03E+00	1.77E+01	---	5.81E-08	No
Thorium-232(+D)[9]	1.12E+00	8.85E-02	---	1.27E-05	Yes
Actinium-228	1.08E+00	---	---	---	---
Thorium-228	1.12E+00	---	---	---	---
Lead-212	1.12E+00	---	---	---	---
			Total Radionuclide Risk =	**6.46E-05**	
			Total Media Risk =	**6.59E-05**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-27 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.6.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC / RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) x 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for elemental mercury (most conservative) used.
9. Ac-228, Th-228, and Pb-212, are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-31. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 6

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	7.86E+01	µg/L	---	---	2.00E+04	NA	no
Antimony	1.62E+00	µg/L	6.00E+00	no			
Arsenic	4.29E+00	µg/L	1.00E+01	no			
Barium	1.58E+01	µg/L	2.00E+03	no			
Cadmium	1.20E-01	µg/L	5.00E+00	no			
Calcium[3]	5.06E+03	µg/L	NA	---	NA	NA	---
Chromium	2.06E+00	µg/L	1.00E+02	no			
Cobalt	4.69E-01	µg/L	---	---	6.00E+00	1.30E+03	no
Iron	1.09E+03	µg/L	---	---	1.40E+04	0.00E+00	no
Lead	3.71E+00	µg/L	1.50E+01	no			
Magnesium[3]	7.66E+02	µg/L	NA	---	NA	NA	---
Manganese	2.00E+02	µg/L	---	---	4.30E+02	NA	no
Nickel	9.89E-01	µg/L	---	---	3.90E+02	6.10E+02	no
Potassium[3]	9.65E+02	µg/L	NA	---	NA	NA	---
Selenium	1.24E+01	µg/L	5.00E+01	no			
Sodium[3]	4.12E+03	µg/L	NA	---	NA	NA	---
Thallium	2.32E+00	µg/L	2.00E+00	YES			
Vanadium	4.18E-01	µg/L	---	---	8.60E+01	NA	no
Zinc	8.84E+00	µg/L	---	---	6.00E+03	7.40E+04	no
Organics							
Acetone	1.06E+01	µg/L	---	---	1.40E+04	NA	no
Benzo[g,h,i]perylene	3.70E-01	µg/L	---	---	NA	NA	---
Dibenz[a,h]anthracene	4.20E-01	µg/L	---	---	3.40E-03	3.80E-03	YES
Indeno[1,2,3-cd]pyrene	3.20E-01	µg/L	---	---	3.40E-02	NA	YES
Toluene	5.70E-01	µg/L	1.00E+03	no			
Xylenes	5.50E-01	µg/L	1.00E+04	no			
Radionuclides							
Cesium-137	1.81E+01	pCi/L	2.00E+02	no			
Lead-212	3.01E+01	pCi/L	---	---	1.80E+00	NA	YES
Potassium-40	4.56E+01	pCi/L	---	---	8.30E-01	NA	YES
Radium-226	1.50E+00	pCi/L	5.00E+00	no			
Radium-228	9.00E-01	pCi/L	5.00E+00	no			
Thorium-232	6.78E-01	pCi/L	1.50E+01	no			
Thorium-234	2.75E+02	pCi/L	---	---	1.90E+00	NA	YES

MCL = Maximum Contaminant Level
RSL = Regional Screening Level
PRG = Preliminary Remediation Goal
AWQC = Ambient Water Quality Criteria
1. Maximum detected concentrations from surface water samples collected from the exposure area.
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-32. Human Health Fish Ingestions Screening for Exposure Area 6 Recreational Fisherman

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?
Inorganics (mg/kg)				
Aluminum	3.54E+01	1.54E+03	RSL	no
Barium	6.11E+00	3.09E+02	RSL	no
Calcium	4.42E+04	EN[3]	---	no
Chromium[4]	2.43E-01	8.32E-03	RSL	YES
Copper	1.28E+01	6.18E+01	RSL	no
Cyanide	2.76E-01	9.27E-01	RSL	no
Iron	9.55E+01	1.08E+03	RSL	no
Magnesium	9.58E+02	EN[3]	---	no
Manganese	8.13E+01	2.16E+02	RSL	no
Mercury[5]	3.18E+00	1.54E-01	RSL	YES
Potassium	3.23E+03	EN[3]	---	no
Sodium	2.36E+03	EN[3]	---	no
Zinc	5.97E+01	4.63E+02	RSL	no
Radionuclides (pCi/g)				
Cesium-137(+D)	1.84E+01	5.44E-02	PRG	YES
Cobalt-60	4.19E-02	9.13E-02	PRG	no
Lead-212	1.31E-01	5.70E-02	PRG	YES
Manganese-54	4.11E-02	6.56E-02	PRG	no
Potassium-40	4.99E+00	5.95E-02	PRG	YES
Sodium-22	3.76E-02	1.62E-01	PRG	no
Thorium-234(+D)	1.26E+00	6.00E-02	PRG	YES
Tin-113	5.05E-02	3.16E-01	PRG	no

PRG = preliminary remediation goal
RSL = regional screening level

1. Maximum detected fish tissue concentration (see Table A.1.2.3)
2. Nonradiological RSLs for ingestion of fish are default residential values from *USEPA Regional Screening Levels calculator* (see Table B-6). Radiological PRGs for ingestion of fish are values from *USEPA Radionuclide Preliminary Remediation Goals for Superfund* calculator (see Table B-7). Websites accessed October 23, 2016.
3. EN = essential nutrient, RSL is not available.
4. RSL for hexavalent chromium used.
5. RSL for methyl mercury used.
6. Pb-212 is a daughter product of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter product is not screened separately since they it is considered in the Th-232(+D) PRG.

Table B-33. Human Health COPC Screening for Exposure Area 7 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	3.60E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Antimony	6.90E-01	3.10E+00	0.1xRSL	no	4.74E+00	no	no
Arsenic	1.49E+01	6.80E-01	RSL	YES	3.50E+00	YES	YES
Barium	1.14E+02	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	4.72E+00	1.60E+01	0.1xRSL	no	7.73E-01	YES	no
Cadmium	3.78E-01	7.10E+00	0.1xRSL	no	3.69E-01	YES	no
Calcium	8.29E+02	EN[6]	Nutrient	no	1.12E+03	YES	no
Chromium[7]	7.07E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	1.83E+01	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	2.47E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Cyanide	1.15E+00	2.30E+00	0.1xRSL	no	NA[8]	---	no
Iron	3.64E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	5.80E+01	4.00E+01	0.1xRSL	YES	1.10E+01	YES	YES
Magnesium	8.13E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	9.93E+02	1.80E+02	0.1xRSL	YES	1.36E+02	YES	YES
Mercury[9]	1.15E+00	7.80E-01	0.1xRSL	YES	9.92E-02	YES	YES
Nickel	9.83E+00	1.50E+02	0.1xRSL	no	4.48E+00	YES	no
Potassium	4.29E+02	EN[6]	Nutrient	no	2.39E+02	YES	no
Selenium	3.63E+00	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Silver	3.25E-01	3.90E+01	0.1xRSL	no	1.16E+00	no	no
Sodium	5.36E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Thallium	3.19E+00	7.80E-02	0.1xRSL	YES	3.77E+00	no	no
Vanadium	6.52E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	7.68E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics (mg/kg)							
Acetone	3.80E-01	6.10E+03	0.1xRSL	no	---	---	no
Bis[2-ethylhexyl]phthalate	5.29E-02	3.90E+01	RSL	no	---	---	no
Carbon disulfide	1.30E-03	7.70E+01	0.1xRSL	no	---	---	no
Chloroform	4.84E-04	3.20E-01	RSL	no	---	---	no
Methyl acetate	2.17E-02	7.80E+03	0.1xRSL	no	---	---	no
Methyl ethyl ketone	3.40E-02	2.70E+03	0.1xRSL	no	---	---	no
Toluene	1.43E-02	4.90E+02	0.1xRSL	no	---	---	no
Xylenes	5.17E-04	5.80E+01	0.1xRSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDD	1.07E-03	2.30E+00	RSL	no	---	---	no
DDE	4.10E-03	2.00E+00	RSL	no	---	---	no
DDT	8.19E-03	1.90E+00	RSL	no	---	---	no
PCB-1254	2.04E-02	2.40E-01	0.1xRSL	no	---	---	no
PCB-1260	9.40E-03	2.40E-01	RSL	no	---	---	no
Radionuclides (pCi/g)							
Americium-241	8.80E-01	2.27E+00	PRG	no	3.55E-02	YES	no
Americium-243(+D)	4.70E-02	1.67E-01	PRG	no	NA[8]	---	no
Cesium-137(+D)	1.49E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-60	1.55E+01	3.29E-02	PRG	YES	NA[8]	---	YES
Curium-243 and Curium-244	9.80E-02	5.90E-02	PRG	YES	1.85E-01	no	no
Plutonium-238	9.40E-02	4.27E+00	PRG	no	2.83E-02	YES	no
Potassium-40	5.29E+01	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	1.24E+01	1.38E-02	PRG	YES	9.14E+00	YES	YES
Lead-210	1.90E+00	NA[11]	---	---	---	---	---
Lead-214	1.22E+01	NA[11]	---	---	---	---	---
Bismuth-214	1.24E+01	NA[11]	---	---	---	---	---
Thorium-230	1.43E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-231	9.60E-01	2.79E+04	PRG	no	NA[8]	---	No
Thorium-232(+D)[12]	4.59E+01	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-224	4.59E+01	NA[11]	---	---	---	---	---
Radium-228	2.61E+00	NA[11]	---	---	---	---	---
Actinium-228	7.61E+00	NA[11]	---	---	---	---	---

Table B-33. Human Health COPC Screening for E Exposure Area 7 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Lead-212	7.16E+00	NA[11]	---	---	---	---	---
Bismuth-212	8.80E+00	NA[11]	---	---	---	---	---
Thallium-208	3.21E+00	NA[11]	---	---	---	---	---
Thorium-228	5.11E+00	NA[11]	---	---	---	---	---
Thorium-234(+D)	5.70E+00	2.72E+02	PRG	no	8.69E-01	YES	no
Uranium-233/Uranium-234	1.33E+00	5.63E+00	PRG	no	1.28E+00	YES	no
Uranium-235(+D)	3.60E-01	1.94E-01	PRG	YES	6.91E-02	YES	YES
Uranium-238(+D)	1.80E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.7.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1)
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-210, Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-34. Human Health Risk/Hazard Calculation for Exposure Area 7 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	8.61E+03	7.70E+04	0.112	---	No
Arsenic	2.57E+00	3.50E+01	0.073	---	No
Chromium[7]	1.46E+01	2.30E+02	0.063	---	No
Cobalt	5.26E+00	2.30E+01	0.229	---	No
Iron	1.09E+04	5.50E+04	0.198	---	No
Lead	2.19E+01	4.00E+02	0.055	---	No
Manganese	1.09E+02	1.80E+03	0.061	---	No
Mercury[8]	2.97E-01	7.80E+00	0.038	---	No
Vanadium	2.69E+01	3.90E+02	0.069	---	No
		Total Hazard Index (HI) =	**0.90**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	2.57E+00	6.80E-01	---	3.77E-06	Yes
Chromium[7]	1.46E+01	3.00E-01	---	4.86E-05	Yes
Cobalt	5.26E+00	4.20E+02	---	1.25E-08	No
			Total Inorganic Risk =	**5.24E-05**	
Radionuclides					
Cesium-137(+D)	1.39E+02	6.06E-02	---	2.29E-03	Yes
Cobalt-60	8.02E-01	3.29E-02	---	2.44E-05	Yes
Potassium-40	6.99E+00	1.43E-01	---	4.89E-05	Yes
Radium-226(+D)[9]	2.43E+00	1.38E-02	---	1.76E-04	Yes
Lead-210	1.90E+00	---	---	---	---
Lead-214	2.43E+00	---	---	---	---
Bismuth-214	2.09E+00	---	---	---	---
Thorium-232(+D)[10]	2.61E+01	2.68E-02	---	9.75E-04	Yes
Radium-224	2.61E+01	---	---	---	---
Actinium-228	1.38E+00	---	---	---	---
Thorium-228	2.40E+00	---	---	---	---
Lead-212	1.47E+00	---	---	---	---
Bismuth-212	1.23E+00	---	---	---	---
Thallium-208	6.36E-01	---	---	---	---
Uranium-235(+D)	8.22E-02	1.94E-01	---	4.24E-07	No
Uranium-238(+D)	8.11E-01	7.99E-01	---	1.02E-06	Yes
			Total Radionuclide Risk =	**3.52E-03**	
			Total Media Risk =	**3.57E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-33 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.7.1.1).
3. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC/RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for methyl mercury (most conservative) used.
9. Radium-226 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.
10. Thorium-232 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.

Table B-35. Human Health Risk/Hazard Calculation for Exposure Area 7 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	8.61E+03	1.10E+06	0.008	---	No
Arsenic	2.57E+00	4.80E+02	0.005	---	No
Chromium[7]	1.46E+01	3.50E+03	0.004	---	No
Cobalt	5.26E+00	3.50E+02	0.015	---	No
Iron	1.09E+04	8.20E+05	0.013	---	No
Lead	2.19E+01	8.00E+02	0.027	---	No
Manganese	1.09E+02	2.60E+04	0.004	---	No
Mercury[8]	2.97E-01	1.20E+02	0.002	---	No
Vanadium	2.69E+01	5.80E+03	0.005	---	No
		Total Hazard Index (HI) =	**0.088**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	2.57E+00	3.00E+00	---	8.55E-07	No
Chromium[7]	1.46E+01	6.30E+00	---	2.31E-06	Yes
Cobalt	5.26E+00	1.90E+03	---	2.77E-09	No
			Total Inorganic Risk =	**3.17E-06**	
Radionuclides					
Cesium-137(+D)	1.39E+02	9.10E-02	---	1.53E-03	Yes
Cobalt-60	8.02E-01	4.80E-02	---	1.67E-05	Yes
Potassium-40	6.99E+00	2.20E-01	---	3.18E-05	Yes
Radium-226(+D)[9]	2.43E+00	5.20E-02	---	4.68E-05	Yes
Lead-210	1.90E+00	---	---	---	---
Lead-214	2.42E+00	---	---	---	---
Bismuth-214	2.09E+00	---	---	---	---
Thorium-232(+D)[10]	2.61E+01	4.20E-02	---	6.22E-04	Yes
Radium-224	2.61E+01	---	---	---	---
Actinium-228	1.38E+00	---	---	---	---
Thorium-228	2.40E+00	---	---	---	---
Lead-212	1.47E+00	---	---	---	---
Bismuth-212	1.23E+00	---	---	---	---
Thallium-208	6.36E-01	---	---	---	---
Uranium-235(+D)	8.22E-02	3.00E-01	---	2.74E-07	No
Uranium-238(+D)	8.11E-01	1.40E+00	---	5.79E-07	No
			Total Radionuclide Risk =	**2.25E-03**	
			Total Media Risk =	**2.25E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-33 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.7.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC/RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for elemental mercury (most conservative) used.
9. Radium-226 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.
10. Thorium-232 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.

Table B-36. Human Health Risk/Hazard Calculation for Exposure Area 7 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	8.61E+03	1.87E+06	0.005	---	No
Arsenic	2.57E+00	7.99E+02	0.003	---	No
Chromium[7]	1.46E+01	5.81E+03	0.003	---	No
Cobalt	5.26E+00	5.78E+02	0.009	---	No
Iron	1.09E+04	1.36E+06	0.008	---	No
Lead	2.19E+01	8.00E+02	0.027	---	No
Manganese	1.09E+02	4.27E+04	0.003	---	No
Mercury[8]	2.97E-01	1.95E+02	0.002	---	No
Vanadium	2.69E+01	9.72E+03	0.003	---	No
		Total Hazard Index (HI) =	**0.08**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	2.57E+00	6.24E+00	---	4.11E-07	No
Chromium[7]	1.46E+01	1.32E+01	---	1.10E-06	Yes
Cobalt	5.26E+00	3.86E+03	---	1.36E-09	No
			Total Inorganic Risk =	**1.52E-06**	
Radionuclides					
Cesium-137(+D)	1.39E+02	1.80E-01	---	7.72E-04	Yes
Cobalt-60	8.02E-01	8.32E-02	---	9.64E-06	Yes
Potassium-40	6.99E+00	4.56E-01	---	1.53E-05	Yes
Radium-226(+D)[9]	2.43E+00	4.36E-02	---	5.58E-05	Yes
Lead-210	1.90E+00	---	---	---	---
Lead-214	2.42E+00	---	---	---	---
Bismuth-214	2.09E+00	---	---	---	---
Thorium-232(+D)[10]	2.61E+01	8.85E-02	---	2.95E-04	Yes
Radium-224	2.61E+01	---	---	---	---
Actinium-228	1.38E+00	---	---	---	---
Thorium-228	2.40E+00	---	---	---	---
Lead-212	1.47E+00	---	---	---	---
Bismuth-212	1.23E+00	---	---	---	---
Thallium-208	6.36E-01	---	---	---	---
Uranium-235(+D)	8.22E-02	6.27E-01	---	1.31E-07	No
Uranium-238(+D)	8.11E-01	2.91E+00	---	2.79E-07	No
			Total Radionuclide Risk =	**1.15E-03**	
			Total Media Risk =	**1.15E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-33 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.7.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC/RSL
5. Onsite Workerl Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for methyl mercury (most conservative) used.
9. Radium-226 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.
10. Thorium-232 is assumed to be in secular equilibrium; therefore, EPC is the highest for the daughter products detected.

Table B-37. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 7

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	9.36E+03	µg/L	---	---	2.00E+04	NA	no
Arsenic	3.95E+00	µg/L	1.00E+01	no			
Barium	9.02E+01	µg/L	2.00E+03	no			
Beryllium	3.20E-01	µg/L	4.00E+00	no			
Cadmium	3.69E-01	µg/L	5.00E+00	no			
Calcium[3]	7.59E+03	µg/L	NA	---	NA	NA	---
Chromium	1.74E+01	µg/L	1.00E+02	no			
Cobalt	5.60E+00	µg/L	---	---	6.00E+00	NA	no
Copper	6.88E+00	µg/L	1.30E+03	no			
Cyanide	4.23E+00	µg/L	2.00E+02	no			
Iron	3.63E+04	µg/L	---	---	1.40E+04	NA	YES
Lead	7.53E+00	µg/L	1.50E+01	no			
Magnesium[3]	1.51E+03	µg/L	NA	---	NA	NA	---
Manganese	3.38E+03	µg/L	---	---	4.30E+02	NA	YES
Mercury	1.50E-01	µg/L	2.00E+00	no			
Nickel	3.40E+00	µg/L	---	---	3.90E+02	NA	no
Potassium[3]	2.97E+03	µg/L	NA	---	NA	NA	---
Selenium	4.00E+00	µg/L	5.00E+01	no			
Sodium[3]	3.99E+03	µg/L	NA	---	NA	NA	---
Thallium	1.40E+00	µg/L	2.00E+00	no			
Vanadium	1.90E+01	µg/L	---	---	8.60E+01	NA	no
Zinc	3.01E-02	µg /L	---	---	6.00E+03	7.40E+01	no
Organics							
DDE	7.00E-03	µg/L	---	---	4.60E-02	2.20E-07	no
DDT	6.32E-02	µg/L	---	---	2.30E-01	2.20E-06	no
Endrin ketone	5.28E-03	µg/L	2.00E+00	no			
Bis[2-ethylhexyl]phthalate	1.40E+00	µg/L	6.00E+00	no			
Caprolactam	9.97E+00	µg/L	---	---	9.90E+03	NA	no
Diethylphthalate	1.60E+00	µg/L	---	---	1.50E+04	NA	no
m,p-Cresol	5.55E+00	µg/L	---	---	9.30E+02	NA	no
Phenol	7.64E-01	µg/L	---	---	5.80E+03	1.00E+01	no
Acetone	6.76E+00	µg/L	---	---	1.40E+04	NA	no
Chloromethane	2.10E-01	µg/L	---	---	1.90E+02	NA	no
Toluene	5.33E+00	µg/L	1.00E+03	no			
Trichloroethene	4.33E-01	µg/L	5.00E+00	no			
Radionuclides							
Bismuth-214	8.07E+01	pCi/L	1.50E+01	YES			
Cesium-137	7.60E+00	pCi/L	2.00E+02	no			
Lead-212	1.70E+01	pCi/L	---	---	1.80E+00	NA	YES
Lead-214	1.10E+02	pCi/L	---	---	1.30E+02	NA	no
Strontium-89 and Strontium-90	2.97E+00	pCi/L	8.00E+00	no			
Tritium	1.25E+04	pCi/L	2.00E+04	no			

AWQC = ambient water quality criterion
MCL = maximum contaminant level
PRG = preliminary remediation goal
RSL = regional screening level
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.7.2).
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-38. Human Health COPC Screening for Exposure Area 8 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics *(mg/kg)*							
Aluminum	3.69E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Antimony	1.29E+00	3.10E+00	0.1xRSL	no	4.74E+00	no	no
Arsenic	7.85E+00	6.80E-01	RSL	YES	3.50E+00	YES	YES
Barium	1.18E+02	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	1.70E+00	1.60E+01	0.1xRSL	no	7.73E-01	YES	no
Cadmium	5.49E-01	7.10E+00	0.1xRSL	no	3.69E-01	YES	no
Calcium	5.65E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	1.45E+02	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	1.33E+01	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	3.68E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Cyanide	2.60E+00	2.30E+00	0.1xRSL	YES	NA[8]	---	YES
Iron	3.72E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	9.81E+01	4.00E+01	0.1xRSL	YES	1.10E+01	YES	YES
Magnesium	1.67E+03	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	2.63E+02	1.80E+02	0.1xRSL	YES	1.36E+02	YES	YES
Mercury[9]	1.27E+00	7.80E-01	0.1xRSL	YES	9.92E-02	YES	YES
Nickel	1.71E+01	1.50E+02	0.1xRSL	no	4.48E+00	YES	no
Potassium	9.16E+02	EN[6]	Nutrient	no	2.39E+02	YES	no
Selenium	2.87E+00	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Silver	4.39E-01	3.90E+01	0.1xRSL	no	1.16E+00	no	no
Sodium	6.14E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Thallium	2.21E+00	7.80E-02	0.1xRSL	YES	3.77E+00	no	no
Vanadium	7.34E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	1.21E+02	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics *(mg/kg)*							
Acetone	1.05E+00	6.10E+03	0.1xRSL	no	---	---	no
Bis[2-ethylhexyl]phthalate	2.20E-01	3.90E+01	RSL	no	---	---	no
Carbon disulfide	8.77E-03	7.70E+01	0.1xRSL	no	---	---	no
Methyl ethyl ketone	6.31E-02	2.70E+03	0.1xRSL	no	---	---	no
Toluene	7.64E-03	4.90E+02	0.1xRSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDD	3.70E-01	2.30E+00	RSL	no	---	---	no
DDE	5.11E-01	2.00E+00	RSL	no	---	---	no
DDT	2.74E-01	1.90E+00	RSL	no	---	---	no
PCB-1242	6.38E-02	2.30E-01	RSL	no	---	---	no
PCB-1254	1.01E-01	2.40E-01	0.1xRSL	no	---	---	no
Radionuclides *(pCi/g)*							
Americium-241	3.38E-01	2.27E+00	PRG	no	3.55E-02	YES	no
Cesium-137(+D)	1.26E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-60	5.86E-01	3.29E-02	PRG	YES	NA[8]	---	YES
Plutonium-238	3.50E-02	4.27E+00	PRG	no	2.83E-02	YES	no
Potassium-40	2.27E+01	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	8.15E+00	1.38E-02	PRG	YES	9.14E+00	no	no
Lead-214	8.15E+00	NA[11]	---	---	---	---	---
Bismuth-214	8.10E+00	NA[11]	---	---	---	---	---
Thorium-230	1.37E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	4.16E+01	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-224	4.16E+01	NA[11]	---	---	---	---	---
Radium-228	3.07E+00	NA[11]	---	---	---	---	---
Actinium-228	7.51E+00	NA[11]	---	---	---	---	---
Thorium-228	2.32E+00	NA[11]	---	---	---	---	---
Lead-212	6.59E+00	NA[11]	---	---	---	---	---
Bismuth-212	7.53E+00	NA[11]	---	---	---	---	---
Thallium-208	2.32E+00	NA[11]	---	---	---	---	---
Uranium-233 and Uranium-234	1.90E+00	5.63E+00	PRG	no	1.28E+00	YES	no
Uranium-238(+D)	1.42E+00	7.99E-01	PRG	YES	1.31E+00	YES	YES

Table B-38. Human Health COPC Screening for Exposure Area 8 – Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.8.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-39. Human Health Risk/Hazard Calculation for Exposure Area 8 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.39E+04	7.70E+04	0.180	---	No
Arsenic	2.89E+00	3.50E+01	0.083	---	No
Chromium[7]	4.90E+01	2.30E+02	0.213	---	No
Cobalt	4.49E+00	2.30E+01	0.195	---	No
Cyanide	2.33E+00	2.30E+01	0.101	---	No
Iron	1.74E+04	5.50E+04	0.316	---	No
Lead	3.37E+01	4.00E+02	0.084	---	No
Manganese	9.52E+01	1.80E+03	0.053	---	No
Mercury[8]	3.67E-01	7.80E+00	0.047	---	No
Vanadium	4.29E+01	3.90E+02	0.110	---	No
		Total Hazard Index (HI) =	**1.38**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	2.89E+00	6.80E-01	---	4.25E-06	Yes
Chromium[7]	4.90E+01	3.00E-01	---	1.63E-04	Yes
Cobalt	4.49E+00	4.20E+02	---	1.07E-08	No
			Total Inorganic Risk =	**1.68E-04**	
Radionuclides					
Cesium-137(+D)	5.03E+01	6.06E-02	---	8.30E-04	Yes
Cobalt-60	5.64E-02	3.29E-02	---	1.71E-06	Yes
Potassium-40	9.05E+00	1.43E-01	---	6.33E-05	Yes
Thorium-232(+D)[9]	3.00E+01	2.68E-02	---	1.12E-03	Yes
Radium-224	3.00E+01	---	---	---	---
Actinium-228	2.78E+00	---	---	---	---
Thorium-228	1.71E+00	---	---	---	---
Lead-212	2.38E+00	---	---	---	---
Bismuth=212	3.25E+00	---	---	---	---
Thallium-208	1.06E+00	---	---	---	---
Uranium-238(+D)	9.72E-01	7.99E-01	---	1.22E-06	Yes
			Total Radionuclide Risk =	**2.01E-03**	
			Total Media Risk =	**2.18E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-38 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.8.1.1).
3. Nonradiological RSLs are residential soil default values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC/RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. If the total media HI ≥1, then the constituents are segregated based on relevant target organs. HQs are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ≥1 and the total organ HI >1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.

Table B-39. Human Health Risk/Hazard Calculation for Exposure Area 8 – Sediment/Soil Media Residential Scenario *(Continued/End)*

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]

8. RSL for methyl mercury (most conservative) used.
9. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Constituent	Target Organ	Residential HQ	
Aluminum	Neurological	0.180	
Lead	Neurological	0.084	
Manganese	Neurological	0.053	
Mercury[8]	Neurological	0.047	
		0.364	Total neurological target organ hazard index
Arsenic	Skin and blood	0.083	Total skin target organ hazard index
Chromium[7]	Gastrointestinal	0.213	
Iron	Gastrointestinal	0.316	
		0.529	Total gastrointestinal target organ hazard index
Vanadium	Kidney	0.110	Total kidney target organ hazard index
Cobalt	Thyroid	0.195	Total thyroid target organ hazard index
Cyanide	Testes	0.101	Total testes target organ hazard index

Table B-40. Human Health Risk/Hazard Calculation for Exposure Area 8 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	1.39E+04	1.10E+06	0.013	---	No
Arsenic	2.89E+00	4.80E+02	0.006	---	No
Chromium[7]	4.90E+01	3.50E+03	0.014	---	No
Cobalt	4.49E+00	3.50E+02	0.013	---	No
Cyanide	2.33E+00	1.50E+02	0.016	---	No
Iron	1.74E+04	8.20E+05	0.021	---	No
Lead	3.37E+01	8.00E+02	0.042	---	No
Manganese	9.52E+01	2.60E+04	0.004	---	No
Mercury[8]	3.67E-01	1.2E+02	0.003	---	No
Vanadium	4.29E+01	5.80E+03	0.007	---	No
		Total Hazard Index (HI) =	**0.14**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Arsenic	2.89E+00	3.00E+00	---	9.63E-07	No
Chromium[7]	4.90E+01	6.30E+00	---	7.78E-06	Yes
Cobalt	4.49E+00	1.90E+03	---	2.36E-09	No
			Total Inorganic Risk =	**8.74E-06**	
Radionuclides					
Cesium-137(+D)	5.03E+01	9.10E-02	---	5.53E-04	Yes
Cobalt-60	5.64E-02	4.80E-02	---	1.18E-06	Yes
Potassium-40	9.05E+00	2.20E-01	---	4.11E-05	Yes
Thorium-232(+D)[9]	3.00E+01	4.20E-02	---	7.13E-04	Yes
Radium-224	3.00E+01	---	---	---	---
Actinium-228	2.78E+00	---	---	---	---
Thorium-228	1.71E+00	---	---	---	---
Lead-212	2.38E+00	---	---	---	---
Bismuth=212	3.25E+00	---	---	---	---
Thallium-208	1.06E+00	---	---	---	---
Uranium-238(+D)	9.72E-01	1.40E+00	---	6.08E-07	No
			Total Radionuclide Risk =	**1.31E-03**	
			Total Media Risk =	**1.32E-03**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-38 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.8.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC/RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for elemental mercury (most conservative) used.
9. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-41. Human Health Risk/Hazard Calculation for Exposure Area 8 –Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics (mg/kg)					
Aluminum	1.39E+04	1.87E+06	0.007	---	No
Arsenic	2.89E+00	7.99E+02	0.004	---	No
Chromium[7]	4.90E+01	5.81E+03	0.008	---	No
Cobalt	4.49E+00	5.78E+02	0.008	---	No
Cyanide	2.33E+00	2.46E+02	0.009	---	No
Iron	1.74E+04	1.36E+06	0.013	---	No
Lead	3.37E+01	8.00E+02	0.042	---	No
Manganese	9.52E+01	4.27E+04	0.002	---	No
Mercury[8]	3.67E-01	1.95E+02	0.002	---	No
Vanadium	4.29E+01	9.72E+03	0.004	---	No
		Total Hazard Index (HI) =	**0.10**		
Carcinogenic Risk Estimate					
Inorganics (mg/kg)					
Arsenic	2.89E+00	6.24E+00	---	4.63E-07	No
Chromium[7]	4.90E+01	1.32E+01	---	3.71E-06	Yes
Cobalt	4.49E+00	3.86E+03	---	1.16E-09	No
			Total Inorganic Risk =	**4.18E-06**	
Radionuclides					
Cesium-137(+D)	5.03E+01	1.80E-01	---	2.80E-04	Yes
Cobalt-60	5.64E-02	8.32E-02	---	6.78E-07	No
Potassium-40	9.05E+00	4.56E-01	---	1.89E-05	Yes
Thorium-232(+D)[9]	3.00E+01	8.85E-02	---	3.39E-04	Yes
Radium-224	3.00E+01	---	---	---	---
Actinium-228	2.78E+00	---	---	---	---
Thorium-228	1.71E+00	---	---	---	---
Lead-212	2.38E+00	---	---	---	---
Bismuth-212	3.25E+00	---	---	---	---
Thallium-208	1.06E+00	---	---	---	---
Uranium-238(+D)	9.72E-01	2.91E+00	---	3.34E-07	No
			Total Radionuclide Risk =	**6.39E-04**	
			Total Media Risk =	**6.43E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-38 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.8.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC/RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. RSL for elemental mercury (most conservative) used.
9. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-42. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 8

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Inorganics							
Aluminum	1.34E+03	µg/L	---	---	2.00E+04	NA	no
Barium	3.54E+01	µg/L	2.00E+03	no			
Beryllium	3.20E-01	µg/L	4.00E+00	no			
Cadmium	2.70E-01	µg/L	5.00E+00	no			
Calcium[3]	1.12E+04	µg/L	NA	---	NA	NA	---
Chromium	1.14E+00	µg/L	1.00E+02	no			
Cobalt	1.10E+00	µg/L	---	---	6.00E+00	1.30E+03	no
Copper	2.92E+00	µg/L	1.30E+03	no			
Cyanide	1.85E+00	µg/L	2.00E+02	no			
Iron	5.99E+03	µg/L	---	---	1.40E+04	NA	no
Lead	1.74E+00	µg/L	1.50E+01	no			
Magnesium[3]	1.04E+03	µg/L	NA	---	NA	NA	---
Manganese	4.60E+02	µg/L	---	---	4.30E+02	NA	YES
Nickel	9.20E-01	µg/L	---	---	3.90E+02	6.10E+02	no
Potassium[3]	3.97E+02	µg/L	NA	---	NA	NA	---
Sodium[3]	2.86E+03	µg/L	NA	---	NA	NA	---
Thallium	1.10E+00	µg/L	2.00E+00	no			
Vanadium	1.12E+01	µg/L	---	---	8.60E+01	NA	no
Zinc	3.10E+01	µg/L	---	---	6.00E+03	7.40E+04	no
Organic							
2-Chloronaphthalene	9.62E-01	µg/L	---	---	---	---	---
2-Chlorophenol	9.62E+00	µg/L	---	---	9.10E+01	8.10E+01	no
2-Methylnaphthalene	9.62E-01	µg/L	---	---	3.60E+01	NA	no
2-Nitroaniline	9.62E+00	µg/L	---	---	1.90E+02	NA	no
2-Nitrophenol	9.62E+00	µg/L	---	---	1.90E+02	NA	no
2,4-Dichlorophenol	9.62E+00	µg/L	---	---	4.60E+01	NA	no
2,4-Dimethylphenol	9.62E+00	µg/L	---	---	---	---	---
2,4-Dinitrophenol	1.92E+01	µg/L	---	---	3.90E+00	NA	YES
2,4-Dinitrotoluene	9.62E+00	µg/L	---	---	2.40E-01	7.70E+01	YES
2,4,5-Trichlorophenol	9.62E+00	µg/L	---	---	1.20E+03	NA	no
2,4,6-Trichlorophenol	9.62E+00	µg/L	---	---	4.10E+00	1.40E+00	YES
2,6-Dinitrotoluene	9.62E+00	µg/L	---	---	4.90E-05	NA	YES
3-Nitroanaline	9.62E+00	µg/L	---	---	3.80E+00	NA	YES
3,3-Dichlorobenzidine	9.62E+00	µg/L	---	---	1.30E-01	NA	YES
4-Bromophenyl phenyl ether	9.62E+00	µg/L	---	---	---	---	---
4-Chloraniline	9.62E+00	µg/L	---	---	3.70E-01	NA	YES
4-Chloro-m-cresol	9.62E+00	µg/L	---	---	9.30E+02	NA	no
4-Chlorophenylphenyl ether	9.62E+00	µg/L	---	---	---	---	---
4-Nitroaniline	9.62E+00	µg/L	---	---	3.80E+00	7.80E+00	YES
4-Nitrophenol	9.62E+00	µg/L	---	---	---	---	---
4,6-Dinitro-2-Methylphenol	9.62E+00	µg/L	---	---	---	---	---
Acenaphthene	9.62E-01	µg/L	---	---	5.30E+02	NA	no
Acenaphthylene	9.62E-01	µg/L	---	---	---	---	---
Acetone	2.33E+00	µg/L	---	---	1.40E+04	NA	no
Acetophenone	9.62E+00	µg/L	---	---	2.00E+04	NA	no
Anthracene	9.62E-01	µg/L	---	---	1.80E+03	8.30E+03	no
Benzaldehyde	9.62E+00	µg/L	---	---	1.90E+01	NA	no
Benzo[a]anthracene	9.62E-01	µg/L	---	---	1.20E-02	3.80E-03	YES
Benzo[a]pyrene	9.62E-01	µg/L	2.00E+00	no			
Benzo[b]fluoranthene	9.62E-01	µg/L	---	---	3.40E-02	3.80E-03	YES
Benzo[g,h,i]perylene	9.62E-01	µg/L	---	---	---	---	---
Benzo[k]fluoranthene	9.62E-01	µg/L	---	---	3.40E-01	3.80E-03	YES
Biphenyl	9.62E+00	µg/L	---	---	8.30E-01	NA	YES
Bis[2-chloroethoxy]methane	9.62E+00	µg/L	---	---	5.90E+01	NA	no
Bis[2-chloroethyl]ether	9.62E+00	µg/L	---	---	1.40E-02	3.00E-02	YES
Bis[2-chloroisopropyl]ether	9.62E+00	µg/L	---	---	---	---	---
Bis[2-ethylhexyl]phthalate	9.62E+00	µg/L	6.00E+00	YES			
Butylbenzylphthalate	9.62E+00	µg/L	---	---	1.60E+01	1.50E+03	no

Table B-42. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 8 *(Continued/End)*

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC[2]	Result > RSL/PRG or AWQC?
Organic							
Caprolactam	1.08E+01	µg/L	---	---	9.90E+03	NA	no
Carbazole	9.62E+00	µg/L	---	---	---	---	---
Chrysene	9.62E-01	µg/L	---	---	3.40E+00	3.80E-03	no
Dibenz[a,h]anthracene	9.62E-01	µg/L	---	---	3.40E-03	3.80E-03	YES
Dibenzofuran	9.62E+00	µg/L	---	---	---	---	---
Dibutylphthalate	9.62E+00	µg/L	---	---	9.00E+02	NA	no
Diethylphthalate	9.62E+00	µg/L	---	---	1.50E+04	NA	no
Dimethylphthalate	9.62E+00	µg/L	---	---	---	---	---
Dioctylphthalate	9.62E+00	µg/L	---	---	5.60E+00	6.00E+00	YES
Diphenylamine	9.62E+00	µg/L	---	---	3.10E+02	NA	no
Fluoranthene	9.62E-01	µg/L	---	---	8.00E+02	1.30E+02	no
Fluorene	9.62E-01	µg/L	---	---	2.90E+02	1.10E+03	no
Hexachlorobenzene	9.62E+00	µg/L	1.00E+00	YES			
Hexachlorobutadiene	9.62E+00	µg/L	---	---	1.40E-01	4.40E-01	YES
Hexachlorocyclopentadiene	9.62E+00	µg/L	5.00E+01	no			
Hexachloroethane	9.62E+00	µg/L	---	---	3.30E-01	1.40E+01	YES
Indeno[1,2,3-cd]pyrene	9.62E-01	µg/L	---	---	3.40E-02	NA	YES
Isophorone	9.62E+00	µg/L	---	---	7.80E+01	3.50E+01	no
m,p-Cresol	9.62E+00	µg/L	---	---	9.30E+02	NA	no
N-Nitrosodipropylamine	9.62E+00	µg/L	---	---	1.10E-02	5.00E-03	YES
o-Cresol	9.62E+00	µg/L	---	---	9.30E+02	NA	no
Pentachlorophenol	9.62E+00	µg/L	1.00E+00	YES			
Phenanthrene	9.62E-01	µg/L	---	---	---	---	---
Phenol	9.62E+00	µg/L	---	---	5.80E+03	1.00E+04	no
Pyrene	9.62E-01	µg/L	---	---	1.20E+02	8.30E+02	no
Naphthalene	9.62E-01	µg/L	---	---	1.70E-01	NA	YES
Nitrobenzene	9.62E+00	µg/L	---	---	1.40E-01	1.70E+01	YES
Toluene	3.47E+00	µg/L	1.00E+03	no			
Trichloroethene	3.80E-01	µg/L	5.00E+00	no			
Pesticides/PCB							
Atrazine	9.62E+00	µg/L	3.00E+00	YES			
DDT	1.42E-02	µg/L	---	---	2.30E-01	2.20E-03	no
Radionuclides							
Lead-214	1.01E+02	pCi/L	---	---	1.30E+02	NA	no
Tritium	1.44E+03	pCi/L	2.00E+04	no			

MCL = Maximum Contaminant Level
RSL = Regional Screening Level
PRG = Preliminary Remediation Goal
AWQC = Ambient Water Quality Criteria
1. Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.8.2).
2. Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-43. Human Health Fish Ingestions Screening for E Exposure Area 8 – Recreational Fisherman

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?
Inorganics (mg/kg)				
Barium	1.21E+00	3.09E+02	RSL	no
Calcium	2.58E+04	EN[3]	---	no
Chromium[4]	2.95E-01	8.32E-03	RSL	YES
Copper	2.56E-01	6.18E+01	RSL	no
Iron	3.51E+01	1.08E+03	RSL	no
Magnesium	6.45E+02	EN[3]	---	no
Manganese	1.22E+00	2.16E+02	RSL	no
Mercury[5]	8.54E-01	1.54E-01	RSL	YES
Potassium	2.42E+03	EN[3]	---	no
Sodium	1.63E+03	EN[3]	---	no
Zinc	2.47E+01	4.63E+02	RSL	no
Radionuclides (pCi/g)				
Cesium-137(+D)	7.84E+00	5.44E-02	PRG	YES
Potassium-40	2.50E+00	5.95E-02	PRG	YES

RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected fish tissue concentration (see Table A.1.3.3)
2. Nonradiological RSLs for ingestion of fish are default residential values from *USEPA Regional Screening Levels calculator* (see Attachment B-6). Radiological PRGs for ingestion of fish are default residential values from *USEPA Radionuclide Preliminary Remediation Goals for Superfund* calculator (see Attachment B-7). Websites accessed October 23, 2016.
3. EN = essential nutrient, RSL is not available.
4. RSL for hexavalent chromium used.
5. RSL for methyl mercury used.

Table B-44. Human Health COPC Screening for Exposure Area 9 – Sediment/Soil Media

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Inorganics (mg/kg)							
Aluminum	1.80E+04	7.70E+03	0.1xRSL	YES	9.79E+03	YES	YES
Arsenic	2.14E+00	6.80E-01	RSL	YES	3.50E+00	No	No
Barium	8.61E+01	1.50E+03	0.1xRSL	no	5.47E+01	YES	no
Beryllium	7.72E-01	1.60E+01	0.1xRSL	no	7.73E-01	no	no
Cadmium	5.05E-02	7.10E+00	0.1xRSL	no	3.69E-01	no	no
Calcium	8.17E+02	EN[6]	Nutrient	no	1.12E+03	no	no
Chromium[7]	3.27E+01	3.00E-01	RSL	YES	1.42E+01	YES	YES
Cobalt	5.50E+00	2.30E+00	0.1xRSL	YES	2.63E+00	YES	YES
Copper	1.41E+01	3.10E+02	0.1xRSL	no	6.52E+00	YES	no
Cyanide	1.42E-01	2.30E+00	0.1xRSL	no	NA[8]	---	no
Iron	1.76E+04	5.50E+03	0.1xRSL	YES	5.32E+03	YES	YES
Lead	1.81E+01	4.00E+01	0.1xRSL	no	1.10E+01	YES	no
Magnesium	3.76E+02	EN[6]	Nutrient	no	2.75E+02	YES	no
Manganese	1.81E+02	1.80E+02	0.1xRSL	YES	1.36E+02	YES	YES
Mercury[9]	7.66E-02	7.80E-01	0.1xRSL	no	9.92E-02	no	no
Nickel	6.29E+00	1.50E+02	0.1xRSL	no	4.48E+00	YES	no
Nitrogen-Nitrate-Nitrite	1.92E+00	7.80E+02	0.1xRSL	no	1.25E+00	YES	no
Orthophosphate	2.62E+00	---	---	---	2.07E+01	no	no
Phosphate	3.75E+02	---	---	---	1.75E+02	YES	no
Potassium	3.20E+02	EN[6]	Nutrient	no	2.39E+02	YES	no
Selenium	3.37E+00	3.90E+01	0.1xRSL	no	3.89E+00	no	no
Sodium	2.72E+01	EN[6]	Nutrient	no	7.33E+01	no	no
Thallium	4.59E+00	7.80E-02	0.1xRSL	YES	3.77E+00	YES	YES
Vanadium	4.23E+01	3.90E+01	0.1xRSL	YES	2.48E+01	YES	YES
Zinc	3.11E+01	2.30E+03	0.1xRSL	no	1.70E+01	YES	no
Organics (mg/kg)							
Benzo[a]pyrene	5.29E-03	1.60E-02	RSL	no	3.09E-01	no	no
Benzo[b]fluoranthene	5.45E-03	1.60E-01	RSL	no	2.89E-01	no	no
Benzo[g,h,i]perylene	4.24E-03	---	---	---	---	---	no
Benzoic acid	3.08E-01	2.50E+04	0.1xRSL	no	---	---	no
Bis[2-ethylhexyl]phthalate	2.67E-01	3.90E+01	RSL	no	---	---	no
Camphene	2.50E-03	----	----	---	---	---	no
Chrysene	4.38E-03	1.60E+01	RSL	no	---	---	no
Dibutylphthalate	2.77E-02	6.30E+02	0.1xRSL	no	---	---	no
Diethylphthalate	6.01E-03	5.10E+03	0.1xRSL	no	---	---	no
Fluoranthene	7.13E-03	2.40E+02	0.1xRSL	no	---	---	no
Phenol	4.21E-03	1.90E+03	0.1xRSL	no	---	---	no
Pyrene	6.67E-03	1.80E+02	0.1xRSL	no	---	---	no
Docosane	5.40E-01	---	---	---	---	---	no
2-Hexanone	2.87E-04	2.00E+01	0.1xRSL	no	---	---	no
Acetone	3.32E-01	6.10E+03	0.1xRSL	no	---	---	no
Benzene	1.06E-03	1.20E+00	RSL	no	---	---	no
Carbon disulfide	1.76E-02	7.70E+01	0.1xRSL	no	---	---	no
Chloroform	8.96E-04	3.20E-01	RSL	no	---	---	no
Chloromethane	2.98E-04	1.10E+01	0.1xRSL	no	---	---	no
Methyl ethyl ketone	2.55E-02	2.70E+03	0.1xRSL	no	---	---	no
Methyl isobutyl ketone	5.57E-04	3.30E+03	0.1xRSL	no	---	---	no
Styrene	1.49E-04	6.00E+02	0.1xRSL	no	---	---	no
Toluene	3.90E-03	4.90E+02	0.1xRSL	no	---	---	no
Xylenes	4.58E-04	5.80E+01	0.1xRSL	no	---	---	no
Phenols	2.15E-01	1.90E+03	0.1xRSL	no	---	---	no
Pesticides/PCBs (mg/kg)							
DDE	8.48E-04	2.00E+00	RSL	no	---	---	no
PCB-1254	1.90E-03	2.4E-01	0.1xRSL	no	---	---	no

Table B-44. Human Health COPC Screening for Exposure Area 9 - Sediment/Soil Media *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?	2X Average Background Concentration[3]	Exceeds 2X Average Background?[4]	COPC?[5]
Radionuclides (pCi/g)							
Cesium-137(+D)	1.17E+02	6.06E-02	PRG	YES	1.89E-01	YES	YES
Cobalt-60	4.48E-01	3.29E-02	PRG	YES	NA[8]	---	YES
Manganese-54	4.76E-02	6.26E-01	PRG	no	NA[8]	---	no
Plutonium-238	1.76E-01	4.27E+00	PRG	no	2.83E-02	YES	no
Plutonium-239(+D) /Plutonium-240	1.71E-01	3.79E+00	PRG	no	5.13E-02	YES	no
Potassium-40	3.22E+00	1.43E-01	PRG	YES	3.05E+00	YES	YES
Radium-226(+D)[10]	1.72E+00	1.38E-02	PRG	YES	9.14E+00	No	No
Lead-214	1.72E+00	NA[11]	---	---	---	---	---
Bismuth-214	1.47E+00	NA[11]	---	---	---	---	---
Strontium-89 and Strontium-90(+D)	1.30E+00	1.34E+01	PRG	no	NA[8]	---	no
Strontium-90(+D)	2.28E+00	4.21E+00	PRG	no	7.54E-01	YES	no
Thorium-230	1.11E+00	5.07E+00	PRG	no	2.19E+00	no	no
Thorium-232(+D)[12]	2.59E+00	2.68E-02	PRG	YES	2.10E+00	YES	YES
Radium-228	1.17E+00	NA[11]	---	---	---	---	---
Actinium-228	2.51E+00	NA[11]	---	---	---	---	---
Thorium-228	2.45E+00	NA[11]	---	---	---	---	---
Lead-212	2.59E+00	NA[11]	---	---	---	---	---
Thallium-208	7.60E-01	NA[11]	---	---	---	---	---
Thorium-234(+D)	3.83E+00	2.72E+02	PRG	no	8.69E-01	YES	no
Uranium-233 and Uranium-234	1.22E+00	5.63E+00	PRG	no	1.28E+00	no	no
Uranium-238(+D)	1.23E+00	7.99E-01	PRG	YES	1.31E+00	no	no

COPC = constituent of potential concern
RSL = regional screening level
PRG = preliminary remediation goal

1. Maximum detected concentration from surface soil/sediment interval (0-1 ft) (see Table A.1.9.1.1).
2. Nonradiological RSLs are residential soil values from the generic *USEPA Regional Screening Levels* (RSLs) table, dated May 2016. Radiological PRGs are residential soil site-specific values derived using *USEPA Radionuclide Toxicity and Preliminary Remediation Goals (PRG) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default values. Website accessed October 6, 2016.
3. LTR IOU background screening values (see Table A.1.10.1).
4. For screening purposes, maximum concentrations of the naturally-occurring (nonanthropogenic) constituents are compared to 2X average background concentrations.
5. Constituents are identified as COPCs if the maximum detected concentration exceeds the human health screening value and the 2X average background concentration.
6. EN = essential nutrient, RSL not available.
7. RSL for hexavalent chromium (most conservative) used.
8. NA = not available (a background value is not available for this constituent).
9. RSL for methyl mercury (most conservative) used.
10. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since the constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Ra-226. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
11. NA = not applicable per footnotes 10 and 12.
12. Ra-228, Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not screened separately since they are considered in the Th-232 (+D) PRG.

Table B-45. Human Health Risk/Hazard Calculation for Exposure Area 9 – Sediment/Soil Media Residential Scenario

Analyte[1]	Exposure Point Concentration[2]	Residential RSL/PRG[3]	Residential Hazard Estimate[4]	Residential Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	9.63E+03	7.70E+04	0.125	---	No
Chromium[7]	1.65E+01	2.30E+02	0.072	---	No
Cobalt	2.14E+00	2.30E+01	0.093	---	No
Iron	8.55E+03	5.50E+04	0.155	---	No
Manganese	1.14E+02	1.80E+03	0.063	---	No
Thallium	2.63E+00	7.80E-01	3.377	---	Yes
Vanadium	2.48E+01	3.90E+02	0.064	---	No
		Total Hazard Index (HI) =	**3.95**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	1.65E+01	3.00E-01	---	5.50E-05	Yes
Cobalt	2.14E+00	4.20E+02	---	5.10E-09	No
			Total Inorganic Risk =	**5.50E-05**	
Radionuclides					
Cesium-137(+D)	2.09E+01	6.06E-02	---	3.44E-04	Yes
Cobalt-60	1.14E-01	3.29E-02	---	3.47E-06	Yes
Potassium-40	1.83E+00	1.43E-01	---	1.28E-05	Yes
Thorium-232(+D)[8]	2.48E+00	2.68E-02	---	9.25E-05	Yes
Actinium-228	1.53E+00	---	---	---	---
Thorium-228	2.45E+00	---	---	---	---
Lead-212	1.62E+00	---	---	---	---
Thallium-208	4.76E-01	---	---	---	---
			Total Radionuclide Risk =	**4.53E-04**	
			Total Media Risk =	**5.08E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-44that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.9.1.1).
3. Nonradiological RSLs are default residential soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are residential soil site-specific values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator and eliminating the fruit and vegetable consumption pathways. All other inputs are default parameters (see Attachment B-3).
4. Residential Hazard Estimate = EPC/RSL.
5. Residential Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. If the total media HI ≥1, then the constituents are segregated based on relevant target organs. HQs are summed according to target organs (see table below). Constituents are identified as COCs if the total organ HQ ≥1 and the total organ HI >1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Constituent	Target Organ	Residential HQ	
Aluminum	Neurological	0.125	
Manganese	Neurological	0.063	
		0.188	Total neurological target organ hazard index
Thallium	Skin	3.377	Total skin target organ hazard index
Chromium[7]	Gastrointestinal	0.072	
Iron	Gastrointestinal	0.155	
		0.227	Total gastrointestinal target organ hazard index
Vanadium	Kidney	0.093	Total kidney target organ hazard index
Cobalt	Thyroid	0.093	Total thyroid target organ hazard index
Cobalt	Thyroid	0.195	Total thyroid target organ hazard index
Cyanide	Testes	0.101	Total testes target organ hazard index

Table B-46. Human Health Risk/Hazard Calculation for Exposure Area 9 – Sediment/Soil Media Industrial Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	Industrial Worker RSL/PRG[3]	Industrial Worker Hazard Estimate[4]	Industrial Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	9.63E+03	1.10E+06	0.009	---	No
Chromium[7]	1.65E+01	3.50E+03	0.005	---	No
Cobalt	2.14E+00	3.50E+02	0.006	---	No
Iron	8.55E+03	8.20E+05	0.010	---	No
Manganese	1.14E+02	2.60E+04	0.004	---	No
Thallium	2.63E+00	1.20E+01	0.220	---	No
Vanadium	2.48E+01	5.80E+03	0.004	---	No
		Total Hazard Index (HI) =	**0.26**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	1.65E+01	6.30E+00	---	2.62E-06	Yes
Cobalt	2.14E+00	1.90E+03	---	1.13E-09	No
			Total Inorganic Risk =	**2.62E-06**	
Radionuclides					
Cesium-137(+D)	2.09E+01	9.10E-02	---	2.29E-04	Yes
Cobalt-60	1.14E-01	4.80E-02	---	2.38E-06	Yes
Potassium-40	1.83E+00	2.20E-01	---	8.31E-06	Yes
Thorium-232(+D)[8]	2.48E+00	4.20E-02	---	5.90E-05	Yes
Actinium-228	1.53E+00	---	---	---	---
Thorium-228	2.45E+00	---	---	---	---
Lead-212	1.62E+00	---	---	---	---
Thallium-208	4.76E-01	---	---	---	---
			Total Radionuclide Risk =	**2.99E-04**	
			Total Media Risk =	**3.02E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-44 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.9.1.1).
3. Nonradiological RSLs are industrial soil values from the generic *USEPA Regional Screening Levels (RSLs) Table,* dated May 2016 (see Attachment B-1). Radiological PRGs are default industrial worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-4).
4. Industrial Worker Hazard Estimate = EPC/RSL.
5. Industrial Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-47. Human Health Risk/Hazard Calculation for Exposure Area 9 – Sediment/Soil Media On-Site Worker Scenario

Analyte[1]	Exposure Point Concentration[2]	On-Site Worker RSL/PRG[3]	Onsite Worker Hazard Estimate[4]	On-Site Worker Risk Estimate[5]	COC?[6]
Noncarcinogenic Hazard Estimate					
Inorganics *(mg/kg)*					
Aluminum	9.63E+03	1.87E+06	0.005	---	No
Chromium[7]	1.65E+01	5.81E+03	0.003	---	No
Cobalt	2.14E+00	5.78E+02	0.004	---	No
Iron	8.55E+03	1.36E+06	0.006	---	No
Manganese	1.14E+02	4.27E+04	0.003	---	No
Thallium	2.63E+00	1.95E+01	0.135	---	No
Vanadium	2.48E+01	9.72E+03	0.003	---	No
		Total Hazard Index (HI) =	**0.16**		
Carcinogenic Risk Estimate					
Inorganics *(mg/kg)*					
Chromium[7]	1.65E+01	1.32E+01	---	1.25E-06	Yes
Cobalt	2.14E+00	3.86E+03	---	5.55E-10	No
			Total Inorganic Risk =	**1.25E-06**	
Radionuclides					
Cesium-137(+D)	2.09E+01	1.80E-01	---	1.16E-04	Yes
Cobalt-60	1.14E-01	8.32E-02	---	1.37E-06	Yes
Potassium-40	1.83E+00	4.56E-01	---	4.01E-06	Yes
Thorium-232(+D)[8]	2.48E+00	8.85E-02	---	2.80E-05	Yes
Actinium-228	1.53E+00	---	---	---	---
Thorium-228	2.45E+00	---	---	---	---
Lead-212	1.62E+00	---	---	---	---
Thallium-208	4.76E-01	---	---	---	---
			Total Radionuclide Risk =	**1.49E-04**	
			Total Media Risk =	**1.51E-04**	

RSL = regional screening level
PRG = preliminary remediation goal
COC = constituent of concern

1. Analytes from Table B-44 that were identified as constituents of potential concern.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration (see Table A.1.9.1.1).
3. Nonradiological RSLs are site-specific onsite worker soil values derived using the *USEPA Regional Screening Levels (RSLs)* website calculator (see Attachment B-2). Radiological PRGs are site-specific onsite worker soil values derived using the *USEPA Radionuclide Preliminary Remediation Goals (PRGs) for Superfund* website calculator (see Attachment B-5).
4. Onsite Worker Hazard Estimate = EPC/RSL.
5. Onsite Worker Risk Estimate = (EPC / RSL or PRG) × 1E-06.
6. For noncarcinogens, no constituents are identified as COCs if the total media HI <1. For carcinogens, constituents are identified as COCs if the individual cancer risk is ≥1E-06.
7. RSL for hexavalent chromium (most conservative) used.
8. Ac-228, Th-228, Pb-212, Bi-212, and Ti-208 are daughter products of Th-232 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest activity (most conservative) was used to estimate the activity of Th-232. The daughter products are not evaluated separately since they are considered in the Th-232 (+D) PRG.

Table B-48. Surface Water Comparison to MCLs / (RSLs/PRGs or AWQC) for Exposure Area 9

Analyte	Maximum Result[1]	Units	MCL[2]	Result > MCL?	Tap Water RSL/PRG[2]	AWQC	Result > RSL/PRG or AWQC?
Inorganics							
Antimony	4.49E-03	mg/L	6.00E-03	no			
Barium	2.91E-02	mg/L	2.00E+00	no			
Calcium[3]	1.24E+01	mg/L	NA	---	NA	NA	---
Chromium	1.19E-03	mg/L	1.00E-01	no			
Iron	1.62E+00	mg/L	---	---	1.40E+01	NA	no
Magnesium[3]	1.13E+00	mg/L	NA	---	NA	NA	---
Manganese	1.09E-01	mg/L	---	---	4.30E-01	NA	no
Potassium[3]	3.20E-01	mg/L	NA	---	NA	NA	---
Silver	2.68E-04	mg/L	---	---	9.40E-02	NA	no
Sodium[3]	5.89E+00	mg/L	NA	---	NA	NA	---
Zinc	4.73E-03	mg/L	---	---	6.00E+00	7.40E+01	no
Organics							
Bis[2-ethylhexyl]phthalate	3.51E-04	mg/L	6.00E-03	no			
Chloromethane	4.06E-04	mg/L	---	---	1.90E-01	NA	no
Toluene	5.66E-04	mg/L	1.00E+00	no			
Radionuclides							
Tritium	6.01E+02	pCi/L	2.00E+04	no			

AWQC = ambient water quality criteria
MCL = maximum concentration limit
PRG = preliminary remediation goal
RSL = regional screening level
1 - Maximum detected concentrations from surface water samples collected from the exposure area (see Table A.1.9.2).
2 - Nonradiological constituent values from Attachment B-8; radiological constituent values from Attachment B-9.
3- Calcium, magnesium, potassium, and sodium are essential nutrients that do not have a MCL, RSL or AWQC.

Table B-49. Human Health Fish Ingestions Screening for Exposure Area 9 – Recreational Fisherman

Analyte	Detected Maximum Concentration[1]	Human Health Screening Value[2]	Human Health Screening Value Source[2]	Exceeds Human Health Screening Value?
Inorganics (mg/kg)				
Barium	1.78E+00	3.09E+02	RSL	no
Calcium	2.23E+04	EN[3]	---	no
Chromium[4]	2.66E-01	2.32E-03	RSL	YES
Copper	2.88E-01	6.18E+01	RSL	no
Iron	2.72E+01	1.08E+03	RSL	no
Magnesium	5.96E+02	EN[3]	---	no
Manganese	3.62E+00	2.16E+02	RSL	no
Mercury[5]	2.44E-01	1.54E-01	RSL	YES
Potassium	3.40E+03	EN[3]	---	no
Sodium	1.36E+03	EN[3]	---	no
Zinc	2.73E+01	4.63E+02	RSL	no
Radionuclides (pCi/g)				
Cesium-137(+D)	4.25E+01	5.44E-02	PRG	YES
Potassium-40	3.11E+00	5.95E-02	PRG	YES

MCL = Maximum Contaminant Level
RSL = Regional Screening Level
PRG = Preliminary Remediation Goal
AWQC = Ambient Water Quality Criteria

1. Maximum detected fish tissue concentration (see Table A.1.4.3)
2. Nonradiological RSLs for ingestion of fish are default residential values from *USEPA Regional Screening Levels* calculator. Radiological PRGs for ingestion of fish are default residential values from *USEPA Radionuclide Preliminary Remediation Goals for Superfund* calculator. Websites accessed October 23, 2016.
3. EN = essential nutrient, RSL is not available.
4. RSL for hexavalent chromium used.
5. RSL for methyl mercury used.

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Attachment B-1

USEPA Regional Screening Levels Table
RSLs for Default Resident and Default Industrial Worker Scenarios
(website accessed October 6, 2016)

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USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed October 6, 2016)

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tapwater *(µg/L)*	key	MCL *(µg/L)*
				9.0E-01	I	3.1E+01	A	V	Acetone	67-64-1	6.1E+04	n	6.7E+05	nms	1.4E+04	n	
				1.0E+00	P	5.0E-03	P		Aluminum	7429-90-5	7.7E+04	n	1.1E+06	nm	2.0E+04	n	
						1.0E-01	I	V	Ammonia	7664-41-7							
				4.0E-04	I				Antimony (metallic)	7440-36-0	3.1E+01	n	4.7E+02	n	7.8E+00	n	6.0E+00
1.5E+00	I	4.3E-03	I	3.0E-04	I	1.5E-05	C		Arsenic, Inorganic	7440-38-2	6.8E-01 3.5E+01	c*R nc	3.0E+00 4.8E+02	cR nc	5.2E-02	c	1.0E+01
				2.0E-01	I	5.0E-04	H		Barium	7440-39-3	1.5E+04	n	2.2E+05	nm	3.8E+03	n	2.0E+03
4.0E-03	P			1.0E-01	I			V	Benzaldehyde	100-52-7	1.7E+02	c*	8.2E+02	c	1.9E+01	c	
5.5E-02	I	7.8E-06	I	4.0E-03	I	3.0E-02	I	V	Benzene	71-43-2	1.2E+00	c*	5.1E+00	c*	4.6E-01	c*	5.0E+00
				4.0E+00	I				Benzoic Acid	65-85-0	2.5E+05	nm	3.3E+06	nm	7.5E+04	n	
		2.4E-03	I	2.0E-03	I	2.0E-05	I		Beryllium and compounds	7440-41-7	1.6E+02	n	2.3E+03	n	2.5E+01	n	4.0E+00
8.0E-03	I			5.0E-01	I	4.0E-04	X	V	Biphenyl, 1,1'-	92-52-4	4.7E+01	n	2.0E+02	n	8.3E-01	n	
				3.0E-03	P				Bis(2-chloroethoxy)methane	111-91-1	1.9E+02	n	2.5E+03	n	5.9E+01	n	
1.1E+00	I	3.3E-04	I					V	Bis(2-chloroethyl)ether	111-44-4	2.3E-01	c	1.0E+00	c	1.4E-02	c	
2.2E+02	I	6.2E-02	I					V	Bis(chloromethyl)ether	542-88-1	8.3E-05	c	3.6E-04	c	7.2E-05	c	
7.9E-03	I	1.1E-06	I	2.0E-02	I			V	Bromoform	75-25-2	1.9E+01	c*	8.6E+01	c	3.3E+00	c	8.0E+01(F)
		1.8E-03	I	1.0E-03	I	1.0E-05	A		Cadmium (Diet)	7440-43-9	7.1E+01	n	9.8E+02	n			
		1.8E-03	I	5.0E-04	I	1.0E-05	A		Cadmium (Water)	7440-43-9					9.2E+00	n	5.0E+00
				5.0E-01	I	2.2E-03	C		Caprolactam	105-60-2	3.1E+04	n	4.0E+05	nm	9.9E+03	n	
				1.0E-01	I	7.0E-01	I	V	Carbon Disulfide	75-15-0	7.7E+02	ns	3.5E+03	ns	8.1E+02	n	
				2.0E-02	P			V	Chloroethanol, 2-	107-07-3	1.6E+03	n	2.3E+04	n	4.0E+02	n	
3.1E-02	C	2.3E-05	I	1.0E-02	I	9.8E-02	A	V	Chloroform	67-66-3	3.2E-01	c	1.4E+00	c	2.2E-01	c	8.0E+01(F)
						9.0E-02	I	V	Chloromethane	74-87-3	1.1E+02	n	4.6E+02	n	1.9E+02	n	
2.4E+00	C	6.9E-04	C					V	Chloromethyl Methyl Ether	107-30-2	2.0E-02	c	8.9E-02	c	6.5E-03	c	
				5.0E-03	I			V	Chlorophenol, 2-	95-57-8	3.9E+02	n	5.8E+03	n	9.1E+01	n	
				1.5E+00	I				Chromium(III), Insoluble Salts	16065-83-1	1.2E+05	nm	1.8E+06	nm	2.2E+04	n	
5.0E-01	J	8.4E-02	S	3.0E-03	I	1.0E-04	I		Chromium(VI)	18540-29-9	3.0E-01 2.3E+02	c n	6.3E+00 3.5E+03	c n	3.5E-02	c	
									Chromium, Total	7440-47-3							1.0E+02
		9.0E-03	P	3.0E-04	P	6.0E-06	P		Cobalt	7440-48-4	2.3E+01 4.2E+02	n c	3.5E+02 1.9E+03	n c	6.0E+00	n	
				4.0E-02	H				Copper	7440-50-8	3.1E+03	n	4.7E+04	n	8.0E+02	n	1.3E+03
				5.0E-02	I	6.0E-01	C		Cresol, m-	108-39-4	3.2E+03	n	4.1E+04	n	9.3E+02	n	
				5.0E-02	I	6.0E-01	C		Cresol, o-	95-48-7	3.2E+03	n	4.1E+04	n	9.3E+02	n	
				1.0E-01	A	6.0E-01	C		Cresol, p-	106-44-5	6.3E+03	n	8.2E+04	n	1.9E+03	n	
				1.0E-01	A				Cresol, p-chloro-m-	59-50-7	6.3E+03	n	8.2E+04	n	1.4E+03	n	
				6.0E-04	I	8.0E-04	S	V	Cyanide (CN-)	57-12-5	2.3E+01	n	1.5E+02	n	1.5E+00	n	2.0E+02

USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed October 6, 2016) *(Continued)*

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tapwater *(µg/L)*	key	MCL *(µg/L)*
2.4E-01	I	6.9E-05	C						DDD	72-54-8	2.3E+00	c	9.6E+00	c	3.2E-02	c	
3.4E-01	I	9.7E-05	C					V	DDE, p,p'-	72-55-9	2.0E+00	c	9.3E+00	c	4.6E-02	c	
3.4E-01	I	9.7E-05	I	5.0E-04	I				DDT	50-29-3	1.9E+00	c*	8.5E+00	c*	2.3E-01	c*	
8.4E-02	I			2.0E-02	I			V	Dibromochloromethane	124-48-1	8.3E+00	c	3.9E+01	c	8.7E-01	c	8.0E+01(F)
5.4E-03	C	1.1E-05	C	7.0E-02	A	8.0E-01	I	V	Dichlorobenzene, 1,4-	106-46-7	2.6E+00	c	1.1E+01	c	4.8E-01	c	7.5E+01
4.5E-01	I	3.4E-04	C						Dichlorobenzidine, 3,3'-	91-94-1	1.2E+00	c	5.1E+00	c	1.3E-01	c	
				3.0E-03	I				Dichlorophenol, 2,4-	120-83-2	1.9E+02	n	2.5E+03	n	4.6E+01	n	
				2.0E-02	I				Dimethylphenol, 2,4-	105-67-9	1.3E+03	n	1.6E+04	n	3.6E+02	n	
				2.0E-03	I				Dinitrophenol, 2,4-	51-28-5	1.3E+02	n	1.6E+03	n	3.9E+01	n	
6.8E-01	I								Dinitrotoluene Mixture, 2,4/2,6-	NA	8.0E-01	c	3.4E+00	c	1.1E-01	c	
3.1E-01	C	8.9E-05	C	2.0E-03	I				Dinitrotoluene, 2,4-	121-14-2	1.7E+00	c*	7.4E+00	c	2.4E-01	c	
1.5E+00	P			3.0E-04	X				Dinitrotoluene, 2,6-	606-20-2	3.6E-01	c*	1.5E+00	c	4.9E-02	c	
				2.5E-02	I				Diphenylamine	122-39-4	1.6E+03	n	2.1E+04	n	3.1E+02	n	
				3.0E-04	I				Endrin	72-20-8	1.9E+01	n	2.5E+02	n	2.3E+00	n	2.0E+00
1.1E-02	C	2.5E-06	C	1.0E-01	I	1.0E+00	I	V	Ethylbenzene	100-41-4	5.8E+00	c	2.5E+01	c	1.5E+00	c	7.0E+02
				1.0E-03	X			V	Dibenzofuran	132-64-9	7.3E+01	n	1.0E+03	n	7.9E+00	n	
1.6E+00	I	4.6E-04	I	8.0E-04	I			V	Hexachlorobenzene	118-74-1	2.1E-01	c	9.6E-01	c	9.8E-03	c	1.0E+00
7.8E-02	I	2.2E-05	I	1.0E-03	P			V	Hexachlorobutadiene	87-68-3	1.2E+00	c*	5.3E+00	c	1.4E-01	c*	
				6.0E-03	I	2.0E-04	I	V	Hexachlorocyclopentadiene	77-47-4	1.8E+00	n	7.5E+00	n	4.1E-01	n	5.0E+01
				5.0E-03	I	3.0E-02	I	V	Hexanone, 2-	591-78-6	2.0E+02	n	1.3E+03	n	3.8E+01	n	
				7.0E-01	P				Iron	7439-89-6	5.5E+04	n	8.2E+05	nm	1.4E+04	n	
9.5E-04	I			2.0E-01	I	2.0E+00	C		Isophorone	78-59-1	5.7E+02	c*	2.4E+03	c*	7.8E+01	c*	
									Lead and Compounds	7439-92-1	4.0E+02	L	8.0E+02	L	1.5E+01	L	1.5E+01
				1.4E-01	I	5.0E-05	I		Manganese (Diet)	7439-96-5							
				2.4E-02	S	5.0E-05	I		Manganese (Non-diet)	7439-96-5	1.8E+03	n	2.6E+04	n	4.3E+02	n	
				3.0E-04	I	3.0E-04	S		Mercuric Chloride (and other mercury salts)	7487-94-7	2.3E+01	n	3.5E+02	n	5.7E+00	n	2.0E+00
						3.0E-04	I	V	Mercury (elemental)	7439-97-6	1.1E+01	ns	4.6E+01	ns	6.3E-01	n	2.0E+00
				1.0E-04	I				Methyl Mercury	22967-92-6	7.8E+00	n	1.2E+02	n	2.0E+00	n	
				5.0E-03	I				Methoxychlor	72-43-5	3.2E+02	n	4.1E+03	n	3.7E+01	n	4.0E+01
				1.0E+00	X			V	Methyl Acetate	79-20-9	7.8E+04	ns	1.2E+06	nms	2.0E+04	n	
				6.0E-01	I	5.0E+00	I	V	Methyl Ethyl Ketone (2-Butanone)	78-93-3	2.7E+04	n	1.9E+05	nms	5.6E+03	n	
						3.0E+00	I	V	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	3.3E+04	ns	1.4E+05	nms	6.3E+03	n	
2.0E-03	I	1.0E-08	I	6.0E-03	I	6.0E-01	I	V	Methylene Chloride	75-09-2	5.7E+01	c**	1.0E+03	c**	1.1E+01	c**	5.0E+00
		2.6E-04	C	2.0E-02	I	9.0E-05	A		Nickel Soluble Salts	7440-02-0	1.5E+03	n	2.2E+04	n	3.9E+02	n	
									Nitrate + Nitrite (as N)	NA							1.0E+04
				1.0E-01	I				Nitrite	14797-65-0	7.8E+03	n	1.2E+05	nm	2.0E+03	n	1.0E+03
				1.0E-02	X	5.0E-05	X		Nitroaniline, 2-	88-74-4	6.3E+02	n	8.0E+03	n	1.9E+02	n	

USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed October 6, 2016) *(Continued)*

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO *(mg/kg-day)*$^{-1}$	key	IUR *(µg/m^3)*$^{-1}$	key	RfD_o *(mg/kg-day)*	key	RfC_i *(mg/m^3)*	key	VOC	Analyte	CAS No.	Resident Soil *(mg/kg)*	key	Industrial Soil *(mg/kg)*	key	Tapwater *(µg/L)*	key	MCL *(µg/L)*
2.0E-02	P			4.0E-03	P	6.0E-03	P		Nitroaniline, 4-	100-01-6	2.7E+01	c**	1.1E+02	c*	3.8E+00	c*	
		4.0E-05	I	2.0E-03	I	9.0E-03	I	V	Nitrobenzene	98-95-3	5.1E+00	c*	2.2E+01	c*	1.4E-01	c*	
7.0E+00	I	2.0E-03	C						Nitroso-di-N-propylamine, N-	621-64-7	7.8E-02	c	3.3E-01	c	1.1E-02	c	
4.0E-01	I	5.1E-06	C	5.0E-03	I				Pentachlorophenol	87-86-5	1.0E+00	c	4.0E+00	c	4.1E-02	c	1.0E+00
4.0E-03	X			2.0E-03	P				Pentaerythritoltetranitrate (PETN)	78-11-5	1.3E+02	n	5.7E+02	c**	1.9E+01	c**	
				3.0E-01	I	2.0E-01	C		Phenol	108-95-2	1.9E+04	n	2.5E+05	nm	5.8E+03	n	
1.4E-02	I	2.4E-06	C	2.0E-02	I				Bis(2-ethylhexyl)phthalate	117-81-7	3.9E+01	c*	1.6E+02	c	5.6E+00	c*	6.0E+00
1.9E-03	P			2.0E-01	I				Butyl Benzyl Phthalate	85-68-7	2.9E+02	c*	1.2E+03	c	1.6E+01	c	
				1.0E-01	I				Dibutyl Phthalate	84-74-2	6.3E+03	n	8.2E+04	n	9.0E+02	n	
				8.0E-01	I				Diethyl Phthalate	84-66-2	5.1E+04	n	6.6E+05	nm	1.5E+04	n	
2.0E+00	S	5.7E-04	S					V	Aroclor 1242	53469-21-9	2.3E-01	c	9.5E-01	c	7.8E-03	c	
2.0E+00	S	5.7E-04	S	2.0E-05	I			V	Aroclor 1254	11097-69-1	2.4E-01	c**	9.7E-01	c*	7.8E-03	c*	
2.0E+00	S	5.7E-04	S					V	Aroclor 1260	11096-82-5	2.4E-01	c	9.9E-01	c	7.8E-03	c	
				6.0E-02	I			V	Acenaphthene	83-32-9	3.6E+03	n	4.5E+04	n	5.3E+02	n	
				3.0E-01	I			V	Anthracene	120-12-7	1.8E+04	n	2.3E+05	nm	1.8E+03	n	
7.3E-01	E	1.1E-04	C					V	Benz[a]anthracene	56-55-3	1.6E-01	c	2.9E+00	c	1.2E-02	c	
1.2E+00	C	1.1E-04	C						Benzo(j)fluoranthene	205-82-3	4.2E-01	c	1.8E+00	c	6.5E-02	c	
7.3E+00	I	1.1E-03	C						Benzo[a]pyrene	50-32-8	1.6E-02	c	2.9E-01	c	3.4E-03	c	2.0E-01
7.3E-01	E	1.1E-04	C						Benzo[b]fluoranthene	205-99-2	1.6E-01	c	2.9E+00	c	3.4E-02	c	
7.3E-02	E	1.1E-04	C						Benzo[k]fluoranthene	207-08-9	1.6E+00	c	2.9E+01	c	3.4E-01	c	
				8.0E-02	I			V	Chloronaphthalene, Beta-	91-58-7	4.8E+03	n	6.0E+04	n	7.5E+02	n	
7.3E-03	E	1.1E-05	C						Chrysene	218-01-9	1.6E+01	c	2.9E+02	c	3.4E+00	c	
7.3E+00	E	1.2E-03	C						Dibenz[a,h]anthracene	53-70-3	1.6E-02	c	2.9E-01	c	3.4E-03	c	
				4.0E-02	I				Fluoranthene	206-44-0	2.4E+03	n	3.0E+04	n	8.0E+02	n	
				4.0E-02	I			V	Fluorene	86-73-7	2.4E+03	n	3.0E+04	n	2.9E+02	n	
7.3E-01	E	1.1E-04	C						Indeno[1,2,3-cd]pyrene	193-39-5	1.6E-01	c	2.9E+00	c	3.4E-02	c	
		3.4E-05	C	2.0E-02	I	3.0E-03	I	V	Naphthalene	91-20-3	3.8E+00	c*	1.7E+01	c*	1.7E-01	c*	
				4.0E-03	I			V	Methylnapthalene, 2-	91-57-6	2.4E+03	n	3.0E+03	n	3.6E+01	n	
				3.0E-02	I			V	Pyrene	129-00-0	1.8E+03	n	2.3E+04	n	1.2E+02	n	
				5.0E-03	I	2.0E-02	C		Selenium	7782-49-2	3.9E+02	n	5.8E+03	n	1.0E+02	n	5.0E+01
				5.0E-03	I				Silver	7440-22-4	3.9E+02	n	5.8E+03	n	9.4E+01	n	
				2.0E-01	I	1.0E+00	I	V	Styrene	100-42-5	6.0E+03	ns	3.5E+04	ns	1.2E+03	n	1.0E+02
				1.0E-05	X				Thallium (Soluble Salts)	7440-28-0	7.8E-01	n	1.2E+01	n	2.0E-01	n	2.0E+00
				8.0E-02	I	5.0E+00	I	V	Toluene	108-88-3	4.9E+03	ns	4.7E+04	ns	1.1E+03	n	1.0E+03
4.6E-02	I	4.1E-06	I	5.0E-04	I	2.0E-03	I	V	Trichloroethylene	79-01-6	9.4E-01	c**	6.0E+00	c**	4.9E-01	c**	5.0E+00
				1.0E-01	I				Trichlorophenol, 2,4,5-	95-95-4	6.3E+03	n	8.2E+04	n	1.2E+03	n	

USEPA Regional Screening Levels Table *RSLs for Default Resident and Default Industrial Worker Scenarios* (website accessed October 6, 2016) *(Continued/End)*

Toxicity and Chemical-specific Information									Contaminant		Screening Levels						
SFO $(mg/kg\text{-}day)^{-1}$	key	IUR $(\mu g/m^3)^{-1}$	key	RfD_o $(mg/kg\text{-}day)$	key	RfC_i (mg/m^3)	key	VOC	Analyte	CAS No.	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Tapwater (µg/L)	key	MCL (µg/L)
1.1E-02	I	3.1E-06	I	1.0E-03	P				Trichlorophenol, 2,4,6-	88-06-2	4.9E+01	c**	2.1E+02	c**	4.1E+00	c**	
				3.0E-03	I	4.0E-05	A		Uranium (Soluble Salts)	NA	2.3E+02	n	3.5E+03	n	6.0E+01	n	3.0E+01
				5.0E-03	S	1.0E-04	A		Vanadium and Compounds	7440-62-2	3.9E+02	n	5.8E+03	n	8.6E+01	n	
				2.0E-01	S	1.0E-01	S	V	Xylene, P-	106-42-3	5.6E+02	ns	2.4E+03	ns	1.9E+02	n	
				2.0E-01	S	1.0E-01	S	V	Xylene, m-	108-38-3	5.5E+02	ns	2.4E+03	ns	1.9E+02	n	
				2.0E-01	S	1.0E-01	S	V	Xylene, o-	95-47-6	6.5E+02	ns	2.8E+03	ns	1.9E+02	n	
				2.0E-01	I	1.0E-01	I	V	Xylenes	1330-20-7	5.8E+02	ns	2.5E+03	ns	1.9E+02	n	1.0E+04
				3.0E-01	I				Zinc and Compounds	7440-66-6	2.3E+04	n	3.5E+05	nm	6.0E+03	n	

I = Integrated Risk Information System
V = volatile
n = noncancer
nms = noncancer, concentration may exceed ceiling limit, concentration may exceed Csat
P = Provisional Peer-Reviewed Toxicity Values
nm = noncancer, concentration may exceed ceiling limit
C = California Environmental Protection Agency
c*R = cancer, where: n SL <100X SL, Relative Bioavailability Applied (RBA)
cR = cancer, RBA
c* = cancer – where SL <100X c SL
c = cancer
H = Health Effects Assessment Summary Table
J = New Jersey
A = Agency for Toxic Substances and Disease Registry
ns = noncancer, concentration may exceed Csat
S = see user guide Chapter 5
X = Appendix PPRTV Screen
c** = cancer – where SL <10X c SL

Attachment B-2

USEPA Regional Screening Levels Website:
Site-Specific RSLs for Onsite Worker Scenario
(website accessed October 14, 2016)

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Site-specific
Onsite Worker Equation Inputs for Sediment/Soil

Variable	Value
TR (target cancer risk) unitless	0.000001
THQ (target hazard quotient) unitless	1
AT_{ow} (averaging time - outdoor worker)	365
EF_{ow} (exposure frequency - outdoor worker) day/yr	150
ED_{ow} (exposure duration - outdoor worker) yr	20
ET_{ow} (exposure time - outdoor worker) hr	8
LT (lifetime) yr	70
BW_{ow} (body weight - outdoor worker)	80
IR_{ow} (soil ingestion rate - outdoor worker) mg/day	100
SA_{ow} (surface area - outdoor worker) cm^2/day	3527
AF_{ow} (skin adherence factor - outdoor worker) mg/cm^2	0.12

Site-specific Onsite Worker Risk-Based Screening Levels for Sediment/Soil

Chemical	Ingestion SF *(mg/kg-day)*$^{-1}$	Inhalation Unit Risk *(µg/m^3)*$^{-1}$	Chronic RfD *(mg/kg-day)*	Chronic RfC *(mg/m^3)*	Ingestion SL TR=1.0E-6 *(mg/kg)*	Dermal SL TR=1.0E-6 *(mg/kg)*	Inhalation SL TR=1.0E-6 *(mg/kg)*	Carcinogenic SL TR=1.0E-6 *(mg/kg)*	Ingestion SL THQ=1 *(mg/kg)*	Dermal SL THQ=1 *(mg/kg)*	Inhalation SL THQ=1 *(mg/kg)*	Noncarcinogenic SL THI=1 *(mg/kg)*	Screening Level *(mg/kg)*
Acetone	-	-	9.00E-01	3.09E+01	-	-	-	-	1.75E+06	-	3.08E+06	1.12E+06	1.12E+06 sat
Aluminum	-	-	1.00E+00	5.00E-03	-	-	-	-	1.95E+06	-	4.96E+07	1.87E+06	1.87E+06 max
Antimony (metallic)	-	-	4.00E-04	-	-	-	-	-	7.79E+02	-	-	7.79E+02	7.79E+02 nc
Aroclor 1242	2.00E+00	5.71E-04	-	-	3.41E+00	5.75E+00	2.64E+01	1.98E+00	-	-	-	-	1.98E+00 ca
Aroclor 1254	2.00E+00	5.71E-04	2.00E-05	-	3.41E+00	5.75E+00	3.77E+01	2.02E+00	3.89E+01	6.57E+01	-	2.44E+01	2.02E+00 ca*
Aroclor 1260	2.00E+00	5.71E-04	-	-	3.41E+00	5.75E+00	5.89E+01	2.06E+00	-	-	-	-	2.06E+00 ca
Arsenic, Inorganic	1.50E+00	4.30E-03	3.00E-04	1.50E-05	7.57E+00	3.58E+01	8.08E+03	6.24E+00	9.73E+02	4.60E+03	1.49E+05	7.99E+02	6.24E+00 ca
Barium	-	-	2.00E-01	5.00E-04	-	-	-	-	3.89E+05	-	4.96E+06	3.61E+05	3.61E+05 max
Benzaldehyde	4.00E-03	-	1.00E-01	-	1.70E+03	-	-	1.70E+03	1.95E+05	-	-	1.95E+05	1.70E+03 sat
Benzene	5.50E-02	7.80E-06	4.00E-03	3.00E-02	1.24E+02	-	1.16E+01	1.06E+01	7.79E+03	-	7.75E+02	7.05E+02	1.06E+01 ca*
Benzo[a]pyrene	7.30E+00	1.10E-03	-	-	9.33E-01	1.70E+00	3.16E+04	6.02E-01	-	-	-	-	6.02E-01 ca
Benzo[b]fluoranthene	7.30E-01	1.10E-04	-	-	9.33E+00	1.70E+01	3.16E+05	6.02E+00	-	-	-	-	6.02E+00 ca
Benzo[g,h,i]perylene	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzoic Acid	-	-	4.00E+00	-	-	-	-	-	7.79E+06	1.84E+07	-	5.47E+06	5.47E+06 max
Beryllium and compounds	-	2.40E-03	2.00E-03	2.00E-05	-	-	1.45E+04	1.45E+04	3.89E+03	-	1.98E+05	3.82E+03	3.82E+03 nc
Bis(2-chloroethyl)ether	1.10E+00	3.30E-04	-	-	6.19E+00	-	3.29E+00	2.15E+00	-	-	-	-	2.15E+00 ca
Bis(2-ethylhexyl)phthalate	1.40E-02	2.40E-06	2.00E-02	-	4.87E+02	1.15E+03	1.45E+07	3.42E+02	3.89E+04	9.20E+04	-	2.74E+04	3.42E+02 ca*
Butyl Benzyl Phthalate	1.90E-03	-	2.00E-01	-	3.59E+03	8.47E+03	-	2.52E+03	3.89E+05	9.20E+05	-	2.74E+05	2.52E+03 ca
Cadmium (Diet)	-	1.80E-03	1.00E-03	1.00E-05	-	-	1.93E+04	1.93E+04	1.95E+03	1.15E+04	9.92E+04	1.64E+03	1.64E+03 nc
Carbon Disulfide	-	-	1.00E-01	7.00E-01	-	-	-	-	1.95E+05	-	5.97E+03	5.79E+03	5.79E+03 sat
Chloroform	3.10E-02	2.30E-05	1.00E-02	9.77E-02	2.20E+02	-	2.92E+00	2.88E+00	1.95E+04	-	1.87E+03	1.71E+03	2.88E+00 ca
Chloromethane	-	-	-	9.00E-02	-	-	-	-	-	-	7.72E+02	7.72E+02	7.72E+02 nc
Chlorophenol, 2-	-	-	5.00E-03	-	-	-	-	-	9.73E+03	-	-	9.73E+03	9.73E+03 nc
Chromium(III)	-	-	1.50E+00	-	-	-	-	-	2.92E+06	-	-	2.92E+06	2.92E+06 max

Site-specific Onsite Worker Risk-Based Screening Levels for Sediment/Soil *(Continued)*

Chemical	Ingestion SF *(mg/kg-day)*$^{-1}$	Inhalation Unit Risk *(µg/m^3)*$^{-1}$	Chronic RfD *(mg/kg-day)*	Chronic RfC *(mg/m^3)*	Ingestion SL TR=1.0E-6 *(mg/kg)*	Dermal SL TR=1.0E-6 *(mg/kg)*	Inhalation SL TR=1.0E-6 *(mg/kg)*	Carcinogenic SL TR=1.0E-6 *(mg/kg)*	Ingestion SL THQ=1 *(mg/kg)*	Dermal SL THQ=1 *(mg/kg)*	Inhalation SL THQ=1 *(mg/kg)*	Noncarcinogenic SL THI=1 *(mg/kg)*	Screening Level *(mg/kg)*
Chromium(VI)	5.00E-01	8.40E-02	3.00E-03	1.00E-04	1.36E+01	-	4.13E+02	1.32E+01	5.84E+03	-	9.92E+05	5.81E+03	1.32E+01 ca
Chrysene	7.30E-03	1.10E-05	-	-	9.33E+02	1.70E+03	3.16E+06	6.02E+02	-	-	-	-	6.02E+02 ca
Cobalt	-	9.00E-03	3.00E-04	6.00E-06	-	-	3.86E+03	3.86E+03	5.84E+02	-	5.95E+04	5.78E+02	5.78E+02 nc
Copper	-	-	4.00E-02	-	-	-	-	-	7.79E+04	-	-	7.79E+04	7.79E+04 nc
Cyanide	-	-	6.0E-04	8.0E-04	-	-	-	-	4.7E+01	-	4.4E+01	2.3E+01	2.3E+01 nc
DDD	2.40E-01	6.90E-05	-	-	2.84E+01	6.71E+01	5.03E+05	1.99E+01	-	-	-	-	1.99E+01 ca
DDE, p,p'-	3.40E-01	9.70E-05	-	-	2.00E+01	-	5.54E+02	1.93E+01	-	-	-	-	1.93E+01 ca
DDT	3.40E-01	9.70E-05	5.00E-04	-	2.00E+01	1.58E+02	3.58E+05	1.78E+01	9.73E+02	7.67E+03	-	8.64E+02	1.78E+01 ca*
DDT/DDE/DDD (total)	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibutyl Phthalate	-	-	1.00E-01	-	-	-	-	-	1.95E+05	4.60E+05	-	1.37E+05	1.37E+05 max
Ethylbenzene	1.10E-02	2.50E-06	1.00E-01	1.00E+00	6.19E+02	-	5.79E+01	5.30E+01	1.95E+05	-	4.14E+04	3.41E+04	5.30E+01 ca
Fluoranthene	-	-	4.00E-02	-	-	-	-	-	7.79E+04	1.42E+05	-	5.02E+04	5.02E+04 nc
Hexanone, 2-	-	-	5.00E-03	3.00E-02	-	-	-	-	9.73E+03	-	2.91E+03	2.24E+03	2.24E+03 nc
Iron	-	-	7.00E-01	-	-	-	-	-	1.36E+06	-	-	1.36E+06	1.36E+06 max
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	8.00E+02	8.00E+02 nc
Mercuric Chloride	-	-	3.00E-04	3.00E-04	-	-	-	-	5.84E+02	-	2.98E+06	5.84E+02	5.84E+02 nc
Mercury (elemental)	-	-	-	3.00E-04	-	-	-	-	-	-	7.60E+01	7.60E+01	7.60E+01 sat
Methoxychlor	-	-	5.00E-03	-	-	-	-	-	9.73E+03	2.30E+04	-	6.84E+03	6.84E+03 nc
Methyl Acetate	-	-	1.00E+00	-	-	-	-	-	1.95E+06	-	-	1.95E+06	1.95E+06 sat
Methyl Ethyl Ketone	-	-	6.00E-01	5.00E+00	-	-	-	-	1.17E+06	-	4.45E+05	3.22E+05	3.22E+05 sat
Methyl Isobutyl Ketone	-	-	-	3.00E+00	-	-	-	-	-	-	2.31E+05	2.31E+05	2.31E+05 sat
Methyl Mercury	-	-	1.00E-04	-	-	-	-	-	1.95E+02	-	-	1.95E+02	1.95E+02 nc
Methylnaphthalene, 2-	-	-	4.00E-03	-	-	-	-	-	7.79E+03	1.42E+04	-	5.02E+03	5.02E+03 nc
Nickel Soluble Salts	-	2.60E-04	2.00E-02	9.00E-05	-	-	1.34E+05	1.34E+05	3.89E+04	-	8.93E+05	3.73E+04	3.73E+04 nc
Nitrate + Nitrite (as N)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite	-	-	1.00E-01	-	-	-	-	-	1.95E+05	-	-	1.95E+05	1.95E+05 max
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenol	-	-	3.00E-01	2.00E-01	-	-	-	-	5.84E+05	1.38E+06	1.98E+09	4.10E+05	4.10E+05 max
Pyrene	-	-	3.00E-02	-	-	-	-	-	5.84E+04	1.06E+05	-	3.77E+04	3.77E+04 nc
Selenium	-	-	5.00E-03	2.00E-02	-	-	-	-	9.73E+03	-	1.98E+08	9.73E+03	9.73E+03 nc
Silver	-	-	5.00E-03	-	-	-	-	-	9.73E+03	-	-	9.73E+03	9.73E+03 nc
Styrene	-	-	2.00E-01	1.00E+00	-	-	-	-	3.89E+05	-	6.83E+04	5.81E+04	5.81E+04 sat
Thallium (Soluble Salts)	-	-	1.00E-05	-	-	-	-	-	1.95E+01	-	-	1.95E+01	1.95E+01 nc
Toluene	-	-	8.00E-02	5.00E+00	-	-	-	-	1.56E+05	-	1.57E+05	7.81E+04	7.81E+04 sat
Vanadium and Compounds	-	-	5.04E-03	1.00E-04	-	-	-	-	9.81E+03	-	9.92E+05	9.72E+03	9.72E+03 nc
Xylenes	-	-	2.00E-01	1.00E-01	-	-	-	-	3.89E+05	-	4.19E+03	4.14E+03	4.14E+03 sat
Zinc and Compounds	-	-	3.00E-01	-	-	-	-	-	5.84E+05	-	-	5.84E+05	5.84E+05 max

RfD = reference dose
RfC = reference concentration
SF = slope factor
SL = screening level
TR = target risk
THQ = target hazard quotient
THI = target hazard index

ca = cancer
ca* = cancer – where ncSL<100X ca SL
max = SL exceeds ceiling limit
nc = noncancer
sat = SL exceeds csat

Attachment B-3

USEPA Radionuclide Preliminary Remediation Goals Website:
Site-Specific PRGs for Resident Scenario
(website accessed October 23, 2016)

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Site-Specific Resident Equation Inputs for Sediment/Soil

Variable	Value	Variable	Value	Variable	Value
TR (target cancer risk) unitless	0.000001	IRA_{res-c} (inhalation rate - resident child) m^3/day	10	ED_{res-a} (exposure duration - resident adult) yr	0
t_{res} (time - resident) yr	26	$IFS_{res-adj}$ (age-adjusted soil ingestion factor - resident) mg	1120000	EF_{res-c} (exposure frequency - resident child) day/yr	0
ED_{res} (exposure duration - resident) yr	26	$IFA_{res-adj}$ (age-adjusted soil inhalation factor - resident) m^3	161000	EF_{res-a} (exposure frequency - resident adult) day/yr	0
ET_{res} (exposure time - resident) hr/day	24	GSF_i (gamma shielding factor - indoor) unitless	0.4	City (Climate Zone)	0
ET_{res-c} (exposure time - resident child) hr/day	24	$MLF_{produce}$ (produce plant mass loading factor) unitless	0.26	A_s (acres)	0.5
ET_{res-a} (exposure time - resident adult) hr/day	24	Slab size for ACF (area correction factor) m^2	1000029	Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
ET_{res-i} (exposure time - indoor resident) hr/day	16.416	Cover thickness for GSF (gamma shielding factor) cm	0	PEF (particulate emission factor) m^3/kg	1.36E+09
ET_{res-o} (exposure time - outdoor resident) hr/day	1.752	IRV_{res-a} (vegetable consumption rate - resident adult) g/day	0	A (PEF Dispersion Constant)	16.2302
ED_{res-c} (exposure duration - resident child) yr	6	IRV_{res-c} (vegetable consumption rate - resident child) g/day	0	B (PEF Dispersion Constant)	18.7762
ED_{res-a} (exposure duration - resident adult) yr	20	$IFV_{res-adj}$ (age-adjusted vegetable ingestion factor - resident) g	0	C (PEF Dispersion Constant)	216.108
EF_{res} (exposure frequency - resident) day/yr	350	$IFF_{res-adj}$ (age-adjusted fruit ingestion factor - resident) g	0	V (fraction of vegetative cover) unitless	0.5
EF_{res-c} (exposure frequency - resident child) day/yr	350	IRF_{res-a} (fruit consumption rate - resident adult) g/day	0	U_m (mean annual wind speed) m/s	4.69
EF_{res-a} (exposure frequency - resident adult) day/yr	350	IRF_{res-c} (fruit consumption rate - resident child) g/day	0	U_t (equivalent threshold value)	11.32
IRS_{res-a} (soil intake rate - resident adult) mg/day	100	$CF_{res-produce}$ (contaminated plant fraction) unitless	0	F(x) (function dependent on U_m/U_t) unitless	0.194
IRS_{res-c} (soil intake rate - resident child) mg/day	200	TR (target cancer risk) unitless	0		
IRA_{res-a} (inhalation rate - resident adult) m^3/day	20	ED_{res-c} (exposure duration - resident child) yr	0		

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Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Produce Consumption PRG *(pCi/g)*	Total PRG *(pCi/g)*
Ac-228	4.92E-11	4.04E-06	4.92E-12	4.66E+06	4.40E+09	7.35E+02	-	7.35E+02
Am-241	3.77E-08	2.77E-08	1.84E-10	4.95E+00	2.29E+02	4.27E+00	-	2.27E+00
Am-243	3.70E-08	9.78E-08	1.85E-10	4.83E+00	2.28E+02	1.18E+00	-	9.48E-01
Am-243+D	3.70E-08	6.67E-07	1.99E-10	4.49E+00	2.28E+02	1.74E-01	-	1.67E-01
Ba-133	3.29E-11	1.44E-06	1.31E-11	1.42E+02	5.36E+05	1.68E-01	-	1.68E-01
Bi-212	8.44E-11	4.96E-07	1.68E-12	8.32E+07	1.57E+10	3.65E+04	-	3.65E+04
Bi-212+D	8.44E-11	4.96E-07	1.68E-12	8.32E+07	1.57E+10	3.65E+04	-	3.65E+04
Bi-214	3.10E-11	7.34E-06	4.03E-13	1.05E+09	1.30E+11	7.50E+03	-	7.50E+03
Bi-214+D	3.10E-11	7.34E-06	4.03E-13	1.05E+09	1.30E+11	7.50E+03	-	7.50E+03
C-14	1.69E-11	7.86E-12	2.77E-12	3.23E+02	5.00E+05	1.64E+04	-	3.16E+02
Cf-244	3.23E-11	6.06E-11	2.75E-13	1.59E+09	1.28E+11	9.33E+08	-	5.85E+08
Cm-244	3.56E-08	1.40E-10	1.56E-10	9.04E+00	3.75E+02	1.31E+03	-	8.77E+00
Cm-245	3.81E-08	2.74E-07	1.87E-10	4.78E+00	2.22E+02	4.23E-01	-	3.88E-01

Isotope	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Soil Ingestion Slope Factor (risk/pCi)	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Consumption PRG (pCi/g)	Total PRG (pCi/g)
Cm-246	3.81E-08	1.80E-08	1.82E-10	4.92E+00	2.22E+02	6.44E+00	-	2.75E+00
Cm-247	3.49E-08	1.31E-06	1.80E-10	4.96E+00	2.42E+02	8.83E-02	-	8.68E-02
Cm-247+D	3.49E-08	1.37E-06	1.81E-10	4.93E+00	2.42E+02	8.45E-02	-	8.30E-02
Co-58	7.92E-12	4.48E-06	7.10E-12	1.17E+04	9.90E+07	2.40E+00	-	2.40E+00
Co-60	1.01E-10	1.24E-05	3.81E-11	8.26E+01	2.94E+05	3.29E-02	-	3.29E-02
Cs-134	6.99E-11	7.10E-06	5.74E-11	1.36E+02	1.06E+06	1.42E-01	-	1.42E-01
Cs-137	1.12E-10	5.52E-10	4.26E-11	2.78E+01	1.00E+05	2.79E+02	-	2.53E+01
Cs-137+D	1.12E-10	2.53E-06	4.26E-11	2.78E+01	1.00E+05	6.08E-02	-	6.06E-02
Eu-152	1.91E-10	5.41E-06	1.46E-11	1.11E+02	8.00E+04	3.87E-02	-	3.87E-02
Eu-155	1.92E-11	1.25E-07	5.18E-12	6.69E+02	1.71E+06	3.60E+00	-	3.58E+00
I-129	1.64E-10	6.18E-09	2.78E-10	3.21E+00	5.15E+04	1.87E+01	-	2.74E+00
K-40	2.22E-10	7.99E-07	5.85E-11	1.53E+01	3.80E+04	1.45E-01	-	1.43E-01
Mn-54	1.21E-11	3.89E-06	4.92E-12	3.82E+03	1.47E+07	6.27E-01	-	6.26E-01
Np-237	2.87E-08	5.17E-08	1.25E-10	7.14E+00	2.94E+02	2.24E+00	-	1.69E+00
Np-237+D	2.87E-08	8.55E-07	1.41E-10	6.33E+00	2.94E+02	1.35E-01	-	1.32E-01
Np-239	4.48E-12	5.69E-07	1.41E-11	1.76E+05	5.24E+09	5.66E+02	-	5.64E+02
Pb-210	1.59E-08	1.48E-09	1.72E-09	7.58E-01	7.75E+02	1.14E+02	-	7.52E-01
Pb-212	6.40E-10	4.96E-07	6.33E-11	2.09E+05	1.96E+08	3.46E+03	-	3.41E+03
Pb-214	4.00E-11	9.94E-07	7.92E-13	3.99E+08	7.46E+10	4.12E+04	-	4.12E+04
Pm-146	1.02E-10	3.27E-06	1.03E-11	2.93E+02	2.80E+05	1.20E-01	-	1.20E-01
Pu-238	5.22E-08	6.91E-11	2.25E-10	4.39E+00	1.79E+02	1.85E+03	-	4.27E+00
Pu-239	5.55E-08	2.09E-10	2.28E-10	3.92E+00	1.52E+02	5.54E+02	-	3.79E+00
Pu-239+D	5.55E-08	2.09E-10	2.28E-10	3.92E+00	1.52E+02	5.54E+02	-	3.79E+00
Pu-240	5.55E-08	7.12E-11	2.28E-10	3.92E+00	1.52E+02	1.63E+03	-	3.81E+00
Ra-224	1.13E-08	3.91E-08	4.26E-10	3.77E+03	1.34E+06	5.32E+03	-	2.20E+03
Ra-224+D	1.13E-08	4.19E-08	4.26E-10	3.77E+03	1.34E+06	4.96E+03	-	2.14E+03
Ra-226	2.82E-08	2.50E-08	6.77E-10	1.33E+00	3.01E+02	4.66E+00	-	1.03E+00
Ra-226(+D)	2.82E-08	8.37E-06	6.77E-10	1.33E+00	3.01E+02	1.39E-02	-	1.38E-02
Ru-106	2.24E-10	0.00E+00	1.12E-10	1.40E+02	6.63E+05	-	-	1.40E+02
Ru-106+D	2.24E-10	9.71E-07	1.12E-10	1.40E+02	6.63E+05	2.10E+00	-	2.07E+00
Sn-113	1.47E-11	2.28E-08	1.17E-11	4.37E+03	3.29E+07	2.90E+02	-	2.72E+02
Sr-89	3.03E-11	7.24E-09	3.33E-11	3.49E+03	3.63E+07	2.08E+03	-	1.30E+03
Sr-90	4.26E-10	4.83E-10	8.62E-11	1.39E+01	2.67E+04	3.58E+02	-	1.34E+01
Sr-90+D	4.33E-10	1.95E-08	1.35E-10	8.90E+00	2.62E+04	7.99E+00	-	4.21E+00

Isotope	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Soil Ingestion Slope Factor (risk/pCi)	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Consumption PRG (pCi/g)	Total PRG (pCi/g)
Th-228	1.32E-07	5.64E-09	2.43E-10	3.47E+01	6.04E+02	1.94E+02	-	2.80E+01
Th-230	3.41E-08	8.45E-10	1.66E-10	5.38E+00	2.48E+02	1.37E+02	-	5.07E+00
Th-231	1.50E-12	2.49E-08	5.96E-12	9.27E+05	3.48E+10	2.88E+04	-	2.79E+04
Th-232	4.33E-08	3.58E-10	1.84E-10	4.85E+00	1.95E+02	3.23E+02	-	4.67E+00
Th-232+D	8.70E-08	4.04E-06	2.17E-09	4.11E-01	9.70E+01	2.86E-02	-	2.68E-02
Tl-208	0.00E+00	1.75E-05	0.00E+00	-	-	2.05E+04	-	2.05E+04
U-233	2.83E-08	7.11E-10	1.50E-10	5.95E+00	2.98E+02	1.63E+02	-	5.63E+00
U-234	2.78E-08	2.53E-10	1.48E-10	6.03E+00	3.04E+02	4.57E+02	-	5.84E+00
U-235	2.50E-08	5.51E-07	1.48E-10	6.03E+00	3.38E+02	2.10E-01	-	2.03E-01
U-235+D	2.50E-08	5.76E-07	1.54E-10	5.80E+00	3.38E+02	2.01E-01	-	1.94E-01
U-238	2.36E-08	1.24E-10	1.34E-10	6.66E+00	3.58E+02	9.33E+02	-	6.50E+00
U-238+D	2.37E-08	1.19E-07	1.97E-10	4.53E+00	3.56E+02	9.72E-01	-	7.99E-01
Zn-65	7.55E-12	2.80E-06	2.28E-11	1.06E+03	3.02E+07	1.12E+00	-	1.12E+00
Zr-95	2.12E-11	3.36E-06	1.18E-11	7.77E+03	4.09E+07	3.54E+00	-	3.54E+00

PRG = preliminary remediation goal

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Attachment B-4

USEPA Radionuclide Preliminary Remediation Goals for Superfund Table:
Default PRGs for Industrial Worker Scenario
(website accessed October 14, 2016)

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Default
Industrial Worker Equation Inputs for Soil/Sediment

Variable	Value
Slab Size for ACF (area correction factor) m^2	Default (isotope-specific)
TR (target cancer risk) unitless	0.000001
t_w (time -composite worker) yr	25
ED_w (exposure duration - composite worker) yr	25
ET_w (exposure time - composite worker) hr/day	8
EF_w (exposure frequency - composite worker) day/yr	250
IR_w (soil intake rate - composite worker) mg/day	100
IRA_w (inhalation rate - composite worker) m^3/day	60
GSF_o (gamma shielding factor - outdoors) unitless	1

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Isotope	Inhalation Slope Factor (Lungtype) (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	PARticulate Emission or Volatilization factor (m3/kg)	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)
Ac-228	4.9E-11 (S)	4.04E-06	8.58E-13	1.36E+09	9.2E+07	5.5E+09	2.7E+03	2.7E+03
Am-241	3.8E-08 (F)	2.77E-08	9.10E-11	1.36E+09	3.6E+01	2.9E+02	1.6E+01	1.1E+01
Am-243+D	3.7E-08 (F)	6.67E-07	9.25E-11	1.36E+09	3.5E+01	2.9E+02	6.6E-01	6.4E-01
Ba-133	3.3E-11 (S)	1.44E-06	4.40E-12	1.36E+09	1.5E+03	6.7E+05	6.2E-01	6.2E-01
Bi-210m	2.9E-08 (S)	1.03E-06	2.92E-11	1.36E+09	1.1E+02	3.7E+02	4.3E-01	4.3E-01
Bi-212+D	8.4E-11 (S)	4.96E-07	4.44E-13	1.36E+09	1.1E+09	1.9E+10	1.3E+05	1.3E+05
Bi-214+D	3.1E-11 (S)	7.34E-06	1.47E-13	1.36E+09	9.9E+09	1.6E+11	2.7E+04	2.7E+04
C-14	1.7E-11 (S)	7.86E-12	1.38E-12	1.36E+09	2.3E+03	6.4E+05	6.2E+04	2.2E+03
Cf-244	3.2E-11 (S)	6.06E-11	9.03E-14	1.36E+09	1.7E+10	1.6E+11	3.4E+09	2.8E+09
Cm-244	3.6E-08 (S)	1.40E-10	6.88E-11	1.36E+09	7.2E+01	4.8E+02	4.9E+03	6.2E+01
Cm-245	3.8E-08 (F)	2.74E-07	9.18E-11	1.36E+09	3.5E+01	2.9E+02	1.6E+00	1.5E+00
Cm-246	3.8E-08 (F)	1.80E-08	9.10E-11	1.36E+09	3.5E+01	2.9E+02	2.4E+01	1.4E+01
Cm-247	3.5E-08 (F)	1.31E-06	8.58E-11	1.36E+09	3.7E+01	3.1E+02	3.3E-01	3.3E-01
Co-58	7.9E-12 (S)	4.48E-06	1.56E-12	1.36E+09	1.8E+05	1.2E+08	8.7E+00	8.7E+00
Co-60	1.0E-10 (S)	1.24E-05	7.33E-12	1.36E+09	1.5E+03	3.7E+05	1.2E-01	1.2E-01
Cs-134	7.0E-11 (S)	7.10E-06	4.48E-11	1.36E+09	6.0E+02	1.3E+06	5.2E-01	5.2E-01
Cs-137+D	1.1E-10 (S)	2.53E-06	3.18E-11	1.36E+09	1.3E+02	1.3E+05	2.3E-01	2.3E-01

Isotope	Inhalation Slope Factor (Lungtype) (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	PARticulate Emission or Volatilization factor (m3/kg)	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Total PRG (pCi/g)
Eu-152	1.9E-10 (F)	5.41E-06	2.87E-12	1.36E+09	2.0E+03	1.0E+05	1.4E-01	1.4E-01
Eu-155	1.9E-11 (S)	1.25E-07	8.29E-13	1.36E+09	1.4E+04	2.1E+06	1.3E+01	1.3E+01
I-129	1.6E-10 (V)	6.18E-09	1.17E-10	1.36E+09	2.7E+01	6.6E+04	7.1E+01	2.0E+01
K-40	2.2E-10 (S)	7.99E-07	1.51E-11	1.36E+09	2.1E+02	4.9E+04	5.5E-01	5.5E-01
Mn-54	1.2E-11 (S)	3.89E-06	1.48E-12	1.36E+09	4.4E+04	1.8E+07	2.3E+00	2.3E+00
Np-237+D	2.9E-08 (S)	8.55E-07	4.96E-11	1.36E+09	6.5E+01	3.8E+02	5.1E-01	5.1E-01
Np-239	4.5E-12 (S)	5.69E-07	2.19E-12	1.36E+09	3.9E+06	6.5E+09	2.1E+03	2.1E+03
Pb-210	1.6E-08 (S)	1.48E-09	5.99E-10	1.36E+09	7.7E+00	9.9E+02	4.3E+02	7.5E+00
Pb-212	6.4E-10 (S)	4.96E-07	1.31E-11	1.36E+09	3.5E+06	2.4E+08	1.3E+04	1.3E+04
Pb-214	4.0E-11 (S)	9.94E-07	2.21E-13	1.36E+09	4.9E+09	9.2E+10	1.5E+05	1.5E+05
Pm-146	1.0E-10 (F)	3.27E-06	1.97E-12	1.36E+09	5.3E+03	3.5E+05	4.4E-01	4.4E-01
Pu-238	5.2E-08 (F)	6.91E-11	1.17E-10	1.36E+09	3.0E+01	2.3E+02	7.0E+03	2.7E+01
Pu-239+D	5.6E-08 (F)	2.09E-10	1.21E-10	1.36E+09	2.6E+01	2.0E+02	2.1E+03	2.3E+01
Pu-240	5.6E-08 (F)	7.12E-11	1.21E-10	1.36E+09	2.6E+01	2.0E+02	6.2E+03	2.3E+01
Ra-224+D	1.1E-08 (S)	4.19E-08	8.47E-11	1.36E+09	6.5E+04	1.7E+06	1.8E+04	1.4E+04
Ra-226+D	2.8E-08 (S)	8.37E-06	2.95E-10	1.36E+09	1.1E+01	3.9E+02	5.3E-02	5.2E-02
Ru-106	2.2E-10 (S)	0.00E+00	1.84E-11	1.36E+09	2.9E+03	8.2E+05	.	2.9E+03
Sn-113	1.5E-11 (S)	2.28E-08	1.89E-12	1.36E+09	9.3E+04	4.1E+07	1.1E+03	1.0E+03
Sr-89	3.0E-11 (S)	7.24E-09	6.51E-12	1.36E+09	6.1E+04	4.5E+07	7.6E+03	6.7E+03
Sr-90+D	4.3E-10 (S)	1.95E-08	5.88E-11	1.36E+09	7.2E+01	3.3E+04	3.0E+01	2.1E+01
Tc-99	3.8E-11 (S)	8.28E-11	1.32E-12	1.36E+09	2.4E+03	2.9E+05	5.3E+03	1.6E+03
Th-228	1.3E-07 (S)	5.64E-09	6.40E-11	1.36E+09	4.5E+02	7.4E+02	7.0E+02	2.0E+02
Th-230	3.4E-08 (F)	8.45E-10	7.73E-11	1.36E+09	4.1E+01	3.2E+02	5.2E+02	3.4E+01
Th-231	1.5E-12 (S)	2.49E-08	9.07E-13	1.36E+09	2.1E+07	4.3E+10	1.0E+05	1.0E+05
Th-232+D	8.7E-08 (S)	4.04E-06	7.55E-10	1.36E+09	4.2E+00	1.3E+02	1.1E-01	1.1E-01
Th-234+D	3.1E-11 (S)	1.08E-07	9.51E-12	1.36E+09	8.8E+04	9.3E+07	1.1E+03	1.0E+03
Tl-208	0.00E+00	1.75E-05	0.00E+00	1.36E+09	.	.	7.5E+04	7.5E+04
U-233	2.8E-08 (S)	7.11E-10	5.22E-11	1.36E+09	6.1E+01	3.8E+02	6.2E+02	4.9E+01
U-234	2.8E-08 (S)	2.53E-10	5.11E-11	1.36E+09	6.3E+01	3.9E+02	1.7E+03	5.2E+01
U-235+D	2.5E-08 (S)	5.76E-07	5.00E-11	1.36E+09	6.4E+01	4.3E+02	7.6E-01	7.5E-01
Zn-65	7.5E-12 (F)	2.80E-06	8.92E-12	1.36E+09	9.3E+03	3.7E+07	4.0E+00	4.0E+00
Zr-95	2.1E-11 (S)	3.36E-06	2.18E-12	1.36E+09	1.4E+05	5.1E+07	1.3E+01	1.3E+01

PRG = preliminary remediation goal

Attachment B-

5

USEPA Radionuclide Preliminary Remediation Goals for Superfund Website:
Site-Specific PRGs for Onsite Worker Scenario
(website accessed October 23, 2016)

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Site-specific Onsite Worker Equation Inputs for Sediment/Soil

Variable	Value	Variable	Value
Slab size for ACF (area correction factor) m^2	1000029	A_s (acres)	0.5
Cover layer thickness for GSF (gamma shielding factor) cm	0	A_s (acres)	0.5
TR (target cancer risk) unitless	0.000001	Q/C_{wp} (g/m^2-s per kg/m^3)	93.77
t_{ow} (time - outdoor worker) yr	20	PEF (particulate emission factor) m^3/kg	1.359E+09
EF_{ow} (exposure frequency - outdoor worker) day/yr	150	A (PEF Dispersion Constant)	16.2302
ED_{ow} (exposure duration - outdoor worker) yr	20	B (PEF Dispersion Constant)	18.7762
IRS_{ow} (soil intake rate - outdoor worker) mg/day	100	C (PEF Dispersion Constant)	216.108
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60	V (fraction of vegetative cover) unitless	0.5
ET_{ow} (exposure time - outdoor worker) hr/day	8	U_m (mean annual wind speed) m/s	4.69
City (Climate Zone)	0	U_t (equivalent threshold value)	11.32
A_s (acres)	0.5	F(x) (function dependent on U_m/U_t) unitless	0.194

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Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Ac-228	4.92E-11	4.04E-06	8.58E-13	7.67E+07	9.09E+09	1.78E+03	1.78E+03
Am-241	3.77E-08	2.77E-08	9.10E-11	3.72E+01	6.11E+02	1.34E+01	9.69E+00
Am-243	3.70E-08	9.78E-08	9.03E-11	3.69E+01	6.13E+02	3.74E+00	3.37E+00
Am-243+D	3.70E-08	6.67E-07	9.25E-11	3.61E+01	6.13E+02	5.48E-01	5.39E-01
Ba-133	3.29E-11	1.44E-06	4.40E-12	1.36E+03	1.24E+06	4.56E-01	4.56E-01
Bi-212	8.44E-11	4.96E-07	4.44E-13	9.04E+08	3.23E+10	8.86E+04	8.86E+04
Bi-212+D	8.44E-11	4.96E-07	4.44E-13	9.04E+08	3.23E+10	8.86E+04	8.86E+04
Bi-214	3.10E-11	7.34E-06	1.47E-13	8.30E+09	2.67E+11	1.82E+04	1.82E+04

Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil *(Continued)*

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Bi-214+D	3.10E-11	7.34E-06	1.47E-13	8.30E+09	2.67E+11	1.82E+04	1.82E+04
C-14	1.69E-11	7.86E-12	1.38E-12	2.42E+03	1.34E+06	5.17E+04	2.31E+03
Cf-244	3.23E-11	6.06E-11	9.03E-14	1.39E+10	2.64E+11	2.26E+09	1.93E+09
Cm-244	3.56E-08	1.40E-10	6.88E-11	6.94E+01	9.11E+02	3.73E+03	6.34E+01
Cm-245	3.81E-08	2.74E-07	9.18E-11	3.63E+01	5.95E+02	1.33E+00	1.28E+00
Cm-246	3.81E-08	1.80E-08	9.10E-11	3.67E+01	5.96E+02	2.03E+01	1.28E+01
Cm-247	3.49E-08	1.31E-06	8.58E-11	3.89E+01	6.49E+02	2.79E-01	2.77E-01
Cm-247+D	3.49E-08	1.37E-06	8.62E-11	3.87E+01	6.49E+02	2.66E-01	2.64E-01
Co-58	7.92E-12	4.48E-06	1.56E-12	1.53E+05	2.04E+08	5.82E+00	5.82E+00
Co-60	1.01E-10	1.24E-05	7.33E-12	1.29E+03	6.34E+05	8.32E-02	8.32E-02
Cs-134	6.99E-11	7.10E-06	4.48E-11	5.01E+02	2.18E+06	3.46E-01	3.46E-01
Cs-137	1.12E-10	5.52E-10	3.18E-11	1.31E+02	2.52E+05	8.25E+02	1.13E+02
Cs-137+D	1.12E-10	2.53E-06	3.18E-11	1.31E+02	2.52E+05	1.80E-01	1.80E-01
Eu-152	1.91E-10	5.41E-06	2.87E-12	1.86E+03	1.90E+05	1.08E-01	1.08E-01
Eu-155	1.92E-11	1.25E-07	8.29E-13	1.24E+04	3.64E+06	9.01E+00	9.01E+00
I-129	1.64E-10	6.18E-09	1.17E-10	2.85E+01	1.38E+05	5.91E+01	1.92E+01
K-40	2.22E-10	7.99E-07	1.51E-11	2.21E+02	1.02E+05	4.57E-01	4.56E-01
Mn-54	1.21E-11	3.89E-06	1.48E-12	3.65E+04	3.03E+07	1.52E+00	1.52E+00
Np-237	2.87E-08	5.17E-08	4.70E-11	7.09E+01	7.89E+02	7.06E+00	6.37E+00
Np-237+D	2.87E-08	8.55E-07	4.96E-11	6.72E+01	7.89E+02	4.27E-01	4.24E-01
Np-239	4.48E-12	5.69E-07	2.19E-12	3.26E+06	1.08E+10	1.37E+03	1.37E+03
Pb-210	1.59E-08	1.48E-09	5.99E-10	7.48E+00	1.92E+03	3.32E+02	7.29E+00
Pb-212	6.40E-10	4.96E-07	1.31E-11	2.91E+06	4.04E+08	8.40E+03	8.38E+03
Pb-214	4.00E-11	9.94E-07	2.21E-13	4.10E+09	1.54E+11	9.99E+04	9.99E+04
Pm-146	1.02E-10	3.27E-06	1.97E-12	4.61E+03	6.05E+05	3.04E-01	3.04E-01
Pu-238	5.22E-08	6.91E-11	1.17E-10	3.08E+01	4.69E+02	5.71E+03	2.88E+01
Pu-239	5.55E-08	2.09E-10	1.21E-10	2.76E+01	4.08E+02	1.75E+03	2.54E+01
Pu-239+D	5.55E-08	2.09E-10	1.21E-10	2.76E+01	4.08E+02	1.75E+03	2.54E+01

Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil *(Continued)*

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Pu-240	5.55E-08	7.12E-11	1.21E-10	2.76E+01	4.09E+02	5.13E+03	2.57E+01
Ra-224	1.13E-08	3.91E-08	8.47E-11	5.44E+04	2.77E+06	1.29E+04	1.04E+04
Ra-224+D	1.13E-08	4.19E-08	8.47E-11	5.44E+04	2.77E+06	1.20E+04	9.82E+03
Ra-226	2.82E-08	2.50E-08	2.95E-10	1.13E+01	8.07E+02	1.47E+01	6.35E+00
Ra-226+D	2.82E-08	8.37E-06	2.95E-10	1.13E+01	8.07E+02	4.38E-02	4.36E-02
Ru-106	2.24E-10	0.00E+00	1.84E-11	2.45E+03	1.37E+06	-	2.45E+03
Ru-106+D	2.24E-10	9.71E-07	1.84E-11	2.45E+03	1.37E+06	5.09E+00	5.08E+00
Sn-113	1.47E-11	2.28E-08	1.89E-12	7.76E+04	6.78E+07	7.04E+02	6.98E+02
Sr-89	3.03E-11	7.24E-09	6.51E-12	5.13E+04	7.49E+07	5.05E+03	4.60E+03
Sr-90	4.26E-10	4.83E-10	5.14E-11	8.17E+01	6.70E+04	1.06E+03	7.58E+01
Sr-90+D	4.33E-10	1.95E-08	5.88E-11	7.14E+01	6.59E+04	2.36E+01	1.77E+01
Th-228	1.32E-07	5.64E-09	6.40E-11	3.78E+02	1.25E+03	4.70E+02	1.79E+02
Th-230	3.41E-08	8.45E-10	7.73E-11	4.31E+01	6.64E+02	4.32E+02	3.70E+01
Th-231	1.50E-12	2.49E-08	9.07E-13	1.75E+07	7.19E+10	6.98E+04	6.95E+04
Th-232	4.33E-08	3.58E-10	8.47E-11	3.94E+01	5.23E+02	1.02E+03	3.53E+01
Th-232+D	8.70E-08	4.04E-06	7.55E-10	4.42E+00	2.60E+02	9.03E-02	8.85E-02
Th-234	3.08E-11	1.77E-08	9.51E-12	7.36E+04	1.54E+08	4.33E+03	4.09E+03
Th-234+D	3.08E-11	1.08E-07	9.51E-12	7.36E+04	1.54E+08	7.10E+02	7.03E+02
Tl-208	0.00E+00	1.75E-05	0.00E+00	-	-	4.96E+04	4.96E+04
U-233	2.83E-08	7.11E-10	5.22E-11	6.39E+01	8.01E+02	5.13E+02	5.30E+01
U-234	2.78E-08	2.53E-10	5.11E-11	6.52E+01	8.15E+02	1.44E+03	5.80E+01
U-235	2.50E-08	5.51E-07	4.92E-11	6.78E+01	9.06E+02	6.62E-01	6.56E-01
U-235+D	2.50E-08	5.76E-07	5.00E-11	6.67E+01	9.06E+02	6.34E-01	6.27E-01
U-238	2.36E-08	1.24E-10	4.66E-11	7.15E+01	9.60E+02	2.94E+03	6.51E+01
U-238+D	2.37E-08	1.19E-07	5.62E-11	5.93E+01	9.56E+02	3.07E+00	2.91E+00
Zn-65	7.55E-12	2.80E-06	8.92E-12	7.77E+03	6.24E+07	2.71E+00	2.71E+00
Zr-95	2.12E-11	3.36E-06	2.18E-12	1.21E+05	8.44E+07	8.58E+00	8.58E+00

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PRG = preliminary remediation goal

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Attachment B-6

USEPA Regional Screening Levels Website:
Site-Specific RSLs for Recreational Fisherman Scenario
(website accessed October 23, 2016)

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Site-specific Equation Inputs for Fish Ingestion - Recreational Fisherman

Variable	Value
TR (target cancer risk) unitless	0.000001
THQ (target hazard quotient) unitless	1
AT (averaging time)	365
EF_{res-a} (exposure frequency) days/yr	350
ED_{res} (exposure duration) yr	26
LT (lifetime) yr	70
BW_{res-a} (body weight) kg	80
IRF_{res-a} (fish consumption rate) mg/day	54000

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Site-specific Recreational Fisherman Risk -Based Screening Levels for Fish Ingestion

Chemical	Ingestion SF *(mg/kg-day)*$^{-1}$	Chronic RfD *(mg/kg-day)*	Screening Level *(mg/kg)*
Aluminum	-	1.00E+00	1.54E+03 nc
Barium	-	2.00E-01	3.09E+02 nc
Calcium	-	-	-
Chromium(III), Insoluble Salts	-	1.50E+00	2.32E+03 nc
Chromium(VI)	5.00E-01	3.00E-03	8.32E-03 ca
Chromium, Total	-	-	-
Copper	-	4.00E-02	6.18E+01nc
Cyanide (CN-)	-	6.00E-04	9.27E-01nc
Manganese (Diet)	-	1.40E-01	2.16E+02 nc
Mercuric Chloride	-	3.00E-04	4.63E-01nc
Mercury (elemental)	-	-	-
Methyl Mercury	-	1.00E-04	1.54E-01nc
Potassium	-	-	-
Sodium	-	-	-
Zinc and Compounds	-	3.00E-01	4.63E+02 nc

Output generated 23OCT2016:11:42:29
SF = slope factor
RfD = reference dose
ca = cancer
nc = noncancer

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Attachment B-7

USEPA Preliminary Remediation Goals for Superfund Website:
Site-Specific PRGs for Recreational Fisherman Scenario
(website accessed October 23, 2016)

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Site-specific Equation Inputs for Fish Ingestion - Recreational Fisherman

Variable	Value
$CF_{res\text{-}fish}$ (contaminated fish fraction) unitless	1
ED_{res} (exposure duration - resident) yr	26
$IRFI_{res}$ (fish intake rate - adult) g/day	54
TR (target cancer risk) unitless	0.000001
EF_{res} (exposure frequency - resident) day/yr	350

Output generated 23OCT2016:12:07:10

Site-specific Recreational Fisherman Preliminary Remediation Goals for Fish Ingestion

Isotope	Food Ingestion Slope Factor *(risk/pCi)*	Ingestion of Fish PRG TR=1.0E-6 *(pCi/g)*
Co-60	2.23E-11	9.13E-02
Cs-137	3.74E-11	5.44E-02
Cs-137+D	3.74E-11	5.44E-02
K-40	3.42E-11	5.95E-02
Mn-54	3.10E-12	6.56E-01
Na-22	1.26E-11	1.62E-01
Pb-212	3.57E-11	5.70E-02
Pu-238	1.69E-10	1.20E-02
Sn-113	6.44E-12	3.16E-01
Sr-89	1.84E-11	1.11E-01
Sr-90	6.88E-11	2.96E-02
Sr-90+D	9.51E-11	2.14E-02
Th-234	3.39E-11	6.00E-02
Th-234+D	3.39E-11	6.00E-02

Output generated 23OCT2016:12:07:10
PRG = preliminary remediation goal
TR = target risk

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Attachment B-8

USEPA Regional Screening Levels Table
MCLs/RSLs/AWQC for Surface Water Data Screening of Nonradiological Constituents
(website accessed October 17, 2016)

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MCLs/RSLs/AWQC for Surface Water Data Screening of Nonradiological Constituents

Analyte	CAS No.	MCL[1] *(µg/L)*	Tapwater SL[2] *(µg/L)*	SCDHEC AWQC[3] *(µg/L)*
Acetone	67-64-1		1.4E+04	
Aluminum	7429-90-5		2.0E+04	
Antimony (metallic)	7440-36-0	6.0E+00		
Arsenic, Inorganic	7440-38-2	1.0E+01		
Atrazine	1912-24-9	3.0E+00		
Barium	7440-39-3	2.0E+03		
Benzaldehyde	100-52-7		1.9E+01	
Beryllium	7440-41-7	4.0E+00		
Bis(2-chloroethoxy)methane	111-91-1		5.9E+01	
Bis(2-chloroethyl)ether	111-44-4		1.4E-02	3.0E-02
Bromoform	75-25-2	8.0E+01		
Cadmium (Water)	7440-43-9	5.0E+00		
Caprolactam	105-60-2		9.9E+03	
Chloromethane	74-87-3		1.9E+02	
Chlorophenol, 2-	95-57-8		9.1E+01	8.1E+01
Chromium(III), Insoluble Salts	16065-83-1		2.2E+04	
Chromium(VI)	18540-29-9		3.5E-02	
Chromium	7440-47-3	1.0E+02		
Cobalt	7440-48-4		6.0E+00	1.3E+03
Copper	7440-50-8	1.3E+03		
Cyanide	57-12-5	2.0E+02		
DDE, p,p'-	72-55-9		4.6E-02	2.2E-04
DDT	50-29-3		2.3E-01	2.2E-03
Dibromochloromethane	124-48-1	8.0E+01		
Dichlorophenol, 2,4-	120-83-2		4.6E+01	
Dinitrophenol, 2,4-	51-28-5		3.9E+01	6.9E+01
Dinitrotoluene Mixture, 2,4/2,6-	NA		1.1E-01	1.1E-01
Dinitrotoluene, 2,4-	121-14-2		2.4E-01	7.7E+01
Dinitrotoluene, 2,6-	606-20-2		4.9E-02	
Diphenylamine	122-39-4		3.1E+02	
Endrin Ketone	53494-70-5	2.0E+00		
Hexachlorobenzene	118-74-1	1.0E+00		
Hexachlorobutadiene	87-68-3		1.4E-01	4.4E-01
Hexachlorocyclopentadiene	77-47-4	5.0E+01	4.1E-01	4.0E+01
Hexachloroethane	67-72-1		3.3E-01	1.4E+01
Iron	7439-89-6		1.4E+04	
Isophorone	78-59-1		7.8E+01	3.5E+01
Lead	7439-92-1	1.5E+01		
Manganese	7439-96-5		4.3E+02	
Mercuric Chloride	7487-94-7	2.0E+00		
Mercury	7439-97-6	2.0E+00		
Methyl Mercury	22967-92-6		2.0E+00	
Methylene Chloride	75-09-2	5.0E+00		
Nickel Soluble Salts	7440-02-0		3.9E+02	6.1E+02
Nitroaniline, 2-	88-74-4		1.9E+02	
Nitroaniline, 4-	100-01-6		3.8E+00	
Nitrobenzene	98-95-3		1.4E-01	1.7E+01

MCLs/RSLs/AWQC for Surface Water Data Screening of Nonradiological Constituents
(Continued)

Analyte	CAS No.	MCL[1] *(µg/L)*	Tapwater SL[2] *(µg/L)*	SCDHEC AWQC[3] *(µg/L)*
Nitroso-di-N-propylamine, N-	621-64-7		1.1E-02	5.0E-03
Pentachlorophenol	87-86-5	1.0E+00		
Phenol	108-95-2		5.8E+03	1.0E+04
Bis(2-ethylhexyl)phthalate	117-81-7	6.0E+00		
Butyl Benzyl Phthalate	85-68-7		1.6E+01	1.5E+03
Diethylphthalate	84-66-2		1.5E+04	1.7E+04
Anthracene	120-12-7		1.8E+03	8.3E+03
Benz[a]anthracene	56-55-3		1.2E-02	3.8E-03
Benzo[a]pyrene	50-32-8	2.0E-01		
Benzo[b]fluoranthene	205-99-2		3.4E-02	3.8E-03
Benzo[k]fluoranthene	207-08-9		3.4E-01	3.8E-03
Chrysene	218-01-9		3.4E+00	3.8E-03
Dibenz[a,h]anthracene	53-70-3		3.4E-03	3.8E-03
Fluoranthene	206-44-0		8.0E+02	1.3E+02
Fluorene	86-73-7		2.9E+02	1.1E+03
Indeno[1,2,3-cd]pyrene	193-39-5		3.4E-02	
Methylnaphthalene, 2-	91-57-6		3.6E+01	
Naphthalene	91-20-3		1.7E-01	
Pyrene	129-00-0		1.2E+02	8.3E+02
Selenium	7782-49-2	5.0E+01		
Silver	7440-22-4		9.4E+01	
Styrene	100-42-5	1.0E+02		
Thallium	7440-28-0	2.0E+00		
Toluene	108-88-3	1.0E+03		
Trichloroethylene	79-01-6	5.0E+00		
Trichlorofluoromethane	75-69-4		5.2E+03	
Trichlorophenol, 2,4,5-	95-95-4		1.2E+03	
Trichlorophenol, 2,4,6-	88-06-2		4.1E+00	1.4E+00
Vanadium	7440-62-2		8.6E+01	
Xylenes	1330-20-7	1.0E+04		
Zinc	7440-66-6		6.0E+03	7.4E+04

MCL = maximum contaminant level
SL = screening level
SCDHEC = South Carolina Department of Health and Environmental Control
AWQC = ambient water quality criteria
1. Values from *USEPA, EPA-816-F-09-004,* May 2009.
2. Values from *USEPA Regional Screening Levels (RSLS) – Generic Tables, Summary Table* (May 2016).
3.Values from *R.61-68, Water Classification& Standards, South Carolina Department of Health and Environmental Control, Bureau of Water*

Attachment B-9

USEPA Regional Screening Levels Table
MCLs/PRGs for Surface Water Data Screening of Radiological Constituents
(website accessed October 17, 2016)

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MCLs/PRGs for Surface Water Data Screening of Radiological Constituents

Isotope	MCL *(pCi/L)*	Tapwater PRG *(pCi/L)*
Am-241	1.5E+01	
Bi-214	1.5E+01	
Cs-137	2.0E+02	
Cm-244	1.5E+01	
Co-60	1.0E+02	
H-3	2.0E+04	
I-129	1.0E+00	
K-40		8.3E-01
Pb-212		1.8E+00
Pb-214		1.3E+02
Pu-238	1.5E+01	
Pu-239	1.5E+01	
Pu-239	1.5E+01	
Pu-240	1.5E+01	
Ra-226	1.5E+01	
Ra-228+D	5.0E+00	
Sr-89	8.0E+00	
Sr-90	8.0E+00	
Sr-90+D	8.0E+00	
Tc-99	9.0E+02	
Th-232	1.5E+01	
Th-232+D	1.5E+01	
Th-234		1.9E+00
U-234	1.9E+05	
U-235	6.5E+01	
U-235+D	6.5E+01	
U-238	1.0E+01	
U-238+D	1.0E+01	

MCL = maximum contaminant level
PRG = preliminary remediation goal (November 2014)

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APPENDIX C

Ecological Risk Assessment

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C.1. INTRODUCTION

The ecological risk assessment (ERA) in support of the Lower Three Runs (LTR) Integrator Operable Unit (IOU) is presented in this appendix. From this point forward, the investigation area will be referred to as the LTR IOU. The LTR IOU is defined as the LTR stream and its tributaries and impoundments, including surface water, sediment, floodplain soils (sediment/soil), and related biota in these water bodies and associated floodplains/wetlands. The LTR IOU is downgradient from two major industrial reactor areas, R-Area and P-Area. These areas include various subunits that have been combined as area completion unit R Area Operable Unit (RAOU) and P Area OU (PAOU). Both RAOU and PAOU have undergone the CERCLA RI/FS process and subsequent remedial action as described in the final Record of Decision (RODs) for these OUs.

The ERA process is in accordance with the conceptual site model (CSM) presented in Section 2. The CSM is a graphical depiction of the known and suspected sources of contamination within the LTR IOU, the types of contaminants and potentially affected media, the known and potential routes of migrations, and the potential ecological receptors, including terrestrial receptors and aquatic/semi-aquatic receptors. Concentrations of constituents present in sediment/soil and surface water are screened, in a multi-step process, to screening values in order to determine the potential for impact to either of these receptor groups.

The ERA is conducted and presented for each of nine exposure areas (EAs). EAs represent geographically distinct locations with the LTR IOU, each of which contain environmental media to which a receptor may be exposed, that allow for the summary of data and evaluation of potential exposure. This approach allows for remedial decisions to be made on a smaller scale within the larger IOU area. The EAs include the following:

1. Pond A and R Discharge Canal
2. Canal between Pond A and Pond B
3. Pond B
4. Canal between Pond B and PAR Pond
5. Joyce Branch/Old Discharge Canal
6. PAR Pond
7. Pond 2 and associated canals
8. Ponds 4 and 5 and Canal to Pond C
9. Pond C

Figure C-1 presents the LTR IOU and the associated nine EAs.

Various datasets exist for each EA. Much of the characterization data were collected in 2009-2010, but are supplemented by historical data for development of the risk assessment. Media include sediment/soil and surface water. More recently, a 2016 Sampling and Analysis Plan Addendum implemented the collection and analysis of additional surface water and sediment samples from PAR Pond (SRNS 2016). All data used in the ERA are presented in Appendix A.

C.1.1 Background

The LTR IOU represents the integration of potential contamination discharged to surface water or migrating through groundwater from upgradient source OUs, National Pollutant Discharge Elimination System outfalls, and operational facilities to points of potential receptor exposure. The LTR IOU consists of natural and man-made water bodies including streams and man-made ponds and canals that transmitted and temporarily stored reactor cooling water. The cooling water was obtained from the Savannah River, was circulated through P Reactor and R Reactor, and was then discharged into the LTR IOU and eventually back into the Savannah River. The water bodies are segregated into EAs based on the primary source of contamination (R Reactor or P Reactor) for investigation, evaluation, and potential remediation purposes. EAs within the LTR IOU are defined as surface water bodies including natural streams, man-made canals, man-made ponds and associated natural wetlands including sediment/soil (floodplain soils), sediment, and biota.

The risk assessment considers environmental media within the canals and ponds only including sediments and immediately adjacent floodplain soils (collectively referred herein as sediment/soil), and surface water in the ponds and canals.

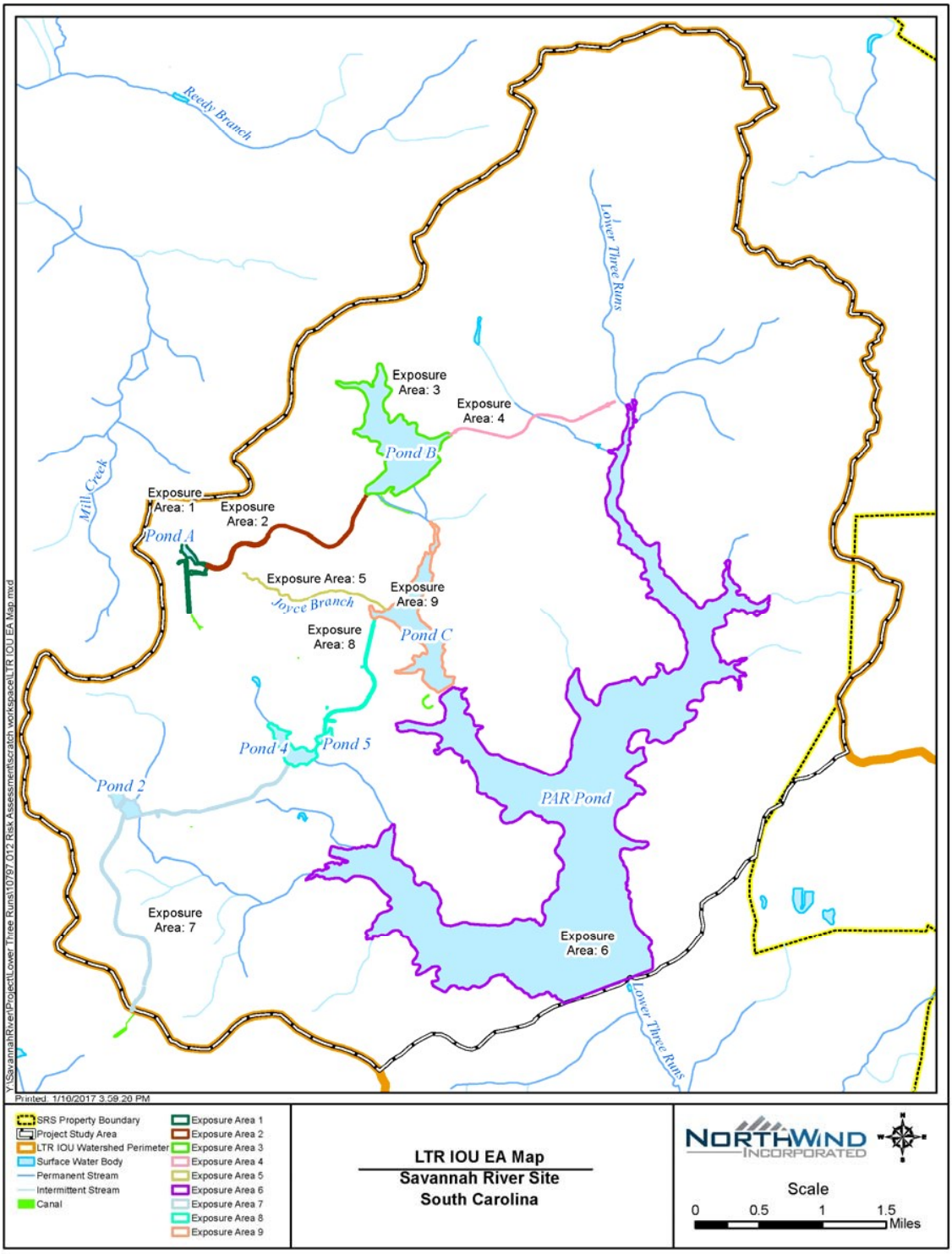


Figure C-1. Lower Three Runs Operable Unit and Associated Exposure Areas

C.1.2 Data

For the IOU program, previous characterization efforts have focused primarily on determining the nature of contamination and identifying areas where IOU Phase II early actions were required. Several characterization efforts were performed for the LTR RI/BRA from the initial RI Work Plan through the data evaluation/culling process that resulted in the final dataset supporting this document. The *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (WSRC 2002) compiled existing data that were available for the LTR IOU (including sediment, sediment/soil, surface water, and fish) from various sampling and monitoring efforts conducted by various investigators which established the LTR IOU database (Phase I). Chapter 3 provides a detailed discussion of these efforts. Below is a brief summary of the select studies summarized in the RI Work Plan:

- Surface Sediments in Pre-Cooler Ponds 2, 4 and 5 were collected in March 2000 (WSRC-TR-2000-00164, Savannah River Technology Center) to determine levels of radioactivity, lead and mercury in sediments that could be exposed if the pre-cooler dams were eliminated or allowed to fail. Results indicated evidence of radioisotope (namely cobalt- [Co-]60 and cesium-[Cs-]137), lead and mercury contamination exceeding background levels.
- Sediment cores from shallow and deep-water locations in PAR Pond, Pond C, and L Lake were collected in July 1995 (WSRC-TR-96-0238, Savannah River Technology Center) to develop a defensible characterization of contaminants found in sediments in these water bodies. Results indicated mercury and radioisotope contamination exceeding concentrations from the reference sites.
- Sediments were collected in August 1995 (Phase I) and April 1996 (Phase 2) at four sites in Pond 2, eight sites in or near Pond 5, and one site along the canal between Pond 2 and Pond 5 (WSRC-TR-96-0175, Savannah River Technology Center) to identify the maximum levels of contamination that could be exposed by fluctuating water levels in ponds as a result of shutting down the river water distribution system. Results indicated that radioisotope activity levels were comparable to activities measured during other studies of the PAR Pond cooling system.
- Sediment and small mammal samples were collected from exposed sediments of PAR Pond in 1995 before the reservoir was refilled following a 4-year drawdown (WSRC-TR-96-0292,

Savannah River Technology Center). Samples were analyzed for radionuclides and metals in order to determine if contaminant levels in the PAR Pond sediments were high enough to cause deleterious ecological effects. Results indicated that mercury was slightly elevated and Cs-137 was present at levels well in excess of levels at control sites. Also, levels of Cs-137 detected in small mammals were elevated, while no evidence of mercury bioaccumulation was seen.

Upon completion of the Work Plan, the LTR IOU entered Phase II of the IOU program (investigation process). Phase II was the ongoing monitoring and assessment of the IOU (with periodic reporting) prior to the onset of Phase III final action determinations. Below is a summary of the monitoring presented in periodic reports.

- Areas targeted for additional sampling included the unnamed tributary south of R-Area in the Ponds 4/5 subunit and the unnamed tributary northeast of P-Area of the Pond 2 subunit. Sediment/soil samples were collected in Ponds 4/5 subunit for definitive level data (i.e., full suite of analytes including target compound list, target analyte list, gross alpha, nonvolatile beta, gamma spectroscopy. Additionally, samples collected in the Pond 2 subunit were analyzed for metals and gamma emitters (primarily Cs-137) along the reach of the tributary for definitive level data.
- A third round of LTR IOU sampling was performed, consisting of follow-on speciation for alpha spectroscopy and nonvolatile beta-emitting radionuclides in sediment/soil samples south of R-Area.

Following analysis of data collected from these sampling efforts, additional sampling was defined in *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters [SAP]* (SRNS 2010). This SAP included characterization of all subunits (Upper, Middle, and Lower) of the LTR IOU which were targeted for further characterization based on gaps in definitive characterization data from the previous investigations.

In 2009/2010, extensive sampling of the LTR IOU was performed to augment prior data collected in the IOU in order to ensure that sufficient information is available for evaluating risks to human health and ecological receptors. This sampling was performed as outlined in an approved Sampling and Analysis Plan (SRNS 2012) and included sampling within three types of systems: canals; pre-

cooler ponds/PAR Pond; and stream/channel/floodplain. Within each system, the sample design involved an even spacing of transects to collect an unbiased population of data. Data consisted of field gamma readings along transects that were supplemented with the collection of sediment, sediment/soil, and surface water samples for laboratory analyses. The sampling effort included collection of both filtered and unfiltered surface water samples, composite and two depth intervals for sediment/soil, and biological data (primarily fish) from LTR EAs as well as several background locations for all media.

In 2016, additional sediment and surface water samples were collected in PAR Pond in accordance with *Sampling and Analysis Plan (SAP) for the Lower Three Runs Stream, Floodplain, and Headwaters – PAR Pond,* SGCP-SAP-2009-00003, Revision 1 (SRNS 2016). The identification and definition of problems warranting action and associated extent of contamination is based on the final data set that includes both high and medium level pedigree historic data as well as data collected from the 2009/2010 characterization effort. Historical data sets were assigned a high, medium, or low pedigree rating based on availability of published reports, level of quality assurance/quality control documentation, etc. A summary of the number of analytical data supporting the Phase III evaluation is shown below.

Media	# LTR IOU Analytical Records		
	Ponds and Canal System 2009/2010 Data	Medium/High Pedigree Historical Data	2009/2010 Background Data
Sediment	5,539	53,822	564
Sediment/Soil	26,750		1,040
Surface Water	15,455	33,124	855
Fish	504	4,945	268

Data summaries for each media by EA are presented in Appendix A. For discussion of the nature and extent of contamination, see Chapter 3 of the Remedial Investigation.

C.1.3 Habitats/Receptors/Preliminary Assessment and Measurement Endpoints

The LTR IOU includes the stream systems/water bodies, canals, and floodplains/wetlands associated with the Upper subunit of the LTR IOU. The ecological setting, including habitats, wildlife, and TES species, are discussed in Chapter 2 (Section 2.1).

The habitats within the LTR IOU support both terrestrial and aquatic/semi-aquatic receptors. The media of concern is primarily sediment/soil (stream/pond sediment and floodplain/wetland soils) and surface water.

Assessment endpoints are tailored to groups of organisms with similar feeding strategies and/or exposure scenarios appropriate for the LTR IOU. Based on these considerations, the following assessment and measurement endpoints and their representative receptors were selected as discussed below:

- Protection of soil-dwelling invertebrate communities to maintain species diversity and nutrient cycling. Soil-dwelling invertebrate communities are selected because the soil invertebrate community is ecologically important, is susceptible to constituents in soil, and may be exposed at the LTR IOU. The soil-dwelling invertebrate community is essential for decomposition of detritus and for energy and nutrient cycling. Soil-dwelling invertebrates are an important component of the diet of insectivorous mammals and birds. Earthworms are chosen as the representative species of soil-dwelling invertebrates because they are important of the soil-dwelling invertebrates in promoting soil fertility, they are highly exposed to soil constituents, and toxicity information is available. The measurement endpoint is a comparison of the measured constituent concentration in soil to earthworm toxicity benchmarks. This preliminary comparison is expressed as a hazard quotient (HQ) calculation based on the screening of LTR IOU data summarized in Appendix A.
- Protection of herbivorous mammal communities to ensure that exposure of contaminants in forage and soils does not have a negative impact on growth, survival, and reproduction. Herbivorous mammals are ecologically important because they provide a food base for higher trophic level receptors and are also susceptible to soil constituents within the LTR IOU. A mouse was chosen as the representative species of herbivorous mammals because they are exposed to soil constituents by their consumption of plant material. They also ingest soil during feeding. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in soil to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in

laboratory studies. This preliminary comparison is expressed as an HQ calculation based on the screening of LTR IOU data summarized in Appendix A.

- Protection of insectivorous mammal communities to ensure that exposure of contaminants in prey, forage, and soils does not have a negative impact on growth or survival. Insectivorous mammals are ecologically important because they help to control the size of the terrestrial invertebrate population that might otherwise damage populations of plant primary producers.

They are also susceptible to soil constituents within the LTR IOU. Montane shrews are chosen as the representative species of the insectivorous mammals because they are highly exposed to constituents by their consumption of large quantities of terrestrial invertebrates. They also ingest soil during feeding, including soil within the bodies of earthworms and other prey. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in soil to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in laboratory studies. This preliminary comparison is expressed as an HQ calculation based on the screening of LTR IOU data summarized in Appendix A.

- Protection of omnivorous mammal communities to ensure that exposure of contaminants in prey, forage, and abiotic media does not have a negative impact on growth, survival and reproduction. Mammalian omnivores are ecologically important because they consume a variety of small mammals and plants, helping balance the populations of terrestrial invertebrates, rodents, and other small mammals as well as disperse seeds for plant reproduction. They are also susceptible to soil constituents at the waste unit. Raccoons were chosen as the representative receptor because they are exposed to constituents by their consumption of terrestrial invertebrates and small mammals. They also ingest soil during feeding, including soil within the bodies of earthworms and other prey. The measurement endpoint is assessed by the site-specific raccoon trophic model conducted using the LTR IOU data summarized in Appendix A and the Savannah River Ecology Laboratory (SREL) biological data collected in 2011.

- Protection of insectivorous bird communities to ensure that exposure of contaminants in prey, forage, and soils does not have a negative impact on growth, survival, and reproduction.

Insectivorous birds are ecologically important because they help to control the size of the terrestrial invertebrate population that might otherwise damage populations of plant primary producers. They are also susceptible to soil constituents at the waste unit. American robins are chosen as the representative species of the insectivorous bird niche because they are highly exposed to constituents by their consumption of terrestrial invertebrates. They also ingest soil during feeding, including soil within the bodies of earthworms and other prey. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in soil to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in laboratory studies. This preliminary comparison is expressed as an HQ calculation based on the screening of LTR IOU data summarized in Appendix A.

- Protection of aerial insectivorous mammal communities to ensure that exposure of contaminants in prey, forage, and surface water does not have a negative impact on growth, survival, and reproduction. Aerial insectivorous mammals are ecologically important because they help to control the size of the invertebrate population that might otherwise damage populations of plant primary producers. They are also susceptible to soil or water constituents within the LTR IOU. A bat is chosen as the representative species of the aerial insectivorous mammal niche because they are exposed to constituents by their consumption of flying invertebrates and utilize aquatic habitats as a source of water. Bats provide a beneficial service by foraging on flying insects, many of which are pests. They also eat large numbers of moths and beetles that cause agricultural damage. Bats will opportunistically roost and forage in various habitats. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in soil and surface water to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in laboratory studies. This comparison is expressed as an HQ calculation based on the screening of the LTR IOU data summarized in Appendix A.
- Protection of benthic invertebrate (sediment dwelling organism) communities from toxic effects of contaminants in order to maintain species diversity, biomass, and nutrient cycling (trophic structure). Identification of a specific receptor for this endpoint is not necessary. The benthic invertebrate community is ecologically important, serving as prey items for many other

species as well as maintaining nutrient cycling in an aquatic system. Benthic organisms are also susceptible to constituents in sediment and are potentially exposed within the LTR IOU. The measurement endpoint is the measured concentration in sediment media compared to sediment toxicity threshold values. This preliminary comparison is expressed as an HQ calculation based on the screening of LTR IOU data summarized in Appendix A.

- Protection of aquatic organism communities from the toxic effects of contaminants in abiotic media and food to maintain species diversity and to ensure that ingestion of contaminants in fish and aquatic invertebrates does not have a negative impact on growth, survival and reproduction. The aquatic community is ecologically important, serving as prey items for many species. Aquatic organisms are susceptible to constituents in surface water and are potentially exposed to contamination within the LTR IOU. The measurement endpoint is the measured concentration in surface water media compared to ambient water quality criteria. This preliminary comparison is expressed as an HQ calculation based on the screening of LTR IOU data summarized in Appendix A.

- Protection of avian aquatic predators in order to ensure that exposure to contaminants in aquatic prey and abiotic media does not have a negative impact on growth, survival, and reproduction. Aquatic predators are ecologically important, are susceptible to constituents in surface water and sediment, and are potentially exposed via food chain uptake to contamination migrating from the waste unit. The great blue heron and belted kingfisher were chosen as the representative receptors since it would be exposed via ingestion of biotic and abiotic media. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in sediment/surface water and biota compared to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in laboratory studies. This comparison is expressed as an HQ calculation based on the screening of the LTR data described in Appendix A. This endpoint is also assessed by the site-specific trophic SREL biological data collected in 2011.

- Protection of mammalian aquatic predators in order to ensure that exposure to contaminants in aquatic prey and abiotic media does not have a negative impact on growth, survival, and reproduction. Aquatic predators are ecologically important, are susceptible to constituents in

surface water and sediment, and are potentially exposed via food chain uptake to contamination migrating at the waste unit. The raccoon and river otter were chosen as the representative receptors since these organisms would be exposed via ingestion of biotic and abiotic media associated with the LTR IOU. The measurement endpoint is a comparison of the modeled constituent concentrations in the food chain using the measured concentrations in sediment/surface water and biota to ecological threshold values applicable to wildlife receptors that are based on measured responses of similar species in laboratory studies. This comparison is expressed as an HQ calculation based on screening of the LTR IOU data summarized in Appendix A. This endpoint is also assessed by the site-specific SREL biological data collected in 2011.

The preliminary conceptual site model (CSM) for the LTR IOU is provided in Chapter 2. Data used in this evaluation are provided in Appendix A of this document or presented in the text when data evaluations require a discussion of supplemental data.

C.1.4 Sources of Literature-Based Threshold Values

Ecological threshold levels are media- and receptor-specific values that can be used to evaluate (i.e., screen) sediment/soil and surface water data from potentially contaminated sites. The thresholds are derived from several sources and are used to evaluate No and Low Adverse Effect Levels. The LTR Ecological Screening Values (ESVs) are used in the initial screening-level effects evaluation and are based on No Observed Adverse Effect Level (NOAEL) thresholds. For constituents that exceed ESVs and background screening, Refinement Screening Values (RSVs) are used for the refinement-level risk calculation. The RSVs are based on Low Observed Adverse Effect Level (LOAEL) thresholds appropriate for refinement of sediment/soil and surface water media constituents.

The threshold values used for the screening-level and refinement-level assessments were derived from four sources: 1) the USEPA Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft (USEPA 2015); 2) the Los Alamos National Laboratory (LANL) ECORISK Database Tool (LANL 2015); 3) the South Carolina Department of Health and Environmental Control, R.61-68, Water Classifications and Standards (SCDHEC 2014); and 4) EPA Region 5

Ecological Screening Levels (USEPA 2003). A brief discussion of the hierarchy of values and generic methodology used to derive values in these sources follows.

1) The USEPA Region 4 Ecological Risk Assessment Supplement Guidance Interim Draft (USEPA 2015) provides threshold values for hazardous waste sites for surface water (Table 1a), sediment (Tables 2a, b, and c), and soil (Table 3) for non-radiological constituents and is provided in Attachment C-2.

- The sediment screening values in Table 2 are derived from statistical interpretation of effects databases obtained from the literature; these benchmarks are generally based on observations of direct toxicity to benthic organisms. Table 2 provides both ESVs (for the screening level assessment) and RSVs (for the refinement level assessment).

- The soil screening values in Table 3 typically address toxicity through direct exposure (i.e., toxicity to soil invertebrates such as earthworms and plants). The hierarchy for soil benchmarks is as follows: EPA Ecological Screening levels (EcoSSLs), Department of Energy Laboratories (i.e., Los Alamos National Laboratory and Oak Ridge National Laboratory), and equilibrium partitioning (EqP) modeled values for organic chemicals. Table 3 provides only a screening level threshold.

- The hierarchy of surface water values compiled in Table 1 is as follows: National Recommended Surface Water Criteria (NWQC), Tier 2 values or equivalent from the Great Lakes Initiative, State surface water standards, Suter and Tsao 1996 values, Canadian Water Quality Values, the minimum value from either the Target Lipid Model or ECOSAR (Ecological Structure Activity Relationship) model, and, lastly, Office of Pesticide Programs Aquatic Life Benchmarks. In general, the most conservative was selected as the ESV. For the NWQC, the chronic ambient water quality criteria (AWQC) value for the protection of aquatic life is used as the screening value. Table 1 chronic values are used for both the screening and refinement level assessments.

2) The Los Alamos National Laboratory (LANL) developed the ECORISK Database Tool (LANL 2015) to document and archive ecological screening levels; the LANL database tool includes thresholds for surface water and sediment/soil. LANL develops literature-based

toxicity reference values (TRVs) for various chemical exposure pathways, then, using the derived TRVs as well as dose rates (for radionuclides) and other benchmarks, LANL calculated No Effect and Low Effect ecological screening levels (ESLs) for various media and receptors. Details of this process are described in Toxicity Reference Value Development Methods for the Los Alamos National Laboratory, Revision 1 (LANL 2014). The ECORISK Database Tool compiles the resulting No Effect and Low Effect ESLs by media (surface water, sediment, soil) and receptor. The minimum ESL available from all receptors for a given media and constituent was used as the threshold level as follows: the minimum No Effect ESL was used as the threshold for the screening level assessment, and the minimum Low Effect ESL was used as the threshold for the refinement level assessment. Copies of the screening value tables used in this evaluation are provided in Attachment C-3 to this appendix.

3) An additional source of threshold values used only for the assessment of surface water is the South Carolina Department of Health and Environmental Control, R.61-68, Water Classifications and Standards (freshwater aquatic life chronic values) regulation (SCDHEC 2014). These thresholds were used for both the screening level and refinement level assessments. A copy of this regulation is provided in Attachment C-4.

4) Where screening values were unavailable from the identified sources for both sediment/soil and surface water, ESLs were derived from USEPA Region 5 (USEPA 2003); these values are provided in Attachment C-5. The ESLs represent a protective benchmark (e.g., water quality criteria, sediment quality guidelines/criteria, and chronic no adverse effect levels) for 223 contaminants and the environmental media of concern for the LTR IOU (i.e., water and sediment/soil).

The screening values derived from these sources are compared in four tables that are presented in Attachment C-1. All ESVs available for a given constituent are identified by source, with the most conservative (i.e., lowest selected screening value) highlighted in yellow. The four tables are as follows:

- Table I.A. SEDIMENT/SOIL MEDIA Screening Level (No Effect Screening Level)

- The source of the "EPA R4 Sediment" column is the Freshwater Sediment Screening Value ESV column from EPA Table 2 for sediment.
- The source of the "EPA R4 Soil" column is the Screening Level column from EPA Table 3 for soils. Note: One value in this column is from EPA Region 5 and is indicated by a footnote.
- The source of the "LANL Sediment" column is the No Effect ESL for sediment from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level.
- The source of the "LANL Soil" column is the No Effect ESL for soil from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level.

- Table I.B. SEDIMENT/SOIL MEDIA Refinement Level (Low Effect Screening Level)
  - The source of the "EPA R4 Sediment" column is the Freshwater Sediment Screening Value RSV column from EPA Table 2 for sediment.
  - There are no EPA Region 4 RSV values for soil, so "NA" is listed under "EPA R4 Soil."
  - The source of the "LANL Sediment" column is the Low Effect ESL for sediment from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level.
  - The source of the "LANL Soil" column is the Low Effect ESL for soil from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level.

- Table II.A. SURFACE WATER MEDIA Screening Level (Chronic/No Effect Screening Level)
  - The source of the "SCDHEC WQS" column is the Freshwater Aquatic Life Criterion Continuous Concentration (CCC) column from the SCDHEC regulation.
  - The source of the "EPA R4 Surface Water" column is the Freshwater Screening Values Chronic column from EPA Table 1 for surface water. Note: Two values in this column are from EPA Region 5 and are indicated by footnotes.

- The source of the "LANL Surface Water" column is the No Effect ESL for surface water from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level.

- Table II.B. SURFACE WATER MEDIA Refinement Level (Chronic/Low Effect Screening Level)
  - The source of the "SCDHEC WQS" column is the Freshwater Aquatic Life Criterion Continuous Concentration (CCC) column from the SCDHEC regulation.
  - The source of the "EPA R4 Surface Water" column is the Freshwater Screening Values Chronic column from EPA Table 1. Note: Two values in this column are from EPA Region 5 and are indicated by footnotes.
  - The source of the "LANL Surface Water" column is determined as follows: If the lowest of the LANL values from Attachment C-3 Los Alamos National Laboratory ECORISK Database table of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level is for protection of aquatic communities, the No Effect ESL is used; if the lowest of the LANL values is for wildlife receptors, the Low Effect ESL is used.

C.2 ECOLOGICAL RISK ASSESSMENT PROCESS

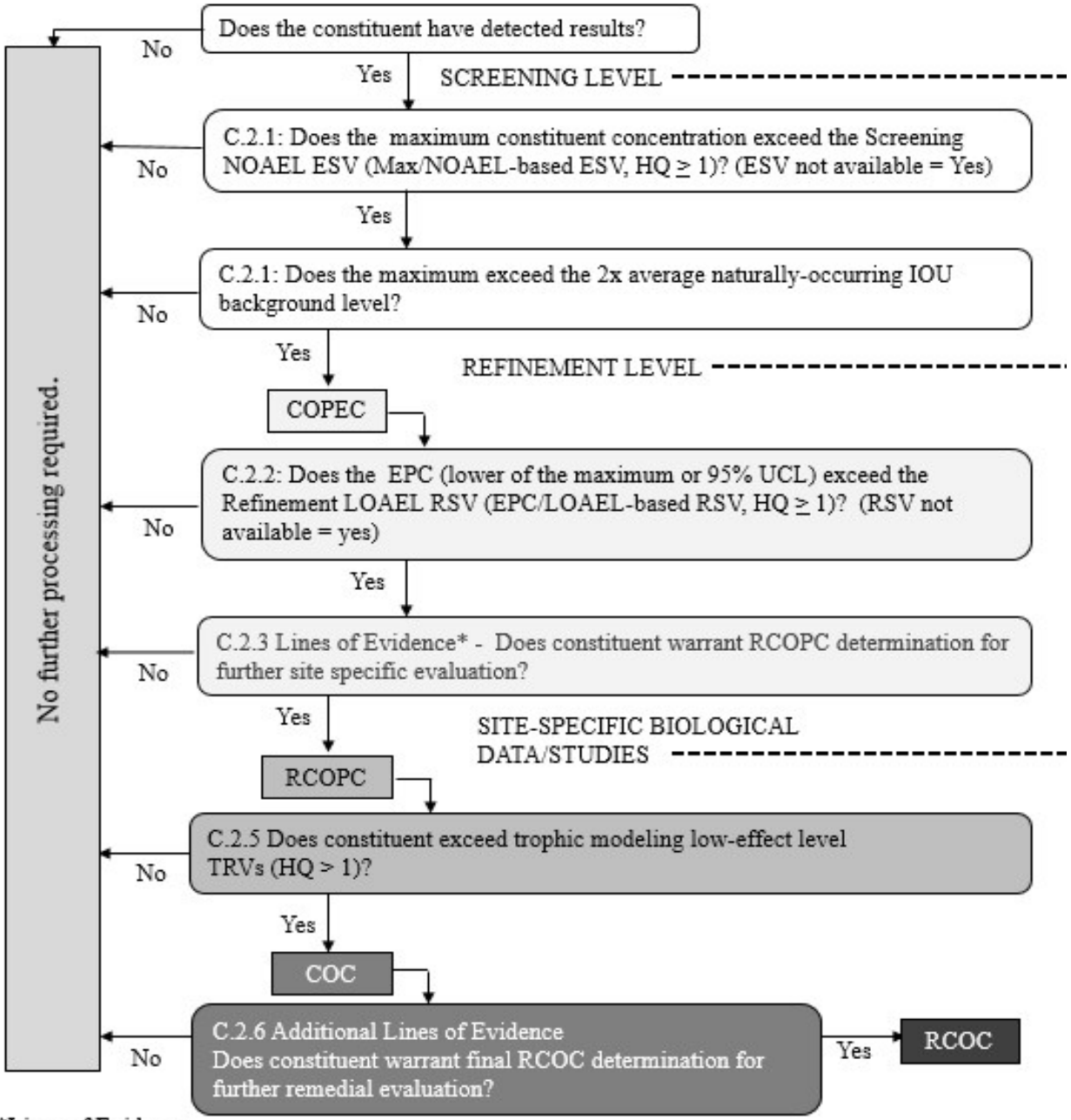
This LTR IOU ERA consists of steps designed to provide a scientifically based and defensible assessment of exposure and hazard assessment for ecological receptors that will support a risk management decision regarding site remediation. The ERA for the LTR IOU includes a background comparison and a screening-level ecological effects evaluation (Section C.2.1) in which constituent concentrations in sediment/soil or surface water media are compared to relevant ecological screening levels; constituents that exceed ecological screening values (ESVs) (or that have no ESV) are considered contaminants of potential ecological concern (COPECs). COPECs that result from the screening-level evaluation are carried forward to a refinement-level risk (hazard) calculation (Section C.2.2) in which refinement level hazard quotients (HQ) are calculated for each COPEC. The refinement level screening is based on LOAEL or chronic level thresholds and the 95%UCL on the mean. Constituents that fail the refinement level screening are considered constituents of potential concern (COPCs). Uncertainties associated with the screening

thresholds, background concentrations, frequency of detection, age of data, or contaminants that result from the screening and refinement processes are discussed in an uncertainty evaluation presented in Section C.2.3. The uncertainty discussion concludes with a determination of whether the constituent should or should not be considered a refined constituent of potential concern (RCOPC) and carried forward for site-specific trophic level modeling. Constituents that are considered RCOPCs are evaluated in the site-specific trophic models. COCs are constituents that are identified as posing a potential risk to ecological receptors through the modeling effort. An uncertainty discussion for the COCs is applied based on results of the modeling effort and other lines of evidence to determine if the constituent is a refined constituent of concern (RCOCs). If RCOCs are identified, final action consideration is warranted. The ecological risk assessment process for LTR is outlined in the Figure C-2.

C.2.1 Screening-Level Effects Evaluation

The purpose of the ecological screening-level effects evaluation for the LTR IOU is to conduct a conservative screen to identify constituents that may pose unacceptable risk to ecological receptors. The screening level evaluation is the initial step in determining constituents that require further evaluation. Screening is conducted based on comparing the maximum concentration to the Ecological Screening Levels (ESVs) that are found in Attachment C-1, Tables I.A and II.A and to 2x the average IOU background level. The maximum values of each constituent with detected values for each EA are presented in Appendix A. Tables A.1.1.1.1 – A.1.9.3 provide summary statistics for the sediment/soil medium (0-1ft interval), surface water medium, and fish media (if available). The IOU background data used in the screening-level effects evaluation are summarized in Appendix A, Table A.1.10.1, for the sediment/soil medium (0-1ft depth interval), Table A.1.10.2 for the surface water medium, and Table A.1.10.3 for fish media.

Since maximum media concentrations are used in this step of the process, the assumption is made that ecological receptors are exposed to the highest (i.e., worst) concentration of a given constituent present at the unit. The combination of maximum media concentrations and conservative threshold values provide confidence that the constituents of potential concern (COPCs) resulting from the screenings are indeed protective.



*Lines of Evidence

1. Unit Related Uncertainty
   - nature and extent of contamination, consistency with history of use, presence in background
2. Data Quality Uncertainty
   - analytical data quality, physical characteristics
3. Risk Assessment Uncertainty
   - toxicity data, radioactive decay

Figure C-2. Lower Three Runs Ecological Risk Assessment Process

Constituents that are recognized as essential nutrients (calcium, magnesium, potassium and sodium) are identified as such and are not subject to further evaluation since these constituents are deemed necessary for life processes and therefore consumption from natural sources is deemed to not be detrimental.

The ecological effects evaluation identifies the potential for adverse ecological effects based on conservative assumptions. The most conservative value (i.e., lowest concentration) between the EPA Region 4 and the NOAEL-based LANL values are used to conduct the screening-level assessment. For the evaluation of surface water media, the April 2008 SCDHEC Water Quality Standards (chronic values) are also considered.

C.2.1.1 ESV Screening-- Sediment/Soil Media

The screening-level evaluation process is outlined below:

- Compare the unit maximum detected concentration to the LTR ESV concentration (No Effect Screening Level) for the surface interval (0-1 ft.).
- Calculate a screening level Hazard Quotient (HQ) = Maximum Detected Concentration / ESV.
- Compare the unit maximum concentration to 2X the average IOU background concentration.
- Constituents exceeding the ESV (HQ >1) or with no ESV and exceeding background screen are identified as constituents of potential ecological concern (COPECs) and carried forward to step C.2.2. Constituents that are not identified as COPECs are dropped from further evaluation.

C.2.1.2 ESV Screening-- Surface Water Media

The screening-level evaluation process is outlined below:

- Compare the unit maximum concentration to the LTR ESV concentration (AWQC chronic values or No Effect ESL); calculate a screening level HQ = Maximum Detected Concentration/ESV.
- Compare the unit maximum concentration of constituents to 2X the average IOU background concentration.

- Constituents exceeding the ESV (HQ >1) or with no ESV and exceeding the background screen are identified as COPECs and carried forward to step C.2.2. Constituents that are not identified as COPECs are dropped from further evaluation.

Table C-1 (for sediment/soil) and Table C-2 (for surface water) summarize the ecological screening-level effects evaluation for EA 1. The refinement tables (as discussed in Section C.2.2) follow in similar fashion. The subsequent screening-level evaluation tables (and refinement tables) for remaining EAs (EA 2 through EA 9) follow these initial tables for each consecutive EA.

C.2.2. Refinement-level Risk (Hazard) Calculation

The refinement evaluation uses the Refinement Screening Levels (RSVs) that are found in Attachment C-1, Tables I.B and II.B. Because of the conservative approach of the initial screening-level evaluation (i.e., ESV screening), some of the constituents identified for further evaluation may or may not pose a possible unacceptable risk to ecological receptors. The refined screening process applies a more realistic and holistic approach to screening to further refine the list of constituents to those constituents that require further discussion and scrutiny. The method used to further refine ecological COPCs is based on the calculation of a refinement-level HQ by comparing the Exposure Point Concentration (EPC) to a Lowest Observable Adverse Effects Level (LOAEL) RSV. LOAEL-based RSVs are derived from Low Effect ESLs. The EPC is represented by the lower of the 95%UCL on the mean and the maximum detected concentration.

Calculation of the HQ is illustrated in the equation below:

Constituents with an HQ >1 are further discussed in Step C.2.3.

C.2.2.1 RSV Screening-- Sediment/Soil Media

For the COPECs identified from Step C.2.1.1, the refinement level process is outlined below:

- Calculate a refinement level HQ using the EPC and the LTR RSV (LOAEL-based ESL).
- Constituents with refinement level HQ >1 or with no RSV are identified as COPCs and carried forward to Section 2.3. Constituents that are not identified as COPCs are dropped from further evaluation.

C.2.2.2 RSV Screening-- Surface Water Media

For the COPECs identified from Step C.2.1.2, the refinement level process is outlined below:

- Calculate a refinement level HQ using the EPC and the LTR RSV (chronic value for AWQC, LOAEL ESL for wildlife receptors).
- Constituents with a refinement level HQ >1 or with no RSV are identified as COPCs and carried forward to Section 2.3. Constituents that are not identified as COPCs are dropped from further evaluation.

C.2.3 Results/Refinement of Constituents of Potential Concern

The refinement level risk calculation is based, in general, on LOAEL or chronic level thresholds. Constituents that fail the refinement level screening are considered constituents of potential concern (COPCs).

Table C-3 (for sediment/soil) and Table C-4 (for surface water) summarize the ecological refinement-level hazard calculation for EA1. The refinement tables follow, in similar fashion, the screening-level tables with subsequent refinement tables for remaining EAs (EA 2 through EA 9).

Uncertainties associated with the screening thresholds, background concentrations, frequency of detection, age of data, or contaminants that result from the screening and refinement processes are discussed in an uncertainty evaluation presented in Section C.2.3. The initial uncertainty discussion concludes with a determination of whether the constituent should or should not be considered a refined constituent of potential concern (RCOPC) and carried forward for site-specific trophic level modeling. Constituents that are not identified as RCOPCs are dropped from further evaluation. Results of the trophic level modeling are considered in a second uncertainty discussion which concludes with a determination of whether the constituent is considered an RCOC. The major categories of uncertainty used in this evaluation and the major emphasis include:

- Unit related uncertainty which includes uncertainties related to the nature and extent of contamination, consistency with history of use, and presence in background;

- Data quality uncertainty and risk assessment uncertainties which includes uncertainties related to data quality and physical characteristics; and
- Risk assessment uncertainty which includes uncertainties related to toxicity data and changes in constituent activity concentrations due to radioactive decay.

Using the three-step process described above, results of the ecological risk assessment are presented below by EA.

In addition to the IOU background data set found in Appendix A Tables A.1.10.1 and A.1.10.2, supplementary information used to characterize the presence of constituents in background is derived from two additional sources: 1) a 1997 study of SRS wetland soils (Dixon et al, 1997) that will be referred to as the "Wetland Study" and 2) a report of SRS soils from thirty-nine approved waste unit investigations between 1993 and 1999 (WSRC 2006b) that will be referred to as "SRS background." Also, where ESLs were unavailable for radionuclides, toxicity uncertainty is addressed by comparing unit activity concentrations to Tier 3 Biota Concentration Guides (BCGs) found in the RESidual RADioactivity (RESRAD) BIOTA database (ANL 2006), which ~~is~~ are provided in Attachment C-7.

The RESRAD screening values are used in uncertainty discussions to determine the significance of detected radionuclides when typical risk screening values are not available, and the radionuclide may be expected to be present based on the data and physical half-life. The RESRAD screening and other lines of evidence are used, applying best professional judgement, in Section C.2 to determine whether the constituent requires further consideration.

The RESRAD Tier 3 values were generated by Savannah River National Laboratory based on the most conservative activity for each nuclide available for terrestrial animals and terrestrial plants for terrestrial systems, and aquatic animals and riparian animals for aquatic systems.

Site-specific trophic level modeling was also conducted using the LTR IOU data summarized in Appendix A and supplemented by SREL biological data collected in 2011. This effort addressed the uncertainty associated with relying strictly on literature-based toxicity values and exposure assumptions. Results of the modeling effort, *Risks to Ecological Receptors Posed by Contaminants*

of Potential Concern in the Lower Three Runs Cooling Ponds and Canals, is provided in its entirety as Attachment C-9 and is discussed further in section C.2.5.

In the uncertainty evaluation, exposure area concentrations are compared to background concentrations as one line of evidence to assist in the identification of RCOCs. A brief description of the primary sources of background information is provided below.

The IOU background dataset provided in Appendix A identifies minimum, mean, and maximum concentrations (or activities) for sediment/soil and surface water media. A more thorough description of the IOU background dataset is provided in Chapter 3 (Section 3.3).

The *Background Soils Statistical Summary Report for the Savannah River Site* (WSRC 2006b) is used routinely in Operable Unit (OU) risk assessments performed by ACP. The document provides statistical summaries for many naturally-occurring constituents at SRS. Appendix B-2 (all-depth intervals) is the primary source of information used in this evaluation; an exception is that Appendix B-1 (0-1 ft) was used for the cesium-137 background comparisons.

The *Geochemical and Physical Properties of Wetland Soils at the Savannah River Site* (Dixon et al, 1997) is a publication by the Savannah River Technology Center (currently Savannah River National Laboratory) that is used routinely in the IOU Periodic Reports to assist in data evaluation. This report focuses primarily on metals and is referred to as the "Wetland Study" in this evaluation.

C.2.3.1 Exposure Area 1

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 1 are provided below.

C.2.3.1.1 Screening Results for Exposure Area 1 for Sediment/Soil

Using maximum detected values, Table C-1 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft. sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, americium-243, bis[2-ethylhexyl]phthalate, bismuth-212, californium-244, carbon-14, curium-244, curium-245/curium-246, cyanide, DDE, DDT, lead214, potassium-40,

magnesium, methyl acetate, thallium-208, toluene and vanadium. Figure 3-1 shows the sampling locations for EA 1 for results discussed in the following section.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There was also no screening value for methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.1.2 Refinement-level Risk Results for Exposure Area 1 for Sediment/Soil

Using EPC values (i.e., 95%UCL on the mean), Table C-3 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: americium-243, bis[2ethylhexyl] phthalate, bismuth-212, californium-244, carbon-14, curium-244, curium-245 and curium-246, lead-214, magnesium, methyl acetate, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There were also no screening values for methyl acetate or magnesium. The COPCs are discussed further below.

C.2.3.1.3 Refinement-Level Uncertainty Discussion for Exposure Area 1 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 1.A for the sediment/soil medium. Sampling locations described for EA 1 are shown in Figure 3-1.

Amercium-243 was detected in 2 out of 5 samples with a maximum of 0.277 pCi/g detected at sample location RDC-002-001 in R-Discharge canal in 2010 (Table A.1.1.1.1, Figure 3-1). The EPC for americium-243 is 0.23 pCi/g. All samples were collected in 2010. Americium-243 does not have an ecological screening value with which to screen nor is background data available.

Americium-243 (half-life of 7,370 years), and americium-241 (half-life of 432 years) are produced together in reactors, and both isotopes behave the same in the environment. Americium-243 released into water from nuclear facilities will tend to stick to particles in the water or the sediment, and is so strongly attached to soil particles, that while plants may take it up from the soil, the amount taken up is small, especially in the parts of the plant that are most often eaten (i.e., the fruit, grain, and seeds). While fish may take up americium-243, the amount that builds up in the flesh is very small (ATSDR, 2004).

Americium243 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- No screening value or background value is available.
- It is not readily bioavailable.

Californium-244 had a single detected result (maximum 0.17 pCi/g and EPC of 0.17 pCi/g) out of two analyses for EA 1 from 2013 data (Table A.1.1.1.1, Figure 3-1). No additional data for californium-244 is available in any other EA. It does not have an ecological screening value with which to screen nor is background data available. There is no known source for californium-244 at SRS. The half-life of californium-244 is 19.4 minutes.

Californium-244 is not recommended for further remedial evaluation as an ecological RCOPC n sediment/soil based on the following lines of evidence:

- No screening value or background value is available.
- There is no known source of californium-244 at SRS.
- This radionuclide has a short half-life.

Bismuth-212 was detected in 7 out of 13 samples with a mean of 0.7338 pCi/g and a maximum of 1.31 pCi/g at the R-Area Downstream of R-1 location (Table A.1.1.1.1, Figure 3-1) with most recent detects from 2010. The EPC is 0.98 pCi/g. Bismuth-212 came through screening because there is no published ecological screening threshold level. Bismuth-212 is naturally-occurring and the maximum detected activity concentration (1.31 pCi/g), is within background activity levels

(when compared to the maximum IOU background activity of 2.59 pCi/g). Additionally, the radiological half-life for bismuth-212 is short at only 60.5 minutes.

Bismuth-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It has a very short half-life.

Carbon-14 was detected in 3 out of 5 samples with a mean of 0.9784 pCi/g and a maximum of 2.69 pCi/g at the PAT-1-5 (Pond A, Transect 1) location with a "J" qualified (i.e., estimated) result (Table A.1.1.1.1, Figure 3-1). The EPC is 2.02 pCi/g. Carbon-14 came through screening because there is no published ecological screening threshold level. For evaluation, the maximum detected value (2.69 pCi/g) was compared to, and found to be well below the Residual Radioactivity (RESRAD) Biota (ANL 2016) screening activity of 4,760 pCi/g.

Carbon-14 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It is naturally-occurring.

Curium-244 was detected in 7 out of 9 samples with a maximum of 0.04 pCi/g from 2006 (Table A.1.1.1.1, Figure 3-1). The EPC is 0.03 pCi/g. Curium-244 came through screening because there is no published ecological screening threshold level. The maximum detected activity concentration (0.045 pCi/g) is below the RESRAD Biota screening activity concentration of 4,060 pCi/g. Curium-244 is also well within background activities (when compared to the SRS maximum background activity of 0.40 pCi/g). Considering these uncertainties, curium-244 is not an ecological COPC.

Curium-244 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It does not appear to be unit related since it is indistinguishable from background.

Curium-245/-246 was detected in 2 out of 5 samples with a maximum of 0.33 pCi/g at the R-Area Downstream of R-1 location in 2010 (Table A.1.1.1.1, Figure 3-1). The EPC is 0.27 pCi/g. Curium-245/-246 came through screening because there is no published ecological screening threshold level.

Analyses of SRS Tank Farm waste over the years indicate that Cm-243/244 is about 1,000 times more abundant than Cm-245/246. Curium isotopes are chemically identical to each other, so environmental transport processes will not separate them. Therefore, any sample that contains Cm-245/246, will contain 3 orders of magnitude more Cm-243-244. This condition was not met in the sample results. A probable cause of the false-positives is partial breakthrough of natural Th-228 into the Am-Cm chemical separation at the laboratory.

Curium-245/246 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There is no published screening value
- The detects were determined to be an analytical error

Lead-214 was detected in 32 out of 32 samples with a maximum of 3.71 pCi/g at PAT2-5 (Pond A, Transect 2) with most recent detects from 2010 (Table A.1.1.1.1, Figure 3-1). The EPC is 1.17 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is naturally-occurring and the maximum detected activity concentration (3.71 pCi/g) is within IOU background activity concentrations. The IOU maximum background activity concentration was 8.42 pCi/g. The half-life of lead-214 is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.

- It has a very short half-life.

Potassium-40 was detected in 12 of 32 samples with a maximum of 4.15 pCi/g at the PAT3-2 location in 2010 (Table A.1.1.1.1, Figure 3-1). The EPC for potassium-40 is 3.90 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. b Potassium-40 is naturally-occurring and the maximum detected activity concentration (4.15 pCi/g) is well below the RESRAD Biota screening activity concentration of 119 pCi/g and is within background activity; the SRS maximum background is 8.53 pCi/g and the IOU maximum background is 13 pCi/g.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It is within SRS and IOU background levels.
- It is well below the RESRAD Biota screening activity.

Thallium-208 was detected in 33 of 33 samples with a maximum of 0.73 piC/g at the R-Area Downstream of R-1 location (Table A.1.1.1.1, Figure 3-1). The maximum was collected in 1999, and more recent detect was from 2010. The EPC is 0.44 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is a naturally-occurring radionuclide and the maximum detected activity (0.73 pCi/g) is within background activity concentrations. The IOU maximum background activity concentration was 1.14 pCi/g. The half-life of thallium-208 is 3.05 minutes.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Vanadium was detected in 12 out of 12 samples for EA 1 with a maximum of 61.4 mg/kg from the RDC001-001 location (Table A.1.1.1.1, Figure 3-1). The EPC for vanadium is 32.1 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 1.A, shows HQ exceedances (HQ >1) for vanadium for the American robin as avian herbivore (HQ = 1.89), American robin as avian omnivore (HQ = 2.14), and American robin as avian insectivore (HQ = 2.47). However, vanadium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), and the Wetland Study maximum (144 mg/kg). Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective.

Bis[2-ethylhexyl]phthalate was detected in only 2 detects out of 12 samples, with 1 of the 2 detects being "J" qualified (i.e., estimated). The EPC and maximum (from the LTROU-13 location in 2001) concentrations are both 3.57 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 1.A, shows an HQ exceedance (HQ >1) for bis[2-ethylhexyl]phthalate for American robin as avian omnivore (HQ = 8.93), American robin as avian insectivore (HQ = 17.9), violet-green swallow as avian aerial insectivore (HQ = 13.7), and American kestrel as avian intermediate carnivore (HQ = 3.57). However, bis[2-ethylhexyl]phthalate is a common laboratory artifact, and the maximum detected concentration falls below the IOU background maximum (38.7 mg/kg).

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It does not appear to be unit related since it is below background.
- It is a common laboratory artifact.

Methyl acetate was detected in 1 of 12 samples. The detected result (0.0039 mg/kg) was from the PAT1-3 location (Pond A, Transect 1) (Table A.1.1.1.1, Figure 3-1). The one detect is "J" qualified (i.e., estimated). Methyl acetate came through screening because there is no published ecological screening threshold level. Methyl acetate is used a food flavoring and found naturally in fruits. Consumer uses include adhesive, sealants, paints and coatings.

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It was present only in one sample with an estimated result.
- It does not have a published ecological screening threshold.
- It is not known to be associated with LTR IOU operational effluents.

No constituents are identified as RCOPCs for evaluation in trophic modeling. Multiple lines of evidence support this recommendation, largely low frequency of detection, estimated detects, and comparison to background levels. For radiological constituents, comparison to RESRAD Biota screening activity offered an additional line of evidence. In summary, no constituents were identified as RCOCs for sediment/soil for EA 1.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 1 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Amercium-243					X	X	
Californium-244		X			X	X	
Bismuth-212	X		X		X	X	
Carbon-14	X					X	
Curium-244	X		X			X	
Curium-245/246				X		X	
Lead-214	X		X		X	X	
Potassium-40	X		X			X	
Thallium-208	X		X		X	X	
Vanadium	X		X			X	
Bis[2-ethylhexyl]phtalate			X		X		
Methyl Acetate	X	X	X			X	

C.2.3.1.4 Screening Results for Exposure Area 1 for the Surface Water Medium

Using maximum detected values, Table C-2 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: aluminum, iron, manganese, cholоromethane, DDT, curium-244, iodine-129, potassium-40, technetium-99, and thorium-234. Figure 3-1 shows the sampling locations for EA 1 for results discussed in the following section.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There was also no screening value for chloromethane. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.1.5 Refinement-level Risk Results for Exposure Area 1 for Surface Water

Using EPC values, Table C-4 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: aluminum, iron, manganese, cholоromethane, DDT, curium-244, iodine-129, potassium-40, technetium-99, and thorium-234.

The radionuclide constituents were identified as COPCs since there are no published ESVs available for these constituents. There is also no published screening value for chloromethane.

The COPCs are discussed below.

C.2.3.1.6 Refinement-level Uncertainty Discussion for Exposure Area 1 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward as an RCOPC for site-specific trophic level modeling. HQ calculations for receptors that pertain to an RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 1.B for surface water. Constituents that are carried forward as an RCOPC for trophic modeling are also discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations for EA 1 are shown in Figure 3-1.

Curium-244 was detected 5 out of 10 samples with a maximum of 0.01 pCi/L and an RME of 0.0047pCi/L. The maximum result was collected at the R-Area Downstream of R-1 location in 2000 (Table A.1.1.2, Figure 3-1). Curium-244 came through screening because there is no published ecological screening threshold level. However, the maximum detected activity concentration, 0.01 pCi/L, is below the RESRAD Biota screening activity concentration of 66.4 pCi/L. Results from 2001 through 2005 data and the most recent samples (results from 2006 through 2010) are all non-detects. The half-life of curium-244 is 18.1 years.

Curium-244 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is below the RESRAD Biota screening activity.
- Recent data are all non-detects.

Iodine-129 was detected in 1 of 7 samples with an EPC and maximum of 32.30 pCi/L from the R-Area Downstream of R-1 locations in 2002 (Table A.1.1.2, Figure 3-1). Iodine-129 came through screening because there is no published ecological screening threshold level. However, the maximum detected activity concentration, 32.30 pCi/L, is below the RESRAD Biota screening activity concentration of 38,500 pCi/L. Additionally, the most recent samples are nondetects.

Iodine-129 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- Recent data are all non-detects.

Potassium-40 was detected in 21 of 139 samples, with a maximum of 464.4 pCi/L from the R-Area Downstream of R-1 location (Table A.1.1.2, Figure 3-1). Potassium-40 came through screening because there is no published ecological screening threshold level. However, potassium-40 is naturally-occurring and the mean activity concentration, 29.91 pCi/L, is below the RESRAD Biota screening activity concentration of 249 pCi/L and is within background activity concentrations (IOU maximum background activity concentration of 275.4 pCi/L). Potassium-40 is a naturally-occurring radionuclide, and can be found wherever potassium is found. Potassium is

a constituent of natural clay minerals, and surface water often contains suspended clay. The reported concentration of 464 pCi/L corresponds to about 550 mg/L total potassium, which if accurate, would mean that the sample was very turbid. Potassium-40 was not used in any SRS process, and SRS regards this detection as non-DOE related.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is below the RESRAD Biota screening activity.
- It is within background activity levels.
- It was not used in any SRS process and is not considered DOE related.

Technetium-99 was detected in 3 of 9 samples, with a maximum of 0.57 pCi/L and an RME of 0.32 pCi/L. The maximum result was collected at the R-Area Downstream of R-1 location (Table A.1.1.2, Figure 3-1). Technetium-99 came through screening because there is no published ecological screening threshold level. However, the maximum detected activity concentration, 0.57 pCi/L, is below the RESRAD Biota screening activity concentration of 667,000 pCi/L and is within background values (IOU maximum background activity concentration of 0.81 pCi/L). Additionally, the most recent samples are non-detects.

Technetium-99 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is below the RESRAD Biota screening activity.
- It is within background activity levels.
- Recent data are all non-detects.

Thorium-234 was detected in 1 out of 1 sample with a result of 710.1 pCi/L from the R-Area Downstream of R-1 location (Table A.1.1.2, Figure 3-1). Thorium-234 came through screening because there is no published ecological screening threshold level. Thorium-234 occurs naturally, but as the daughter product of uranium-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples for two reasons: 1) the low strength of

its gamma signal makes for high detection limits and correspondingly high analytical uncertainty; and 2) gamma peak overlap with actinium-228 causes falsely elevated reported concentrations and additional uncertainty. Because of its extremely low solubility and short half-life (24 days), thorium-234 would not be expected to occur in surface water at these concentrations unless local uranium-238 concentrations were extremely high in either surface water or sediment. However, observed uranium-238 levels are very low in both sediment/soil and surface water in EA 1. Furthermore, uranium-234/-238 isotopic ratios in EA 1 sediment/soils are consistent with natural uranium, but are not consistent with either enriched or depleted uranium. Measured uranium-238 concentrations and uranium isotopic ratios provide a much more reliable guide to reactor effluents than thorium-234; and therefore, the reported detections of 710 pCi/L are not believed to be DOE-related, and are perhaps spurious. Additionally, the maximum detected activity concentration, 710.1 pCi/L, is below the RESRAD Biota screening activity concentration of 266,000 pCi/L.

Thorium-234 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- There is high analytical uncertainty associated with thorium-234.
- It is not considered to be DOE-related.

Aluminum was detected in 4 of 6 samples with a maximum of 1,060 µg/L and mean of 235.79 µg/L. The EPC and maximum detected concentration are both 1,060 µg/L, which exceeds the RSV of 87 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 1.B, shows an HQ exceedance (HQ >1) for aluminum for aquatic life (HQ = 12.2). However, aluminum is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum detected concentration of 6,060 µg/L. Aluminum detects in SRS soils are common, even in reference areas, and are related to naturally high aluminum levels in soils rather than to SRS industrial operations. In aquatic environments, aluminum can be particularly high due to low pH waters.

Aluminum is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring and it is typical for it to be high in aquatic systems.
- It is not associated with SRS industrial operations.
- It is well within background levels.

Chloromethane was detected in only 1 of 6 total samples in EA 1 with that one detect being "J" qualified (i.e., estimated). Chloromethane came through screening because there is no published ecological screening threshold level. Chloromethane is a common laboratory artifact and a volatile that would not likely be present long-term in surface water. There is also no operational source for chloromethane in the LTR system.

Chloromethane is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- It is a common laboratory artifact.
- It is not associated with SRS industrial operations.

Iron was detected in 6 of 6 samples. The EPC for iron is 7,171 µg/L with a maximum detected concentration of 12,600 µg/L at the LTROU-01 sampling location in 2003 (Table A.1.1.2, Figure 3-1). Recent levels from 2010 show a range from 1,230 to 3,540 µg/L. The maximum detected concentration exceeds the LTR RSV of 1,000 µg/L and is slightly above the IOU background maximum detected concentration of 12,400 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 1.B, shows one HQ exceedance (HQ >1) for iron for benthic organisms (HQ = 7.17). However, iron is naturally-occurring, and although the maximum is slightly greater than background, in aquatic environments, particularly low flow conditions, iron can precipitate out in low pH conditions. Therefore, levels can be quite elevated. Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring and levels can be elevated by low pH aquatic environments.
- Screening threshold may be overprotective.

Manganese was detected in 6 of 6 samples. The EPC for manganese is 764 µg/L with a maximum detected concentration of 1,180 µg/L from the LTROU-01 location in 2003 (Table A.1.1.2, Figure 3-1). The mean is 375.2 µg/L based on unfiltered results. The uncertainty evaluation presented in Attachment C-6, Table 1.B, shows one HQ exceedance (HQ >1) for manganese for aquatic life (HQ = 8.21). However, manganese is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum of 2,690 µg/L. With reference levels greater than screening levels, this indicates the RSV (93 µg/L) is likely overprotective.

Manganese is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within background concentrations.
- RSV may be overly conservative.

DDT was detected in 1 out of 6 samples. The EPC and maximum detected concentrations are both 0.137 µg/L for DDT. The maximum detected concentration exceeds the LTR RSV for surface water of 0.001 µg/L and is above the IOU background maximum of 0.033 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 1.B, shows an HQ exceedance (HQ >1) for DDT for aquatic community organisms (HQ = 137).

DDT is recommended for trophic level modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- It has an elevated HQ based on the maximum concentration.
- The mean concentration also exceeds the RSV.

In summary, only DDT is identified as a RCOPC for further evaluation. No other constituents were identified as RCOPCs for surface water for EA 1. This determination is based on operational knowledge of contaminants associated with reactor effluents, frequencies of detection, background comparisons, the pedigree of data supporting screening, and trophic modeling that further assessed potential RCOCs. The radionuclides that came through screening as COPCs are those that do not have published ecological thresholds, but all were ruled out as RCOPCs because unit activities are below associated RESRAD Biota screening activity levels. Three metals identified as COPCs were ruled out as RCOPCs because they are naturally-occurring and fall within background levels. DDT is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in sections C.2.5 and C.2.6.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 1 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Curium-244	X					X	
Iodine-129	X					X	
Potassium-40	X	X	X			X	
Technetium-99	X		X			X	
Thorium-234	X	X				X	X
Aluminum	X	X	X				
Chloromethane	X	X		X	X	X	
Iron	X					X	
Manganese	X		X			X	
DDT*							

* Carried forward for site-specific trophic modeling

C.2.3.2 Exposure Area 2

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 2 are provided below.

C.2.3.2.1 Screening Results for Exposure Area 2 for Sediment/Soil

Using maximum detected values, Table C-5 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, actinium-228, americium-243, arsenic, bis[2-ethylhexyl]phthalate, bismuth-212, carbon-14, chromium, curium-243 and curium-244, curium-245 and curium-246, iron, lead, lead-212, lead-214, potassium-40, thallium-208, toluene, and vanadium. Figure 3-2 shows the sampling locations for EA2 for results discussed in the following section.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.2.2 Refinement-level Risk Results for Exposure Area 2 for Sediment/Soil

Using EPC values (i.e., 95%UCL on the mean), Table C-7 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: actinium-228, americium-243, bismuth-212, carbon-14, curium-243 and curium-244, curium-245 and curium-246, lead-212, lead-214, potassium-40, thallium-208, toluene, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There was also no screening value for methyl acetate. The COPCs are discussed further below.

C.2.3.2.3 Refinement-level Uncertainty Discussion for Exposure Area 2 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to an RSV exceedance from Section C.2.2 are referred to in this section and can be found in Attachment C-6 in Table 2.A for the sediment/soil medium. Sampling locations described for EA 2 are shown in Figure 3-2.

Actinium-228 was detected in 44 of 44 samples with a maximum of 2.84 pCi/g at the RDC010-001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC for actinium-228 is

1.05 pCi/g. Actinium-228 came through screening because there is no published ecological screening threshold level. Actinium-228 is naturally-occurring and the maximum detected activity concentration (2.84 pCi/g) is within background activity concentrations; the IOU maximum background activity concentration is 3.83 pCi/g.

Actinium-228 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.

Americium-243 was detected in 4 of 16 samples with a maximum of 0.13 pCi/g at the RDC013-001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC for americium-243 is 0.05 pCi/g. Americium-243 came through screening because there is no published ecological screening threshold level.

Americium-243 does not have an ecological screening value with which to screen nor is background data available. Americium-243 (half-life of 7,370 years), and americium-241 (half-life of 432 years) are produced together in reactors, and both isotopes behave the same in the environment. Americium-243 is not recommended for further evaluation since it was detected relatively infrequently, and not considered widespread in the LTR IOU; nor is it readily bioavailable. Americium-243 released into water from nuclear facilities will tend to stick to particles in the water or the sediment, and is so strongly attached to soil particles, that while plants may take it up from the soil, the amount taken up is small, especially in the parts of the plant that are most often eaten (i.e., the fruit, grain, and seeds). While fish may take up americium-243, the amount that builds up in the flesh is very small (ATSDR, 2004).

- Americium-243 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:
  - It is not readily bioavailable.
  - No screening value or background value is available.

Bismuth-212 was detected in 19 of 44 samples with a mean of 0.6861 pCi/g and a maximum of 2.7 pCi/g at the RDC010-001 location in 2010 with 5 "J" qualified (i.e., estimated) results (Table A.1.2.1.1, Figure 3-2). The EPC is 0.89 pCi/g. Bismuth-212 came through screening because there is no published ecological screening threshold level. Bismuth-212 is a naturally-occurring radionuclide and the mean activity concentration (0.6861 pCi/g) is within background activity levels when compared to the maximum IOU background activity of 2.59 pCi/g. Additionally, the radiological half-life for bismuth-212 is short at only 60.5 minutes.

Bismuth-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It is within background levels.
- It has a very short half-life.

Carbon-14 was detected in 1 of 8 samples with a maximum of 0.7 pCi/g at the RDC010-001 location in 2010 (Table A.1.2.1.1, Figure 3-2); the one detection is "J" qualified (i.e., estimated). The EPC is also 0.7 pCi/g. Carbon-14 came through screening because there is no published ecological screening threshold level. Carbon-14 is a naturally-occurring radionuclide, and the maximum detected activity (0.7 pCi/g) is well below the RESRAD Biota screening activity of 4,760 pCi/g.

Carbon-14 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It is naturally-occurring.

Curium-243/-244 was detected in 2 out of 16 samples with a maximum of 0.057 pCi/g at the RDC012-005 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC is 0.041 pCi/g. Curium243/-244 came through screening because there is no published ecological screening threshold level. The maximum detected activity concentration for curium-243/-244 (0.057 pCi/g)

is well below the RESRAD Biota screening activity concentration for curium-244 of 4,060 pCi/g and is within SRS background activity; the SRS mean background for curium-243/-244 is 0.067 pCi/g and the maximum background is 0.40 pCi/g.

Curium-243/-244 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is within SRS background levels.
- It is well below the RESRAD Biota screening activity.

Curium-245/-246 was detected in 2 of 16 samples with a maximum of 0.076 pCi/g at the RDC013-001 location in 2010 (Table A.1.2.1.1, Figure 3-2); both detects are "J" qualified (i.e., estimated). The EPC for curium-245/-246 is 0.049 pCi/g. Curium-245/-246 came through screening because there is no published ecological screening threshold level.

Analyses of SRS Tank Farm waste over the years indicate that Cm-243/244 is about 1,000 times more abundant than Cm-245/246. Curium isotopes are chemically identical to each other, so environmental transport processes will not separate them. Therefore, any sample that contains Cm-245/246, will contain 3 orders of magnitude more Cm-243-244. This condition was not met tin the sample results. A probable cause of the false-positives is partial breakthrough of natural Th-228 into the Am-Cm chemical separation at the laboratory.

Curium-245/-246 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The detects are estimated results ("J'" qualified).
- There is no ecological screening value

Lead-212 was detected in 44 of 44 samples with a maximum of 2.59 pCi/g at the RDC010-001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC for lead-212 is 1.16 pCi/g. Lead-212 came through screening because there is no published ecological screening threshold level. Lead-212 is naturally-occurring and the maximum detected activity (2.59 pCi/g) is within background activity

levels; the IOU maximum background activity level is 3.05 pCi/g. The half-life of lead-212 is 3.7 days.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It has a very short half-life.

Lead-214 was detected in 44 of 44 samples with a maximum of 2.33 pCi/g at the RDC007-001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC for lead-214 is 1.00 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is a naturally-occurring radionuclide and the maximum detected activity concentration (2.33-pCi/g) is within background activity levels; the IOU maximum background activity concentration is 8.42 pCi/g. The half-life of lead-214 is 26 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It has a very short half-life.

Potassium-40 was detected in 11 of 44 samples with a maximum of 4.6 pCi/g at the RDC006001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC for potassium-40 is 1.20 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. Potassium-40 is naturally-occurring and the maximum detected activity concentration (4.6 pCi/g) is well below the RESRAD Biota screening activity concentration of 119 pCi/g and is within background activity; the SRS maximum background is 8.53 pCi/g and the IOU maximum background is 13 pCi/g.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It is within SRS and IOU background levels.
- It is well below the RESRAD Biota screening activity.

Thallium-208 was detected in 44 of 44 samples with a maximum of 1.02 pCi/g at the RSC010-001 location (Table A.1.2.1.1, Figure 3-2). The EPC is 0.46 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is a naturally-occurring radionuclide and the maximum detected activity (1.02 pCi/g) is within background activity levels; the IOU maximum background activity is 1.14 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.

Toluene was detected in 1 of 16 samples with a maximum of 0.19 mg/kg at the RDC013-001 location in 2010 (Table A.1.2.1.1, Figure 3-2). The EPC is also 0.19 mg/kg, which exceeds the RSV for sediment/soil of 0.1 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 2.A, shows an HQ exceedance (HQ >1) for toluene for aquatic community organisms (HQ = 1.9). However, toluene is a common laboratory artifact and has a single detection with low detection frequency (1/16).

Toluene is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has only a single detection.
- It is a common laboratory artifact.

Vanadium was detected in 16 of 16 samples with a maximum of 112 mg/kg at the RDC010-001 location Table A.1.2.1.1, Figure 3-2). The EPC for vanadium is 43.84 mg/kg, which exceeds the RSV of 13 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 2.A, shows HQ exceedances (HQ >1) for vanadium for American robin as avian herbivore (HQ = 2.58), American robin as avian omnivore (HQ = 2.92), and American robin as avian insectivore (HQ = 3.37). However, vanadium is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum concentration (130 mg/kg) and the wetland study maximum concentration (144 mg/kg). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring and is common in SRS background soils.
- It is within IOU background and wetland study levels.
- Screening thresholds may be overprotective.

No constituents are identified as RCOPCs for evaluation in trophic modeling. Most of the constituents that came through for the sediment/soil media were radionuclides with no published threshold level, but these were all ruled out due to being naturally-occurring constituents within background levels, and in some cases, being below RESRAD Biota screening levels and/or having low detection rates. The rest of the constituents were similarly screened out because they are naturally-occurring and/or within background levels. In summary, no constituents were identified as RCOCs for sediment/soil for EA 2.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 2 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Actinium-228	X		X			X	
Americium-243					X	X	
Bismuth-212	X		X		X	X	
Carbon-14	X					X	

Curium-243/-244	X		X			X	
Curium-245/-246				X		X	
Lead-212	X		X		X	X	
Lead-214	X		X		X	X	
Potassium-40	X		X			X	
Thallium-208	X		X			X	
Toluene	X				X		
Vanadium	X		X			X	

C.2.3.2.4 Screening Results for Exposure Area 2 for Surface Water

Using maximum detected values, Table C-6 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: aluminum, anthracene, bis[2-ethylhexyl]phthalate, bismuth-214, fluoranthene, iron, manganese, mercury, pyrene, and zinc. Figure 3-2 shows the sampling locations for EA 2 for results discussed in the following section.

Bismuth-214 was identified as a COPEC since there is no published ESV available for this constituent. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.2.5 Refinement-level Risk Results for Exposure Area 2 for Surface Water

Using EPC values (i.e., 95% UCL on the mean), Table C-8 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: aluminum, anthracene, bis[2-ethylhexyl]phthalate, bismuth-214, fluoranthene, iron, manganese, mercury, and pyrene.

C.2.3.2.6 Refinement-level Uncertainty Discussion for Exposure Area 2 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward as RCOPCs for site-specific trophic level modeling. HQ calculations for receptors that pertain to an RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6, in Table 2.B for surface water. Constituents that are carried forward as an RCOPC for trophic modeling are also

discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations for EA 2 are shown in Figure 3-2.

Bismuth-214 was detected in 1 of 13 samples with a maximum of 48 pCi/L at the RDC009-002 location in 2010 (Table A.1.2.2, Figure 3-2). The EPC is also 48 pCi/L. Bismuth-214 came through screening because there is no published ecological screening threshold level. Bismuth-214 is a naturally-occurring daughter of radon and radium; it was not used at SRS. Due to the high solubility and mobility of its gaseous parent radon, there are many examples of elevated levels of bismuth-214 in SRS groundwater with concentrations as high as 500 pCi/L for reasons that are not known. Bodies of surface water which are fed by groundwater, such as the small streams, can inherit these high bismuth-214 concentrations. Because bismuth-214, and its parent's radon and radium, were not used at SRS, and because elevated levels of bismuth-214 are well known in SRS groundwater, the detections of bismuth-214 are accepted as real, and believed to be natural.

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring and is known to exist in high concentrations in SRS groundwater.
- It was not used at SRS, so detections are considered natural.
- It has only a single detection.

Aluminum was detected in 12 of 12 samples with a maximum detected concentration of 454 µg/L at the LTROU-21 location in 2001 (Table A.1.2.2, Figure 3-2). The EPC for aluminum is 235.7 µg/L, which exceeds the RSV of 87 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for aluminum for aquatic life (HQ = 2.71). However, aluminum is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (6,060 µg/L). Additionally, aluminum detects in SRS soils are common, even in reference areas, and are related to naturally high aluminum levels in soils rather than to SRS industrial operations. In aquatic environments, aluminum can be particularly high due to low pH waters.

Aluminum is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is well within IOU background levels.
- It is not associated with SRS industrial operations.

Anthracene was detected in 1 of 12 samples, with the maximum detected concentration of 0.41 µg/L at the LTROU-14 location in 2001 (Table A.1.2.2, Figure 3-2). The EPC is also 0.41 µg/L, which exceeds the RSV of 0.02 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 3.A, shows an HQ exceedance (HQ >1) for anthracene for aquatic life (HQ = 20.3). However, the 1 detect is "J" qualified (i.e., estimated), and more recent samples (2010) are all non-detects. Additionally, anthracene is used as a component in asphalt and is ubiquitous in the environment, where it readily biodegrades.

Anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- Recent data are all non-detects.
- It is ubiquitous in the environment.
- It readily biodegrades.

Bis[2-ethylhexyl]phthalate was detected in 1 of 12 samples, with a maximum of 16 µg/L at the RDC010-002 location in 2010 (Table A.1.2.2, Figure 3-2). The EPC is also 16 µg/L, which exceeds the RSV of 3.00 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for bis[2-ethylhexyl]phthalate for aquatic life (HQ = 5.33). However, bis[2-ethylhexyl]phthalate is a common laboratory artifact with a low frequency of detection.

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has only a single detection.

- It is a common laboratory artifact.

Fluoranthene was detected in 1 of 12 samples, with a maximum of 0.34 µg/L at the LTROU-14 location in 2001 (Table A.1.2.2, Figure 3-2). The EPC is also 0.34 µg/L, which exceeds the RSV of 0.04 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for fluoranthene for aquatic community organisms (HQ = 8.38). However, the one detect is "J" qualified (i.e., estimated), and all recent data (2010) are non-detects. Additionally, fluoranthene is a ubiquitous combustion by-product.

Fluoranthene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- All recent data are non-detects.
- It is a ubiquitous combustion by-product.

Iron was detected in 12 of 12 samples with a maximum of 6,890 µg/L at the RDC012-002 location in 2010 (Table A.1.2.2, Figure 3-2). The EPC for iron is 3,159 µg/L, which exceeds the RSV of 1,000 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for iron for aquatic community organisms (HQ = 3.16). However, iron is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (12,400 µg/L). Further, in aquatic environments, particularly low flow conditions, iron can precipitate out in low pH conditions. Therefore, levels can be quite elevated.

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within IOU background levels.

Manganese was detected in 12 of 12 samples with a maximum of 910 µg/L at the RDC012-002 location in 2010 (Table A.1.2.2, Figure 3-2). The mean is 340.55 µg/L based on unfiltered results. The EPC for manganese is 466.8 µg/L, which exceeds the RSV of 93 µg/L. The uncertainty

evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for manganese for aquatic life (HQ = 5.02). However, manganese is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum concentration (2,690 µg/L). With reference levels greater than screening levels, this indicates the RSV (93 µg/L) is likely overprotective.

Manganese is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within background concentrations.
- The RSV may be overly conservative.

Mercury was detected in 1 of 12 samples with an EPC and maximum of 0.45 µg/L at the LTROU-14 location in 2001 (Table A.1.2.2, Figure 3-2). The EPC exceeds the LTR RSV of 0.0013 µg/L (wildlife-based threshold level for total mercury). The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for mercury for aquatic life (HQ = 345). The maximum detected concentration also exceeds the IOU background maximum (0.24 µg/L).

Mercury is recommended for further remedial evaluation as an ecological RCOPC for trophic modeling in surface water based on the following lines of evidence:

- The EPC exceeds the RSV (HQ = 345).
- The maximum detection exceeds the background maximum.

Pyrene was detected in 1 of 12 samples with an EPC and maximum of 0.30 µg/L at the LTROU-14 location in 2001 (Table A.1.2.2, Figure 3-2). The EPC exceeds the RSV of 0.025 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 2.B, shows an HQ exceedance (HQ >1) for pyrene for aquatic community organisms (HQ = 12.1). However, the one detect is "J" qualified (i.e., estimated), and all recent data (2010) are non-detects. Additionally, pyrene is a ubiquitous combustion by-product.

Pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a ubiquitous combustion by-product.
- It has a single detection that is an estimated value ("J" qualified).
- Recent data are all non-detects.

In summary, only mercury is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in sections C.2.5 and C.2.6. COPCs for EA 2 were mostly metals and organics, and they were typically screened out due to being within background levels, being naturally-occurring, and for having very low detection rates. Additionally, the organics are, for the most part, ubiquitous in the environment and/or readily biodegradable.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented in the following table:

EA 2 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Bismuth-214	X	X				X	
Aluminum	X	X	X				
Anthracene	X				X		
Bis[2-ethylhexyl]phthalate	X				X		
Fluoranthene	X			X			
Iron	X		X				
Manganese	X		X			X	
Mercury *							
Pyrene	X		X	X			

* Carried forward for site-specific trophic modeling.

C.2.3.3 Exposure Area 3

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 3 are provided below.

C.2.3.3.1 Screening Results for Exposure Area 3 for Sediment/Soil

Using maximum detected values, Table C-9 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, aluminum, barium, beryllium, cadmium, carbon disulfide, chromium, copper, DDE, iron, lead, lead-214, nickel, thallium-208, vanadium, and zinc.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.3.2 Refinement-level Risk Results for Exposure Area 3 for Sediment/Soil

Using EPC values, Table C-11 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: barium, lead-214, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. The COPCs are discussed further below.

C.2.3.3.3 Refinement-level Uncertainty Discussion for Exposure Area 3 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 3.A for sediment/soil. Constituents that are carried forward as an RCOPC for trophic modeling are also discussed in this section. Sampling locations for EA 3 are shown in Figure 3-3.

Barium was detected in 12 of 12 samples with an EPC and maximum of 64.7 mg/kg at the LTROU-15 location in 2001 (Table A.1.3.1.1, Figure 3-3). The EPC exceeds the RSV of 60 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 3.A, shows an HQ exceedance (HQ >1) for barium for benthic organisms (HQ = 1.08). However, barium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (353 mg/kg), the SRS background maximum (252 mg/kg), as well as the wetland study maximum (1,840 mg/kg). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Additionally, all recent data (2010) are below the RSV.

Barium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent.
- It is well within background levels.
- Screening thresholds may be overprotective.
- All recent data are below screening thresholds.

Lead-214 was detected in 16 of 16 samples with a maximum activity level of 1.79 pCi/g at the LTROU-15 location in 2001 (Table A.1.3.1.1, Figure 3-3). The EPC is 1.16 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold. However, lead-214 is a naturally-occurring radionuclide and the maximum detected activity (1.79 pCi/g) is within background activity levels; the IOU maximum background activity is 8.42 pCi/g. The half-life of lead-214 is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Thallium-208 was detected 16 of 16 samples with a maximum activity level of 0.69 pCi/g at the PBT1-2 location in 2010 (Table A.1.3.1.1, Figure 3-3). The EPC is 0.47 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold. However, thallium-208 is a naturally-occurring radionuclide and the maximum detected activity (0.69 pCi/g) is within background activity levels; the IOU maximum background activity is 1.14 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.

Vanadium was detected in 6 of 6 samples with a maximum of 57.8 mg/kg at the LTROU-15 location in 2001 (Table A.1.3.1.1, Figure 3-3). The EPC for vanadium is 53.96 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 3.A, shows HQ exceedances (HQ >1) for vanadium for the American robin as avian herbivore (HQ = 3.17), American robin as avian omnivore (HQ = 3.60), and American robin as avian insectivore (HQ = 4.15). However, vanadium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), as well as the

Wetland Study maximum (144 mg/kg). Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely over protective.

No constituents were retained as RCOPCs for trophic modeling based on review of sediment/soil data for EA 3. The two radionuclides and the two metals that came through as COPCs are all naturally-occurring, common in background soils, and within background ranges. Therefore, all constituents were ruled out as RCOCs. In summary, no constituents were identified as RCOCs for sediment/soil for EA 3.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 3 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Barium	X		X			X	
Lead-214	X		X		X	X	
Thallium-208	X		X			X	
Vanadium	X		X			X	

C.2.3.3.4 Screening Results for Exposure Area 3 for Surface Water

Using maximum detected values, Table C-11 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: anthracene, fluoranthene, mercury, and pyrene.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.3.5 Refinement-level Risk Results for Exposure Area 3 for Surface Water

Using EPC values, Table C-12 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: anthracene, fluoranthene, mercury, and pyrene.

The radionuclide constituents were identified as COPCs since there are no published ESVs available for these constituents. The COPCs are discussed below.

C.2.3.3.6 Refinement-level Uncertainty Discussion for Exposure Area 3 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 3.B for surface water. Constituents that are carried forward as an RCOPC for trophic modeling are also discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations for EA 3 are shown in Figure 3-3.

Anthracene was detected in 1 of 3 samples with a maximum EPC and maximum of 0.41 µg/L at the LTROU-14 location in 2001 (Table A.1.3.2, Figure 3-1). The EPC exceeds the RSV of 0.02 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 3.B, shows an HQ exceedance (HQ >1) for anthracene for aquatic life (HQ = 20.3). However, the one detection is "J" qualified (i.e., estimated). Anthracene is used as a component in asphalt and is ubiquitous in the environment, where it readily biodegrades.

Anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is ubiquitous in the environment.
- It readily biodegrades.

Fluoranthene was detected in 1 of 3 samples with an EPC and maximum of 0.34 µg/L at the LTROU-14 location in 2001 (Table A.1.3.2, Figure 3-1). The EPC exceeds the RSV of 0.04 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 3.B, shows an HQ exceedance (HQ >1) for fluoranthene for aquatic community organisms (HQ = 8.38). However, the one detect is "J" qualified (i.e., estimated). Also, fluoranthene is a ubiquitous combustion byproduct.

Fluoranthene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detect that is an estimated value ("J" qualified).
- It is ubiquitous in the environment.
- It readily biodegrades.

Mercury was detected in 1 of 3 samples with a mean of 0.17 µg/L and a maximum of 0.45 µg/L at the LTROU-14 location in 2001 (Table A.1.3.2, Figure 3-1). The EPC is also 0.45 µg/L, which exceeds the LTR RSV of 0.0013 µg/L (wildlife-based threshold level for total mercury). The uncertainty evaluation presented in Attachment C-6, Table 3.B, shows an HQ exceedance (HQ >1) for mercury for aquatic life (HQ = 345). The maximum detected concentration also exceeds the IOU background maximum (0.24 µg/L).

Mercury is recommended for further remedial evaluation as an ecological RCOPC for trophic modeling in surface water based on the following lines of evidence:

- The EPC exceeds the RSV (HQ = 345).
- The maximum detection exceeds the background maximum.

Pyrene was detected in 1 of 3 samples with an EPC and maximum of 0.30 µg/L at the LTROU-14 location in 2001 (Table A.1.3.2, Figure 3-3). The one detect is "J" qualified (i.e., estimated), and more recent data (2010) are all non-detects. Pyrene is a ubiquitous combustion by-product.

Pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detect that is an estimated value ("J-qualified).
- It is ubiquitous in the environment.
- All recent data are non-detects.

In summary, only mercury is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in Sections C.2.5 and C.2.6. The other COPCs for EA 3 surface water were all semivolatiles that were ruled out as RCOCs due to low frequency of detection, estimated detections, and for being ubiquitous in the environment.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 3 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Anthracene	X				X		
Fluoranthene	X			X	X		
Mercury*							
Pyrene	X			X			

* Carried forward for site-specific trophic modeling.

C.2.3.4 Exposure Area 4

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 4 are provided below.

C.2.3.4.1 Screening Results for Exposure Area 4 for Sediment/Soil

Using maximum detected values, Table C-13 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft. sediment/soil interval evaluated for terrestrial and aquatic receptors: americium-243, bis[2-ethylhexyl]phthalate, bismuth-212, carbon-14, curium243 and curium-244, DDT, lead-214, thallium-208, and vanadium. Figure 3-4 shows the sampling locations for EA 4 for results discussed in the following section.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.4.2 Refinement-level Risk Results for Exposure Area 4 for Sediment/Soil

Using EPC values, Table C-15 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft sediment/soil interval: americium-243, bismuth-212, carbon-14, curium-243 and curium-244, DDT, lead-214, thallium-208, and vanadium. The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. The COPCs are discussed further below.

C.2.3.4.3 Refinement-level Uncertainty Discussion for Exposure Area 4 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 4.A for the sediment/soil medium. Sampling locations described for EA 4 are shown in Figure 3-4.

Americium-243 was detected in 1 of 13 samples with a maximum of 0.067 pCi/g at the RDC022-005 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is also 0.067 pCi/g. Americium-243 came through screening because there is no published ecological screening threshold level.

Americium-243 (half-life of 7,370 years), and americium-241 (half-life of 432 years) are produced together in reactors, and both isotopes behave the same in the environment. Americium-243 released into water from nuclear facilities will tend to stick to particles in the water or the sediment, and is so strongly attached to soil particles, that while plants may take it up from the soil, the amount taken up is small, especially in the parts of the plant that are most often eaten (i.e., the fruit, grain, and seeds). While fish may take up americium-243, the amount that builds up in the flesh is very small (ATSDR, 2004).

Americium-243 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is not readily bioavailable.
- No screening value or background value is available.

Bismuth-212 was detected in 16 of 36 samples with a mean of 0.70 pCi/g and a maximum of 1 .98 pCi/g at the RDC016-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is 0.9 pCi/g. Bismuth-212 came through screening because there is no published ecological screening threshold level. Bismuth-212 is a naturally-occurring radionuclide and the maximum detected activity (1.98 pCi/g) is within background activity levels; the IOU maximum background activity is 2.59 pCi/g. Additionally, the radiological half-life for bismuth-212 is short at only 60.5 minutes.

Bismuth-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It does not appear to be unit related since it is indistinguishable from background.
- It has a very short half-life.

Carbon-14 was detected in 2 of 7 samples with a mean of 0.37 pCi/g and a maximum of 0.63 pCi/g at the RDC015-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is 0.59 pCi/g. Carbon-14 came through screening because there is no published ecological screening threshold

level. The maximum detected activity (0.63pCi/g) is well below the RESRAD Biota screening value (4,760 pCi/g).

Carbon-14 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It is naturally-occurring.

Curium-243/-244 was detected in 1 out of 13 samples with a maximum of 0.04 pCi/g at the RDC016-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is also 0.04 pCi/g. Curium-243/-244 came through screening because there is no published ecological screening threshold level. However, the one detect is "J" qualified (i.e., estimated), and the maximum detected activity concentration for curium-243/-244 (0.04 pCi/g) is well below the RESRAD Biota screening activity concentration for curium-244 of 4,060 pCi/g. The SRS mean background for curium-243/-244 is 0.067 pCi/g and the maximum background is 0.40 pCi/g.

Curium-243/-244 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a single detect that is an estimated result "J" qualified).
- It is within SRS background levels.
- It is well below the RESRAD Biota screening activity.

Lead-214 was detected in 36 of 36 samples with a mean of 0.98 pCi/g and a maximum of 1.8 pCi/g at the RDC022-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is 1.06 pCi/g, and 17 of 36 detects are "J" flagged (i.e., estimated). Lead-214 came through screening because there is no published ecological screening threshold level. However, lead-214 is a naturally-occurring radionuclide and the maximum detected activity (1.8 pCi/g) is well within background activity levels; the IOU maximum background activity concentration is 8.42 pCi/g. Additionally, the radiological half-life for lead-214 is short at only 26 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Half of detects are estimated.
- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Thallium-208 was detected in 35 of 36 samples with a mean of 0.41 pCi/g and a maximum of 0.73 pCi/g at the RDC016-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC is 0.45 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. However, thallium-208 is a naturally-occurring radionuclide and the maximum detected activity (0.73 pCi/g) is within background activity levels; the IOU maximum background activity is 1.14pCi/g. Additionally, the radiological half-life for thallium-208 is short at only 3.1 minutes.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

DDT was detected in 1 of 12 samples with an EPC and maximum of 0.0049 mg/kg at the RDC018-003 location in 2010 (Table A.1.4.1.1, Figure 3-4). The uncertainty evaluation presented in Attachment C-6, Table 4.A, shows one HQ exceedance (HQ >1) for DDT for benthic organisms (HQ = 1.03). However, this calculation is based on one single detect; when all 12 samples are considered, the mean DDT concentration of 0.0007 mg/kg is well below the RSV (0.005 mg/kg).

DDT is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean is below the RSV.
- There is no history of process related use at SRS.

Vanadium was detected in 12 of 12 samples with a mean of 24.13 mg/kg and a maximum of 51.1 mg/kg at the RDC021-001 location in 2010 (Table A.1.4.1.1, Figure 3-4). The EPC for vanadium is 31.03 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 4.A, shows HQ exceedances (HQ >1) for vanadium for the American robin as avian herbivore (HQ = 1.83), American robin as avian omnivore (HQ = 2.07), and American robin as avian insectivore (HQ = 2.39). However, vanadium is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum (130 mg/kg), the SRS background maximum concentration (104 mg/kg), as well as the Wetland Study maximum concentration (144 mg/kg). Background levels are substantially higher than screening thresholds indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- The screening level is likely overprotective.

No constituents are identified as RCOPCs for evaluation in trophic modeling. Most of the constituents that came through as COPCs for the sediment/soil media were radionuclides with no published threshold level, and these were all ruled out due to a combination of being within background activity levels, being naturally-occurring, and in some cases, being below RESRAD Biota screening levels or having low detection rates. While vanadium was ruled out because it is naturally-occurring, both constituent concentrations were within background levels. In summary, no constituents were identified as RCOCs for sediment/soil for EA 4.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 4 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Americium-243					X	X	
Bismuth-212	X		X		X	X	
Carbon-14	X					X	
Curium-243/-244	X		X	X		X	
Lead-214			X		X	X	
Thallium-208	X		X		X	X	
DDT	X	X					
Vanadium	X		X			X	

C.2.3.4.4 Screening Results for Exposure Area 4 for Surface Water

Using maximum detected values, Table C-14 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: aluminum, anthracene, benzo[a]anthracene, bis[2-ethylhexyl]phthalate, caprolactam, fluoranthene, iron, manganese, and pyrene.

C.2.3.4.5 Refinement-level Risk Results for Exposure Area 4 for Surface Water

Using EPC values, Table C-16 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: aluminum, anthracene, benzo[a]anthracene, bis[2-ethylhexyl]phthalate, caprolactam, fluoranthene, iron, manganese, and pyrene.

C.2.3.4.6 Refinement-level Uncertainty Discussion for Exposure Area 4 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 4.B for surface water. Sampling locations for EA 4 are shown in Figure 3-4.

Caprolactam was detected in 1 of 11 samples with an EPC and maximum of 1.28 µg/L at the LTROU-22 location in 2001 (Table A.1.4.2, Figure 3-4). Caprolactam came through screening because there is no published ecological screening threshold level. The one detect is "J" qualified (i.e., estimated).

Caprolactam is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has only a single detection.
- The detection is an estimated result.

Aluminum was detected in 10 of 10 samples with a mean of 97.2 µg/L and a maximum detected concentration of 364 µg/L at the RDC020-002 location in 2010 (Table A.1.4.2, Figure 3-4). The EPC for aluminum is 182.7 µg/L, which exceeds the RSV of 87 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for aluminum for aquatic life (HQ = 2.10). However, aluminum is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum detected concentration (6,060 µg/L). Aluminum detects in SRS soils are common, even in reference areas, and are related to naturally high aluminum levels in soils rather than to SRS industrial operations. In aquatic environments, aluminum can be particularly high due to low pH waters.

Aluminum is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring and it is typical for it to be high in aquatic systems.
- It is not associated with SRS industrial operations.
- It is well within background levels.

Anthracene was detected in 1 of 10 samples with an EPC and maximum of 0.23 µg/L at the LTROU-22 location in 2001 (Table A.1.4.2, Figure 3-4). The one detect is "J" qualified (i.e., estimated), and all recent data (2010) are non-detects. The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for anthracene for aquatic life

(HQ = 11.6). Anthracene is used as a component in asphalt and is ubiquitous in the environment, where it readily biodegrades.

Anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- All recent data are non-detects.
- It is ubiquitous in the environment.
- It readily biodegrades.

Benzo[a]anthracene was detected in 1 of 11 samples with a mean of 0.44 µg/L and a maximum of 0.31 µg/L at the LTROU-22 location in 2001 (Table A.1.4.2, Figure 3-4). The one detection is "J" flagged (i.e., estimated). The EPC is also 0.31 µg/L, which exceeds the RSV (0.027 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows an HQ exceedance (HQ >1) for benzo[a]anthracene for aquatic community organisms (HQ = 11.4). However, the one detect from 2001 is estimated, and all recent data (2010) are non-detects. Considering these uncertainties, benzo[a]anthracene is not an ecological COPC.

Benzo[a]anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detection is an estimated result ("J" qualified),
- All recent data are non-detects.

Bis[2-ethylhexyl]phthalate was detected in 4 of 11 samples with a mean of 2.50 µg/L and a maximum detected concentration of 12 µg/L at the RDC015-002 location in 2010 (Table A.1.4.2, Figure 3-4). The EPC for bis[2-ethylhexyl]phthalate is 5.51 µg/L, which exceeds the RSV of 3.0 µg/L. Two of the four detects are "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for bis[2-ethylhexyl]phthalate for aquatic life (HQ = 1.84). However, bis[2-ethylhexyl]phthalate is a common laboratory artifact.

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- Half of the detects are estimated results ("J" qualified).
- It is a common laboratory artifact.

Fluoranthene was detected 1 of 11 samples with an EPC and maximum of 0.26 µg/L at the LTROU-22 location in 2001 (Table A.1.4.2, Figure 3-4). The EPC exceeds the RSV of 0.04 µg/L. The one detect is "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for fluoranthene for aquatic community organisms (HQ = 6.48). However, fluoranthene is a ubiquitous combustion by-product.

Fluoranthene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- It is a ubiquitous combustion by-product.

Iron was detected in 10 of 10 samples with a mean of 1,275.6 µg/L and a maximum of 5,260 µg/L at the RDC020-002 location in 2010 (Table A.1.4.2, Figure 3-4). The EPC for iron is 3,233 µg/L, which exceeds the RSV of 1,000 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for iron for aquatic community organisms (HQ = 3.23). However, iron is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum concentration (12,400 µg/L). In aquatic environments, particularly low flow conditions, iron can precipitate out in low pH conditions. Therefore, levels can be quite elevated.

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within IOU background levels.

Manganese was detected in 10 of 10 samples with a mean of 59 µg/L and a maximum, detected concentrations of 237 µg/L at the RDC020-002 location in 2010 (Table A.1.4.2, Figure 3-4). The EPC for manganese is 164.9 µg/L, which exceeds the RSV of 93 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for manganese for aquatic community organisms (HQ = 1.77). However, manganese is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum (2,690 µg/L). With reference levels greater than screening levels, this indicates the RSV (93 µg/L) is likely overprotective.

Manganese is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within background concentrations.
- The RSV may be overly conservative.

Pyrene was detected in 1 of 11 samples with an EPC and maximum of 0.31 µg/L at the LTROU-22 location in 2001 (Table A.1.4.2, Figure 3-4). The EPC exceeds the RSV of 0.025 µg/L. The one detect is "J" qualified (i.e., estimated), and all recent data (2010) are nondetects. The uncertainty evaluation presented in Attachment C-6, Table 4.B, shows one HQ exceedance (HQ >1) for pyrene for aquatic community organisms (HQ = 12.2). However, pyrene is a ubiquitous combustion by-product.

Pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a ubiquitous combustion by-product.
- It has a single detect that is an estimated value ("J" qualified).
- All recent data are non-detects.

No constituents are identified as RCOPCs for evaluation in trophic modeling. Most of the constituents that came through as COPCs for the surface water media were semivolatiles that were

ruled out based on low detection frequency and being within background levels, along with other lines of evidence. The other constituents were metals that were ruled out as RCOCs because they are naturally-occurring and within background levels. In summary, no constituents were identified as RCOCs for surface water for EA 4.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 4 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Caprolactam	X	X		X		X	
Aluminum	X	X	X				
Anthracene	X			X	X		
Benzo[a]anthracene	X			X			
Bis[2-ethylhexyl]phthalate	X			X	X		
Fluoranthene	X			X			
Iron	X		X				
Manganese	X		X			X	
Pyrene	X			X			

C.2.3.5 Exposure Area 5

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 5 are provided below.

C.2.3.5.1 Screening Results for Exposure Area 5 for Sediment/Soil

Using maximum detected values, Table C-17 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, actinium-228, americium-243, barium, chromium, copper, cyanide, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, potassium-40, thallium-208, vanadium, and zinc. Figure 3-5 shows the sampling locations for EA5 for results discussed in the following section.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There was also no screening value for methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.5.2 Refinement-level Risk Results for Exposure Area 5 for Sediment/Soil

Using EPC values, Table C-19 identifies the following constituents as COPCs based on RSV screening in the 0- to 1-ft sediment/soil interval: actinium-228, americium-243, barium, cyanide, DDE, DDT, lead-212, lead-214, mercury, potassium-40, thallium-208, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There was also no screening value for methyl acetate. The COPCs are discussed further below.

C.2.3.5.3 Refinement-level Uncertainty Discussion for Exposure Area 5 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and the applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 5.A for sediment/soil. Sampling locations described for EA 5 are shown in Figure 3-5.

Actinium-228 was detected in 15 of 15 samples with a mean of 1.58 pCi/g and a maximum of 3.99 pCi/g at the JBT002-003 location in 2010 (Table A.1.5.1.1, Figure 3-5). The EPC is 2.19 pCi/g. Actinium-228 came through screening because there is no published ecological screening threshold level. Actinium-228 is a naturally-occurring radionuclide and the mean detected activity (1.58 pCi/g) is within background activity levels; the IOU maximum background activity is 3.83 pCi/g and the SRS maximum background activity is 2.54 pCi/g.

Actinium-228 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU and SRS soil background activity ranges.
- It is a naturally-occurring constituent.

Americium-243 was detected in 1 of 5 samples with an EPC and maximum of 0.34 pCi/g at the JBT002-003 location in 2010 (Table A.1.5.1.1, Figure 3-5). Americium-243 came through screening because there is no published ecological screening threshold level. Americium-243 (half-life of 7,370 years) and americium-241 (half-life of 432 years) are produced together in reactors, and both isotopes behave the same in the environment. Americium-243 is not recommended for further evaluation since it was detected relatively infrequently, and is not considered widespread in the LTR IOU; nor is it readily bioavailable. Americium-243 released into water from nuclear facilities will tend to stick to particles in the water or the sediment, and is so strongly attached to soil particles, that while plants may take it up from the soil, the amount taken up is small, especially in the parts of the plant that are most often eaten (i.e., the fruit, grain, and seeds). While fish may take up americium-243, the amount that builds up in the flesh is very small (ATSDR 2004).

Americium-243 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is not readily bioavailable.
- No screening value or background value is available.

Lead-212 was detected in 16 of 17 samples with a mean of 1.39 pCi/g and a maximum of 4.06 pCi/g at the JBT002-003 location in 2010 (Table A.1.5.1.1, Figure 3-5). The EPC is 2.01 pCi/g. Lead-212 came through screening because there is no published ecological screening threshold level. Lead-212 is a naturally-occurring radionuclide and the mean detected activity (1.39 pCi/g) is within background activity levels; the IOU maximum background activity is 3.05 pCi/g, and the SRS maximum background activity is 2.79 pCi/g. The half-life of lead-212 is 10.6 hours.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU and SRS soil background activity ranges.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Lead-214 was detected in 17 of 17 samples with a mean of 1.47 pCi/g and a maximum of 2.69 pCi/g at the LTROU-03 location in 2004 (Table A.1.5.1.1, Figure 3-5). The EPC is 1.82 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is a naturally-occurring radionuclide and the maximum detected activity (2.69 pCi/g) is within the IOU maximum background activity level of 8.42 pCi/g. The half-life of lead-214 is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity ranges.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Potassium-40 was detected in 12 of 17 samples with a mean of 1.93 pCi/g and a maximum of 5.49 pCi/g at the LTROU-03 location in 2004 (Table A.1.5.1.1, Figure 3-5). The EPC is 2.71 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. Potassium-40 is a naturally-occurring radionuclide and the maximum detected activity concentration, 5.49 pCi/g, is below the RESRAD Biota screening activity concentration of 119 pCi/g and is within background activity concentrations; the IOU maximum background activity concentration is 13 pCi/g, and the SRS maximum background activity concentration is 8.53 pCi/g. Potassium-40 was not used in SRS reactor processes, so the detections are regarded as not DOE-related.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in SRS background soils.
- It is within SRS and IOU background levels.
- It is well below the RESRAD Biota screening activity.

Thallium-208 was detected in 16 of 17 samples with a mean of 0.45 pCi/g and a maximum of 1.3 pCi/g at the JBT002-003 location in 2010 (Table A.1.5.1.1, Figure 3-5). The EPC is 0.58 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is a naturally-occurring radionuclide and the mean activity (0.45 pCi/g) is within background activity levels; the IOU maximum background activity is 1.14 pCi/g. The half-life of thallium-208 is 3.05 minutes.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Barium was detected in 5 of 5 samples with a mean of 50.1 mg/kg and a maximum of 102 mg/kg at the LTROU-04 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC for barium is 95.8 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows one HQ exceedance (HQ >1) for barium for benthic organisms (HQ = 1.60). However, barium is naturally-occurring, and the maximum detected concentration (102 mg/kg) falls well below the IOU background maximum (353 mg/kg), the SRS background maximum (252 mg/g), as well as the Wetland Study maximum (1,840 mg/kg). Background levels are substantially higher than screening thresholds indicating that the screening levels are likely overprotective.

Barium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent.
- It is well within background levels.
- Screening thresholds may be overprotective.

Cyanide was detected in 3 of 3 samples with a mean of 0.83 mg/kg and maximum of 1.28 mg/kg at the LTROU-03 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC is also 1.28, which exceeds the LTR RSV for sediment/soil of 1 mg/kg and the estimated IOU mean background concentration of 0.67 mg/kg. None of the detects are "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows HQ exceedances (HQ >1) for cyanide for American robin as an avian herbivore (HQ = 1.28), American robin as an avian omnivore (HQ = 1.28), and for American robin as an avian insectivore (HQ = 1.28).

Cyanide is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean is below the RSV.
- There is no history of process related use at SRS.

DDE was detected in 2 of 4 samples with a mean of 0.0018 mg/kg and a maximum of 0.0044 mg/kg at the LTROU-04 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC is also 0.0044 mg/kg, which exceeds the RSV of 0.0037 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows one HQ exceedance (HQ >1) for DDE for benthic organisms (HQ = 1.18). However, both of the detects are "J" qualified (i.e., estimated), and all recent data (2010) are non-detects. The mean detected concentration (0.0018 mg/kg) is below the RSV (0.004 mg/kg).

DDE is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- All the detects are estimates.
- The mean concentration is below the RSV.
- All recent data are non-detects.

DDT was detected in 1 of 4 samples with a mean of 0.0033 mg/kg and a maximum of 0.011 mg/kg at the LTROU-02 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC is also 0.011 mg/kg, which exceeds the RSV of 0.00477 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows one HQ exceedance (HQ >1) for DDT for benthic organisms (HQ = 2.39). However, the mean detected concentration (0.0033 mg/kg) is below the RSV (0.005 mg/kg). Also, the most recent data (2010) are all non-detects.

DDT is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean concentration is below the RSV.
- All recent data are non-detects.

Mercury was detected in 3 of 5 samples with a mean of 0.099 mg/kg and maximum of 0.229 mg/kg at the LTROU-03 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC for mercury is 0.205 mg/kg, which exceeds the RSV of 0.0035 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows HQ exceedances (HQ >1) for mercury for the deer mouse as mammalian omnivore (HQ = 6.61), the montane shrew as mammalian insectivore (HQ = 13.67), the occult little brown myotis bat as mammalian aerial insectivore (HQ = 10.79), the American robin as avian omnivore (HQ = 28.87), the American robin as avian insectivore (HQ = 58.57), the violet-green swallow as avian aerial insectivore (HQ = 44.57), the American kestrel as avian intermediate carnivore (HQ = 12.06), and the American kestrel as avian top carnivore (HQ = 2.63). However, the RSV (0.0035 mg/kg) identified for mercury in the sediment/soil media was the most conservative screening threshold available (for methylmercury) and is probably overprotective. All recent data (2010) are non-detects. Additionally, mercury is ubiquitous in the environment,

and the maximum detected concentration falls below the SRS background maximum (0.3 mg/kg) as well as the Wetland Study maximum (0.74 mg/kg).

Mercury is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The RSV was probably overly protective.
- It is ubiquitous in the environment.
- It is within background levels.
- All recent data are non-detects.

Vanadium was detected in 5 of 5 samples with a mean of 19.08 mg/kg and a maximum detected concentration of 45.1 mg/kg at the LTROU-03 location in 2003 (Table A.1.5.1.1, Figure 3-5). The EPC for vanadium is 35.78 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 5.A, shows one HQ exceedance (HQ >1) for vanadium for benthic organisms (HQ = 1.18). However, vanadium is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), as well as the Wetland Study maximum (144 mg/kg). Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective.

No constituents are identified as RCOPCs for evaluation in trophic modeling. Most of the constituents that came through for the sediment/soil media were radionuclides with no published threshold level, and these were all ruled out due to a combination of being within background activity levels, being naturally-occurring, and in some cases, being below RESRAD Biota screening levels or having low detection rates. The pesticides were ruled out because mean

concentrations were below RSVs and were also within background levels. All three metals are naturally-occurring, are ubiquitous in the environment, and have overly protective thresholds. In summary, no constituents were identified as RCOCs for sediment/soil for EA 5.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 5 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Actinium-228	X		X			X	
Americium-243					X	X	
Lead-212	X		X		X	X	
Lead-214	X		X		X	X	
Potassium-40	X		X			X	
Thallium-208	X		X		X	X	
Barium	X		X			X	
Cyanide	X	X					
DDE	X			X			
DDT	X						
Mercury	X		X			X	
Vanadium	X		X			X	

C.2.3.5.4 Screening Results for Exposure Area 5 for Surface Water

Using maximum detected values, Table C-18 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: bismuth-214, DDT, iron, and lead-214.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.5.5 Refinement-level Risk Results for Exposure Area 5 for Surface Water

Using EPC values, Table C-20 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: bismuth-214, DDT, iron, and lead-214.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. The COPCs are discussed below.

C.2.3.5.6 Refinement-level Uncertainty Discussion for Exposure Area 5 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and the applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 5.B for surface water. The trophic modeling report is presented in Attachment C-9. Sampling locations described for EA 5 are shown in Figure 3-5.

Bismuth-214 was detected in 1 of 7 samples with an EPC and maximum of 70.2 pCi/L at the LTROU-02 location in 2003 (Table A.1.5.2, Figure 3-5). The one detect is "J" flagged (i.e., estimated). Bismuth-214 came through screening because there is no published ecological screening threshold level. Bismuth-214 is a naturally-occurring daughter of radon and radium; it was not used at SRS. Due to the high solubility and mobility of its gaseous parent radon, there are many examples of elevated levels of bismuth-214 in SRS groundwater with concentrations as high as 500 pCi/L for reasons that are not known. Bodies of surface water, which are fed by groundwater, such as the small streams, can inherit these high bismuth-214 concentrations. Because bismuth-214, and its parent's radon and radium, were not used at SRS, and because elevated levels of bismuth-214 are well known in SRS groundwater, the detections of bismuth-214 are accepted as real, and believed to be natural.

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring and is known to exist in high concentrations in SRS groundwater.
- It was not used at SRS, so detections are considered natural.
- It has a single detect that is an estimated value ("J" qualified).

DDT was detected in 1 of 7 samples with an EPC and maximum of 0.066 µg/L at the LTROU-02 location in 2003 (Table A.1.5.2, Figure 3-5), which exceed the LTR RSV for surface water of 0.001 µg/L and the IOU background maximum detected concentration of 0.033 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 5.B, shows one HQ exceedance (HQ >1) for DDT for benthic organisms (HQ = 66). The mean DDT concentration (0.014 µg/L) also exceeds the RSV.

DDT is identified as an ecological RCOPC and is recommended for trophic modeling as an ecological RCOC in surface water based on the following lines of evidence:

- It has an elevated HQ based on the maximum concentration.
- The mean concentration also exceeds the RSV.

Iron was detected in 7 of 7 samples with a mean of 1,044.4 µg/L and a maximum detected concentration of 1,760 µg/L at the JBT001-002 location in 2010 (Table A.1.5.2, Figure 3-5). The EPC for iron is 1,312 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 5.B, shows one HQ exceedance (HQ >1) for iron for aquatic community organisms (HQ = 1.31). However, iron is naturally-occurring, and the maximum detected concentration (1,760 µg/L) falls well below the IOU background maximum (12,400 µg/L).

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- The screening level is likely overprotective.

Lead-214 was detected in 2 of 7 samples with a maximum of 49.7 µg/L at the LTROU-02 location (Table A.1.5.2, Figure 3-5). The EPC is 33.9 µg/L. The two detects are "J" flagged (i.e., estimated). Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is naturally-occurring, and the half-life is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a naturally-occurring constituent.
- It has a very short half-life.

In summary, only DDT is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in Sections C.2.5 and C.2.6. The two radionuclides came through as COPCs for the surface water media because they have no published threshold level, but these were all ruled out as RCOCs due to being naturally-occurring and having a low (and estimated) frequency of detection. The one metal COPC, iron, is naturally-occurring, is ubiquitous in the environment, and has overly protective thresholds.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 5 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Bismuth-214	x	x		x		x	
DDT*							
Iron	x		x			x	
Lead-214	x				x	x	

* Carried forward for site-specific trophic modeling.

C.2.3.6 Exposure Area 6

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 6 are provided below.

C.2.3.6.1 Screening Results for Exposure Area 6 for Sediment/Soil

Using maximum detected values, Table C-21 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: 2-chlorophenol, acetone, antimony, arsenic, barium, barium-133, benzoic acid, bis[2-ethylhexyl]phthalate, cadmium, carbon disulfide, chloride, chromium, cinnamyl cinnamate,

cobalt-58, cyanide, dibutylphthalate, europium-155, iron, lead, lead-214, manganese, manganese-54, mercury, methyl cyclopentane, methyl isobutyl ketone, neptunium-239, orthophosphate, phenols, phosphate, potassium-40, promethium-146, ruthenium-106, selenium, thallium, thorium-234, tin-113, vanadium, zinc-65, and zirconium-95.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There are also no screening values available for chloride, cinnamyl cinnamate, methyl cyclopentane, methyl isobutyl ketone, orthophosphate, or phosphate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.6.2 Refinement-level Risk Results for Exposure Area 6 for Sediment/Soil

Using EPC values, Table C-23 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: barium-133, chloride, cinnamyl cinnamate, cobalt-58, europium-155, lead-214, manganese-54, mercury, methyl cyclopentane, methyl isobutyl ketone, neptunium-239, orthophosphate, phenols, phosphate, potassium-40, promethium-146, ruthenium-106, selenium, thallium, thorium-234, tin-113, vanadium, zinc-65, and zirconium-95. The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There are also no screening values available for chloride, cinnamyl cinnamate, methyl cyclopentane, methyl isobutyl ketone, orthophosphate, or phosphate. The COPCs are discussed further below.

C.2.3.6.3 Refinement-level Uncertainty Discussion for Exposure Area 6 for Sediment/Soil

An uncertainty analysis is performed for each individual COC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-3 in Table 6.A for sediment/soil. Constituents that are carried forward as an RCOPC for trophic modeling are also discussed in this section. The trophic level modeling report is presented in Attachment C-9. Sampling locations for EA 6 are shown in Figure 3-6.

Chloride was detected in 27 of 44 detects with a mean of 2.69 mg/kg and a maximum of 16.5 mg/kg from the PPSC-SED27 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 4.7 mg/kg. Chloride came through screening because there is no published ecological screening threshold level. Twenty-five of the twenty-seven detected samples (92.6%) are "J" qualified (i.e., estimated).

Chloride is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Almost all the detects are estimates.
- There is no screening threshold available.
- This constituent is not monitored for CERCLA investigations and is viewed more as a water quality parameter.

Cinnamyl cinnamate was detected in 1 of 1 sample (0.26 mg/kg) at the PPSC-SED09 location in 1995 (Table A.1.6.1.1, Figure 3-6). The one detection is "J" flagged (i.e., estimated). Cinnamyl cinnamate came through screening because there is no published ecological screening threshold level. Cinnamyl cinnamate is used in the cosmetic and food industry and is not likely associated with operations within the LRT IOU.

Cinnamyl cinnamate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The one detect is an estimate.
- There is no screening threshold available.
- It is not likely associated with LTR IOU operations.

Methyl cyclopentane was detected in 6 of 6 samples with a mean of 0.0015 mg/kg and maximum of 0.019 mg/kg at the PPSC-SE26 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.0004 mg/kg, and all six detects are "J" flagged (i.e., estimated). Methyl cyclopentane came through screening because there is no published ecological screening threshold level.

Methyl cyclopentane is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- All the detects are estimates.
- There is no screening threshold available.

Methyl isobutyl ketone was detected in 2 of 28 samples with an EPC and maximum of 0.00084 mg/kg at the PPSC-SED01 location in 1995 (Table A.1.6.1.1, Figure 3-6). Both detects are "J" flagged (i.e., estimated). Methyl isobutyl ketone came through screening because there is no published ecological screening threshold level.

Methyl isobutyl ketone is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- All the detects are estimates.
- There is no screening threshold available.

Orthophosphate was detected in 17 of 45 samples with a maximum of 11.9 mg/kg at the PPSC-SED03 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 6.05 mg/kg, and all detects are "J" flagged (i.e., estimated). Orthophosphate came through screening because there is no published ecological screening threshold level.

Orthophosphate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- All the detects are estimates.
- There is no screening threshold available.
- This constituent is not monitored for CERCLA investigations and is viewed more as a water quality parameter.

Phosphate was detected in 45 of 45 samples with a maximum of 722 mg/kg at the PPSC-SED09 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 195.8 mg/kg, and 42 of 45

(93.3 percent) detects are "J" flagged (i.e., estimated). Phosphate came through screening because there is no published ecological screening threshold level.

Phosphate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Most (93.3 percent) of the detects are estimates.
- There is no screening threshold available.
- This constituent is not monitored for CERCLA investigations and is viewed more as a water quality parameter.

Barium-133 was detected in 2 of 257 samples with a maximum of 0.27 pCi/g at the PPSC-SED26 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.017 pCi/g, and one of the two detects is "J" flagged (i.e., estimated). Barium-133 came through screening because there is no published ecological screening threshold level.

Barium-133 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The frequency of detection is very low (0.8%).
- There is no ecological screening value.

Cobalt-58 was detected in 3 of 256 samples with a maximum of 0.03 pCi/g at the PP10B3 (PAR Pond transect) location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.0007 pCi/g. Cobalt-58 came through screening because there is no published ecological screening threshold level. The maximum detected activity concentration (0.03 pCi/g) is below the RESRAD Biota screening value of 1,790 pCi/g. Additionally, cobalt-58 has a short half-life (2.3 months).

Cobalt-58 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The frequency of detection is very low.
- It has a short half-life.

- The maximum is below the RESRAD screening value.

Europium-155 was detected in 81 of 204 samples with a mean of 0.051 pCi/g and a maximum of 0.33 pCi/g at the PPSC-SED27 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.05 pCi/g. Europium-155 came through screening because there is no published ecological screening threshold level. However, the maximum detected activity (0.33 pCi/g) is well below the RESRAD Biota screening value 15,800 pCi/g. The mean activity (0.051 pCi/g) is within background activity levels; the IOU mean background activity is 0.054 pCi/g.

Europium-155 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The maximum is well below the RESRAD screening value.
- The mean activity is within IOU background activity levels.

Lead-214 was detected in 3 of 3 samples with a mean of 1.00 pCi/g and a maximum of 1.46 pCi/g at the PP10B7 location in 2016 (Table A.1.6.1.1, Figure 3-6). The EPC is also 1.46 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is a naturally-occurring radionuclide and the maximum detected activity (1.46 pCi/g) is within background activity concentrations; the IOU mean background activity concentration is 2.32 pCi/g and the maximum is 8.42 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Manganese-54 was detected in 212 detects of 257 with a maximum of 0.049 pCi/g at the PF3-6 location in 1995 (Table A.1.6.1.1, Figure 3-6). Manganese-54 came through screening because there is no published ecological screening threshold level. The mean activity concentration (0.019 pCi/g) is within background activity levels; the IOU maximum detected background

activity concentration is 0.031 pCi/g. Additionally, manganese-54 has a short half-life (10.3 months).

Manganese-54 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean is within background.
- It has a short half-life.

Neptunium-239 was detected in 26 of 247 samples with a mean of 0.091 pCi/g and a maximum of 3.1 pCi/g at the PPSC-SED26 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.19 pCi/g. Neptunium-239 came through screening because there is no published ecological screening threshold level. The half-life of neptunium-239 is 2.36 days.

Neptunium-239 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very short half-life.
- There is no published screening value.

Potassium-40 was detected in146 of 260 samples with a maximum of 4.38 pCi/g at the PP13A9 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.61 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. Potassium40 is a naturally-occurring radionuclide and the maximum detected activity concentration (4.38 pCi/g) is below the RESRAD Biota screening value of 119 pCi/g and is within background activity levels; the IOU maximum detected background activity is 13 pCi/g and SRS maximum detected background activity is 8.53 pCi/g.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The maximum is well below the RESRAD screening value.
- The mean activity is within IOU and SRS background activity levels.

Promethium-146 was detected in 3 of 254 samples with a maximum of 0.013 pCi/g at the PF4-20 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.0013 pCi/g. Promethium-146 came through screening because there is no published ecological screening threshold level.

Promethium-146 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very low frequency of detection (1.2%).
- There is no published screening value.

Ruthenium-106 was detected in 1 of 257 samples with a mean of 0.058 pCi/g and a maximum of 0.23 pCi/g at the PAR Pond Transect 08 Location A1: PP08A1 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is also 0.23 pCi/g. Ruthenium-106 came through screening because there is no published ecological screening threshold level. The half-life of ruthenium-106 is 1.02 years. Ruthenium-106 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very short half-life.
- It has a low detection frequency (1/257).

Thorium-234 was detected in 195 of 257 samples with a maximum of 5.59 pCi/g at the CS01B9 (PAR Pond transect) location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.97 pCi/g. Thorium-234 came through screening because there is no published ecological screening threshold level. Thorium-234 occurs naturally, but as the daughter product of uranium-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples for two reasons: 1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty; and 2) gamma peak overlap with actinium-228 causes falsely elevated reported concentrations and additional uncertainty. The half-life of thorium-234 is 24.1 days. The maximum detected activity (5.59 pCi/g) is likely overestimated and is below the RESRAD Biota screening activity concentration of 2,160 pCi/g.

Thorium-234 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- There is high analytical uncertainty associated with thorium-234.
- It is not considered to be DOE-related.
- It has a very short half-life.

Tin-113 was detected in 1 of 257 samples with a mean of 0.012 pCi/g and a maximum of 0.07 pCi/g at the PAR Pond Sediment: PPSC-SED27 location in 1995 (Table A.1.6.1.1, Figure 3-6).

The EPC is also 0.07 pCi/g. Tin-113 came through screening because there is no published ecological screening threshold level. The half-life of tin-113 is 3.8 months.

Tin-113 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very short half-life.
- It has a low detection frequency (1/257).

Zinc-65 was detected in 7 of 293 samples with a maximum of 0.16 pCi/g at the PPSC-SED26 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.0037 pCi/g. Zinc-65 came through screening because there is no published ecological screening threshold level. The maximum detected activity concentration (0.16 pCi/g) is below the RESRAD Biota screening activity concentration of 413 pCi/g. In addition, zinc-65 has a short half-life (8.0 months).

Zinc-65 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It has a very short half-life.

Zirconium-95 was detected in 51 of 176 samples with a maximum of 0.070 pCi/g at the PP07B3 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC is 0.017 pCi/g. Zirconium-95 came

through screening because there is no published ecological screening threshold level. However, the maximum detected activity concentration (0.070 pCi/g) is below the RESRAD Biota screening activity concentration of 1,170 pCi/g. In addition, zirconium-95 has a short half-life (2.1 months).

Zirconium-95 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- It has a very short half-life.

Mercury was detected in 165 of 371 samples with a mean of 0.065 mg/kg and a maximum of 0.958 mg/kg at the PAR Pond Transect 2 Location 5 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC for mercury is 0.081 mg/kg, which exceeds the LTR RSV for sediment/soil of 0.0035 mg/kg (based on methylmercury threshold level). The uncertainty evaluation presented in Attachment C-6, Table 6.A, shows eight HQ exceedances (HQ >1) for mercury as follows: Deer mouse as a mammalian omnivore (HQ = 2.62), montane shrew as a mammalian insectivore (HQ = 5.42), occult little brown myotis bat as a mammalian aerial insectivore (HQ = 4.28), American robin as an avian omnivore (HQ = 11.45), American robin as an avian insectivore (HQ = 23.23), violet-green swallow as an avian aerial insectivore (HQ = 17.67), American kestrel as an avian intermediate carnivore (HQ = 4.78), and American kestrel as an avian top carnivore (HQ = 1.04). The maximum detected concentration (0.958 mg/kg) exceeds the IOU background maximum (0.21 mg/kg), the SRS background maximum (0.3 mg/kg), and the Wetland Study maximum (0.74 mg/kg).

Mercury is recommended for trophic level modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There are eight HQ exceedances.
- The maximum exceeds the IOU, SRS, and Wetland Study background levels.

Phenols are detected in 9 of 43 samples with a maximum of 0.32 mg/kg at the PPSC-SED26 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC for phenols is 0.21 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 6.A, shows one HQ exceedance (HQ >1) for

phenols for benthic organisms (HQ = 1.78). However, all 9 detects are "J" qualified (i.e., estimated). In addition, the J-qualified data are from 1999 with newer data falling below the RSV. Additionally, phenols also readily degrade in the environment.

Phenols are not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- All detects are estimated and are from an older data set; newer data are all non-detects.
- It readily biodegrades in the environment.

Selenium was detected in 7 of 59 samples with a maximum of 7.64 mg/kg at the PPSC-SED07 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC for selenium is 4.15 mg/kg, which exceeds the RSV of 2.9 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 6.A, shows nine HQ exceedances (HQ >1) for selenium as follows: aquatic community organisms (HQ = 1.43), generic plant (HQ = 1.38), deer cottontail as mammalian herbivore (HQ = 1.43), deer mouse as mammalian omnivore (HQ = 3.46), montane shrew as mammalian insectivore (HQ = 4.19), occult little brown myotis bat as mammalian aerial insectivore (HQ = 3.19), American robin as avian herbivore (HQ = 2.07), American robin as avian omnivore (HQ = 2.44), American robin as avian insectivore (HQ = 1.50), and violet-green swallow as avian aerial insectivore (HQ = 1.98). However, selenium is naturally-occurring, and the maximum detected concentration falls below the SRS background maximum detected concentration (12.2 mg/kg) and the Wetland Study maximum detected concentration (13 mg/kg).

Selenium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- It is within both SRS background and the Wetland Study ranges.

Thallium was detected in 4 of 60 samples with a maximum of 6.89 mg/kg at the PPSC-SED08 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC for thallium is 2.76 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 6.A, shows two HQ exceedances (HQ >1) for thallium for generic plant (HQ = 5.53) and montane shrew as mammalian insectivore

(HQ = 1.26). However, thallium is naturally-occurring, and the maximum detected concentration falls below the IOU background maximum detected concentration (11.2 mg/kg) and the SRS background maximum detected concentrations (8.13 mg/kg).

Thallium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- It is within both SRS and IOU background ranges.

Vanadium was detected in 64 of 64 samples with a maximum of 57.1 mg/kg at the PPSC-SED07 location in 1995 (Table A.1.6.1.1, Figure 3-6). The EPC for vanadium is 21.18 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 6.A, shows HQ exceedances (HQ >1) for vanadium for the American robin as avian herbivore (HQ = 1.25), American robin as avian omnivore (HQ = 1.41), and American robin as avian insectivore (HQ = 1.63); however, vanadium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), and the Wetland Study maximum (144 mg/kg). Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective.

In summary, only mercury is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in sections C.2.5 and C.2.6. The radionuclides came through as COPCs for the sediment/soil media because they have no published threshold levels, but these were all ruled out as RCOCs due to short half-lives, being below RESRAD Biota screening levels, or for being within background ranges. Multiple constituents were identified as COPCs due to unavailability

of screening thresholds, but these generally had low detection rates and high incidence of estimated values. The remaining inorganic COPCs were ruled out as RCOCs due to being naturally-occurring and falling within background ranges.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 6 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Chloride				X		X	
Cinnamyl Cinnamate		X		X		X	
Methyl Cyclopentane				X		X	
Methyl Isobutyl Ketone				X		X	
Orthophosphate		X		X		X	
Phosphate		X		X		X	
Barium-133	X					X	
Cobalt-58	X				X	X	
Europium-155	X		X			X	
Lead-214	X		X		X	X	
Manganese-54			X		X	X	
Neptunium-239					X	X	
Potassium-40	X		X			X	
Promethium-146	X					X	
Ruthenium-106	X				X	X	
Thorium-234	X	X				X	X
Tin-113	X				X	X	
Zinc-65	X				X	X	
Zirconium-95	X				X	X	
Mercury*							
Phenols				X	X		
Selenium	X		X				
Thallium	X		X				
Vanadium	X		X			X	

* Carried forward for site-specific trophic modeling.

C.2.3.6.4 Screening Results for Exposure Area 6 for Surface Water

Using maximum detected values, Table C-22 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors:

dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, lead-212, manganese, potassium-40, radium-226, selenium, and thorium-234.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.6.5 Refinement-level Risk Results for Exposure Area 6 for Surface Water

Using EPC values, Table C-24 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, lead-212, potassium-40, and thorium-234.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. The COPCs are discussed further below.

C.2.3.6.6 Refinement-level Uncertainty Discussion for Exposure Area 6 for Surface Water

An uncertainty analysis is performed for each individual COC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling. HQ calculations for receptors that pertain to RSV exceedance from section C.2.2 are referred to in this discussion and can be found in Attachment C-3 in Table 6.B for surface water. Sampling locations for EA 6 are shown in Figure 3-6.

Lead-212 was detected in 3 of 31 samples with a mean of 2.75 pCi/L and a maximum of 30.1 pCi/L at the PW2-1 location in 1995 (Table A.1.6.2, Figure 3-6). The EPC is 4.31 pCi/L.

Lead-212 came through screening because there is no published ecological screening threshold level. Lead-212 is a naturally-occurring radionuclide, and the mean activity (2.75 pCi/L) is within background activity levels; the estimated IOU mean background activity is 7.00 pCi/L. The half-life of lead-212 is 3.7 days. Lead-212 is a daughter of the naturally-occurring radium 224, radium-228 and thorium-232; in surface water, it may be in secular equilibrium with radium-224. Lead-212 probably exists in SRS waters, but because of its short half-life (10 hours), and the short

half-life of radium-224 (3.6 days) a sample would have to be analyzed very quickly after being taken for it to be detected at a laboratory. It is rarely detected at SRS, because most samples are analyzed a week or more after collection.

If lead-212 were due to SRS processes, it would have to have decayed from thorium-232, which had a very limited use at SRS. Thorium-232 concentrations in EA 6 sediment/soils are consistent with natural levels. Therefore, the lead-212 detections in EA 6 surface waters are regarded as natural

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence**:**

- It is within background activity levels.
- It has a very short half-life.
- It is naturally-occurring.

Potassium-40 was detected in 5 of 51 samples with a mean of 17.24 pCi/L and a maximum of 45.6 pCi/L at the PW2-1 location in 1995 (Table A.1.6.2, Figure 3-6). The EPC is 10.89 pCi/L. Potassium-40 came through screening because there is no published ecological screening threshold level. Potassium-40 is a naturally-occurring radionuclide and the maximum detected activity (45.6 pCi/L) is below the RESRAD Biota screening value of 249 pCi/L and is within background activity concentrations; the IOU background maximum activity concentration is 275.4 pCi/L.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is below the RESRAD Biota screening level.
- It is within background activity levels.

Thorium-234 was detected in 5 of 8 samples with a mean of 118.91 pCi/L and a maximum of 275 pCi/L at the PW2-1 location in 1995 (Table A.1.6.2, Figure 3-6). The EPC is 0.9 pCi/L. Thorium-234 came through screening because there is no published ecological screening threshold level. However, the maximum detected activity concentration (275 pCi/L) is well below the

RESRAD Biota screening value 266,000 pCi/L. Additionally, the half-life is very short at 24.1 days.

Thorium-234 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The maximum falls well below the RESRAD Biota screening level.
- It has a very short half-life.

Dibenz[a,h]anthracene was detected in 1 of 14 samples with an EPC and maximum of 0.42 µg/L at the PAR-13-2016 location in 2016 (Table A.1.6.2, Figure 3-6). The one detect is "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 6.B, shows one HQ exceedance (HQ >1) for dibenz[a,h]anthracene for aquatic community organisms (HQ = 124). However, dibenz[a,h]anthracene is a ubiquitous PAH. With background levels greater than screening levels, the RSV (0.0034 µg/L) is likely overprotective.

Dibenz[a,h]anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The single detect is an estimated value.
- It is ubiquitous in the environment.
- The RSV may be overly conservative.

Indeno[1,2,3-cd]pyrene was detected in 1 of 14 samples with an EPC and maximum of 0.32 µg/L at the PAR-13-2016 location in 2016 (Table A.1.6.2, Figure 3-6). The one detect is "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 6.B, shows one HQ exceedance (HQ >1) for indeno[1,2,3-cd]pyrene for aquatic community organisms (HQ = 1.14). Indeno[1,2,3-cd]pyrene is a ubiquitous PAH. With background levels greater than screening levels, the RSV (0.28 µg/L) is likely overprotective.

Indeno[1,2,3-cd]pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detect that is an estimated result ("J" qualified).
- It is ubiquitous in the environment.
- The RSV may be overly conservative.

No constituents are identified as RCOPCs for evaluation in trophic modeling. The three radionuclides in EA 6 came through screening as COPCs because they have no published ecological screening thresholds, but all were ruled out as RCOCs because they were either below RESRAD Biota screening levels, within background activity levels, are naturally-occurring radionuclides, have short half-lives, or a combination of all four. The two semivolatiles that came through screening are ubiquitous in the environment, have very low (and estimated) detection frequencies, and ultimately may have overly conservative screening values since background levels exceed the RSVs. In summary, no constituents were identified as RCOCs for surface water for EA 6.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 6 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Lead-212	X		X		X	X	
Potassium-40	X		X			X	
Thorium-234	X		X			X	X
Dibenz[a,h]anthracene	X		X			X	
Indeno[1,2,3-cd]pyrene	X					X	

C.2.3.7 Exposure Area 7

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 7 are provided below.

C.2.3.7.1 Screening Results for Exposure Area 7 for Sediment/Soil

Using maximum detected values, Table C-25 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft. sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, actinium-228, aluminum, americium-243, arsenic, barium, beryllium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, curium-243 and curium-244, cadmium, chromium, cobalt, copper, cyanide, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, methyl acetate, nickel, PCB-1254, potassium-40, radium-224, thallium-208, thorium-231, thorium-234, toluene, and vanadium.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There was also no screening value for methyl acetate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.7.2 Refinement-level Risk Results for Exposure Area 7 for Sediment/Soil

Using EPC values (i.e., 95%UCL on the mean), Table C-27 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: actinium-228, americium-243, barium, bismuth-212, bismuth-214, curium-243 and curium-244, cyanide, lead-212, lead-214, mercury, methyl acetate, potassium-40, radium-224, thallium-208, thorium-231, thorium-234, and vanadium. The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There was also no screening value for methyl acetate. The COPCs are discussed further below.

C.2.3.7.3 Refinement-level Uncertainty Discussion for Exposure Area 7 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 7A for sediment/soil. Constituents that are carried forward as RCOPC for trophic modeling are also discussed in this

section. The trophic modeling report is presented in Attachment C-9. Sampling locations described for EA 7 are shown in Figure 3-7.

Actinium-228 was detected in 116 of 119 samples with a mean of 1.30 pCi/g and a maximum of 7.61 pCi/g at the Pond 2 P25-016-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 1.47 pCi/g. Actinium-228 came through screening because there is no published ecological screening threshold. Actinium-228 is a naturally-occurring radionuclide and the mean activity (1.30 pCi/g) is within background activity levels; the IOU maximum background activity is 3.83 pCi/g, and the SRS maximum background activity is 2.54pCi/g. The half-life is very short at 6.2 hours.

Actinium-228 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity range.
- It is a naturally-occurring constituent.
- It has a short half-life.

Americium-243 was detected in 1 of 20 samples with an EPC and maximum of 0.047 pCi/g at the PDC015-001 location in 2010 (Table A.1.7.1.1, Figure 3-7). Americium-243 came through screening because there is no published ecological screening threshold. The one detection was "J" flagged (i.e., estimated).

Americium-243 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a single detect with a low frequency of detection (1/20).
- The single detection is an estimated result, i.e., "J" qualified.
- No screening value or background value is available.

Bismuth-212 was detected in 47 of 87 samples with a mean of 0.87 pCi/g and a maximum of 8.80 pCi/g at the Pond 2 P25-016-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is

1.00 pCi/g. Bismuth-212 came through screening because there is no published ecological screening threshold. Bismuth-212 is a naturally-occurring radionuclide and the mean activity (0.87 pCi/g) is within background activity levels; the IOU maximum background activity is 2.59 pCi/g.

Bismuth-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity range.
- It is a naturally-occurring constituent.

Bismuth-214 was detected in 135 of 136 samples with a mean of 1.57 pCi/g and a maximum of 12.37 pCi/g at the Pond 2 P25-019-01 in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 2.32 pCi/g. Bismuth-214 came through screening because there is no published ecological screening threshold. Bismuth-214 is a naturally-occurring radionuclide and the mean activity (1.57 pCi/g) is within background activity levels; the IOU maximum background activity is 8.12 pCi/g, and the SRS maximum background activity concentration is 1.74 pCi/g.

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity ranges.
- It is a naturally-occurring constituent.

Curium-243/-244 was detected in 1 out of 13 samples with a maximum of 0.04 pCi/g at the RDC016-001 location in 2010 (Table A.1.7.1.1, Figure 3-7). The EPC is also 0.04 pCi/g. Curium-243/-244 came through screening because there is no published ecological screening threshold level. However, the one detect is "J" qualified (i.e., estimated), and the maximum detected activity concentration for curium-243/-244 (0.04 pCi/g) is well below the RESRAD Biota screening activity concentration for curium-244 of 4,060 pCi/g. The SRS mean background for curium-243/-244 is 0.067 pCi/g and the maximum background is 0.40 pCi/g.

Curium-243/-244 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a single detect that is an estimated result ("J" qualified).
- It is within SRS background levels.
- It is well below the RESRAD Biota screening activity.

Lead-212 was detected in 138 of 138 samples with a mean of 1.45 pCi/g and a maximum of 7.16 pCi/g at the Pond 2 P25-019-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 1.59 pCi/g. Lead-212 came through screening because there is no published ecological screening threshold. Lead-212 is a naturally-occurring radionuclide and the mean activity (1.45 pCi/g) is within background activity levels; the SRS maximum background activity is 2.79 pCi/g, and the IOU maximum background activity concentration is 3.05 pCi/g.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity ranges.
- It is a naturally-occurring constituent.

Lead-214 was detected in 137 of 137 samples with a mean of 1.69 pCi/g and a maximum of 12.23 pCi/g at the Pond 2 P25-019-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 2.43 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold. Lead-214 is a naturally-occurring radionuclide and the mean activity (1.69 pCi/g) is within background activity levels; the IOU maximum background activity is 8.42 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity ranges.
- It is a naturally-occurring constituent.

Potassium-40 was detected in 80 of 129 samples with a mean of 4.13 pCi/g and a maximum of 52.92 pCi/g at the Pond 2 P25-019-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 6.99 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold. Potassium-40 is a naturally-occurring radionuclide and can be found wherever potassium is found. The maximum detected activity concentration (52.92 pCi/g) is below the RESRAD Biota screening value of 119 pCi/g. Potassium is a constituent of natural clay minerals in sediment and soil. All potassium-40 samples from EA 7 which exceeded the IOU background were collected from stream or pond sediment. The SRS maximum soil background of 8.53 pCi/g was determined from dry upland soils, and therefore should not be applied to stream or pond sediment. The IOU background of 13 pCi/g does represent stream sediments, but its applicability is not certain, as most samples were collected several miles away from the IOU.

The maximum concentration in EA 7 does appear high, but is not impossible for a nonindustrially impacted Coastal Plain stream sediment. The result of 52.9 pCi/g corresponds to 6.3% total potassium, which is consistent with illitic clay, or with decayed vegetable matter, or with a site impacted by agricultural wood ash or fertilizer. Further, potassium-40 was not used in SRS reactor processes, so the detections are regarded as not DOE-related.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is below RESRAD Biota screening value.
- It is a naturally-occurring constituent.
- It is not considered DOE-related.

Radium-224 was detected in 11 of 11 samples with a mean of 18.88 pCi/g and a maximum of 45.9 pCi/g at the Pond 2 P25-019-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 26.14 pCi/g. Radium-224 came through screening because there is no published ecological screening threshold. The half-life of radium-224 is 3.65 days.

Radium-224 is a daughter product of naturally-occurring thorium-234. Thorium-232 is a constituent of primordial origin with a half- life of 14 billion years. Its daughter products, including

radium-224, would be in secular equilibrium. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238 and thorium-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but thorium-232 is not a COC in the P-Area and R-Area waste units and EA 7 concentrations are typical of natural thorium.

Radium-224 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very short half-life.
- It is a daughter of naturally-occurring thorium-232.

Thallium-208 was detected in 133 of 135 samples with a mean of 0.53 pCi/g and a maximum of 3.21 pCi/g at the Pond 2 P25-019-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 0.71 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold. Thallium-208 is a naturally-occurring radionuclide and the mean activity (0.53 pCi/g) is within background activity levels; the IOU maximum background activity is 1.14 pCi/g. The half-life of thallium-208 is 3.05 minutes.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Thorium-231 was detected in 4 of 4 samples with an EPC and maximum of 0.96 pCi/g at the P2-3-3 location in 1995 (Table A.1.7.1.1, Figure 3-7). Thorium-231 came through screening because there is no published ecological screening threshold. The maximum detected activity (0.96 pCi/g) is within background activity levels; the IOU maximum background activity of 2.06 pCi/g). The half-life of thorium-231 is very short at 1.06 days.

Thorium-231 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the background activity range.
- It has a short half-life.

Thorium-234 was detected in 7 of 7 samples with a mean of 2.18 pCi/g and a maximum of 5.70 pCi/g at the Pond 2 P25-008-01 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC is 4.45 pCi/g. Thorium-234 came through screening because there is no published ecological screening threshold. Thorium-234 occurs naturally, but as the daughter product of uranium-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples for two reasons: (1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty; and (2) gamma peak overlap with actinium-228 causes falsely elevated reported concentrations and additional uncertainty. The half-life of thorium-234 is 24.1 days. The maximum detected activity concentration (5.70 pCi/g) is over-estimated and is below the RESRAD Biota screening activity concentration of 2,160 pCi/g.

Thorium-234 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There can be high analytical uncertainty with this constituent causing falsely elevated reported concentrations.
- Unit activities are below the RESRAD Biota screening level.
- It has a short half-life.

Methyl acetate was detected in 1 of 34 samples with an EPC and maximum of 0.022 mg/kg at the P2T3-3 in 2010 (Table A.1.7.1.1, Figure 3-7). Methyl acetate came through screening because there is no published ecological screening threshold. The maximum detected concentration (0.022 mg/kg) falls below the IOU background maximum (0.064 mg/kg).

Methyl acetate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a single detect with a very low frequency of detection (1/34).
- Unit concentrations are within IOU background levels.

Barium was detected in 36 of 36 samples with a mean of 20.27 mg/kg and a maximum of 114 mg/kg at the LTROU-09 location in 2003 (Table A.1.7.1.1, Figure 3-7). The EPC is also 114 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 3.A, shows an HQ exceedance (HQ >1) for barium for benthic organisms (HQ = 1.90). However, barium is naturally-occurring, and the maximum detected concentration (114 mg/kg) falls well below the IOU background maximum (353 mg/kg), the SRS background maximum (252 mg/kg), as well as the wetland study maximum (1,840 mg/kg). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Barium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- Unit concentrations are within IOU background levels.
- Screening thresholds may be overprotective.

Cyanide was detected in 2 of 5 samples with a mean of 0.32 mg/kg and a maximum of 1.15 mg/kg at the LTROU-09 location in 2003 (Table A.1.7.1.1, Figure 3-7). The EPC is also 1.15 mg/kg, which exceeds the LTR RSV for sediment/soil (1 mg/kg). One of the two detects are "J" qualified (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 7.A, shows HQ exceedances (HQ >1) for cyanide for aquatic community organisms, American robin as an avian herbivore, American robin as an avian omnivore, and for American robin as an avian insectivore (all HQs = 1.15). However, the mean (0.32 mg/kg) is below the RSV (1 mg/kg).

Cyanide is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- One of two detects is an estimated result ("J" qualified).
- There is no history of process related use at SRS.

- The mean concentration is below the RSV.

Mercury was detected in 68 of 76 samples with a mean of 0.16 mg/kg and a maximum of 1.15 mg/kg at the P25-005 location in 2000 (Table A.1.7.1.1, Figure 3-7). The EPC for mercury is 0.297 mg/kg., which exceeds the LTR RSV for sediment/soil of 0.0035 mg/kg (based on the methylmercury threshold level). The uncertainty evaluation presented in Attachment C-6 Table 7.A, shows HQ exceedances (HQ >1) for mercury as follows: Deer mouse as a mammalian omnivore (HQ = 9.58), montane shrew as a mammalian insectivore (HQ = 19.8), occult little brown myotis bat as a mammalian aerial insectivore (HQ = 15.6), American robin as an avian omnivore (HQ = 41.8), American robin as an avian insectivore (HQ = 84.9), violetgreen swallow as an avian aerial insectivore (HQ = 64.6), American kestrel as an avian intermediate carnivore (HQ = 17.5), and American kestrel as an avian top carnivore (HQ = 3.81). The maximum detected concentration exceeds the IOU background maximum (0.21 mg/kg), the SRS background maximum (0.3 mg/kg), and the Wetland Study maximum (0.74 mg/kg).

Mercury is recommended for trophic level modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There are eight HQ exceedances.
- The maximum detection exceeds IOU, SRS, and Wetland Study background levels.

Vanadium was detected in 36 of 36 samples with a mean of 23.07 mg/kg and a maximum of 65.2 mg/kg at the PDC003-001 location in 2010 (Table A.1.7.1.1, Figure 3-7). The EPC for vanadium is 26.92 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 7.A, shows HQ exceedances (HQ >1) for vanadium for American robin as avian herbivore (HQ = 1.58), American robin as avian omnivore (HQ = 1.79), and American robin as avian insectivore (HQ = 2.07). However, vanadium is naturally-occurring, and the maximum detected concentration (65.2 mg/kg) falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), as well as the wetland study maximum (144 mg/kg). Background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective.

In summary, only mercury is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in sections C.2.5 and C.2.6. Most of the other COPCs for EA 7 sediment/soil were radionuclides that had no screening value that were ruled out as COPCs due to being naturally-occurring, within background activity levels, being below RESRAD Biota screening levels, and/or having short half-lives. Cyanide was ruled out as a COPC because the mean concentration was ultimately below the RSV. The final metal, vanadium, was ruled out as a COPC because concentrations are within background levels, it is naturally-occurring, and the screening level is likely overprotective.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented in the following table:

EA 7 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Actinium-228	X		X		X	X	
Americium-243	X			X		X	
Bismuth-212	X		X			X	
Bismuth-214	X		X			X	
Curium-243/-244	X		X	X		X	
Lead-212	X		X			X	
Lead-214	X		X			X	
Potassium-40	X	X				X	
Radium-224	X				X	X	
Thallium-208	X		X		X	X	
Thorium-231			X		X	X	
Thorium-234	X			X		X	X
Methyl acetate	X		X			X	
Barium	X		X			X	
Cyanide	X	X					
Mercury*							
Vanadium	X		X			X	

* Carried forward for site-specific trophic modeling.

C.2.3.7.4 Screening Results for Exposure Area 7 for Surface Water

Using maximum detected values, Table C-26 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: aluminum, bismuth-214, caprolactam, chloromethane, chromium, copper, DDT, iron, lead, lead-212, lead-214, and manganese.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There are also no screening values for caprolactam or chloromethane. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.7.5 Refinement-level Risk Results for Exposure Area 7 for Surface Water

Using EPC values (i.e., 95%UCL on the mean), Table C-28 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: aluminum, bismuth-214, caprolactam, chloromethane, DDT, iron, lead, lead-212, lead-214, and manganese.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There are also no published screening values for caprolactam or chloromethane. The COPCs are discussed below.

C.2.3.7.6 Refinement-level Uncertainty Discussion for Exposure Area 7 for Surface Water

An uncertainty analysis is performed for each individual COC below, including an interpretive discussion of the applicable uncertainty factors and a recommendation whether the constituent should or should not be carried forward for trophic level modeling. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 7.B for surface water. Constituents that are carried forward as RCOPC for trophic modeling are also discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations described for EA 7 are shown in Figure 3-7.

Bismuth-214 was detected in 1 of 23 samples with a mean of 18.5 pCi/L and a maximum of 80.7 pCi/L at the LTROU-25 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC is also 80.7 pCi/L. The one detect is "J" flagged (i.e., estimated). Bismuth-214 came through screening because there is no published ecological screening threshold level.

Bismuth-214 is a naturally-occurring daughter of radon and radium; it was not used at SRS. Due to the high solubility and mobility of radium, and especially radon, there are many examples of elevated levels of bismuth-214 in SRS groundwater s, with concentrations as high as 500 pCi/L not unknown. Bodies of surface water which are fed by groundwater, such as the small creeks in EA 7, can inherit these high bismuth-214 concentrations. Because bismuth-214, and its parent's radon and radium, were not used at SRS, and because elevated levels of bismuth-214 are well known in SRS groundwater, the detections of bismuth-214 are accepted as real, and are believed to be natural.

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detect with a low frequency of detection (1/23) and the detect is estimated.
- It is a naturally-occurring constituent.

Lead-212 was detected in 1 of 23 samples with a mean of 13.18 pCi/L and a maximum of 17 pCi/L at the LTROU-19 location in 2001 (Table A.1.7.2, Figure 3-7). The EPC is also 17 pCi/L. The one detect is "J" flagged (i.e., estimated). Lead-212 came through screening because there is no published ecological screening threshold level.

Lead-212 is a daughter of the naturally-occurring radium-224, radium-228 and thorium-232; in surface water, it may be in secular equilibrium with radium-224. Lead-212 probably exists in SRS waters, but because of its short half-life (10 hours), and the short half-life of radium-224 (3.6 days) a sample would have to be analyzed very quickly after being taken for it to be detected at a laboratory. It is rarely detected at SRS, because most samples are analyzed a week or more after collection. If lead-212 were due to SRS processes, it would have to have decayed from thorium-232, which had a very limited use at SRS. Thorium-232 concentrations in EA 7 sediment/soils are consistent with natural levels. Therefore, the lead-212 detections in EA 7 surface waters are regarded as natural.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detect with a low frequency of detection (1/23) and the detect is estimated.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Lead-214 was detected in 2 of 23 samples with a mean of 18.46 pCi/L and the maximum of 110 pCi/L at the LTROU-25 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC is 43.95 pCi/L. The two detects are "J" flagged (i.e., estimated). Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is naturally-occurring, and the half-life is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- Both detections are estimated results ("J" qualified).

- It is a naturally-occurring constituent.
- It has a very short half-life.

Caprolactam is detected in 2 of 24 samples with a mean of 2.61 µg/L and a maximum of 9.97 µg/L at the LTROU-19 location in 2001 (Table A.1.7.2, Figure 3-7). The EPC is 5.96 µg/L. Caprolactam came through screening because there is no published ecological screening threshold. One of the two detects is "J" qualified (i.e., estimated).

Caprolactam is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- One of the only detects is an ~~e~~stimated result.
- There is no published ecological screening threshold available for comparison.

Chloromethane is detected in 1 of 17 samples with a mean of 0.14 µg/L and a maximum of 0.21 µg/L at the PDC001-002 location in 2010 (Table A.1.7.2, Figure 3-7). The EPC is also 0.21 µg/L. Chloromethane came through screening because there is no published ecological screening threshold. The one detect is "J" qualified (i.e., estimated). Chloromethane is a common laboratory artifact.

Chloromethane is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- It is a common laboratory artifact.

Aluminum was detected in 23 of 24 samples with a mean of 682.6 µg/L and a maximum of 9,360 µg/L at the LTROU-08 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC for aluminum is 2,364 µg/L which exceeds the LTR RSV for surface water of 87 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 7.B, shows an HQ exceedance (HQ >1) for aluminum for aquatic life (HQ = 27.2). The maximum detected concentration exceeds the IOU background maximum (6,060 µg/L).

Aluminum is recommended for trophic level modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- The mean, maximum, and EPC exceed the RSV.
- The maximum exceeds the background maximum.

DDT was detected in 3 of 24 samples with a mean of 0.017 µg/L and a maximum of 0.063 µg/L at the LTROU-24 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC for DDT is 0.021 µg/L, which exceeds the LTR RSV for surface water of 0.001 µg/L and the IOU background maximum concentration of 0.033 µg/L. One of the three detects is "J" flagged (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 7.B, shows an HQ exceedance (HQ >1) for DDT for aquatic organisms (HQ = 20.8). The mean DDT concentration (0.017 µg/L) also exceeds the RSV.

DDT is recommended for trophic modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- The mean and EPC both exceed the RSV.
- The EPC and maximum both exceed the IOU background maximum.

Iron was detected in 24 of 24 samples with a mean of 3,996.3 µg/L and a maximum of 36,300 µg/L at the LTROU-08 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC for iron is 5,081 µg/L. The maximum detected concentration exceeds the LTR RSV of 1,000 µg/L and is above the IOU background maximum detected concentration of 12,400 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 7.B, shows an HQ exceedance (HQ >1) for iron for aquatic organisms (HQ = 5.08).

Iron is recommended for trophic level modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- The mean, maximum, and EPC exceed the RSV.
- The maximum is above the background maximum.

Lead was detected in 5 of 24 samples with a mean of 1.067 µg/L and a maximum of 7.53 µg/L at the LTROU-08 location in 2003 (Table A.1.7.2, Figure 3-7). The EPC for lead is 1.81 µg/L, which exceeds the LTR RSV for surface water of 0.54 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 7.B, shows an HQ exceedance (HQ >1) for lead for aquatic community organisms (HQ = 1.81). However, lead is naturally occurring, and the maximum detected concentration (7.53 µg/L) falls well below the IOU background maximum detected concentration (20 µg/L).

Lead is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within background levels.

Manganese was detected in 24 of 24 samples with a mean of 548.81 µg/L and a maximum detected concentration of 3,380 µg/L at the PDC005-002 location in 2010 (Table A.1.7.2, Figure 3-7). The EPC for manganese is 1,280 µg/L which exceeds the LTR RSV for surface water of 93 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 7.B, shows an HQ exceedance (HQ >1) for manganese for aquatic community organisms (HQ = 13.8). While manganese is naturally occurring, the maximum detected concentration exceeds the IOU background maximum detected concentration (2,690 µg/L).

Manganese is recommended for trophic modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- The mean and EPC exceeds the RSV.
- The maximum exceeds the IOU background maximum.

In summary, aluminum, DDT, iron, and manganese are identified as RCOPCs for evaluation in trophic modeling and will be further addressed in Sections C.2.5 and C.2.6. The three radionuclides were ruled out as RCOCs because they are naturally-occurring and low detection frequencies (and two have very short half-lives). Two organics were ruled out as RCOCs due to low detection

frequencies and estimated detects. The one remaining metal that did not require modeling, lead, was ruled out as RCOC because it is naturally-occurring and within background levels.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 7 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Bismuth-214	x	x		x		x	
Lead-212	x			x	x	x	
Lead-214	x			x	x	x	
Caprolactam				x		x	
Chloromethane				x	x	x	
Aluminum*							
DDT*							
Iron*							
Lead	x		x				
Manganese*							

* Carried forward for site-specific trophic modeling.

C.2.3.8 Exposure Area 8

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 8 are provided below.

C.2.3.8.1 Screening Results for Exposure Area 8 for Sediment/Soil

Using maximum detected values, Table C-29 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, actinium-228, aluminum, arsenic, barium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, cadmium, carbon disulfide, chromium, cobalt, copper, cyanide, DDD, DDE, DDT, iron, lead, lead-212, lead-214, manganese, mercury, nickel, PCB-1242, PCB-1254, potassium-40, radium-224, thallium-208, vanadium, and zinc.

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.8.2 Refinement-level Risk Results for Exposure Area 8 for Sediment/Soil

Using EPC values (i.e., 95% UCL on the mean), Table C-31 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: actinium-228, barium, bis[2-ethylhexyl]phthalate, bismuth-212, bismuth-214, cyanide, DDD, DDE, DDT, lead, lead-212, lead-214, mercury, radium-224, thallium-208, vanadium, and potassium-40.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. The COPCs are discussed further below.

C.2.3.8.3 Refinement-level Uncertainty Discussion for Exposure Area 8 for Sediment/Soil

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors and a recommendation whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 8.A for sediment/soil. Constituents that are carried forward as RCOPCs for trophic modeling are also discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations described for EA 8 are shown in Figure 3-8.

Actinium-228 was detected in 57 of 57 samples with a mean of 1.78 pCi/g and a maximum of 7.51 pCi/g at the Pond 5 P25-055-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 2.78 pCi/g. Actinium-228 came through screening because there is no published ecological screening threshold level. Actinium-228 is a naturally-occurring radionuclide and the mean activity (1.78 pCi/g) is within background activity levels; the SRS maximum background activity concentration is 2.54 pCi/g, and the IOU maximum background activity concentration is 3.83 pCi/g.

Actinium-228 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- Mean activity is within SRS and IOU background activity levels.

Bismuth-212 was detected in 11 of 21 samples with a mean of 2.29 pCi/g and a maximum of 7.53 pCi/g at the Pond 4 P25-022-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 3.25 pCi/g. Bismuth-212 came through screening because there is no published ecological screening threshold level. Bismuth-212 is a naturally-occurring radionuclide and the maximum detected activity (2.29 pCi/g) is within background activity levels; the IOU maximum background activity is 2.59 pCi/g.

Bismuth-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- Mean activity is within IOU background activity levels.

Bismuth-214 was detected in 71 of 71 samples with a mean of 2.17 pCi/g and a maximum of 8.1 pCi/g at the Pond 5 P25-055-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 3.29 pCi/g. Bismuth-214 came through screening because there is no published ecological screening threshold level. Bismuth-214 is naturally-occurring, and the maximum detected activity (8.1 pCi/g) is within background activity levels; the IOU maximum background activity is 8.12 pCi/g. In addition, the mean activity concentration (2.17 pCi/g) is below the mean background activity concentration (2.26 pCi/g).

Bismuth-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- Mean and maximum activities are within IOU background activity levels.

Lead-212 was detected in 72 of 72 samples with a mean of 1.94 pCi/g and a maximum of 6.59 pCi/g at the Pond 4 P25-022-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 2.38 pCi/g. Lead-212 came through screening because there is no published ecological screening threshold level. Lead-212 is a naturally-occurring radionuclide and the mean activity (1.94 pCi/g) is within background activity levels; the SRS maximum background activity concentration is 2.79 pCi/g, and the IOU maximum background activity concentration is 3.05 pCi/g.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- The mean activity is within IOU background activity levels.

Lead-214 was detected in 72 of 72 samples with a mean of 2.21 pCi/g and a maximum of 8.15 pCi/g at the Pond 5 P25-055-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 3.30 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is naturally-occurring, and the maximum detected activity (8.15 pCi/g) is within background activity levels; the IOU maximum background activity is 8.42 pCi/g.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- The maximum activity is within IOU background activity levels.

Potassium-40 was detected in 50 of 71 samples with a mean of 5.52 pCi/g and a maximum of 22.73 pCi/g at the Pond 5 P25-054-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 9.05 pCi/g. Potassium-40 came through screening because there is no published ecological screening threshold level. Potassium-40 is naturally-occurring and the maximum detected activity (22.73 pCi/g) is below the RESRAD Biota screening value of 119 pCi/g. Further, potassium-40 was not used in SRS reactor processes, so the detections are regarded as not DOE related.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- The maximum falls below the RESRAD Biota screening value.
- It is not considered DOE-related.

Radium-224 was detected in 9 of 9 samples with a mean of 25.86 pCi/g and a maximum of 41.58 pCi/g at the Pond 5 P25-042-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 29.96 pCi/g. Radium-224 came through screening because there is no published ecological screening threshold level. Radium-224 has a half-life of 3.65 days.

Radium-224 is a daughter product of naturally-occurring thorium-234. Thorium-232 is a constituent of primordial origin with a half-life of 14 billion years. Its daughter products, including radium-224, would be in secular equilibrium. Primordial nuclides are those that are long-lived and have existed in the earth's crust throughout history. The main contributors to external exposure from primordial nuclides are potassium-40, uranium-238 and thorium-232 (and their daughter products).

Thorium did have a very limited role in SRS reactor processes, but thorium-232 is not a COC in the P-Area and R-Area waste units are typical of natural thorium.

Radium-224 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a very short half-life.
- It is a daughter of naturally-occurring thorium-232.

Thallium-208 was detected in 69 of 70 samples with a mean of 0.71 pCi/g and a maximum of 3.05 pCi/g at the Pond 5 P25-054-01 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC is 1.06 pCi/g. Thallium-208 came through screening because there is no published ecological screening threshold level. Thallium-208 is naturally-occurring, and the mean activity

concentration (0.71 pCi/g) is within background activity levels; the IOU maximum background activity concentration is 1.14 pCi/g.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- The mean activity is within IOU background activity levels.

Barium was detected in 18 of 18 samples with a mean of 27.70 mg/kg with a maximum of 118 mg/kg at the LTROU-17 location in 2001 (Table A.1.8.1.1, Figure 3-8). The EPC for barium is 63.24 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows an HQ exceedance (HQ >1) for barium for benthic organisms (HQ = 1.05). However, barium is naturally occurring, and the maximum detected concentration (118 mg/kg) falls below the IOU background maximum (353 mg/kg), the SRS background maximum (252 mg/kg), as well as the wetland study maximum (1,840 mg/kg). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective. Additionally, more recent samples are all below the RSV (60 mg/kg).

Barium is not recommended for further remedial evaluation as an ecological RCPOC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- More recent samples are below the RSV.
- Screening thresholds may be overprotective.

Bis[2-ethylhexyl]phthalate was detected in 1 of 18 samples with an EPC and maximum of 0.22 mg/kg at the LTROU-18 location in 2001 (Table A.1.8.1.1, Figure 3-8). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows an HQ exceedance (HQ >1) for bis[2-ethylhexyl]phthalate for the American robin as an avian insectivore (HQ = 1.10). However, the one detect is "J" qualified (i.e., estimated), and bis[2-ethylhexyl]phthalate is a common laboratory artifact.

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It has a single detection that is an estimated result (J" qualified).
- It is a common laboratory artifact.

Cyanide was detected in 3 of 4 samples with a mean of 0.87 mg/kg and a maximum of 2.6 mg/kg at the LTROU-06 location in 2003 (Table A.1.8.1.1, Figure 3-8). The EPC for cyanide is 2.33 mg/kg, which exceeds the LTR RSV for sediment/soil (1 mg/kg). Two of the three detects are "J" flagged (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows HQ exceedances (HQ >1) for cyanide are as follows: Aquatic community organisms (HQ = 2.33), American robin as an avian herbivore (HQ = 2.33), American robin as an avian omnivore (HQ = 2.33), American robin as an avian insectivore (HQ = 2.33), and for violet-green swallow as an avian aerial insectivore (HQ = 1.67).

Cyanide is recommended for trophic modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There are five HQ exceedances.

DDD was detected in 1 of 18 samples with an EPC and maximum of 0.37 mg/kg at the LTROU05 location in 2001 (Table A.1.8.1.1, Figure 3-8). The EPC exceeds the LTR RSV for sediment/soil (0.0078 mg/kg). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows an HQ exceedance (HQ >1) for DDD for benthic organisms (HQ = 47.4). The mean DDD concentration (0.021 mg/kg) also exceeds the RSV.

DDD is recommended for trophic modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean, maximum, and EPC all exceed the RSV.

DDE was detected in 4 of 18 samples with a mean of 0.029 mg/kg and a maximum detected concentration of 0.51 mg/kg at the LTROU-05 location in 2001 (Table A.1.8.1.1, Figure 3-8). Three of the four detects are "J" flagged (i.e., estimated). The EPC for DDE is 0.262 mg/kg, which

exceeds the LTR RSV for sediment/soil (0.0037 mg/kg). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows an HQ exceedance (HQ >1) for DDE for benthic organisms (HQ = 70.1). The mean DDE concentration (0.029 mg/kg) also exceeds the RSV.

DDE is recommended for trophic level modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean, maximum, and EPC all exceed the RSV.

DDT was detected in 2 of 18 samples with a mean of 0.016 mg/kg and a maximum detected concentration of 0.274 mg/kg at the LTROU-05 location in 2001 (Table A.1.8.1.1, Figure 3-8). The EPC for DDT is 0.224 mg/kg, which exceeds the LTR RSV for sediment/soil (0.0048 mg/kg). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows an HQ exceedance (HQ >1) for DDT for benthic organisms (HQ = 47). The mean DDT concentration (0.017 mg/kg) also exceeds the RSV.

DDT is recommended for trophic modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean, maximum, and EPC all exceed the RSV.

Lead was detected in 65 of 65 samples with a mean of 19.17 mg/kg and a maximum detected concentration of 98.12 mg/kg at the P25-020 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC for lead is 33.74 mg/kg, which exceeds the LTR RSV for sediment/soil of 28 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows two HQ exceedances (HQ >1) for lead for American robin as an avian omnivore (HQ = 1.02) and for American robin as an avian insectivore (HQ = 1.21). While lead is naturally-occurring, the maximum detected concentration exceeds the IOU background maximum detected concentration (59.8 mg/kg), the SRS background maximum detected concentration (26.6 mg/kg), and the wetland study maximum detected concentration (48.1 mg/kg).

Lead is recommended for trophic modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There are two HQ exceedances.
- The maximum exceeds background levels.

Mercury was detected in 58 of 65 samples with a mean of 0.19 mg/kg and a maximum detected concentration of 1.27 mg/kg at the P25-030 location in 2000 (Table A.1.8.1.1, Figure 3-8). The EPC for mercury is 0.37 mg/kg, which exceeds the LTR RSV for sediment/soil of 0.0035 mg/kg (methylmercury-based threshold level). The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows eight HQ exceedances (HQ >1) for mercury as follows: Deer mouse as a mammalian omnivore (HQ = 11.84), montane shrew as a mammalian insectivore (HQ = 24.47), occult little brown myotis bat as a mammalian aerial insectivore (HQ = 19.32), American robin as avian omnivore (HQ = 51.69), American robin as an avian insectivore (HQ = 104.86), violetgreen swallow as an avian aerial insectivore (HQ = 79.78), American kestrel as an avian intermediate carnivore (HQ = 21.59), and American kestrel as an avian top carnivore (HQ = 4.71). The maximum detected concentration (1.27 mg/kg) exceeds the IOU background maximum detected concentration (0.21 mg/kg), the SRS background maximum detected concentration (0.3 mg/kg), and the wetland study maximum detected concentration (0.74 mg/kg).

Mercury is recommended for trophic level modeling as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- There are eight HQ exceedances.
- The maximum exceeds background levels.

Vanadium was detected in 18 of 18 samples with a mean of 20.12 mg/kg and a maximum detected concentration of 73.4 mg/kg at the LTROU-17 in 2001 (Table A.1.8.1.1, Figure 3-8). The EPC for vanadium is 42.89 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 8.A, shows three HQ exceedances (HQ >1) for vanadium as follows: American robin as an avian herbivore (HQ = 2.52), American robin as an avian omnivore (HQ = 2.86), and American robin as an avian insectivore (HQ = 3.30). However, vanadium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), as well as the wetland study maximum (144 mg/kg).

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is naturally-occurring.
- It is within background levels.

In summary, cyanide, DDD, DDE, DDT, lead, and mercury are identified as RCOPCs for evaluation in trophic modeling and will be further addressed in sections C.2.5 and C.2.6. The radionuclides identified as COPCs all came through screening because there were no published ecological screening thresholds available, but all were ruled out as RCOCs because they are naturally-occurring and within background activity levels. Bis[2-ethylhexyl]phthalate was ruled out since it is a common laboratory artifact and had very low detection frequency, and barium and vanadium were both ruled out because they are naturally-occurring metals that were within background ranges.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 8 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Actinium-228	X		X			X	
Bismuth-212	X		X			X	
Bismuth-214	X		X			X	
Lead-212	X		X			X	
Lead-214	X		X			X	
Potassium-40	X	X				X	
Radium-224	X				X	X	
Thallium-208	X		X			X	
Barium	X					X	
Bis[2-ethylhexyl]phthalate				X	X		
Cyanide*							
DDD*							
DDE *							
DDT*							
Lead*							
Mercury*							
Vanadium	X		X				

* Carried forward for site-specific trophic modeling.

C.2.3.8.4 Screening Results for Exposure Area 8 for Surface Water

Using maximum detected values, Table C-30 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2-chloronaphthalene, 2-nitroaniline, 3,3-dichlorobenzidine, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-bromophenyl phenyl ether, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, aluminum, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, bis[2-ethylhexyl]phthalate, caprolactam, carbazole, chrysene, DDT, dibenz[a,h]anthracene, dibenzofuran, dimethylphthalate, dioctylphthalate, fluoranthene, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclopentadiene, indeno[1,2,3-cd]pyrene, iron, lead-214, manganese, and pyrene.

The radionuclide constituent was identified as a COPEC since there is no published ESV available for this constituent. There are also no published screening values for 2-nitroaniline, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, caprolactam, or carbazole. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.8.5 Refinement-level Uncertainty Discussion for Exposure Area 8 for Surface Water

An uncertainty analysis is performed for each COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors and a recommendation whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 8.B for surface water. Constituents that are carried forward as RCOPCs for trophic modeling are also discussed in this section. The trophic modeling report is presented in Attachment C-9. Sampling locations described for EA 8 are shown in Figure 3-8.

C.2.3.8.6 Refinement-level Risk Results for Exposure Area 8 for Surface Water

Using EPC values (i.e., 95%UCL on the mean), Table C-32 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2-chloronaphthalene, 2-nitroaniline, 3,3-dichlorobenzidine, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-bromophenyl phenyl ether, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, aluminum, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, benzo[k]fluoranthene, biphenyl, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, bis[2-ethylhexyl]phthalate, caprolactam, carbazole, chrysene, DDT, dibenz[a,h]anthracene, dibenzofuran, dimethylphthalate, dioctylphthalate, fluoranthene, hexachlorobenzene, hexachlorocyclopentadiene, indeno[1,2,3-cd]pyrene, iron, lead-214, manganese, and pyrene.

The radionuclide constituent was identified as a COPC since there is no published RSV available for this constituent. There are also no published screening values for 2-nitroaniline, 3-nitroanaline, 4,6-dinitro-2-methylphenol, 4-chloro-m-cresol, 4-chlorophenylphenyl ether, 4-nitroaniline, acetophenone, bis[2-chloroethoxy]methane, bis[2-chloroethyl] ether, bis[2-chloroisopropyl]ether, caprolactam, or carbazole. The COPCs are discussed below.

During the analysis of the data for EA 8, it was determined that several organic constituents were reported as detects in the LTR IOU database. All the compounds in question were reported as detected in 1 of 9 samples, with the same maximum concentration (i.e., 0.00962 µg/L). These results are from the same sample location, LTR ERDMS IOULTR2 Sampling Event LTROU-06, collected on November 4, 2003, and all results had the "not qualified" (i.e., "NQ") data quality label. However, all these results should have been identified as non-detect (i.e., flagged "U") and, therefore, should not be carried forward into the surface water screening step. As a result, all of the results for these compounds are considered "false positives" and are not carried forward as RCOPCs.

Lead-214 was detected in 1 of 9 samples with a mean of 19.62 pCi/L and the maximum of 101 pCi/L at the Pond 5 P25-055-01 location in 2000 (Table A.1.8.2, Figure 3-8). The EPC is also

101 pCi/L. The one detect is "J" flagged (i.e., estimated). Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is naturally-occurring, and the half-life is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It has a single detection that is an estimated result ("J" qualified).
- It is a naturally-occurring constituent.
- It has a very short half-life.

2,4,5-trichlorophenol was detected in 1 of 9 samples with a mean of 1.82 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV (1.9 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for 2,4,5-trichlorophenol for aquatic life (HQ = 5.06). However, the one detect is a false positive, and all recent data (2010) are non-detects.

2,4,5-trichlorophenol is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.~~,~~
- All recent data are non-detects.

2,4,6-trichlorophenol was detected in 1 of 9 samples with a mean of 1.82 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L for 2,4,6-trichlorophenol, which exceeds the RSV (4.9 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for 2,4,6-trichlorophenol for aquatic life (HQ = 1.96). However, the one detect is a false positive, and all recent data (2010) are non-detects.

2,4,6-trichlorophenol is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

2-chloronaphthalene was detected in 1 of 9 samples with a mean of 0.33 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L for 2-chloronaphthalene, which exceeds the RSV (0.396 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for 2-chloronaphthalene for aquatic life (HQ = 2.43). The one detect is a false positive, and all recent data (2010) are non-detects.

2-chloronaphthalene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

2-nitroaniline was detected in 1 of 9 samples with a mean of 1.96 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. 2-nitroaniline came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

2-nitroaniline is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

3,3-dichlorobenzidine was detected in 1 of 9 samples with a mean of 1.64 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L for 3,3-dichlorobenzidine, which exceeds the RSV (4.50 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for

3,3-dichlorobenzidine for aquatic life (HQ = 2.14). However, the one detect is a false positive, and all recent data (2010) are non-detects.

3,3-dichlorobenzidine is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

3-nitroanaline was detected in 1 of 9 samples with a mean of 1.67 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. 3-nitroanaline came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

3-nitroanaline is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

4,6-dinitro-2-methylphenol was detected in 1 of 9 samples with a mean of 1.89 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. 4,6-dinitro-2-methylphenol came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

4,6-dinitro-2-methylphenol is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

4-bromophenyl phenyl ether was detected in 1 of 9 samples with a mean of 1.64 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. The EPC also is 9.62 µg/L for 4-bromophenyl phenyl ether, which exceeds the RSV (1.50 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for 4-bromophenyl phenyl ether for aquatic life (HQ = 6.41). However, the one detect is a false positive, and all recent data (2010) are non-detects.

4-bromophenyl phenyl ether is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

4-chloro-m-cresol was detected in 1 of 9 samples with a mean of 1.68 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also .62 µg/L. 4-chloro-m-cresol came through screening because there is no published ecological screening threshold level. The one detect is a false positive, and all recent data (2010) are nondetects.

4-chloro-m-cresol is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

4-chlorophenylphenyl ether was detected in 1 of 9 samples with a mean of 1.65 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. 4-chlorophenylphenyl_ether came through screening because there is no published ecological screening threshold level. The one detect is a false positive, and all recent data (2010) are non-detects.

4-chlorophenylphenyl ether is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

4-nitroaniline was detected in 1 of 9 samples with a mean of 1.82 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. 4-nitroaniline came through screening because there is no published ecological screening threshold level. The one detect is a false positive, and all recent data (2010) are non-detects.

4-nitroaniline is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Acetophenone was detected in 1 of 9 samples with a mean of 1.70 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. Acetophenone came through screening because there is no published ecological screening threshold level. The one detect is a false positive, and all recent data (2010) are non-detects.

Acetophenone is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Aluminum was detected in 7 of 9 samples with a mean of 230.23 µg/L and a maximum detected concentration of 1,340 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC for aluminum is 852.6 µg/L, which exceeds the RSV (87 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for aluminum for aquatic life (HQ = 9.80). However, aluminum is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (6,060 µg/L). Background levels

are substantially higher than the screening thresholds indicating that the screening level is probably overprotective.

Aluminum is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- It is within background levels.
- The screening threshold may be overprotective.

Anthracene was detected in 1 of 9 samples with a mean of 0.32 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV (0.02 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for anthracene for aquatic life (HQ = 48.1). Additionally, the one detect is a false positive, and all recent data (2010) are non-detects.

Anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Benzo[a]anthracene was detected in 1 of 9 samples with a mean of 0.31 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV (0.027 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for benzo[a]anthracene for aquatic community organisms (HQ = 35.6). The one detect is a false positive, and all recent data (2010) are non-detects.

Benzo[a]anthracene is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Benzo[a]pyrene was detected in 1 of 9 samples with a mean of 0.32 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV (0.014 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for benzo[a]pyrene for aquatic community organisms (HQ = 68.7). The one detect is a false positive, and all recent data (2010) are non-detects.

Benzo[a]pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Benzo[g,h,i]perylene was detected in 1 of 9 samples with a mean of 0.31 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC also is 0.96 µg/L, which exceeds the RSV (0.44 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for benzo[g,h,i]perylene for aquatic life (HQ = 2.19). The one detect is a false positive, and all recent data (2010) are non-detects.

Benzo[g,h,i]perylene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive,
- All recent data are non-detects.

Benzo[k]fluoranthene was detected in 1 of 9 samples with a mean of 0.33 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC also is 0.96 µg/L, which exceeds the RSV (0.0041 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for benzo[k]fluoranthene for

aquatic community organisms (HQ = 235). Additionally, the one detect is a false positive, and all recent data (2010) are non-detects.

Benzo[k]fluoranthene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Biphenyl was detected in 1 of 9 samples with a mean of 1.79 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV (6.5 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for biphenyl for aquatic community organisms (HQ = 1.48). The EPC and maximum detected concentrations are both 9.62 µg/L for biphenyl. However, the one detect is a false positive, and all recent data (2010) are non-detects.

Biphenyl is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Bis[2-chloroethoxy]methane was detected in 1 of 9 samples with a mean of 1.79 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. Bis[2-chloroethoxy]methane came through screening because there is no published ecological screening threshold level. Additionally, the one detect is a false positive, and all recent data (2010) are non-detects.

Bis[2-chloroethoxy]methane is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Bis[2-chloroethyl]ether was detected in 1 of 9 samples with a mean of 1.69 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. Bis[2-chloroethyl]ether came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

Bis[2-chloroethyl]ether is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Bis[2-chloroisopropyl]ether was detected in 1 of 9 samples with a mean of 1.67 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L. Bis[2-chloroisopropyl]ether came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

Bis[2-chloroisopropyl]ether is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Bis[2-ethylhexyl]phthalate was detected in 1 of 9 samples with a mean of 1.46 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC also is 9.62 µg/L. Bis[2-ethylhexyl]phthalate is a common laboratory artifact.

Bis[2-ethylhexyl]phthalate is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- All recent data are non-detects.
- It is a common laboratory artifact.

Caprolactam was detected in 2 of 9 samples with a mean of 3.44 µg/L and a maximum of 10.8 µg/L at the LTROU-17 location in 2001 (Table A.1.8.2, Figure 3-8). The EPC is 7.8 µg/L. Caprolactam came through screening because there is no published ecological screening threshold level. However, the two detects are false positives.

Caprolactam is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The two detects are false positives.
- There is no published screening value.

Carbazole was detected in 1 of 9 samples with a mean of 1.46 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L came through screening because there is no published ecological screening threshold level. However, the one detect is a false positive, and all recent data (2010) are non-detects.

Carbazole is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Chrysene was detected in 1 of 9 samples with a mean of 0.32 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV of 0.0018 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for chrysene for aquatic community organisms (HQ = 534). However, the one detect is a false positive, and all recent data (2010) are non-detects.

Chrysene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

DDT was detected in 1 of 9 samples with a mean of 0.0090 µg/L and a maximum of 0.014 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.014 µg/L, which exceeds the RSV of 0.001 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for DDT for aquatic community organisms (HQ = 14.2). The mean DDT concentration (0.009 µg/L) also exceeds the RSV.

DDT is recommended for trophic modeling as an ecological RCOPC in surface water based on the following lines of evidence:

- There is one HQ exceedance.
- The mean exceeds the RSV.

Dibenz[a,h]anthracene was detected in 1 of 9 samples with a mean of 0.31 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV of 0.0034 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for dibenz[a,h]anthracene for aquatic community organisms (HQ = 283). Additionally, the one detect is a false positive, and all recent data (2010) are non-detects.

Dibenz[a,h]anthracene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Dibenzofuran was detected in 1 of 9 samples with a mean of 1.62 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV of 3.7 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for dibenzofuran for aquatic community organisms (HQ = 2.60). One detect is a false positive, and all recent data (2010) are non-detects.

Dibenzofuran is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Dimethylphthalate was detected in 1 of 9 samples with a mean of 1.66 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV of 3.00 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for dimethylphthalate for aquatic community organisms (HQ = 3.21). The one detect is a false positive, and all recent data (2010) are non-detects.

Dimethylphthalate is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Dioctylphthalate was detected in 1 of 9 samples with a mean of 1.91 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV of 3.00 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for dioctylphthalate for aquatic community organisms (HQ = 3.21). The one detect is a false positive, and all recent data (2010) are non-detects.

Dioctylphthalate is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Fluoranthene was detected in 1 of 9 samples with a mean of 0.32 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV of 0.040 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for fluoranthene for aquatic community organisms (HQ = 24.1). The one detect is a false positive, and all recent data (2010) are non-detects.

Fluoranthene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Hexachlorobenzene was detected in 1 of 9 samples with a mean of 1.63 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 9.62 µg/L, which exceeds the RSV of 0.0003 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for hexachlorobenzene for aquatic life (HQ = 32,100). The one detect is a false positive, and all recent data (2010) are non-detects.

Hexachlorobenzene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Hexachlorocyclopentadiene was detected in 1 of 9 samples with a mean of 1.75 µg/L and a maximum of 9.62 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC also is 9.62 µg/L, which exceeds the RSV of 0.45 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for hexachlorocyclopentadiene for aquatic life (HQ = 21.4). The one detect is a false positive, and all recent data (2010) are non-detects.

Hexachlorocyclopentadiene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Indeno[1,2,3-cd]pyrene was detected in 1 of 9 samples with a mean of 0.31 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV of 0.28 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for indeno[1,2,3-cd]pyrene for aquatic life (HQ = 3.44). The one detect is a false positive, and all recent data (2010) are non-detects.

Indeno[1,2,3-cd]pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.

Iron was detected in 8 of 9 samples with a mean of 2,440.37 µg/L and a maximum of 5,990 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC for iron is 3,761 µg/L, which exceeds the RSV (1,000 µg/L). The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for iron for aquatic life (HQ = 3.76). However, iron is naturally-occurring, and the maximum detected concentration (5,990 µg/L) falls below the IOU background maximum (12,400 µg/L). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- The screening level is likely overprotective.

Manganese was detected in 9 of 9 samples with a mean of 153.44 µg/L, with a maximum detected concentration of 460 µg/L at the PDC016-002 location in 2010 (Table A.1.8.2, Figure 3-8). The EPC for manganese is 252.3 µg/L, which exceeds the RSV of 93 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for manganese for aquatic life (HQ = 2.71). However, manganese is naturally-occurring, and the maximum detected concentration (460 µg/L) falls below the IOU background maximum (2,690 µg/L). Background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Manganese is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective.

Pyrene detected in 1 of 9 samples with a mean of 0.33 µg/L and a maximum of 0.96 µg/L at the LTROU-06 location in 2003 (Table A.1.8.2, Figure 3-8). The EPC is also 0.96 µg/L, which exceeds the RSV of 0.025 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 8.B, shows an HQ exceedance (HQ >1) for pyrene for aquatic community organisms (HQ = 38.5). The is also 0.96 µg/L for pyrene. The one detect is a false positive, and all recent data (2010) are non-detects. In addition, pyrene is a ubiquitous by-product of combustion.

Pyrene is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is a false positive.
- All recent data are non-detects.
- It is a ubiquitous combustion by-product.

In summary, only DDT is identified as an RCOPC for evaluation in trophic modeling and will be further addressed in Sections C.2.5 and C.2.6. Most of the identified COPCs for EA 8 surface

water were organics with only one elevated detect, but in all cases, the one detect was a false positive and more recent results are non-detects. Iron and manganese were ruled out because they are both naturally-occurring and the detected concentrations are within background levels.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 8 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Lead-214	X			X	X	X	
2,4,5-trichlorophenol	X			X			
2,4,6-trichlorophenol	X			X			
2-chloronaphthalene	X			X			
2-nitroaniline	X			X			
3,3-dichlorobenzidine	X			X			
3-nitroanaline	X			X			
4,6-dinitro-2-methylphenol	X			X			
4-bromophenyl phenyl ether	X			X			
4-chloro-m-cresol	X			X			
4-chlorophenylphenyl ether	X			X			
4-nitroaniline	X			X			
Acetophenone	X			X			
Aluminum	X		X			X	
Anthracene	X			X			
Benzo[a]anthracene	X			X			
Benzo[a]pyrene	X			X			
Benzo[g,h,i]perylene	X			X			
Benzo[k]fluoranthene	X			X			
Biphenyl	X			X			
Bis[2-chloroethoxy]methane	X			X			
Bis[2-chloroethyl]ether	X			X			
Bis[2-chloroisopropyl]ether	X			X			
Caprolactam				X		X	
Carbazole	X			X			
Chrysene	X			X			
DDT*							
Dibenz[a,h]anthracene	X			X			
Dibenzofuran	X			X			
Dimethylphthalate	X			X			
Dioctylphthalat	X			X			
Fluoranthene	X			X			

EA 8 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Hexachlorobenzene	X			X			
Hexa-chlorocyclopentadiene	X			X			
Indeno[1,2,3-cd]pyrene	X			X			
Iron	X		X			X	
Manganese	X		X			X	
Pyrene	X			X			

* Carried forward for site-specific trophic modeling.

C.2.3.9 Exposure Area 9

Results of the ESV screening (Step C.2.1), refinement-level risk calculations (Step C.2.2), and a discussion of associated uncertainties for each constituent of potential concern for LTR Exposure Area 9 are provided below.

C.2.3.9.1 Screening Results for Exposure Area 9 for Sediment/Soil

Using maximum detected values, Table C-33 identifies the following constituents as COPECs based on ESV screening in the 0 to 1 ft sediment/soil interval evaluated for terrestrial and aquatic receptors: acetone, barium, benzoic acid, bis[2-ethylhexyl]phthalate, camphene, carbon disulfide, chloride, chloromethane, chromium, cyanide, dibutylphthalate, docosane, lead, lead-212, lead-214, manganese-54, methyl isobutyl ketone, orthophosphate, phenols, phosphate, potassium-40, thallium, thallium-208, thorium-234, and vanadium

The radionuclide constituents were identified as COPECs since there are no published ESVs available for these constituents. There was also no screening value for camphene, chloride, chloromethane, docosane, methyl isobutyl ketone, orthophosphate, or phosphate. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.9.2 Refinement-level Risk Results for Exposure Area 9 for Sediment/Soil

Using EPC values (i.e., 95% UCL on the mean), Table C-35 identifies the following constituents as COPCs based on RSV screening in the 0 to 1 ft. sediment/soil interval: camphene, chloride, chloromethane, docosane, lead-212, lead-214, manganese-54, methyl isobutyl ketone,

orthophosphate, phenols, phosphate, potassium-40, thallium, thallium-208, thorium-234, and vanadium.

The radionuclide constituents were identified as COPCs since there are no published RSVs available for these constituents. There was also no screening value for camphene, chloride, chloromethane, docosane, methyl isobutyl ketone, orthophosphate, or phosphate. The COPCs are discussed further below.

C.2.3.9.3 Refinement-level Uncertainty Discussion for Exposure Area 9 for Sediment/Soil

An uncertainty analysis is performed for each individual COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 9.A for sediment/soil. Sampling locations described for EA 9 are shown in Figure 3-9.

Camphene was detected in 1 of 1 sample with an EPC and maximum of 0.0025 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Camphene came through screening because there is no published ecological screening threshold level. The one detect is "J" qualified (i.e., estimated).

Camphene is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The one detect is estimated.
- This constituent is not part of analytical suites for CERCLA investigations.

Chloride was detected in 6 of 9 samples, with a mean of 4.067 mg/kg and a maximum of 15.1 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Chloride came through screening because there is no published ecological screening threshold level. Five of the six detects are "J" qualified (i.e., estimated) and are all from 1995.

Chloride is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Five of the six detects are estimates.
- This constituent is not monitored for CERCLA investigations and is viewed more as water quality parameters.

Chloromethane was detected in 2 of 15 samples with a mean of 0.0002 mg/kg and a maximum of 0.0003 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Chloromethane came through screening because there is no published ecological screening threshold level. One of the two detects is "J" qualified (i.e., estimated).

Chloromethane is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- One of the two detects is estimated.
- There is no published screening value with which to compare.

Docosane was detected in 1 of 1 samples with an EPC and maximum of 0.54 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Docosane came through screening because there is no published ecological screening threshold level. The one detect is "J" qualified (i.e., estimated).

Docosane is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The one detect is estimated.
- This constituent is not part of analytical suites for CERCLA investigations.

Methyl isobutyl ketone was detected in 2 of 15 samples with a maximum of 0.00056 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). The EPC is 0.0006 mg/kg. Methyl isobutyl ketone came through screening because there is no published

ecological screening threshold level. Both of the detects are "J" qualified (i.e., estimated), and recent data (2010) are all non-detects.

Methyl isobutyl ketone is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Both detects are estimated.
- Recent data are all non-detects.

Orthophosphate was detected in 1 of 9 samples with a maximum of 2.62 mg/kg at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Orthophosphate came through screening because there is no published ecological screening threshold level. The one detect is "J" qualified (i.e., estimated).

Orthophosphate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The one detect is estimated.
- This constituent is not monitored for CERCLA investigations and is viewed more as a water quality parameter.

Phosphate was detected in 9 of 9 samples with a mean of 146.67 mg/kg and a maximum of 375 mg/kg at the Pond C: PPSC-SED11 location in 1995 (Table A.1.9.1.1, Figure 3-9). The EPC is 210.4 mg/kg. Phosphate came through screening because there is no published ecological screening threshold level. Eight of the nine detects are "J" qualified (i.e., estimated).

Phosphate is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Most of the detects are estimated results.
- This constituent is not monitored for CERCLA investigations and is viewed more as a water quality parameter.

Lead-212 was detected in 23 of 23 samples with a maximum of 2.59 pCi/g at the PCT3-2 location in 2010 (Table A.1.9.1.1, Figure 3-9). The EPC for lead-212 is 1.62 pCi/g. Lead-212 came through screening because there is no published ecological screening threshold level. Lead-212 is a naturally-occurring radionuclide and the maximum detected activity (2.59 pCi/g) is within background activity levels; the IOU maximum background activity level is 3.05 pCi/g and the SRS maximum background activity is 2.79 pCi/g. The half-life of lead-212 is 3.7 days.

Lead-212 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent that is common in SRS background soils.
- It has a very short half-life.

Lead-214 was detected in 16 of 16 samples with a mean of 0.99 pCi/g and a maximum of 1.72 pCi/g at PCT3-2 location in 2010 (Table A.1.9.1.1, Figure 3-9). The EPC is 1.16 pCi/g. Lead-214 came through screening because there is no published ecological screening threshold level. Lead-214 is a naturally-occurring radionuclide and the maximum detected activity concentration (1.72 pCi/g) is within IOU background activity; the IOU maximum background activity is 8.42 pCi/g. The half-life of lead-214 is 26.8 minutes.

Lead-214 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Manganese-54 was detected in 5 of 7 samples with a mean of 0.027 pCi/g and a maximum of 0.048 pCi/g at the Pond C: PPSC-SED11 location in 1995 (Table A.1.9.1.1, Figure 3-9).

Manganese-54 came through screening because there is no published ecological screening threshold level. However, the mean activity (0.027 pCi/g) is within background activity levels; the IOU maximum detected background activity is 0.031 pCi/g. Additionally, manganese-54 has a short half-life (10.3 months).

Manganese-54 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The mean activity is within background.
- It has a very short half-life.

Potassium-40 was detected in 16 of 21 samples with a mean of 1.02 pCi/g and a maximum of 3.22 pCi/g at the Pond C SED12/Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). Potassium-40 came through screening because there is no published ecological screening threshold level. However, potassium-40 is a naturally-occurring radionuclide and the maximum detected activity concentration (3.22 pCi/g) is below the RESRAD Biota screening activity concentration of 119 pCi/g and is within background activity levels; the SRS maximum background is 8.53 pCi/g, and the IOU maximum background is 13 pCi/g. Potassium-40 was not used in SRS reactor processes, so the detections are regarded as not DOE-related.

Potassium-40 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is below the RESRAD Biota screening activity.
- It is within background activity levels.
- It was not used in any SRS process and is considered non-DOE related.

Thallium-208 was detected in 16 of 16 samples with a mean of 0.39 pCi/g and a maximum of 0.76 pCi/g at the PCT3-2 location in 2010 (Table A.1.9.1.1, Figure 3-9). Thallium-208 came through screening because there is no published ecological screening threshold level. However, thallium-208 is a naturally-occurring radionuclide and the maximum detected activity (0.76 pCi/g)

is within background activity levels; the IOU maximum background activity concentration is 1.14 pCi/g. The half-life of thallium-208 is 3.05 minutes.

Thallium-208 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Unit activities are within the IOU soil background activity range.
- It is a naturally-occurring constituent.
- It has a very short half-life.

Thorium-234 was detected in 3 of 8 samples with a mean of 1.43 pCi/g and a maximum of 3.83 pCi/g at the Pond C: PPSC-SED11 location in 1995 (Table A.1.9.1.1, Figure 3-9). Thorium234 came through screening because there is no published ecological screening threshold level. Thorium-234 occurs naturally, but as the daughter product of uranium-238, can also be expected as a possible reactor waste product. It is rarely analyzed for in environmental samples for two reasons: 1) the low strength of its gamma signal makes for high detection limits and correspondingly high analytical uncertainty; and 2) gamma peak overlap with actinium-228 causes falsely elevated reported concentrations and additional uncertainty. The half-life of thorium-234 is 24.1 days. The maximum detected activity (3.83 pCi/g) is overestimated and, even so, is below the RESRAD Biota screening value (2,160 pCi/g).

Thorium-234 is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is well below the RESRAD Biota screening activity.
- There is high analytical uncertainty associated with thorium-234.
- It is not considered to be DOE-related.
- It has a very short half-life.

Phenols were detected in 1 of 9 samples with an EPC and maximum of 0.22 mg/kg at the Pond C SED12/ Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). The EPC is also 0.22 mg/kg, which exceeds the RSV of 0.12 mg/kg. The uncertainty evaluation presented in

Attachment C-6, Table 9.A, shows an HQ exceedance (HQ >1) for phenols for benthic organisms (HQ = 1.79). However, the one detect is "J" qualified (i.e., estimated). In addition, the J-qualified data are from 1995 with more recent (2010) data all being non-detects. Phenols readily degrade in the environment.

Phenols are not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- The one detect is an estimate.
- It readily degrades in the environment.
- More recent data are all non-detects.

Thallium was detected in 2 of 15 samples with a mean of 4.92 mg/kg and a maximum of 4.59 mg/kg at the Pond C SED12/ Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). The EPC for thallium is 2.63 mg/kg, which exceeds the RSV of 0.5 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 9.A, shows HQ exceedances (HQ >1) for thallium for generic plant (HQ = 5.27) and for montane shrew as mammalian insectivore (HQ = 1.20). However, thallium is naturally-occurring, and the maximum detected concentration (4.59 mg/kg) falls well below the IOU background maximum detected concentration (11.2 mg/kg) and the SRS background maximum detected concentrations (8.13 mg/kg). Both detects are "J" flagged (i.e., estimated).

Thallium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- Both detects are estimated results.
- It is within IOU and SRS background levels.

Vanadium was detected in 15 of 15 samples with a mean of 18.58 mg/kg and a maximum of 42.3 mg/kg at the Pond C SED12/ Pond C SED28 location in 1995 (Table A.1.9.1.1, Figure 3-9). The EPC for vanadium is 24.81 mg/kg, which exceeds the RSV of 13 mg/kg. The uncertainty evaluation presented in Attachment C-6, Table 9.A, shows HQ exceedances (HQ >1) for vanadium for American robin as avian herbivore (HQ = 1.46), American robin as avian omnivore (HQ =

1.65), and American robin as avian insectivore (HQ = 1.91). However, vanadium is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (130 mg/kg), the SRS background maximum (104 mg/kg), as well as the wetland study maximum (144 mg/kg). The background levels are substantially higher than screening thresholds, indicating that the screening levels are probably overprotective.

Vanadium is not recommended for further remedial evaluation as an ecological RCOPC in sediment/soil based on the following lines of evidence:

- It is a naturally-occurring constituent that is common in the environment.
- It does not appear to be unit related since it is below background.
- Screening level is likely overprotective

No constituents are identified as RCOPCs for evaluation in trophic modeling. All the organics and radionuclides that came through screening as COPCs for sediment/soil have no published screening levels. The organics were ruled out as RCOCs due to low detection frequencies and high frequencies of estimated results. The radionuclides were ruled out as RCOCs were all within background activity levels and in addition had either short half-lives or were below the RESRAD Biota screening value. The inorganics that came through as COPCs were ruled out as RCOCs because they are all naturally-occurring and, despite HQ exceedances, are within background levels. In summary, no constituents were identified as RCOCs for sediment/soil for EA 9.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented in the following table:

EA 9 – Sediment/Soil	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Camphene	X			X		X	
Chloride	X			X		X	
Chloromethane	X			X		X	
Docosane	X			X		X	
Methyl isobutyl ketone	X			X		X	
Orthophosphate	X			X		X	
Phosphate	X			X		X	
Lead-212	X		X		X	X	
Lead-214	X		X		X	X	
Manganese-54			X		X	X	
Potassium-40	X	X	X			X	
Thallium-208	X		X		X	X	
Thorium-234		X		X		X	X
Phenols	X			X	X		
Thallium			X	X			
Vanadium	X		X			X	

C.2.3.9.4 Screening Results for Exposure Area 9 for Surface Water

Using maximum detected values, Table C-34 identifies the following constituents as COPECs based on ESV screening in the surface water media for terrestrial and aquatic receptors: chloromethane, iron, manganese, and silver.

Chloromethane was identified as a COPEC since there is no published ESV available for this constituent. The COPECs are carried forward and processed further in the refinement-level evaluation step discussed below.

C.2.3.9.5 Refinement-level Risk Results for Exposure Area 9 for Surface Water

Using EPC values (i.e., 95% UCL on the mean), Table C-36 identifies the following constituents as COPCs based on RSV screening in the surface water media for terrestrial and aquatic receptors: chloromethane, iron, manganese, and silver.

Chloromethane was identified as a COPEC since there is no published ESV available for this constituent. The COPCs are discussed below.

C.2.3.9.6 Refinement-level Uncertainty Discussion for Exposure Area 9 for Surface Water

An uncertainty analysis is performed for each individual COPC below, including an interpretive discussion of the lines of evidence and applicable uncertainty factors resulting in a recommendation on whether the constituent should or should not be carried forward for site-specific trophic level modeling as an RCOPC. HQ calculations for receptors that pertain to RSV exceedance from Section C.2.2 are referred to in this discussion and can be found in Attachment C-6 in Table 9.B for surface water. Sampling locations described for EA 9 are shown in Figure 3-9.

Chloromethane was detected in 1 of 3 samples with an EPC and maximum of 0.41 µg/L at the PC-SW location in 2010 (A.1.9.2, Figure 3-9). Chloromethane came through screening because there is no published ecological screening threshold level. However, there is a low detection frequency, and the one detect is "J" qualified (i.e., estimated). Additionally, chloromethane is a common laboratory artifact.

Chloromethane is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- The one detect is an estimate.
- It is a common laboratory artifact.

Iron was detected in 2 of 2 samples with a mean of 1,165.5 µg/L and a maximum of 1,620 µg/L at the LTROU-16 location in 2001 (A.1.9.2, Figure 3-9). The EPC is also 1,620 µg/L for iron, which exceeds the RSV of 1,000 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 9.B, shows an HQ exceedance (HQ >1) for iron for aquatic community organisms (HQ = 1.62). However, iron is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (12,400 µg/L). The background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Iron is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally occurring.
- It is within background levels.
- Screening thresholds may be overprotective.

Manganese was detected in 2 of 2 samples with a mean of 56.67 µg/L and a maximum of 109 µg/L at the LTROU-16 location in 2001 (A.1.9.2, Figure 3-9). The EPC is also 109 µg/L for manganese, which exceeds the RSV of 93 µg/L. The uncertainty evaluation presented in Attachment C-6, Table 9.B, shows an HQ exceedance (HQ >1) for manganese for aquatic life (HQ = 1.17). However, manganese is naturally-occurring, and the maximum detected concentration falls well below the IOU background maximum (2,690 µg/L). The background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Manganese is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally occurring.
- It is within background levels.
- Screening thresholds may be overprotective.

Silver was detected in 1 of 2 samples. The EPC is 0.27 µg/L with a maximum detected concentration of 0.27 µg/L from the LTROU-16 location in 2001 (Table A.1.9.2, Figure 3-9). The RSV is 0.06 µg/L. The one detect is "J" flagged (i.e., estimated). The uncertainty evaluation presented in Attachment C-6, Table 9.B, shows one HQ exceedance (HQ >1) for silver for aquatic life (HQ = 4.47).

Silver is not recommended for further remedial evaluation as an ecological RCOPC in surface water based on the following lines of evidence:

- It is naturally occurring.
- The one detect is estimated.

No constituents were identified as RCOPCs for trophic modeling. Chloromethane was identified as a COPC because it has no published ecological screening value, but it was ruled out as an RCOC due to low (and estimated) detection frequency and because it is a common laboratory artifact. Iron and manganese were ruled out as RCOCs because they are within background values, are naturally-occurring, and, since background levels greatly exceed screening levels, the screening levels may be overprotective. In summary, no constituents were identified as RCOCs for surface water for EA 9.

A summary table of the LOEs used in the uncertainty evaluation, as described in Section C.2.3, is presented below:

EA 9 – Surface Water	UNCERTAINTY CATEGORY						
	Unit Related			Data Quality Related		Risk Assessment Related	
Constituent	Nature and Extent	History of Use	Presence in Background	Analytical Data Quality	Physical Characteristics	Toxicity	Radioactive Decay
Chloromethane				X	X	X	
Iron	X		X			X	
Manganese	X		X			X	
Silver	X			X			

C.2.4 Screening Ecological Effects Conclusion

The following three possible decisions can be made upon completion of the screening level evaluation:

- There are adequate data to conclude that ecological risks are negligible and, therefore, there is no need for remediation on the basis of ecological risk.
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is not warranted.
- The information is not adequate to make a decision at this point, and the ecological risk assessment process will continue to address data gaps.

The screening level ecological effects evaluation for the LTR IOU indicates that more information is needed for some constituents to more thoroughly assess the risk potential to ecological receptors.

Of primary interest are the RCOPCs summarized below that have been identified for further evaluation in the trophic modeling effort.

Exposure Area	RCOPC for Sediment/Soil	RCOPC for Surface Water
1	None	DDT
2	None	Hg
3	None	Hg
4	None	None
5	None	DDT
6	Hg	None
7	Hg	Al, Fe, Mn, DDT
8	DDD, DDE, DDT, CN, Pb, Hg	DDT
9	None	None

RCOPC = constituent of potential concern

The scope of trophic level modeling and a discussion of how it addresses uncertainties from previous conservative screening steps are discussed below in Section C.2.5. Results of the trophic level modeling, additional uncertainties, and a conclusion whether the constituent is an RCOC are found in Section C.2.6.

C.2.5 Site-specific Trophic Level Modeling

Trophic level modeling was conducted by SRNL using site-specific data. The trophic level modeling effort, *Risks to Ecological Receptors Posed by Contaminants of Potential Concern in the Lower Three Runs Cooling Ponds and Canals,* is provided in its entirety as Attachment C-9. The effort addressed the uncertainty associated with relying strictly on literature-based toxicity values and exposure assumptions. Summaries of the results of the modeling effort are included in the uncertainty discussions for each constituent in section C.2.6 below and were considered as an additional line of evidence when considering whether a constituent was an RCOC. The following excerpt is taken directly from the Abstract of the report:

The upper portion of Lower Three Runs includes several ponds, reservoirs, and canals that were formerly used as a cooling system for nuclear production reactors. This area was divided into nine exposure areas (EAs) for the assessment of environmental contamination resulting from past reactor operations and other industrial processes. A tiered screening process identified several

contaminants of potential concern including aluminum, cyanide, lead, manganese, mercury, DDD, DDE, and DDT. Risks posed by these contaminants to ecological receptors (river otter, belted kingfisher, raccoon, and blue heron) were assessed using contaminant exposure models that estimated contaminant intake resulting from ingestion of food, water, and sediment/ soil and compared these intakes with toxicity reference values (TRVs).

C.2.6 Additional Risk Information and Uncertainty Evaluation

The contaminant exposure models described in Section C.2.5 are underpinned by various assumptions that contribute to uncertainty in model output. A full discussion of these uncertainties can be found in the trophic level modeling report in Attachment C-9 and is summarized as follows:

Sensitivity analysis showed that model uncertainty can be reduced by adequate sampling of key variables (e.g., fish and sediments). Although sediment samples were collected from all EAs, fish samples were not collected from three EAs and some analytes (pesticides and cyanide) were not measured in fish. Water-to-fish concentration ratios were used to estimate contaminant levels in fish when direct measurements from fish were unavailable; however, such estimates are potentially less accurate than direct measurements.

Additional factors that contribute to uncertainty include temporal changes in contaminant concentrations, uncertainty in contaminant ingestion rates, individual variation in receptor exposure, TRV accuracy, no investigation of dermal and inhalation pathways, assumptions concerning contaminant concentrations in herptiles, use of concentration ratios to estimate contaminant concentrations, interactions among contaminants, environmental factors affecting toxicity, failure to include all relevant contaminants in the assessment, representativeness of the receptors, and representativeness of contaminant measurements.

Site-specific trophic level modeling results are provided below for each RCOPC by exposure area and media. This section includes a discussion of associated uncertainties for each RCOPC and a final determination whether the constituent is an RCOC.

C.2.6.1 Exposure Area 1

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 1 are provided below.

C.2.6.1.1 Trophic level Modeling Results for Exposure Area 1 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 1.

C.2.6.1.2 Trophic level Modeling Results for Exposure Area 1 for Surface Water

DDT

The trophic modeling effort (Attachment C-9) showed DDT exceeded the TRV (0.694 mg/kg/day) for the kingfisher (HQ = 2.1) and slightly exceeded the TRV for the heron (HQ = 1.0) driven by fish ingestion. However, the fish and crayfish levels were calculated from surface water using a bioconcentration factor (BCF) of 3,400. Levels in crayfish were estimated to be the same as fish. Although DDT exceeded the TRV for the kingfisher and heron, the DDT result is based on 2003 data. Recent data for EA 1 show non-detects for all results (3 filtered and 3 unfiltered). There is no operational source for DDT in the LTR IOU. However, DDT is persistent in the environment. DDT was a common insecticide in the 1940s and 50s. Prior to SRS becoming government land in 1951, farming was the principal use of SRS property. DDT was used extensively for farming applications because it was toxic to a wide range of insect pests yet appeared to have a low toxicity to mammals. As such, it is likely that DDT was used as a part of common farming practices prior to the creation of SRS. In 1972, EPA issued a cancellation order for DDT based on its adverse environmental effects, but can still be produced in the US for use in foreign countries (NPIC 1999). DDT is persistent in the environment with a soil half-life from 2 to 15 years. However, several half-lives have already been completed, which may be a possible explanation of why DDT was not detected in more recent samples. The 2003 data is considered medium-pedigree data that is supported by the high pedigree 2009/2010 characterization data.

DDT is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- There was only one detected result greater than the RSV from an older data collection effort.

- Operational uses are not documented for DDT.
- Several half-lives have already been completed.

C.2.6.2 Exposure Area 2

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 2 are provided below.

C.2.6.2.1 Trophic level Modeling Results for Exposure Area 2 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 2.

C.2.6.2.2 Trophic level Modeling Results for Exposure Area 2 for Surface Water

Mercury

The trophic modeling effort (Attachment C-9) shows mercury exceeds the TRV (0.064 mg/kg/day) for the kingfisher (HQ = 3.5) and blue heron (HQ = 2.0) driven by fish ingestion. No fish samples were collected from EA 2. Estimated levels in fish are derived from surface water using concentration ratios from SRS data. The estimated level in fish is 0.8031 mg/kg, less than Savannah River levels in fish upgradient of SRS. Mercury levels for largemouth bass pulled from the IOU database from the Savannah River upgradient of SRS shows a maximum of 1.53 mg/kg (2001 SRS Annual Environmental Report Sample Data Management [SDM] data for largemouth bass) with a mean = 0.2070 mg/kg. The second highest level was 1.45 mg/kg (2014 SDM data for largemouth bass). Levels in fish estimated for EA 2 are below levels reported from the Savannah River. Mercury is ubiquitous in the environment due to inputs into the Savannah River from upgradient sources and atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It has a low frequency of detection in surface water (1 of 12).
- Fish ingestion is the driver for TRV exceedance, and estimated levels in EA 2 are below Savannah River fish concentrations (i.e., fish are within background ranges).

- Mercury is ubiquitous in the environment due to inputs of mercury into the Savannah River from upgradient sources and atmospheric deposition.
- The background surface water maximum also exceeds the RSV, so the RSV may be overly conservative.

C.2.6.3 Exposure Area 3

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 3 are provided below.

C.2.6.3.1 Trophic level Modeling Results for Exposure Area 3 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 3.

C.2.6.3.2 Trophic level Modeling Results for Exposure Area 3 for Surface Water

Mercury

The trophic modeling effort shows the kingfisher (HQ = 3.2) and blue heron (HQ = 1.8) exceed the TRV (0.064 mg/kg/day) for mercury driven by fish ingestion. Mercury in fish upgradient of SRS shows the maximum was 1.53 mg/kg in 2001 EMS largemouth bass, and the mean is 0.2070 mg/kg. The second highest level upgradient is 1.45 mg/kg in 2014 EMS largemouth bass. From EA 3, the maximum in fish is 1.83 mg/kg (largemouth bass) and the mean is 0.6970 mg/kg. Only two records (at 1.83 and 1.7 mg/kg, out of 81 analyses) are higher than the maximum in Savannah River. Mercury is ubiquitous in the environment due to inputs into the Savannah River from upgradient sources and atmospheric deposition. Larger fish, such as those found in Pond B, accumulate higher levels of mercury. The large fish in SRS pond systems are due to the lack of fishing pressure since recreational fishing is not allowed at SRS. As such, a higher proportion of larger fish reside in Pond B, and therefore higher levels of Hg bioaccumulate in these larger fish.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- Fish ingestion is the driver for TRV exceedance, but only two of 81 fish exceed upgradient Savannah River fish concentrations (i.e., fish are within background ranges).

- Mercury is ubiquitous in the environment due to inputs of mercury into the Savannah River from upgradient sources and atmospheric deposition.
- The background surface water maximum also exceeds the RSV, so the RSV may be overly conservative.

C.2.6.4 Exposure Area 4

C.2.6.4.1 Trophic level Modeling Results for Exposure Area 4 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 4.

C.2.6.4.2 Trophic level Modeling Results for Exposure Area 4 for Surface Water

There were no RCOPCs identified for surface water for EA 4.

C.2.6.5 Exposure Area 5

C.2.6.5.1 Trophic level Modeling Results for Exposure Area 5 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 5.

C.2.6.5.2 Trophic level Modeling Results for Exposure Area 5 for Surface Water

DDT

The results of trophic level modeling indicate that DDT did not exceed TRVs for the modeled receptors (river otter, kingfisher, raccoon, or heron). The estimated levels in fish and crayfish were derived from surface water using bioconcentration factors (BCFs) from HAZWRAP 1994. In addition, the DDT result exceeding the RSV is from 2003 data with more recent data (2010) for EA 5 showing all non-detects. There is no operational source for DDT in the LTR IOU. However, DDT is persistent in the environment. DDT was a common insecticide in the 1940s and 50s. Prior to SRS becoming government land in 1951, farming was the principal use of SRS property. DDT was used extensively for farming applications because it was toxic to a wide range of insect pests yet appeared to have a low toxicity to mammals. As such, it is likely that DDT was used as a part of common farming practices prior to the creation of SRS. In 1972, EPA issued a cancellation order for DDT based on its adverse environmental effects, but can still be produced in the US for

use in foreign countries (NPIC 1999). DDT is persistent in the environment with a soil half-life from 2 to 15 years. However, several half-lives have already been completed, which may be a possible explanation of why DDT was not detected in more recent samples. The 2003 data is considered medium-pedigree data that is supported by the high pedigree 2009/2010 characterization data.

DDT is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- Trophic level modeling indicated it did not exceed TRVs for the modeled receptors.
- The one elevated result is from 2003 with more recent data indicating all non-detects.
- Several half-lives have already been completed.
- Operational uses are not documented for DDT.

C.2.6.6 Exposure Area 6

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 6 are provided below.

C.2.6.6.1 Trophic level Modeling Results for Exposure Area 6 for Sediment/Soil

Mercury

Trophic level modeling shows the kingfisher (HQ = 3.0) and blue heron (HQ = 1.7) exceeds the TRV (0.064 mg/kg/day) for mercury driven by fish ingestion. The 95% UCL for fish in EA 6 is 0.689 mg/kg. Mercury in fish in the Savannah River upgradient of SRS shows a maximum of 1.53 mg/kg (2001 EMS largemouth bass) and a mean of 0.2070 mg/kg. The second highest level upgradient is 1.45 mg/kg (2014 EMS largemouth bass). The maximum was 3.18 mg/kg in 1995 during drawdown/refill in a largemouth bass, and the mean was 0.62 mg/kg. Thirteen (13) records (ranging from 3.16 to 1.57 mg/kg, from 1993 to 2000) out of 234 analyses are higher than the maximum in Savannah River representing a low (5.5 percent) frequency. Recent 2010 data show a maximum of 0.401 mg/kg (largemouth bass) below Savannah River levels and a mean of 0.1475 mg/kg.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- Fish ingestion is the driver for TRV exceedance, but EA 6 fish concentrations fall below upgradient Savannah River fish concentrations (i.e., are within background ranges).
- Mercury is ubiquitous in the environment due to inputs of mercury into the Savannah River from upgradient sources and atmospheric deposition.

C.2.6.6.2 Trophic level Modeling Results for Exposure Area 6 for Surface Water

There were no RCOPCs identified for surface water for EA6.

C.2.6.7 Exposure Area 7

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 7 are provided below.

C.2.6.7.1 Trophic level Modeling Results for Exposure Area 7 for Sediment/Soil

Mercury

Trophic level modeling for mercury shows the kingfisher (HQ = 1.0) slightly exceeds the TRV (0.064 mg/kg/day) for mercury driven by fish ingestion. Mercury in fish upgradient of SRS shows a maximum of 1.53 mg/kg (2001 EMS largemouth bass) and a mean of 0.2070 mg/kg. The second highest level upgradient is 1.45 mg/kg (2014 EMS largemouth bass). Levels in fish were provided by SREL, and the EPC of 0.228 mg/kg in fish is below Savannah River levels. Mercury is ubiquitous in the environment due to inputs of mercury into the Savannah River from upgradient sources and atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- Fish ingestion is the driver for TRV exceedance, but EA 7 fish concentrations (as provided by SREL) fall below upgradient Savannah River fish concentrations (i.e., are within background ranges).

- The screening values used are for the organic form, methylmercury, which is the most conservative (i.e., overprotective) approach.
- Mercury is ubiquitous in the environment.

C.2.6.7.2 Trophic level Modeling Results for Exposure Area 7 for Surface Water

Aluminum

Trophic modeling indicated that aluminum exceeded the TRV (19.3 mg/kg/day) for the raccoon (HQ = 2.8) driven by incidental ingestion of sediment. However, aluminum is naturally-occurring and is ubiquitous in the environment. For EA 7, the 95% UCL is 2,364 µg/L, and the mean is 682.6 µg/L, which are both less than the background maximum.

Aluminum is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- The mean and 95%UCL are within background levels.

DDT

Trophic level modeling results indicate that DDT do not exceed TRVs for the trophic model receptors (river otter, kingfisher, raccoon, or heron). There are six detected results for DDT (all from a 2003 sampling event) from the entire canal/PAR Pond system (EA 1 through EA 9) out of 151 analyses representing a low (3.9 percent) frequency of detection.

DDT is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- Trophic modeling indicates TRVs are not exceeded for any receptors.
- It was detected in 3 of 24 samples from 2003 for EA 7, one of the detects is estimated, and recent samples are all non-detects.

Iron

There is no TRV for iron, so no trophic level modeling was conducted. However, the mean (3,996.3 µg/L) and 95% UCL are both below the maximum background. In addition, background levels are substantially higher than the screening thresholds indicating that the screening levels are probably overprotective.

Iron is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- The mean and 95% UCL are within background levels.
- The screening thresholds may be overprotective.
- It is naturally-occurring.

Manganese

Trophic level modeling indicates that manganese does not exceed TRVs for trophic model receptors (river otter, kingfisher, raccoon, and heron). The EA 7 mean (548.81 µg/L) and 95% UCL (1,280 µg/L) are both less than the background maximum.

Manganese is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- It is naturally-occurring.
- The mean and 95% UCL are within background levels.
- Trophic modeling indicates that TRVs are not exceeded for any receptor.

C.2.6.8 Exposure Area 8

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 8 are provided below.

C.2.6.8.1 Trophic level Modeling Results for Exposure Area 8 for Sediment/Soil

Cyanide

The results of the trophic level modeling indicate that cyanide does not exceed TRVs for trophic model receptors (river otter, kingfisher, raccoon, or heron). The mean (0.8714 mg/kg) is less than the RSV (1 mg/kg). One (1) detected result is from 2003 and 3 results from 2001. Recent data from the LTRBRA dataset are all non-detects (2016). Historic 1995 characterization data show only 4 detects out of 68 analyses.

Cyanide is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- TRVs are not exceeded for trophic model receptors.
- The mean is less than the RSV.
- Detected results are from older data sets, with newer data showing all non-detects.
- Two of the three detects are estimated.

DDD

Results of trophic modeling indicate that DDD does not exceed TRVs for trophic model receptors (river otter, kingfisher, raccoon, or heron). The one detect was from 2001. More recent data are all non-detects. There were no surface water detects, therefore, there is no estimate of levels in fish or crayfish.

DDD is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- The one detect is from an older data set, with more recent data showing all non-detects.
- Trophic modeling indicates no TRVs are exceeded for modeled receptors.

DDE

DDE did not exceed TRVs for trophic model receptors (river otter, kingfisher, raccoon, or heron). Two recent detects are "J" qualified (2010), with all other 2010 samples showing nondetects; the two "J" flagged results are far below the RSV. There were no surface water detects, therefore, there is no estimate of levels in fish or crayfish.

DDE is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- Most of the detects are estimated results.
- The detects are from an older data set, with more recent data showing mostly non-detects and two estimated results.
- Trophic modeling indicates no TRVs are exceeded for modeled receptors.

DDT

DDT did not exceed TRVs for trophic models (river otter, kingfisher, raccoon, or heron). Levels in fish were estimated from surface water. Detected results are from 2001 and 2003 with recent data (2010) showing all non-detects.

DDT is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- The detects are from an older data set, with more recent data showing all non-detects.
- Trophic modeling indicates no TRVs are exceeded for modeled receptors.

Lead

Results of trophic level modeling indicate that lead did not exceed TRVs for trophic model receptors (river otter, kingfisher, raccoon, or heron). Levels in fish were estimated from surface water (BCF was from HAZWRAP 1994). The mean (19.17 mg/kg) is less than the RSV (28 mg/kg) and is also within background levels.

Lead is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- Trophic modeling indicates no TRVs are exceeded for modeled receptors.
- The mean is less than the RSV and is within background ranges.

Mercury

Results of trophic level modeling indicate the kingfisher (HQ = 3.7) and heron (HQ = 2.1) exceed the TRV (0.064 mg/kg/day) for mercury driven by fish ingestion. Mercury in fish upgradient of SRS shows a maximum of 1.53 mg/kg (2001 EMS largemouth bass) and a mean of 0.2070 mg/kg. The second highest level upgradient was 1.45 mg/kg (2014 EMS largemouth bass). Levels in fish were provided by SREL; with an EPC of 0.855 mg/kg, which is below Savannah River levels. Mercury is ubiquitous in the environment due to inputs of mercury into the Savannah River from upgradient sources and atmospheric deposition.

Mercury is not recommended for further remedial evaluation as an ecological RCOC in sediment/soil based on the following lines of evidence:

- Fish ingestion is the driver for TRV exceedance, but EA 8 fish concentrations (as provided by SREL) fall below upgradient Savannah River fish concentrations (i.e., are within background ranges).
- The screening values used are for the organic form, methylmercury, which is the most conservative (i.e., overprotective) approach.
- The mean in EA 8 is within background ranges.
- Mercury is ubiquitous in the environment.

C.2.6.8.2 Trophic level Modeling Results for Exposure Area 8 for Surface Water

DDT

Results of the trophic level modeling indicate that none of the trophic model receptors (river otter, kingfisher, raccoon, or heron) exceeded TRVs for DDT. Levels in fish are estimated from surface

water (BCF from HAZWRAP 1994). All recent (2010) DDT results are non-detects. Only a single detected result is greater than the RSV for EA 8. Also, the EPC is below the IOU background maximum concentration of 0.033 µg/L.

DDT is not recommended for further remedial evaluation as an ecological RCOC in surface water based on the following lines of evidence:

- There are no TRV exceedances.
- All recent results are non-detects.

C.2.6.9 Exposure Area 9

Results of the site-specific trophic level modeling effort (Step C.2.5) and a discussion of the associated uncertainties for each RCOPC for LTR Exposure Area 9 are provided below.

C.2.6.9.1 Trophic level Modeling Results for Exposure Area 9 for Sediment/Soil

There were no RCOPCs identified for sediment/soil for EA 9.

C.2.6.9.2 Trophic level Modeling Results for Exposure Area 9 for Surface Water

There were no RCOPCs identified for surface water for EA 9.

C.2.7 Summary/Conclusion of Ecological Risk Assessment

Following is a summary of RCOPCs that were advanced to trophic level modeling for each exposure area along with the final RCOC determination.

Sediment/Soil

Exposure Area	RCOPC (requires trophic level modeling)	COC (TRVs exceeded, HQ >1)	RCOC
1	None	None	None
2	None	None	None
3	None	None	None
4	None	None	None
5	None	None	None
6	Hg	Hg	None
7	Hg	Hg	None
8	DDD, DDE, DDT, CN, Pb, Hg	Hg	None
9	None	None	None

Surface Water

Exposure Area	RCOPC (requires trophic level modeling)	COC (TRVs exceeded, HQ >1)	RCOC
1	DDT	DDT	None
2	Hg	Hg	None
3	Hg	Hg	None
4	None	None	None
5	DDT	None	None
6	None	None	None
7	Al, Fe, Mn, DDT	Al; No TRV for Fe	None
8	DDT	None	None
9	None	None	None

As indicated above, the results of the ERA show no ecological RCOCs are identified for any EA within the LTR IOU. Therefore, there are no problems warranting action from an ecological risk perspective. The revised CSM is presented in Chapter 3.

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Table C-1. Screening Level Evaluation for Exposure Area 1 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg*								
Aluminum	9.02E+03	2.50E+04	a	3.61E-01	no	9.79E+03	no	no
Antimony	5.56E-01	2.70E-01	b	2.06E+00	YES	4.74E+00	no	no
Arsenic	2.34E+00	6.80E+00	d	3.44E-01	no	3.50E+00	no	no
Barium	5.09E+01	2.00E+01	a	2.55E+00	YES	5.47E+01	no	no
Beryllium	3.72E-01	2.50E+00	d	1.49E-01	no	7.73E-01	no	no
Cadmium	6.16E-02	2.70E-01	d	2.28E-01	no	3.69E-01	no	no
Calcium	4.46E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	1.50E+01	2.80E+01	bd	5.36E-01	no	1.42E+01	YES	no
Cobalt	1.99E+00	1.30E+01	bd	1.53E-01	no	2.63E+00	no	no
Copper	6.69E+00	1.50E+01	d	4.46E-01	no	6.52E+00	YES	no
Cyanide	2.23E-01	1.00E-01	cd	2.23E+00	YES	- -	- -	YES
Iron	1.33E+04	2.00E+04	ac	6.65E-01	no	5.32E+03	YES	no
Lead	8.54E+00	1.10E+01	b	7.76E-01	no	1.10E+01	no	no
Magnesium	4.67E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	1.77E+02	2.20E+02	bd	8.05E-01	no	1.36E+02	YES	no
Mercury	3.58E-02	3.50E-04	d	1.02E+02	YES	9.92E-02	no	no
Nickel	2.92E+00	9.70E+00	d	3.01E-01	no	4.48E+00	no	no
Potassium	2.18E+02	EN[7]	NA	NA	NA	2.39E+02	no	no
Selenium	1.89E+00	5.20E-01	bd	3.63E+00	YES	3.89E+00	no	no
Sodium	2.19E+01	EN[7]	d	NA	NA	7.33E+01	no	no
Vanadium	6.14E+01	6.70E+00	d	9.16E+00	YES	2.48E+01	YES	YES
Zinc	2.68E+01	4.60E+01	b	5.83E-01	no	1.70E+01	YES	no
Organics *(mg/kg)*								
Acetone	4.00E-01	4.00E-02	a	1.00E+01	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	3.57E+00	2.00E-02	bd	1.79E+02	YES	- -	- -	YES
Ethylbenzene	6.47E-04	2.70E-01	b	2.40E-03	no	- -	- -	no
Isopropylbenzene	2.59E-03	3.30E-02	a	7.85E-02	no	- -	- -	no
Methyl acetate	3.91E-03	---	NA	NA	NA	- -	- -	YES
Methyl ethyl ketone	2.42E-02	9.92E-01	a	2.44E-02	no	- -	- -	no
Toluene	1.24E-02	1.00E-02	c	1.24E+00	YES	- -	- -	YES
Pesticides/PCBs *(mg/kg)*								
DDD	6.32E-04	1.22E-03	a	5.18E-01	no	- -	- -	no
DDE	3.80E-03	2.07E-03	a	1.84E+00	YES	- -	- -	YES
DDT	2.50E-03	1.19E-03	a	2.10E+00	YES	- -	- -	YES
PCB-1260	3.50E-03	5.90E-02	c	5.93E-02	no	- -	- -	no
Radionuclides *(pCi/g)*								
Actinium-228	2.50E+00	---	d	NA	NA	2.69E+00	no	no
Americium-241	1.84E+00	1.90E+02	d	9.68E-03	no	3.55E-02	YES	no
Americium-243	2.77E-01	---	NA	NA	NA	- -	- -	YES
Bismuth-212	1.31E+00	---	NA	NA	NA	- -	- -	YES
Bismuth-214	3.41E+00	---	NA	NA	NA	4.53E+00	no	no
Californium-244	1.74E-01	---	NA	NA	NA	- -	- -	YES
Carbon-14	2.69E+00	---	NA	NA	NA	- -	- -	YES
Cesium-137	6.86E+02	7.20E+02	c	9.53E-01	no	1.89E-01	YES	no
Cobalt-60	6.48E-01	2.10E+02	c	3.09E-03	no	- -	- -	no
Curium-244	4.46E-02	---	NA	NA	NA	- -	- -	YES
Curium-245/-246	2.69E-01	---	NA	NA	NA	- -	- -	YES
Lead-212	2.16E+00	---	NA	NA	NA	2.42E+00	no	no
Lead-214	3.71E+00	---	NA	NA	NA	- -	- -	YES
Plutonium-238	4.86E-01	1.10E+02	c	4.42E-03	no	2.83E-02	YES	no
Plutonium-239	2.16E+00	1.10E+02	c	1.96E-02	no	- -	- -	no
Plutonium-239/-240	1.18E+00	1.10E+02	c	1.07E-02	no	5.13E-02	YES	no
Potassium-40	4.15E+00	---	NA	NA	NA	3.05E+00	YES	YES
Radium-226	3.41E+00	2.10E-01	c	1.62E+01	YES	9.14E+00	no	no
Radium-228	1.48E+00	2.60E-01	c	5.69E+00	YES	4.48E+00	no	no
Strontium-89/ -90	1.54E+00	1.50E+02	c	1.02E-02	no	- -	- -	no
Thallium-208	7.30E-01	---	NA	NA	NA	- -	- -	YES

Table C-1. Screening Level Evaluation for Exposure Area 1 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Radionuclides *(pCi/g)*								
Thorium-228	3.70E+00	4.30E+01	d	8.60E-02	no	2.71E+00	YES	no
Thorium-230	1.60E+00	5.20E+01	d	3.08E-02	no	2.19E+00	no	no
Thorium-232	3.32E+00	6.20E+00	d	5.35E-01	no	2.10E+00	YES	no
Uranium-233/-234	1.64E+00	4.40E+02	d	3.73E-03	no	1.28E+00	YES	no
Uranium-234	2.78E+00	4.40E+02	d	6.32E-03	no	1.36E+00	YES	no
Uranium-235	1.37E-01	4.40E+02	d	3.11E-04	no	6.91E-02	YES	no
Uranium-238	2.73E+00	4.00E+02	d	6.83E-03	no	1.31E+00	YES	no

1. Maximum detected concentration from Appendix A.1, Table A.1.1.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-2. Screening Level Evaluation for Exposure Area 1 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	1.06E+03	8.70E+01	b	1.22E+01	YES	2.77E+02	YES	YES
Barium	3.77E+01	3.90E+00	c	9.67E+00	YES	1.06E+02	no	no
Calcium	1.27E+04	1.16E+05	b	1.09E-01	no	4.43E+03	YES	no
Chromium	1.32E+00	1.10E+01	abc	1.20E-01	no	2.82E+00	no	no
Cobalt	3.03E+00	3.00E+00	c	1.01E+00	YES	2.48E+01	no	no
Copper	9.80E-01	2.90E+00	a	3.38E-01	no	6.58E+00	no	no
Cyanide	3.02E+00	5.20E+00	c	5.81E-01	no	- -	- -	no
Iron	1.26E+04	1.00E+03	bc	1.26E+01	YES	1.14E+03	YES	YES
Lead	6.70E-01	5.40E-01	a	1.24E+00	YES	3.85E+00	no	no
Magnesium	1.90E+03	8.20E+04	b	2.32E-02	no	1.72E+03	YES	no
Manganese	1.18E+03	9.30E+01	b	1.27E+01	YES	6.89E+01	YES	YES
Nickel	6.40E-01	1.60E+01	a	4.00E-02	no	6.44E+00	no	no
Potassium	8.13E+03	5.30E+04	b	1.53E-01	no	2.83E+03	YES	no
Sodium	2.31E+03	6.80E+05	b	3.40E-03	no	3.73E+03	no	no
Thallium	1.50E+00	3.00E-02	c	5.00E+01	YES	1.35E+01	no	no
Vanadium	3.80E+00	1.90E+01	c	2.00E-01	no	2.49E+01	no	no
Zinc	2.69E+01	3.70E+01	a	7.27E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
Acetone	9.63E+00	1.50E+03	c	6.42E-03	no	- -	- -	no
Bis[2-ethylhexyl]phthalate	2.68E+00	3.00E+00	b	8.93E-01	no	- -	- -	no
Chloromethane	5.62E-01	---	NA	NA	NA	- -	- -	YES
Toluene	7.25E-01	9.80E+00	c	7.40E-02	no	- -	- -	no
Pesticides *(µg/L)*								
DDE	9.34E-03	4.10E-01	b	2.28E-02	no	- -	- -	no
DDT	1.37E-01	1.00E-03	ac	1.37E+02	YES	- -	- -	YES
Radionuclides *(pCi/L)*								
Americium-241	4.02E-02	5.80E+00	c	6.92E-03	no	1.01E-01	no	no
Cesium-137	1.76E+02	1.10E+03	c	1.60E-01	no	1.70E+00	YES	no
Cobalt-60	7.58E+00	3.80E+02	c	1.99E-02	no	- -	- -	no
Curium-244	1.00E-02	---	NA	NA	NA	- -	- -	YES
Iodine-129	3.23E+01	---	NA	NA	NA	- -	- -	YES
Plutonium-238	3.73E-02	1.90E+01	c	1.96E-03	no	7.85E-02	no	no
Plutonium-239	1.11E-02	2.00E+01	c	5.55E-04	no	- -	- -	no
Plutonium-239/ -240	1.00E-02	2.00E+01	c	5.00E-04	no	2.30E-01	no	no
Potassium-40	4.64E+02	---	NA	NA	NA	2.21E+01	YES	YES
Strontium-89 / -90	3.01E+00	5.70E+02	c	5.28E-03	no	- -	- -	no
Technetium-99	5.66E-01	---	NA	NA	NA	- -	- -	YES
Thorium-234	7.10E+02	---	NA	NA	NA	NA	NA	YES
Tritium	3.14E+05	1.60E+08	c	1.97E-03	no	- -	- -	no
Uranium-234	2.03E-01	2.20E+01	c	9.23E-03	no	2.01E-01	YES	no
Uranium-235	8.20E-03	2.40E+01	c	3.42E-04	no	5.63E-02	no	no
Uranium-238	1.81E-01	2.40E+01	c	7.55E-03	no	2.53E-01	no	no

1. Maximum detected concentration from Appendix A.1, Table A.1.1.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-3. Refinement Level Evaluation for Exposure Area 1 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Cyanide	2.23E-01	1.00E+00	cd	2.23E-01	no	no
Vanadium	3.21E+01	1.30E+01	d	2.47E+00	YES	YES
Organics *(mg/kg)*						
Acetone	3.37E-01	6.50E-01	c	5.18E-01	no	no
Bis[2-ethylhexyl]phthalate	3.57E+00	2.00E-01	d	1.79E+01	YES	YES
Methyl acetate	3.91E-03	---	NA	NA	NA	YES
Toluene	1.10E-02	1.00E-01	c	1.10E-01	no	no
Pesticides/PCBs *(mg/kg)*						
DDE	1.60E-03	3.74E-03	a	4.28E-01	no	no
DDT	2.50E-03	4.77E-03	a	5.24E-01	no	no
Radionuclides *(pCi/g)*						
Americium-243	2.77E-01	---	NA	NA	NA	YES
Bismuth-212	9.87E-01	---	NA	NA	NA	YES
Californium-244	1.74E-01	---	NA	NA	NA	YES
Carbon-14	2.02E+00	---	NA	NA	NA	YES
Curium-244	2.89E-02	---	NA	NA	NA	YES
Curium-245/ -246	2.69E-01	---	NA	NA	NA	YES
Lead-214	1.17E+00	---	NA	NA	NA	YES
Potassium-40	3.90E+00	---	NA	NA	NA	YES
Thallium-208	4.37E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-1.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1, Surface Interval (0 to 0.5 ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1 Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-4. Refinement Level Evaluation for Exposure Area 1 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Aluminum	1.06E+03	8.70E+01	b	1.22E+01	YES	YES
Iron	7.17E+03	1.00E+03	bc	7.17E+00	YES	YES
Manganese	7.64E+02	9.30E+01	b	8.21E+00	YES	YES
Organics *(µg/L)*						
Chloromethane	5.62E-01	---	NA	NA	NA	YES
Pesticides *(µg/L)*						
DDT	1.37E-01	1.00E-03	ac	1.37E+02	YES	YES
Radionuclides *(pCi/L)*						
Curium-244	4.65E-03	---	NA	NA	NA	YES
Iodine-129	3.23E+01	---	NA	NA	NA	YES
Potassium-40	5.49E+01	---	NA	NA	NA	YES
Technetium-99	3.20E-01	---	NA	NA	NA	YES
Thorium-234	7.10E+02	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-2.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
   a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
4. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
5. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-5. Screening Level Evaluation for Exposure Area 2 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	2.18E+04	2.50E+04	a	8.72E-01	no	9.79E+03	YES	no
Antimony	2.00E-01	2.70E-01	b	7.41E-01	no	4.74E+00	no	no
Arsenic	1.18E+01	6.80E+00	d	1.74E+00	YES	3.50E+00	YES	YES
Barium	2.11E+01	2.00E+01	a	1.06E+00	YES	5.47E+01	no	no
Beryllium	3.15E-01	2.50E+00	d	1.26E-01	no	7.73E-01	no	no
Cadmium	6.13E-02	2.70E-01	d	2.27E-01	no	3.69E-01	no	no
Calcium	5.18E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	3.20E+01	2.80E+01	bd	1.14E+00	YES	1.42E+01	YES	YES
Cobalt	1.59E+00	1.30E+01	bd	1.22E-01	no	2.63E+00	no	no
Copper	1.31E+01	1.50E+01	d	8.73E-01	no	6.52E+00	YES	no
Iron	4.90E+04	2.00E+04	ac	2.45E+00	YES	5.32E+03	YES	YES
Lead	2.58E+01	1.10E+01	b	2.35E+00	YES	1.10E+01	YES	YES
Magnesium	3.00E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	5.99E+01	2.20E+02	bd	2.72E-01	no	1.36E+02	no	no
Mercury	3.52E-02	3.50E-04	d	1.01E+02	YES	9.92E-02	no	no
Nickel	3.91E+00	9.70E+00	d	4.03E-01	no	4.48E+00	no	no
Potassium	1.98E+02	EN[7]	NA	NA	NA	2.39E+02	no	no
Selenium	2.06E+00	5.20E-01	bd	3.96E+00	YES	3.89E+00	no	no
Thallium	5.14E-01	5.00E-02	d	1.03E+01	YES	3.77E+00	no	no
Vanadium	1.12E+02	6.70E+00	d	1.67E+01	YES	2.48E+01	YES	YES
Zinc	1.96E+01	4.60E+01	b	4.26E-01	no	1.70E+01	YES	no
Organics *(mg/kg)*								
Acetone	4.60E-02	4.00E-02	a	1.15E+00	YES	- -	- -	YES
Bis[2-chloroethyl] ether	8.00E-01	4.76E+00	a	1.68E-01	no	- -	- -	no
Bis[2-ethylhexyl]phthalate	4.40E-02	2.00E-02	bd	2.20E+00	YES	- -	- -	YES
Toluene	1.90E-01	1.00E-02	c	1.90E+01	YES	- -	- -	YES
Radionuclides *(pCi/g)*								
Actinium-228	2.84E+00	---	d	NA	NA	2.69E+00	YES	YES
Americium-241	8.70E-02	1.90E+02	d	4.58E-04	no	3.55E-02	YES	no
Americium-243	1.26E-01	---	NA	NA	NA	- -	- -	YES
Bismuth-212	2.70E+00	---	NA	NA	NA	- -	- -	YES
Bismuth-214	1.71E+00	---	NA	NA	NA	4.53E+00	no	no
Carbon-14	7.00E-01	---	NA	NA	NA	- -	- -	YES
Cesium-137	1.80E+02	7.20E+02	c	2.50E-01	no	1.89E-01	YES	no
Curium-243/244	5.70E-02	---	NA	NA	NA	- -	- -	YES
Curium-245/246	7.60E-02	---	NA	NA	NA	- -	- -	YES
Lead-212	2.59E+00	---	NA	NA	NA	2.42E+00	YES	YES
Lead-214	2.33E+00	---	NA	NA	NA	- -	- -	YES
Neptunium-237	2.30E-02	1.20E+01	c	1.92E-03	no	- -	- -	no
Plutonium-238	4.40E-02	1.10E+02	c	4.00E-04	no	2.83E-02	YES	no
Plutonium-239/240	1.19E-01	1.10E+02	c	1.08E-03	no	5.13E-02	YES	no
Potassium-40	4.60E+00	---	NA	NA	NA	3.05E+00	YES	YES
Radium-226	1.50E+00	2.10E-01	c	7.14E+00	YES	9.14E+00	no	no
Radium-228	2.27E+00	2.60E-01	c	8.73E+00	YES	4.48E+00	no	no
Strontium-90	4.60E-01	1.50E+02	c	3.07E-03	no	7.54E-01	no	No
Thallium-208	1.02E+00	---	NA	NA	NA	- -	- -	YES
Thorium-228	1.56E+00	4.30E+01	d	3.63E-02	no	2.71E+00	no	no
Thorium-230	1.00E+00	5.20E+01	d	1.92E-02	no	2.19E+00	no	no
Thorium-232	1.64E+00	6.20E+00	d	2.65E-01	no	2.10E+00	no	no

Table C-5. Screening Level Evaluation for Exposure Area 2 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Radionuclides** (pCi/g) **cont'd								
Uranium-233/234	1.17E+00	4.40E+02	d	2.66E-03	no	1.28E+00	no	no
Uranium-235	5.70E-02	4.40E+02	d	1.30E-04	no	6.91E-02	no	no
Uranium-238	1.35E+00	4.00E+02	d	3.38E-03	no	1.31E+00	YES	no

1. Maximum detected concentration from Appendix A.1, Table A.1.2.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-6. Screening Level Evaluation for Exposure Area 2 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	4.54E+02	8.70E+01	b	5.22E+00	YES	2.77E+02	YES	YES
Antimony	1.50E+00	3.00E+01	c	5.00E-02	no	2.76E+01	no	no
Arsenic	2.10E+00	1.50E+02	abc	1.40E-02	no	1.00E+01	no	no
Barium	7.28E+01	3.90E+00	c	1.87E+01	YES	1.06E+02	no	no
Calcium	4.32E+04	1.16E+05	b	3.72E-01	no	4.43E+03	YES	no
Chromium	9.49E+00	1.10E+01	abc	8.63E-01	no	2.82E+00	YES	no
Cobalt	2.20E+00	3.00E+00	c	7.33E-01	no	2.48E+01	no	no
Copper	1.10E+00	2.90E+00	a	3.79E-01	no	6.58E+00	no	no
Iron	6.89E+03	1.00E+03	bc	6.89E+00	YES	1.14E+03	YES	YES
Magnesium	3.41E+03	8.20E+04	b	4.16E-02	no	1.72E+03	YES	no
Manganese	9.10E+02	9.30E+01	b	9.78E+00	YES	6.89E+01	YES	YES
Mercury	4.49E-01	1.30E-03	b	3.45E+02	YES	2.54E-01	YES	YES
Nickel	8.50E-01	1.60E+01	a	5.31E-02	no	6.44E+00	no	no
Potassium	5.23E+03	5.30E+04	b	9.87E-02	no	2.83E+03	YES	no
Sodium	6.30E+03	6.80E+05	b	9.26E-03	no	3.73E+03	YES	no
Thallium	1.90E+00	3.00E-02	c	6.33E+01	YES	1.35E+01	no	no
Vanadium	1.21E+00	1.90E+01	c	6.37E-02	no	2.49E+01	no	no
Zinc	6.88E+01	3.70E+01	a	1.86E+00	YES	2.84E+01	YES	YES
Organics *(µg/L)*								
2-Methylnaphthalene	2.91E-01	4.70E+00	b	6.19E-02	no	- -	- -	no
Acenaphthene	3.95E-01	5.80E+00	c	6.81E-02	no	- -	- -	no
Acenaphthylene	3.30E-01	1.30E+01	b	2.54E-02	no	- -	- -	no
Acetone	6.80E+00	1.50E+03	c	4.53E-03	no	- -	- -	no
Anthracene	4.05E-01	2.00E-02	b	2.03E+01	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	1.60E+01	3.00E+00	b	5.33E+00	YES	- -	- -	YES
Fluoranthene	3.35E-01	4.00E-02	c	8.38E+00	YES	- -	- -	YES
Naphthalene	3.68E-01	1.10E+00	c	3.35E-01	no	- -	- -	no
Pyrene	3.02E-01	2.50E-02	c	1.21E+01	YES	- -	- -	YES
Styrene	3.20E-01	3.20E+01	b	1.00E-02	no	- -	- -	no
Toluene	2.20E+00	9.80E+00	c	2.24E-01	no	- -	- -	no
Radionuclides *(pCi/L)*								
Bismuth-214	4.80E+01	---	NA	NA	NA	1.11E+01	YES	YES
Tritium	8.66E+02	1.60E+08	c	5.41E-06	no	- -	- -	no

1. Maximum detected concentration from Appendix A.1, Table A.1.2.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-7. Refinement Level Evaluation for Exposure Area 2 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Arsenic	5.53E+00	3.30E+01	ac	1.68E-01	no	no
Chromium	1.56E+01	1.10E+02	c	1.41E-01	no	no
Iron	1.94E+04	4.00E+04	ac	4.86E-01	no	no
Lead	7.61E+00	2.80E+01	d	2.72E-01	no	no
Vanadium	4.38E+01	1.30E+01	d	3.37E+00	YES	YES
Organics *(mg/kg)*						
Acetone	2.05E-02	6.50E-01	c	3.15E-02	no	no
Bis[2-ethylhexyl]phthalate	4.40E-02	2.00E-01	d	2.20E-01	no	no
Toluene	1.90E-01	1.00E-01	c	1.90E+00	YES	YES
Radionuclides *(pCi/g)*						
Actinium-228	1.18E+00	---	NA	NA	NA	YES
Americium-243	5.46E-02	---	NA	NA	NA	YES
Bismuth-212	8.86E-01	---	NA	NA	NA	YES
Carbon-14	7.00E-01	---	NA	NA	NA	YES
Curium-243 / -244	4.08E-02	---	NA	NA	NA	YES
Curium-245 / -246	4.91E-02	---	NA	NA	NA	YES
Lead-212	1.16E+00	---	NA	NA	NA	YES
Lead-214	1.00E+00	---	NA	NA	NA	YES
Potassium-40	1.20E+00	---	NA	NA	NA	YES
Thallium-208	4.58E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-5.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.2.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1, Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-8. Refinement Level Evaluation for Exposure Area 2 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Aluminum	2.36E+02	8.70E+01	b	2.71E+00	YES	YES
Iron	3.16E+03	1.00E+03	bc	3.16E+00	YES	YES
Manganese	4.67E+02	9.30E+01	b	5.02E+00	YES	YES
Mercury	4.49E-01	1.30E-03	b	3.45E+02	YES	YES
Zinc	2.08E+01	3.70E+01	a	5.62E-01	no	no
Organics *(µg/L)*						
Anthracene	4.05E-01	2.00E-02	b	2.03E+01	YES	YES
Bis[2-ethylhexyl]phthalate	1.60E+01	3.00E+00	b	5.33E+00	YES	YES
Fluoranthene	3.35E-01	4.00E-02	c	8.38E+00	YES	YES
Pyrene	3.02E-01	2.50E-02	c	1.21E+01	YES	YES
Radionuclides *(pCi/L)*						
Bismuth-214	4.80E+01	---	NA	NA	NA	YES

1 Analytes identified as COPECs from Table C-6.
2 EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.2.2, Surface Water (unfiltered results).
3 LTR RSV from Attachment C-1, Table II.B.
4 a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015).
5 Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6 COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-9. Screening Level Evaluation for Exposure Area 3 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	3.17E+04	2.50E+04	a	1.27E+00	YES	9.79E+03	YES	YES
Arsenic	5.30E+00	6.80E+00	d	7.79E-01	no	3.50E+00	YES	no
Barium	6.47E+01	2.00E+01	a	3.24E+00	YES	5.47E+01	YES	YES
Beryllium	7.96E-01	2.50E+00	d	3.18E-01	no	7.73E-01	YES	no
Cadmium	6.05E-01	2.70E-01	d	2.24E+00	YES	3.69E-01	YES	YES
Calcium	4.86E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	6.14E+01	2.80E+01	bd	2.19E+00	YES	1.42E+01	YES	YES
Cobalt	5.63E+00	1.30E+01	bd	4.33E-01	no	2.63E+00	YES	no
Copper	2.09E+01	1.50E+01	d	1.39E+00	YES	6.52E+00	YES	YES
Iron	3.26E+04	2.00E+04	ac	1.63E+00	YES	5.32E+03	YES	YES
Lead	2.33E+01	1.10E+01	b	2.12E+00	YES	1.10E+01	YES	YES
Magnesium	7.44E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	1.76E+02	2.20E+02	bd	8.00E-01	no	1.36E+02	YES	no
Mercury	7.31E-02	3.50E-04	d	2.09E+02	YES	9.92E-02	no	no
Nickel	1.19E+01	9.70E+00	d	1.23E+00	YES	4.48E+00	YES	YES
Potassium	5.52E+02	EN[7]	NA	NA	NA	2.39E+02	YES	no
Selenium	1.23E+00	5.20E-01	bd	2.37E+00	YES	3.89E+00	no	no
Sodium	5.85E+01	EN[7]	d	NA	NA	7.33E+01	no	no
Thallium	9.44E-01	5.00E-02	d	1.89E+01	YES	3.77E+00	no	no
Vanadium	5.78E+01	6.70E+00	d	8.63E+00	YES	2.48E+01	YES	YES
Zinc	5.66E+01	4.60E+01	b	1.23E+00	YES	1.70E+01	YES	YES
Organics *(mg/kg)*								
Acetone	4.07E-01	4.00E-02	a	1.02E+01	YES	- -	- -	YES
Carbon disulfide	1.11E-02	3.60E-03	a	3.08E+00	YES	- -	- -	YES
Methyl ethyl ketone	6.04E-02	9.92E-01	a	6.09E-02	no	- -	- -	no
Toluene	2.93E-03	1.00E-02	c	2.93E-01	no	- -	- -	no
Pesticides/PCBs *(mg/kg)*								
DDE	3.28E-03	2.07E-03	a	1.58E+00	YES	- -	- -	YES
Radionuclides *(pCi/g)*								
Actinium-228	2.55E+00	---	d	NA	NA	2.69E+00	no	no
Bismuth-214	1.57E+00	---	NA	NA	NA	4.53E+00	no	no
Cesium-137	4.57E+02	7.20E+02	c	6.34E-01	no	1.89E-01	YES	no
Lead-212	2.24E+00	---	NA	NA	NA	2.42E+00	no	no
Lead-214	1.79E+00	---	NA	NA	NA	- -	- -	YES
Potassium-40	3.04E+00	---	NA	NA	NA	3.05E+00	no	no
Radium-226	1.33E+00	2.10E-01	c	6.33E+00	YES	9.14E+00	no	no
Thallium-208	6.89E-01	---	NA	NA	NA	- -	- -	YES
Thorium-228	3.13E+00	4.30E+01	d	7.28E-02	no	2.71E+00	YES	no
Thorium-230	1.35E+00	5.20E+01	d	2.60E-02	no	2.19E+00	no	no
Thorium-232	2.45E+00	6.20E+00	d	3.95E-01	no	2.10E+00	YES	no
Uranium-233/-234	1.88E+00	4.40E+02	d	4.27E-03	no	1.28E+00	YES	no
Uranium-238	1.68E+00	4.00E+02	d	4.20E-03	no	1.31E+00	YES	no

1. Maximum detected concentration from Appendix A.1, Table A.1.3.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1 Table A.1.10 IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-10. Screening Level Evaluation for Exposure Area 3 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	4.94E+01	8.70E+01	b	5.68E-01	no	2.77E+02	no	no
Barium	2.66E+01	3.90E+00	c	6.82E+00	YES	1.06E+02	no	no
Calcium	1.09E+04	1.16E+05	b	9.40E-02	no	4.43E+03	YES	no
Chromium	9.49E+00	1.10E+01	abc	8.63E-01	no	2.82E+00	YES	no
Iron	9.17E+02	1.00E+03	bc	9.17E-01	no	1.14E+03	no	no
Lead	3.67E+00	5.40E-01	a	6.80E+00	YES	3.85E+00	no	no
Magnesium	1.11E+03	8.20E+04	b	1.35E-02	no	1.72E+03	no	no
Manganese	4.02E+01	9.30E+01	b	4.32E-01	no	6.89E+01	no	no
Mercury	4.49E-01	1.30E-03	b	3.45E+02	YES	2.54E-01	YES	YES
Nickel	9.50E-01	1.60E+01	a	5.94E-02	no	6.44E+00	no	no
Potassium	4.65E+02	5.30E+04	b	8.77E-03	no	2.83E+03	no	no
Sodium	6.21E+03	6.80E+05	b	9.13E-03	no	3.73E+03	YES	no
Vanadium	1.21E+00	1.90E+01	c	6.37E-02	no	2.49E+01	no	no
Zinc	6.71E+00	3.70E+01	a	1.81E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
2-Methylnaphthalene	2.91E-01	4.70E+00	b	6.19E-02	no	--	--	no
Acenaphthene	3.95E-01	5.80E+00	c	6.81E-02	no	--	--	no
Acenaphthylene	3.30E-01	1.30E+01	b	2.54E-02	no	--	--	no
Anthracene	4.05E-01	2.00E-02	b	2.03E+01	YES	--	--	YES
Bis[2-ethylhexyl]phthalate	3.26E-01	3.00E+00	b	1.09E-01	no	--	--	no
Fluoranthene	3.35E-01	4.00E-02	c	8.38E+00	YES	--	--	YES
Naphthalene	3.68E-01	1.10E+00	c	3.35E-01	no	--	--	no
Pyrene	3.02E-01	2.50E-02	c	1.21E+01	YES	--	--	YES
Radionuclides *(pCi/L)*								
Cesium-137	8.30E+00	1.10E+03	c	7.55E-03	no	1.70E+00	YES	no
Tritium	8.66E+02	1.60E+08	c	5.41E-06	no	- -	- -	no

1. Maximum detected concentration from Appendix A.1, Table A.1.3.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-11. Refinement Level Evaluation for Exposure Area 3 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Aluminum	3.17E+04	5.80E+04	a	5.47E-01	no	no
Barium	6.47E+01	6.00E+01	a	1.08E+00	YES	YES
Cadmium	6.05E-01	2.70E+00	d	2.24E-01	no	no
Chromium	6.14E+01	1.10E+02	c	5.58E-01	no	no
Copper	1.36E+01	4.60E+01	d	2.95E-01	no	no
Iron	2.59E+04	4.00E+04	ac	6.47E-01	no	no
Lead	1.69E+01	2.80E+01	d	6.02E-01	no	no
Nickel	1.19E+01	1.90E+01	d	6.26E-01	no	no
Vanadium	5.40E+01	1.30E+01	d	4.15E+00	YES	YES
Zinc	5.66E+01	4.59E+02	a	1.23E-01	no	no
Organics *(mg/kg)*						
Acetone	4.07E-01	6.50E-01	c	6.26E-01	no	no
Carbon disulfide	1.11E-02	8.20E+00	d	1.35E-03	no	no
Pesticides/PCBs *(mg/kg)*						
DDE	3.28E-03	3.74E-03	a	8.77E-01	no	no
Radionuclides *(pCi/g)*						
Lead-214	1.16E+00	---	NA	NA	NA	YES
Thallium-208	4.66E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-9.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.3.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1, Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-12. Refinement Level Evaluation for Exposure Area 3 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Mercury	4.49E-01	1.30E-03	b	3.45E+02	YES	YES
Organics *(µg/L)*						
Anthracene	4.05E-01	2.00E-02	b	2.03E+01	YES	YES
Fluoranthene	3.35E-01	4.00E-02	c	8.38E+00	YES	YES
Pyrene	3.02E-01	2.50E-02	c	1.21E+01	YES	YES

1. Analytes identified as COPECs from Table C-10.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.3.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1 Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-13. Screening Level Evaluation for Exposure Area 4 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	9.49E+03	2.50E+04	a	3.80E-01	no	9.79E+03	no	no
Arsenic	2.80E+00	6.80E+00	d	4.12E-01	no	3.50E+00	no	no
Barium	3.01E+01	2.00E+01	a	1.51E+00	YES	5.47E+01	no	no
Beryllium	1.76E-01	2.50E+00	d	7.04E-02	no	7.73E-01	no	no
Cadmium	1.33E-02	2.70E-01	d	4.93E-02	no	3.69E-01	no	no
Calcium	1.28E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	1.30E+01	2.80E+01	bd	4.64E-01	no	1.42E+01	no	no
Cobalt	8.10E-01	1.30E+01	bd	6.23E-02	no	2.63E+00	no	no
Copper	3.96E+00	1.50E+01	d	2.64E-01	no	6.52E+00	no	no
Iron	1.39E+04	2.00E+04	ac	6.95E-01	no	5.32E+03	YES	no
Lead	8.84E+00	1.10E+01	b	8.04E-01	no	1.10E+01	no	no
Magnesium	1.18E+02	EN[7]	NA	NA	NA	2.75E+02	no	no
Manganese	1.04E+02	2.20E+02	bd	4.73E-01	no	1.36E+02	no	no
Mercury	1.96E-02	3.50E-04	d	5.60E+01	YES	9.92E-02	no	no
Nickel	2.84E+00	9.70E+00	d	2.93E-01	no	4.48E+00	no	no
Potassium	1.09E+02	EN[7]	NA	NA	NA	2.39E+02	no	no
Selenium	7.25E-01	5.20E-01	bd	1.39E+00	YES	3.89E+00	no	no
Vanadium	5.11E+01	6.70E+00	d	7.63E+00	YES	2.48E+01	YES	YES
Zinc	5.46E+00	4.60E+01	b	1.19E-01	no	1.70E+01	no	no
Organics *(mg/kg)*								
Acetone	2.30E-02	4.00E-02	a	5.75E-01	no	- -	- -	no
Bis[2-ethylhexyl]phthalate	5.20E-02	2.00E-02	bd	2.60E+00	YES	- -	- -	YES
Carbon disulfide	2.40E-03	3.60E-03	a	6.67E-01	no	- -	- -	no
Chloroform	1.10E-03	4.50E-02	a	2.44E-02	no	- -	- -	no
Chrysene	4.20E-02	1.60E-01	c	2.63E-01	no	- -	- -	no
Pesticides/PCBs *(mg/kg)*								
DDT	4.90E-03	1.19E-03	a	4.12E+00	YES	- -	- -	YES
Radionuclides *(pCi/g)*								
Actinium-228	1.93E+00	---	d	NA	NA	2.69E+00	no	no
Americium-241	3.20E-02	1.90E+02	d	1.68E-04	no	3.55E-02	no	no
Americium-243	6.70E-02	---	NA	NA	NA	- -	- -	YES
Bismuth-212	1.98E+00	---	NA	NA	NA	- -	- -	YES
Bismuth-214	1.61E+00	---	NA	NA	NA	4.53E+00	no	no
Carbon-14	6.30E-01	---	NA	NA	NA	- -	- -	YES
Cesium-137	5.00E+01	7.20E+02	c	6.94E-02	no	1.89E-01	YES	no
Curium-243/ -244	4.00E-02	---	NA	NA	NA	- -	- -	YES
Lead-212	1.66E+00	---	NA	NA	NA	2.42E+00	no	no
Lead-214	1.80E+00	---	NA	NA	NA	- -	- -	YES
Plutonium-238	1.08E-01	1.10E+02	c	9.82E-04	no	2.83E-02	YES	no
Plutonium-239/ -240	2.60E-02	1.10E+02	c	2.36E-04	no	5.13E-02	no	no
Potassium-40	2.83E+00	---	NA	NA	NA	3.05E+00	no	no
Radium-226	1.44E+00	2.10E-01	c	6.86E+00	YES	9.14E+00	no	no
Radium-228	1.48E+00	2.60E-01	c	5.69E+00	YES	4.48E+00	no	no
Thallium-208	7.30E-01	---	NA	NA	NA	- -	- -	YES
Thorium-228	1.68E+00	4.30E+01	d	3.91E-02	no	2.71E+00	no	no
Thorium-230	1.11E+00	5.20E+01	d	2.13E-02	no	2.19E+00	no	no
Thorium-232	1.42E+00	6.20E+00	d	2.29E-01	no	2.10E+00	no	no
Uranium-233/ -234	8.80E-01	4.40E+02	d	2.00E-03	no	1.28E+00	no	no
Uranium-235	3.50E-02	4.40E+02	d	7.95E-05	no	6.91E-02	no	no
Uranium-238	9.50E-01	4.00E+02	d	2.38E-03	no	1.31E+00	no	no

Table C-13. Screening Level Evaluation for Exposure Area 4 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]

1. Maximum detected concentration from Appendix A.1, Table A.1.4.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-14. Screening Level Evaluation for Exposure Area 4 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	3.64E+02	8.70E+01	b	4.18E+00	YES	2.77E+02	YES	YES
Antimony	5.30E-01	3.00E+01	c	1.77E-02	no	2.76E+01	no	no
Barium	2.69E+01	3.90E+00	c	6.90E+00	YES	1.06E+02	no	no
Beryllium	1.20E-01	6.60E-01	c	1.82E-01	no	5.66E-01	no	no
Cadmium	9.00E-02	1.00E-01	a	9.00E-01	no	1.72E+00	no	no
Calcium	5.10E+03	1.16E+05	b	4.40E-02	no	4.43E+03	YES	no
Chromium	3.60E+00	1.10E+01	abc	3.27E-01	no	2.82E+00	YES	no
Cobalt	9.50E-01	3.00E+00	c	3.17E-01	no	2.48E+01	no	no
Copper	1.50E+00	2.90E+00	a	5.17E-01	no	6.58E+00	no	no
Iron	5.26E+03	1.00E+03	bc	5.26E+00	YES	1.14E+03	YES	YES
Lead	8.10E-01	5.40E-01	a	1.50E+00	YES	3.85E+00	no	no
Magnesium	7.93E+02	8.20E+04	b	9.67E-03	no	1.72E+03	no	no
Manganese	2.37E+02	9.30E+01	b	2.55E+00	YES	6.89E+01	YES	YES
Mercury	9.70E-02	1.30E-03	b	7.46E+01	YES	2.54E-01	no	no
Potassium	2.65E+03	5.30E+04	b	5.00E-02	no	2.83E+03	no	no
Sodium	2.76E+03	6.80E+05	b	4.06E-03	no	3.73E+03	no	no
Thallium	2.00E+00	3.00E-02	c	6.67E+01	YES	1.35E+01	no	no
Vanadium	1.09E+00	1.90E+01	c	5.74E-02	no	2.49E+01	no	no
Zinc	1.11E+01	3.70E+01	a	3.00E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
1,4-Dichlorobenzene	5.25E-01	9.40E+00	b	5.59E-02	no	---	---	no
Anthracene	2.31E-01	2.00E-02	b	1.16E+01	YES	---	---	YES
Benzo[a]anthracene	3.09E-01	2.70E-02	c	1.14E+01	YES	---	---	YES
Bis[2-ethylhexyl]phthalate	1.20E+01	3.00E+00	b	4.00E+00	YES	---	---	YES
Bromoform	9.40E-01	2.30E+02	b	4.09E-03	no	---	---	no
Caprolactam	1.28E+00	---	NA	NA	NA	---	---	YES
Dibromochloromethane	3.90E-01	3.20E+02	b	1.22E-03	no	---	---	no
Fluoranthene	2.59E-01	4.00E-02	c	6.48E+00	YES	---	---	YES
Fluorene	1.85E-01	3.90E+00	c	4.74E-02	no	---	---	no
Pyrene	3.05E-01	2.50E-02	c	1.22E+01	YES	---	---	YES
Toluene	5.30E-01	9.80E+00	c	5.41E-02	no	---	---	no
Radionuclides *(pCi/L*								
Tritium	6.80E+02	1.60E+08	c	4.25E-06	no	---	---	no

1. Maximum detected concentration from Appendix A.1, Table A.1.4.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-15. Refinement Level Evaluation for Exposure Area 4 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Vanadium	3.10E+01	1.30E+01	d	2.39E+00	YES	YES
Organics *(mg/kg)*						
Bis[2-ethylhexyl]phthalate	5.20E-02	2.00E-01	d	2.60E-01	no	no
Pesticides/PCBs *(mg/kg)*						
DDT	4.90E-03	4.77E-03	a	1.03E+00	YES	YES
Radionuclides *(pCi/g)*						
Americium-243	6.70E-02	---	NA	NA	NA	YES
Bismuth-212	9.00E-01	---	NA	NA	NA	YES
Carbon-14	5.89E-01	---	NA	NA	NA	YES
Curium-243/-244	4.00E-02	---	NA	NA	NA	YES
Lead-214	1.06E+00	---	NA	NA	NA	YES
Thallium-208	4.47E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-13.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.4.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1, Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-16. Refinement Level Evaluation for Exposure Area 4 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Aluminum	1.83E+02	8.70E+01	b	2.10E+00	YES	YES
Iron	3.23E+03	1.00E+03	bc	3.23E+00	YES	YES
Manganese	1.65E+02	9.30E+01	b	1.77E+00	YES	YES
Organics *(µg/L)*						
Anthracene	2.31E-01	2.00E-02	b	1.16E+01	YES	YES
Benzo[a]anthracene	3.09E-01	2.70E-02	c	1.14E+01	YES	YES
Bis[2-ethylhexyl]phthalate	5.51E+00	3.00E+00	b	1.84E+00	YES	YES
Caprolactam	1.28E+00	---	NA	NA	NA	YES
Fluoranthene	2.59E-01	4.00E-02	c	6.48E+00	YES	YES
Pyrene	3.05E-01	2.50E-02	c	1.22E+01	YES	YES

1. Analytes identified as COPECs from Table C-14.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.4.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-17. Screening Level Evaluation for Exposure Area 5 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	2.13E+04	2.50E+04	a	8.52E-01	no	9.79E+03	YES	no
Antimony	5.98E-01	2.70E-01	b	2.21E+00	YES	4.74E+00	no	no
Arsenic	2.90E+00	6.80E+00	d	4.26E-01	no	3.50E+00	no	no
Barium	1.02E+02	2.00E+01	a	5.10E+00	YES	5.47E+01	YES	YES
Beryllium	9.61E-01	2.50E+00	d	3.84E-01	no	7.73E-01	YES	no
Cadmium	2.23E-01	2.70E-01	d	8.26E-01	no	3.69E-01	no	no
Calcium	4.30E+04	EN[7]	NA	NA	NA	1.12E+03	YES	no
Chromium	5.62E+01	2.80E+01	bd	2.01E+00	YES	1.42E+01	YES	YES
Cobalt	9.90E+00	1.30E+01	bd	7.62E-01	no	2.63E+00	YES	no
Copper	2.83E+01	1.50E+01	d	1.89E+00	YES	6.52E+00	YES	YES
Cyanide	1.28E+00	1.00E-01	cd	1.28E+01	YES	- -	- -	YES
Iron	2.46E+04	2.00E+04	ac	1.23E+00	YES	5.32E+03	YES	YES
Lead	2.56E+01	1.10E+01	b	2.33E+00	YES	1.10E+01	YES	YES
Magnesium	1.27E+03	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	9.52E+02	2.20E+02	bd	4.33E+00	YES	1.36E+02	YES	YES
Mercury	2.29E-01	3.50E-04	d	6.54E+02	YES	9.92E-02	YES	YES
Nickel	8.03E+00	9.70E+00	d	8.28E-01	no	4.48E+00	YES	no
Potassium	5.01E+02	EN[7]	NA	NA	NA	2.39E+02	YES	no
Selenium	5.96E-01	5.20E-01	bd	1.15E+00	YES	3.89E+00	no	no
Sodium	3.76E+01	EN[7]	d	NA	NA	7.33E+01	no	no
Vanadium	4.51E+01	6.70E+00	d	6.73E+00	YES	2.48E+01	YES	YES
Zinc	5.34E+01	4.60E+01	b	1.16E+00	YES	1.70E+01	YES	YES
Organics *(mg/kg)*								
Acetone	5.40E-01	4.00E-02	a	1.35E+01	YES	- -	- -	YES
Carbon disulfide	1.77E-03	3.60E-03	a	4.92E-01	no	- -	- -	no
Methyl ethyl ketone	3.31E-02	9.92E-01	a	3.34E-02	no	- -	- -	no
Toluene	6.57E-03	1.00E-02	c	6.57E-01	no	- -	- -	no
Pesticides/PCBs *(mg/kg)*								
DDE	4.41E-03	2.07E-03	a	2.13E+00	YES	- -	- -	YES
DDT	1.14E-02	1.19E-03	a	9.58E+00	YES	- -	- -	YES
PCB-1260	5.30E-03	5.90E-02	c	8.98E-02	no	- -	- -	no
Radionuclides *(pCi/g)*								
Actinium-228	3.99E+00	---	d	NA	NA	2.69E+00	YES	YES
Americium-241	2.12E-01	1.90E+02	d	1.12E-03	no	3.55E-02	YES	no
Americium-243	3.41E-01	---	NA	NA	NA	- -	- -	YES
Bismuth-214	2.99E+00	---	NA	NA	NA	4.53E+00	no	no
Cesium-137	4.05E+02	7.20E+02	c	5.63E-01	no	1.89E-01	YES	no
Cobalt-60	1.83E+00	2.10E+02	c	8.71E-03	no	- -	- -	no
Lead-212	4.06E+00	---	NA	NA	NA	2.42E+00	YES	YES
Lead-214	2.69E+00	---	NA	NA	NA	- -	- -	YES
Potassium-40	5.49E+00	---	NA	NA	NA	3.05E+00	YES	YES
Radium-226	2.12E+00	2.10E-01	c	1.01E+01	YES	9.14E+00	no	no
Radium-228	1.12E+00	2.60E-01	c	4.31E+00	YES	4.48E+00	no	no
Thallium-208	1.30E+00	---	NA	NA	NA	- -	- -	YES
Thorium-228	3.34E+00	4.30E+01	d	7.77E-02	no	2.71E+00	YES	no
Thorium-230	1.79E+00	5.20E+01	d	3.44E-02	no	2.19E+00	no	no
Thorium-232	3.22E+00	6.20E+00	d	5.19E-01	no	2.10E+00	YES	no
Uranium-233/ -234	2.21E+00	4.40E+02	d	5.02E-03	no	1.28E+00	YES	no
Uranium-235	1.52E-01	4.40E+02	d	3.45E-04	no	6.91E-02	YES	no
Uranium-238	2.44E+00	4.00E+02	d	6.10E-03	no	1.31E+00	YES	no

Table C-17. Screening Level Evaluation for Exposure Area 5 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]

1. Maximum detected concentration from Appendix A.1, Table A.1.5.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1 Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-18. Screening Level Evaluation for Exposure Area 5 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	1.57E+02	8.70E+01	b	1.80E+00	YES	2.77E+02	no	no
Arsenic	3.30E+00	1.50E+02	abc	2.20E-02	no	1.00E+01	no	no
Barium	1.45E+01	3.90E+00	c	3.72E+00	YES	1.06E+02	no	no
Beryllium	2.00E-01	6.60E-01	c	3.03E-01	no	5.66E-01	no	no
Calcium	2.42E+03	1.16E+05	b	2.09E-02	no	4.43E+03	no	no
Copper	1.83E+00	2.90E+00	a	6.31E-01	no	6.58E+00	no	no
Cyanide	5.00E+00	5.20E+00	c	9.62E-01	no	---	---	no
Iron	1.76E+03	1.00E+03	bc	1.76E+00	YES	1.14E+03	YES	YES
Lead	2.58E+00	5.40E-01	a	4.78E+00	YES	3.85E+00	no	no
Magnesium	5.37E+02	8.20E+04	b	6.55E-03	no	1.72E+03	no	no
Manganese	4.91E+01	9.30E+01	b	5.28E-01	no	6.89E+01	no	no
Potassium	5.15E+02	5.30E+04	b	9.72E-03	no	2.83E+03	no	no
Sodium	2.15E+03	6.80E+05	b	3.16E-03	no	3.73E+03	no	no
Vanadium	8.14E-01	1.90E+01	c	4.28E-02	no	2.49E+01	no	no
Zinc	9.37E+00	3.70E+01	a	2.53E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
2-Chlorophenol	4.56E-01	3.20E+01	b	1.43E-02	no	---	---	no
Acetone	4.36E+00	1.50E+03	c	2.91E-03	no	---	---	no
Methylene chloride	5.80E-01	2.10E+02	c	2.76E-03	no	---	---	no
Naphthalene	2.22E-01	1.10E+00	c	2.02E-01	no	---	---	no
Pesticides *(µg/L)*								
DDE	2.88E-02	4.10E-01	b	7.02E-02	no	---	---	no
DDT	6.60E-02	1.00E-03	ac	6.60E+01	YES	---	---	YES
Radionuclides *(pCi/L)*								
Bismuth-214	7.02E+01	---	NA	NA	NA	1.11E+01	YES	YES
Lead-214	4.97E+01	---	NA	NA	NA	---	---	YES
Tritium	2.99E+03	1.60E+08	c	1.87E-05	no	---	---	no

1. Maximum detected concentration from Appendix A.1, Table A.1.5.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1 Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-19. Refinement Level Evaluation for Exposure Area 5 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Barium	9.58E+01	6.00E+01	a	1.60E+00	YES	YES
Chromium	5.08E+01	1.10E+02	c	4.61E-01	no	no
Copper	2.28E+01	4.60E+01	d	4.95E-01	no	no
Cyanide	1.28E+00	1.00E+00	cd	1.28E+00	YES	YES
Iron	1.95E+04	4.00E+04	ac	4.88E-01	no	no
Lead	2.34E+01	2.80E+01	d	8.36E-01	no	no
Manganese	9.38E+02	1.10E+03	acd	8.53E-01	no	no
Mercury	2.05E-01	3.50E-03	d	5.86E+01	YES	YES
Vanadium	3.58E+01	1.30E+01	d	2.75E+00	YES	YES
Zinc	5.34E+01	4.59E+02	a	1.16E-01	no	no
Organics *(mg/kg)*						
Acetone	5.40E-01	6.50E-01	c	8.31E-01	no	no
Pesticides/PCBs *(mg/kg)*						
DDE	4.41E-03	3.74E-03	a	1.18E+00	YES	YES
DDT	1.14E-02	4.77E-03	a	2.39E+00	YES	YES
Radionuclides *(pCi/g)*						
Actinium-228	2.19E+00	---	NA	NA	NA	YES
Americium-243	3.41E-01	---	NA	NA	NA	YES
Lead-212	2.01E+00	---	NA	NA	NA	YES
Lead-214	1.82E+00	---	NA	NA	NA	YES
Potassium-40	2.71E+00	---	NA	NA	NA	YES
Thallium-208	5.83E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-17.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.5.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1 Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-20. Refinement Level Evaluation for Exposure Area 5 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Iron	1.31E+03	1.00E+03	bc	1.31E+00	YES	YES
Pesticides *(µg/L)*						
DDT	6.60E-02	1.00E-03	ac	6.60E+01	YES	YES
Radionuclides *(pCi/L)*						
Bismuth-214	7.02E+01	---	NA	NA	NA	YES
Lead-214	3.39E+01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-18.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.5.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-21. Screening Level Evaluation for Exposure Area 6 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	1.82E+04	2.50E+04	a	7.28E-01	no	9.79E+03	YES	no
Antimony	1.10E+01	2.70E-01	b	4.07E+01	YES	4.74E+00	YES	YES
Arsenic	7.67E+00	6.80E+00	d	1.13E+00	YES	3.50E+00	YES	YES
Barium	1.47E+02	2.00E+01	a	7.35E+00	YES	5.47E+01	YES	YES
Beryllium	1.33E+00	2.50E+00	d	5.32E-01	no	7.73E-01	YES	no
Cadmium	5.90E-01	2.70E-01	d	2.19E+00	YES	3.69E-01	YES	YES
Calcium	1.46E+03	EN[7]	NA	NA	NA	1.12E+03	YES	no
Chloride	1.65E+01	---	NA	NA	NA	- -	- -	YES
Chromium	2.54E+01	2.80E+01	bd	9.07E-01	no	1.42E+01	YES	no
Chromium VI	6.20E-01	3.40E-01	d	1.82E+00	YES	- -	- -	YES
Cobalt	7.75E+00	1.30E+01	bd	5.96E-01	no	2.63E+00	YES	no
Copper	7.03E+00	1.50E+01	d	4.69E-01	no	6.52E+00	YES	no
Cyanide	3.40E+00	1.00E-01	cd	3.40E+01	YES	- -	- -	YES
Iron	2.78E+04	2.00E+04	ac	1.39E+00	YES	5.32E+03	YES	YES
Lead	1.79E+01	1.10E+01	b	1.63E+00	YES	1.10E+01	YES	YES
Magnesium	3.03E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	2.66E+02	2.20E+02	bd	1.21E+00	YES	1.36E+02	YES	YES
Mercury	9.58E-01	3.50E-04	d	2.74E+03	YES	9.92E-02	YES	YES
Nickel	9.15E+00	9.70E+00	d	9.43E-01	no	4.48E+00	YES	no
Orthophosphate	1.19E+01	---	NA	NA	NA	- -	- -	YES
Phosphate	7.22E+02	---	NA	NA	NA	- -	- -	YES
Potassium	2.26E+02	EN[7]	NA	NA	NA	2.39E+02	no	no
Selenium	7.64E+00	5.20E-01	bd	1.47E+01	YES	3.89E+00	YES	YES
Silver	9.03E-01	5.00E-01	c	1.81E+00	YES	1.16E+00	no	no
Sodium	3.07E+01	EN[7]	d	NA	NA	7.33E+01	no	no
Thallium	6.89E+00	5.00E-02	d	1.38E+02	YES	3.77E+00	YES	YES
Vanadium	5.71E+01	6.70E+00	d	8.52E+00	YES	2.48E+01	YES	YES
Zinc	3.18E+01	4.60E+01	b	6.91E-01	no	1.70E+01	YES	no
Organics (*mg/kg)*								
2-Chlorophenol	5.92E-02	5.50E-02	c	1.08E+00	YES	- -	- -	YES
Acetone	9.33E-02	4.00E-02	a	2.33E+00	YES	- -	- -	YES
Benzoic acid	2.47E-01	1.00E-02	b	2.47E+01	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	3.05E-02	2.00E-02	bd	1.53E+00	YES	- -	- -	YES
Butylbenzylphthalate	3.64E-02	1.00E-01	c	3.64E-01	no	- -	- -	no
Carbon disulfide	1.92E-02	3.60E-03	a	5.33E+00	YES	- -	- -	YES
Cinnamyl Cinnamate	2.60E-01	---	NA	NA	NA	- -	- -	YES
Dibutylphthalate	2.84E-02	1.10E-02	bcd	2.58E+00	YES	- -	- -	YES
Diethylphthalate	2.07E-02	2.30E-01	b	9.00E-02	no	- -	- -	no
Fluoranthene	3.38E-02	4.20E-01	c	8.05E-02	no	- -	- -	no
Methyl cyclopentane	3.00E-03	---	NA	NA	NA	- -	- -	YES
Methyl ethyl ketone	2.75E-03	9.92E-01	a	2.77E-03	no	- -	- -	no
Methyl isobutyl ketone	8.41E-04	---	NA	NA	NA	- -	- -	YES
Phenol	4.88E-03	1.20E-01	a	4.07E-02	no	- -	- -	no
Styrene	1.38E-04	1.16E-01	a	1.19E-03	no	- -	- -	no
Toluene	3.05E-03	1.00E-02	c	3.05E-01	no	- -	- -	no
Xylenes	4.55E-04	1.00E-01	b	4.55E-03	no	- -	- -	no
Phenols	3.15E-01	1.20E-01	a	2.63E+00	YES	- -	- -	YES
Radionuclides *(pCi/g)*								
Actinium-228	2.35E+00	---	d	NA	NA	2.69E+00	no	no
Barium-133	2.70E-01	---	NA	NA	NA	- -	- -	YES
Cesium-134	1.30E-01	3.30E+02	c	3.94E-04	no	- -	- -	no
Cesium-137	1.24E+02	7.20E+02	c	1.72E-01	no	1.89E-01	YES	no
Cobalt-58	3.23E-02	---	NA	NA	NA	- -	- -	YES
Cobalt-60	1.13E+00	2.10E+02	c	5.38E-03	no	- -	- -	no

Table C-21. Screening Level Evaluation for Exposure Area 6 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Radionuclides *(pCi/g)*								
Europium-152	4.70E-01	1.70E+01	c	2.76E-02	no	- -	- -	no
Europium-155	3.30E-01	---	NA	NA	NA	- -	- -	YES
Lead-212	2.40E+00	---	NA	NA	NA	2.42E+00	no	no
Lead-214	1.46E+00	---	NA	NA	NA	- -	- -	YES
Manganese-54	4.92E-02	---	NA	NA	NA	- -	- -	YES
Neptunium-239	3.10E+00	---	NA	NA	NA	- -	- -	YES
Plutonium-238	6.90E-01	1.10E+02	c	6.27E-03	no	2.83E-02	YES	no
Plutonium-239	4.60E-01	1.10E+02	c	4.18E-03	no	- -	- -	no
Plutonium-239/ -240	1.10E-01	1.10E+02	c	1.00E-03	no	5.13E-02	YES	no
Potassium-40	4.38E+00	---	NA	NA	NA	3.05E+00	YES	YES
Promethium-146	1.25E-02	---	NA	NA	NA	- -	- -	YES
Radium-226	1.13E+00	2.10E-01	c	5.38E+00	YES	9.14E+00	no	no
Radium-228	1.89E+00	2.60E-01	c	7.27E+00	YES	4.48E+00	no	no
Ruthenium-106	2.30E-01	---	NA	NA	NA	- -	- -	YES
Strontium-89/ -90	1.45E+01	1.50E+02	c	9.67E-02	no	- -	- -	no
Strontium-90	1.52E+00	1.50E+02	c	1.01E-02	no	7.54E-01	YES	no
Thorium-228	1.12E+00	4.30E+01	d	2.60E-02	no	2.71E+00	no	no
Thorium-230	5.42E-01	5.20E+01	d	1.04E-02	no	2.19E+00	no	no
Thorium-232	1.06E+00	6.20E+00	d	1.71E-01	no	2.10E+00	no	no
Thorium-234	5.59E+00	---	NA	NA	NA	8.69E-01	YES	YES
Tin-113	7.00E-02	---	NA	NA	NA	- -	- -	YES
Uranium-233/ -234	7.44E-01	4.40E+02	d	1.69E-03	no	1.28E+00	no	no
Uranium-235	1.08E-01	4.40E+02	d	2.45E-04	no	6.91E-02	YES	no
Uranium-238	5.89E-01	4.00E+02	d	1.47E-03	no	1.31E+00	no	no
Zinc-65	1.60E-01	---	NA	NA	NA	- -	- -	YES
Zirconium-95	7.01E-02	---	NA	NA	NA	- -	- -	YES

1. Maximum detected concentration from Appendix A.1, Table A.1.6.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-22. Screening Level Evaluation for Exposure Area 6 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	7.86E+01	8.70E+01	b	9.03E-01	no	2.77E+02	no	no
Antimony	1.62E+00	3.00E+01	c	5.40E-02	no	2.76E+01	no	no
Arsenic	4.29E+00	1.50E+02	abc	2.86E-02	no	1.00E+01	no	no
Barium	1.58E+01	3.90E+00	c	4.05E+00	YES	1.06E+02	no	no
Cadmium	1.20E-01	1.00E-01	a	1.20E+00	YES	1.72E+00	no	no
Calcium	5.06E+03	1.16E+05	b	4.36E-02	no	4.43E+03	YES	no
Chromium	2.06E+00	1.10E+01	abc	1.87E-01	no	2.82E+00	no	no
Cobalt	4.69E-01	3.00E+00	c	1.56E-01	no	2.48E+01	no	no
Iron	1.09E+03	1.00E+03	bc	1.09E+00	YES	1.14E+03	no	no
Lead	3.71E+00	5.40E-01	a	6.87E+00	YES	3.85E+00	no	no
Magnesium	7.66E+02	8.20E+04	b	9.34E-03	no	1.72E+03	no	no
Manganese	2.00E+02	9.30E+01	b	2.15E+00	YES	6.89E+01	YES	YES
Nickel	9.89E-01	1.60E+01	a	6.18E-02	no	6.44E+00	no	no
Potassium	9.65E+02	5.30E+04	b	1.82E-02	no	2.83E+03	no	no
Selenium	1.24E+01	5.00E+00	abc	2.48E+00	YES	7.19E+00	YES	YES
Sodium	4.12E+03	6.80E+05	b	6.06E-03	no	3.73E+03	YES	no
Thallium	2.32E+00	3.00E-02	c	7.73E+01	YES	1.35E+01	no	no
Vanadium	4.18E-01	1.90E+01	c	2.20E-02	no	2.49E+01	no	no
Zinc	8.84E+00	3.70E+01	a	2.39E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
Acetone	1.06E+01	1.50E+03	c	7.07E-03	no	---	---	no
Benzo[g,h,i]perylene	3.70E-01	4.40E-01	b	8.41E-01	no	---	---	no
Dibenz[a,h]anthracene	4.20E-01	3.40E-03	c	1.24E+02	YES	---	---	YES
Indeno[1,2,3-cd]pyrene	3.20E-01	2.80E-01	b	1.14E+00	YES	---	---	YES
Toluene	5.70E-01	9.80E+00	c	5.82E-02	no	---	---	no
Xylenes	5.50E-01	1.30E+01	c	4.23E-02	no	---	---	no
Radionuclides *(pCi/L)*								
Cesium-137	1.81E+01	1.10E+03	c	1.65E-02	no	1.70E+00	YES	no
Lead-212	3.01E+01	---	NA	NA	NA	1.40E+01	YES	YES
Potassium-40	4.56E+01	---	NA	NA	NA	2.21E+01	YES	YES
Radium-226	1.50E+00	1.00E-01	c	1.50E+01	YES	1.08E+00	YES	YES
Radium-228	9.00E-01	9.00E-02	c	1.00E+01	YES	---	---	YES
Thorium-232	6.78E-01	8.10E-01	c	8.37E-01	no	2.30E-01	YES	no
Thorium-234	2.75E+02	---	NA	NA	NA	NA	NA	YES

1. Maximum detected concentration from Appendix A.1, Table A.1.6.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1 Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-23. Refinement Level Evaluation for Exposure Area 6 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Antimony	1.10E+01	2.40E+01	d	4.58E-01	no	no
Arsenic	3.61E+00	3.30E+01	ac	1.09E-01	no	no
Barium	3.41E+01	6.00E+01	a	5.68E-01	no	no
Cadmium	1.73E-01	2.70E+00	d	6.41E-02	no	no
Chloride	4.71E+00	---	NA	NA	NA	YES
Chromium VI	6.20E-01	3.40E+00	d	1.82E-01	no	no
Cyanide	6.47E-01	1.00E+00	cd	6.47E-01	no	no
Iron	8.50E+03	4.00E+04	ac	2.12E-01	no	no
Lead	5.35E+00	2.80E+01	d	1.91E-01	no	no
Manganese	7.81E+01	1.10E+03	acd	7.10E-02	no	no
Mercury	8.13E-02	3.50E-03	d	2.32E+01	YES	YES
Orthophosphate	6.06E+00	---	NA	NA	NA	YES
Phosphate	1.96E+02	---	NA	NA	NA	YES
Selenium	4.15E+00	2.90E+00	c	1.43E+00	YES	YES
Thallium	2.76E+00	5.00E-01	d	5.53E+00	YES	YES
Vanadium	2.12E+01	1.30E+01	d	1.63E+00	YES	YES
Organics *(mg/kg)*						
2-Chlorophenol	5.92E-02	3.90E+00	d	1.52E-02	no	no
Acetone	3.55E-02	6.50E-01	c	5.46E-02	no	no
Benzoic acid	7.00E-02	3.80E+00	a	1.84E-02	no	no
Bis[2-ethylhexyl]phthalate	2.72E-02	2.00E-01	d	1.36E-01	no	no
Carbon disulfide	4.00E-03	8.20E+00	d	4.88E-04	no	no
Cinnamyl Cinnamate	2.60E-01	---	NA	NA	NA	YES
Dibutylphthalate	2.68E-02	1.10E-01	cd	2.44E-01	no	no
Methyl cyclopentane	2.80E-03	---	NA	NA	NA	YES
Methyl isobutyl ketone	8.41E-04	---	NA	NA	NA	YES
Phenols	2.13E-01	1.20E-01	a	1.78E+00	YES	YES
Radionuclides *(pCi/g)*						
Barium-133	1.69E-02	---	NA	NA	NA	YES
Cobalt-58	7.00E-04	---	NA	NA	NA	YES
Europium-155	4.76E-02	---	NA	NA	NA	YES
Lead-214	1.46E+00	---	NA	NA	NA	YES
Manganese-54	1.96E-02	---	NA	NA	NA	YES
Neptunium-239	1.93E-01	---	NA	NA	NA	YES
Potassium-40	6.12E-01	---	NA	NA	NA	YES
Promethium-146	1.30E-03	---	NA	NA	NA	YES
Ruthenium-106	2.30E-01	---	NA	NA	NA	YES
Thorium-234	9.73E-01	---	NA	NA	NA	YES
Tin-113	7.00E-02	---	NA	NA	NA	YES
Zinc-65	3.70E-03	---	NA	NA	NA	YES
Zirconium-95	1.66E-02	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-21.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.6.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1, Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-24. Refinement Level Evaluation for Exposure Area 6 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Manganese	5.07E+01	9.30E+01	b	5.45E-01	no	no
Selenium	3.19E+00	5.00E+00	abc	6.38E-01	no	no
Organics *(µg/L)*						
Dibenz[a,h]anthracene	4.20E-01	3.40E-03	c	1.24E+02	YES	YES
Indeno[1,2,3-cd]pyrene	3.20E-01	2.80E-01	b	1.14E+00	YES	YES
Radionuclides *(pCi/L)*						
Lead-212	4.31E+00	---	NA	NA	NA	YES
Potassium-40	1.09E+01	---	NA	NA	NA	YES
Radium-226	8.19E-01	1.00E+00	c	8.19E-01	no	no
Radium-228	9.00E-01	9.00E-01	c	1.00E+00	no	no
Thorium-234	1.84E+02	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-22.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.6.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1 Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-25. Screening Level Evaluation for Exposure Area 7 (Sediment/Soil)

Analyte	Detected Maximum Concentration1	LTR ESV2	ESV Source3	Screening Level HQ4	Maximum Exceeds ESV (HQ >1)?	2X Average Background5	Maximum Exceeds Background?	COPEC?6
Inorganics *(mg/kg)*								
Aluminum	3.06E+04	2.50E+04	a	1.22E+00	YES	9.79E+03	YES	YES
Antimony	6.90E-01	2.70E-01	b	2.56E+00	YES	4.74E+00	no	no
Arsenic	1.49E+01	6.80E+00	d	2.19E+00	YES	3.50E+00	YES	YES
Barium	1.14E+02	2.00E+01	a	5.70E+00	YES	5.47E+01	YES	YES
Beryllium	4.72E+00	2.50E+00	d	1.89E+00	YES	7.73E-01	YES	YES
Cadmium	3.78E-01	2.70E-01	d	1.40E+00	YES	3.69E-01	YES	YES
Calcium	8.29E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	7.07E+01	2.80E+01	bd	2.53E+00	YES	1.42E+01	YES	YES
Cobalt	1.83E+01	1.30E+01	bd	1.41E+00	YES	2.63E+00	YES	YES
Copper	2.47E+01	1.50E+01	d	1.65E+00	YES	6.52E+00	YES	YES
Cyanide	1.15E+00	1.00E-01	cd	1.15E+01	YES	- -	- -	YES
Iron	3.64E+04	2.00E+04	ac	1.82E+00	YES	5.32E+03	YES	YES
Lead	5.80E+01	1.10E+01	b	5.27E+00	YES	1.10E+01	YES	YES
Magnesium	8.13E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	9.93E+02	2.20E+02	bd	4.51E+00	YES	1.36E+02	YES	YES
Mercury	1.15E+00	3.50E-04	d	3.27E+03	YES	9.92E-02	YES	YES
Nickel	9.83E+00	9.70E+00	d	1.01E+00	YES	4.48E+00	YES	YES
Potassium	4.29E+02	EN[7]	NA	NA	NA	2.39E+02	YES	no
Selenium	3.63E+00	5.20E-01	bd	6.98E+00	YES	3.89E+00	no	no
Silver	3.25E-01	5.00E-01	c	6.50E-01	no	1.16E+00	no	no
Sodium	5.36E+01	EN[7]	NA	NA	NA	7.33E+01	no	no
Thallium	3.19E+00	5.00E-02	d	6.38E+01	YES	3.77E+00	no	no
Vanadium	6.52E+01	6.70E+00	d	9.73E+00	YES	2.48E+01	YES	YES
Zinc	4.45E+01	4.60E+01	b	9.67E-01	no	1.70E+01	YES	no
Organics *(mg/kg)*								
Acetone	3.80E-01	4.00E-02	a	9.50E+00	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	5.90E-02	2.00E-02	bd	2.95E+00	YES	- -	- -	YES
Carbon disulfide	1.30E-03	3.60E-03	a	3.61E-01	no	- -	- -	no
Chloroform	4.84E-04	4.50E-02	a	1.08E-02	no	- -	- -	no
Methyl acetate	2.17E-02	---	NA	NA	NA	- -	- -	YES
Methyl ethyl ketone	3.40E-02	9.92E-01	a	3.43E-02	no	- -	- -	no
Toluene	1.43E-02	1.00E-02	c	1.43E+00	YES	- -	- -	YES
Xylenes	5.17E-04	1.00E-01	b	5.17E-03	no	- -	- -	no
Pesticides/PCBs *(mg/kg)*								
DDD	1.07E-03	1.22E-03	a	8.77E-01	no	- -	- -	no
DDE	4.10E-03	2.07E-03	a	1.98E+00	YES	- -	- -	YES
DDT	8.19E-03	1.19E-03	a	6.88E+00	YES	- -	- -	YES
PCB-1254	2.04E-02	1.40E-02	b	1.46E+00	YES	- -	- -	YES
PCB-1260	9.40E-03	5.90E-02	c	1.59E-01	no	- -	- -	no
Radionuclides *(pCi/g)*								
Actinium-228	7.61E+00	---	d	NA	NA	2.69E+00	YES	YES
Americium-241	8.80E-01	1.90E+02	d	4.63E-03	no	3.55E-02	YES	no
Americium-243	4.70E-02	---	NA	NA	NA	- -	- -	YES
Bismuth-212	8.80E+00	---	NA	NA	NA	- -	- -	YES
Bismuth-214	1.24E+01	---	NA	NA	NA	4.53E+00	YES	YES
Cesium-137	1.49E+02	7.20E+02	c	2.07E-01	no	1.89E-01	YES	no
Cobalt-60	1.55E+01	2.10E+02	c	7.39E-02	no	- -	- -	no
Curium-243/ -244	9.80E-02	---	NA	NA	NA	- -	- -	YES
Lead-210	1.90E+00	7.40E+02	c	2.57E-03	no	- -	- -	no
Lead-212	7.16E+00	---	NA	NA	NA	2.42E+00	YES	YES
Lead-214	1.22E+01	---	NA	NA	NA	- -	- -	YES
Plutonium-238	9.40E-02	1.10E+02	c	8.55E-04	no	2.83E-02	YES	no
Potassium-40	5.29E+01	---	NA	NA	NA	3.05E+00	YES	YES
Radium-224	4.59E+01	---	NA	NA	NA	- -	- -	YES
Radium-226	5.99E+00	2.10E-01	c	2.85E+01	YES	9.14E+00	no	no
Radium-228	2.61E+00	2.60E-01	c	1.00E+01	YES	4.48E+00	no	no

Table C-25. Screening Level Evaluation for Exposure Area 7 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration1	LTR ESV2	ESV Source3	Screening Level HQ4	Maximum Exceeds ESV (HQ >1)?	2X Average Background5	Maximum Exceeds Background?	COPEC?6
Radionuclides *(pCi/g)*								
Thallium-208	3.21E+00	---	NA	NA	NA	- -	- -	YES
Thorium-228	5.11E+00	4.30E+01	d	1.19E-01	no	2.71E+00	YES	no
Thorium-230	1.43E+00	5.20E+01	d	2.75E-02	no	2.19E+00	no	no
Thorium-231	9.60E-01	---	NA	NA	NA	- -	- -	YES
Thorium-232	2.71E+00	6.20E+00	d	4.37E-01	no	2.10E+00	YES	no
Thorium-234	5.70E+00	---	NA	NA	NA	8.69E-01	YES	YES
Uranium-233/ -234	1.33E+00	4.40E+02	d	3.02E-03	no	1.28E+00	YES	no
Uranium-235	3.60E-01	4.40E+02	d	8.18E-04	no	6.91E-02	YES	no
Uranium-238	1.80E+00	4.00E+02	d	4.50E-03	no	1.31E+00	YES	no

1. Maximum detected concentration from Appendix A.1 Table A.1.7.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1 Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-26. Screening Level Evaluation for Exposure Area 7 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	9.36E+03	8.70E+01	b	1.08E+02	YES	2.77E+02	YES	YES
Arsenic	3.95E+00	1.50E+02	abc	2.63E-02	no	1.00E+01	no	no
Barium	9.02E+01	3.90E+00	c	2.31E+01	YES	1.06E+02	no	no
Beryllium	3.20E-01	6.60E-01	c	4.85E-01	no	5.66E-01	no	no
Cadmium	3.69E-01	1.00E-01	a	3.69E+00	YES	1.72E+00	no	no
Calcium	7.59E+03	1.16E+05	b	6.54E-02	no	4.43E+03	YES	no
Chromium	1.74E+01	1.10E+01	abc	1.58E+00	YES	2.82E+00	YES	YES
Cobalt	5.60E+00	3.00E+00	c	1.87E+00	YES	2.48E+01	no	no
Copper	6.88E+00	2.90E+00	a	2.37E+00	YES	6.58E+00	YES	YES
Cyanide	4.23E+00	5.20E+00	c	8.13E-01	no	---	---	no
Iron	3.63E+04	1.00E+03	bc	3.63E+01	YES	1.14E+03	YES	YES
Lead	7.53E+00	5.40E-01	a	1.39E+01	YES	3.85E+00	YES	YES
Magnesium	1.51E+03	8.20E+04	b	1.84E-02	no	1.72E+03	no	no
Manganese	3.38E+03	9.30E+01	b	3.63E+01	YES	6.89E+01	YES	YES
Mercury	1.50E-01	1.30E-03	b	1.15E+02	YES	2.54E-01	no	no
Nickel	3.40E+00	1.60E+01	a	2.13E-01	no	6.44E+00	no	no
Potassium	2.97E+03	5.30E+04	b	5.60E-02	no	2.83E+03	YES	no
Selenium	4.00E+00	5.00E+00	abc	8.00E-01	no	7.19E+00	no	no
Sodium	3.99E+03	6.80E+05	b	5.87E-03	no	3.73E+03	YES	no
Thallium	1.40E+00	3.00E-02	c	4.67E+01	YES	1.35E+01	no	no
Vanadium	1.90E+01	1.90E+01	c	1.00E+00	no	2.49E+01	no	no
Zinc	3.01E+01	3.70E+01	a	8.14E-01	no	2.84E+01	YES	no
Organics *(µg/L)*								
Acetone	6.76E+00	1.50E+03	c	4.51E-03	no	---	---	no
Bis[2-ethylhexyl]phthalate	1.40E+00	3.00E+00	b	4.67E-01	no	---	---	no
Caprolactam	9.97E+00	---	NA	NA	NA	---	---	YES
Chloromethane	2.10E-01	---	NA	NA	NA	---	---	YES
Diethylphthalate	1.60E+00	2.20E+02	b	7.27E-03	no	---	---	no
m,p-Cresol	5.55E+00	5.30E+04	b	1.05E-04	no	---	---	no
Phenol	7.64E-01	1.60E+02	b	4.78E-03	no	---	---	no
Toluene	5.33E+00	9.80E+00	c	5.44E-01	no	---	---	no
Trichloroethene	4.33E-01	2.10E+01	c	2.06E-02	no	---	---	no
Pesticides *(µg/L)*								
DDE	7.00E-03	4.10E-01	b	1.71E-02	no	--	--	no
DDT	6.32E-02	1.00E-03	ac	6.32E+01	YES	--	--	YES
Endrin ketone	5.28E-03	3.60E-02	abc	1.47E-01	no	--	--	no
Radionuclides *(pCi/L)*								
Bismuth-214	8.07E+01	---	NA	NA	NA	1.11E+01	YES	YES
Cesium-137	7.60E+00	1.10E+03	c	6.91E-03	no	1.70E+00	YES	no
Lead-212	1.70E+01	---	NA	NA	NA	1.40E+01	YES	YES
Lead-214	1.10E+02	---	NA	NA	NA	---	---	YES
Strontium-89/ -90	2.97E+00	5.70E+02	c	5.21E-03	no	---	---	no
Tritium	1.25E+04	1.60E+08	c	7.81E-05	no	---	---	no

1. Maximum detected concentration from Appendix A.1, Table A.1.7.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-27. Refinement Level Evaluation for Exposure Area 7 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Aluminum	8.61E+03	5.80E+04	a	1.48E-01	no	no
Arsenic	2.57E+00	3.30E+01	ac	7.78E-02	no	no
Barium	1.14E+02	6.00E+01	a	1.90E+00	YES	YES
Beryllium	8.48E-01	2.50E+01	d	3.39E-02	no	no
Cadmium	1.06E-01	2.70E+00	d	3.93E-02	no	no
Chromium	1.46E+01	1.10E+02	c	1.33E-01	no	no
Cobalt	4.08E+00	1.30E+02	d	3.14E-02	no	no
Copper	5.26E+00	4.60E+01	d	1.14E-01	no	no
Cyanide	1.15E+00	1.00E+00	cd	1.15E+00	YES	YES
Iron	1.09E+04	4.00E+04	ac	2.73E-01	no	no
Lead	2.19E+01	2.80E+01	d	7.80E-01	no	no
Manganese	1.09E+02	1.10E+03	acd	9.91E-02	no	no
Mercury	2.97E-01	3.50E-03	d	8.49E+01	YES	YES
Nickel	2.36E+00	NA	NA	NA	no	no
Vanadium	2.69E+01	1.30E+01	d	2.07E+00	YES	YES
Organics *(mg/kg)*						
Acetone	8.00E-02	6.50E-01	c	1.23E-01	no	no
Bis[2-ethylhexyl]phthalate	5.90E-02	2.00E-01	d	2.95E-01	no	no
Methyl acetate	2.17E-02	---	NA	NA	NA	YES
Toluene	2.40E-03	1.00E-01	c	2.40E-02	no	no
Pesticides/PCBs *(mg/kg)*						
DDE	8.84E-04	3.74E-03	a	2.36E-01	no	no
DDT	1.11E-03	4.77E-03	a	2.33E-01	no	no
PCB-1254	2.04E-02	4.10E-01	d	4.98E-02	no	no
Radionuclides *(pCi/g)*						
Actinium-228	1.47E+00	---	NA	NA	NA	YES
Americium-243	4.70E-02	---	NA	NA	NA	YES
Bismuth-212	1.00E+00	---	NA	NA	NA	YES
Bismuth-214	2.32E+00	---	NA	NA	NA	YES
Curium-243/-244	9.80E-02	---	NA	NA	NA	YES
Lead-212	1.59E+00	---	NA	NA	NA	YES
Lead-214	2.43E+00	---	NA	NA	NA	YES
Potassium-40	6.99E+00	---	NA	NA	NA	YES
Radium-224	2.61E+01	---	NA	NA	NA	YES
Thallium-208	7.05E-01	---	NA	NA	NA	YES
Thorium-231	9.60E-01	---	NA	NA	NA	YES
Thorium-234	4.45E+00	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-25.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.7.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1 Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory Ecorisk Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-28. Refinement Level Evaluation for Exposure Area 7 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Aluminum	2.36E+03	8.70E+01	b	2.72E+01	YES	YES
Chromium	5.25E+00	1.10E+01	abc	4.78E-01	no	no
Copper	2.04E+00	2.90E+00	a	7.04E-01	no	no
Iron	5.08E+03	1.00E+03	bc	5.08E+00	YES	YES
Lead	1.81E+00	5.40E-01	a	3.36E+00	YES	YES
Manganese	1.28E+03	9.30E+01	b	1.38E+01	YES	YES
Organics *(µg/L)*						
Caprolactam	5.96E+00	---	NA	NA	NA	YES
Chloromethane	2.10E-01	---	NA	NA	NA	YES
Pesticides *(µg/L)*						
DDT	2.08E-02	1.00E-03	ac	2.08E+01	YES	YES
Radionuclides *(pCi/L)*						
Bismuth-214	8.07E+01	---	NA	NA	NA	YES
Lead-212	1.70E+01	---	NA	NA	NA	YES
Lead-214	4.40E+01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-26.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.7.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-29. Screening Level Evaluation for Exposure Area 8 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	3.69E+04	2.50E+04	a	1.48E+00	YES	9.79E+03	YES	YES
Antimony	1.29E+00	2.70E-01	b	4.78E+00	YES	4.74E+00	no	no
Arsenic	7.85E+00	6.80E+00	d	1.15E+00	YES	3.50E+00	YES	YES
Barium	1.18E+02	2.00E+01	a	5.90E+00	YES	5.47E+01	YES	YES
Beryllium	1.70E+00	2.50E+00	d	6.80E-01	no	7.73E-01	YES	no
Cadmium	5.49E-01	2.70E-01	d	2.03E+00	YES	3.69E-01	YES	YES
Calcium	5.65E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chromium	1.45E+02	2.80E+01	bd	5.18E+00	YES	1.42E+01	YES	YES
Cobalt	1.33E+01	1.30E+01	bd	1.02E+00	YES	2.63E+00	YES	YES
Copper	3.68E+01	1.50E+01	d	2.45E+00	YES	6.52E+00	YES	YES
Cyanide	2.60E+00	1.00E-01	cd	2.60E+01	YES	- -	- -	YES
Iron	3.72E+04	2.00E+04	ac	1.86E+00	YES	5.32E+03	YES	YES
Lead	9.81E+01	1.10E+01	b	8.92E+00	YES	1.10E+01	YES	YES
Magnesium	1.67E+03	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	2.63E+02	2.20E+02	bd	1.20E+00	YES	1.36E+02	YES	YES
Mercury	1.27E+00	3.50E-04	d	3.61E+03	YES	9.92E-02	YES	YES
Nickel	1.71E+01	9.70E+00	d	1.76E+00	YES	4.48E+00	YES	YES
Potassium	9.16E+02	EN[7]	NA	NA	NA	2.39E+02	YES	no
Selenium	2.87E+00	5.20E-01	bd	5.52E+00	YES	3.89E+00	no	no
Silver	4.39E-01	5.00E-01	c	8.78E-01	no	1.16E+00	no	no
Sodium	6.14E+01	EN[7]	NA	NA	NA	7.33E+01	no	no
Thallium	2.21E+00	5.00E-02	d	4.42E+01	YES	3.77E+00	no	no
Vanadium	7.34E+01	6.70E+00	d	1.10E+01	YES	2.48E+01	YES	YES
Zinc	1.21E+02	4.60E+01	b	2.63E+00	YES	1.70E+01	YES	YES
Organics *(mg/kg)*								
Acetone	1.05E+00	4.00E-02	a	2.63E+01	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	2.20E-01	2.00E-02	bd	1.10E+01	YES	- -	- -	YES
Carbon disulfide	8.77E-03	3.60E-03	a	2.44E+00	YES	- -	- -	YES
Methyl ethyl ketone	6.31E-02	9.92E-01	a	6.36E-02	no	- -	- -	no
Toluene	7.64E-03	1.00E-02	c	7.64E-01	no	- -	- -	no
Pesticides/PCBs *(mg/kg)*								
DDD	3.70E-01	1.22E-03	a	3.03E+02	YES	- -	- -	YES
DDE	5.11E-01	2.07E-03	a	2.47E+02	YES	- -	- -	YES
DDT	2.74E-01	1.19E-03	a	2.30E+02	YES	- -	- -	YES
PCB-1242	6.38E-02	4.10E-02	bd	1.56E+00	YES	- -	- -	YES
PCB-1254	1.01E-01	1.40E-02	b	7.21E+00	YES	- -	- -	YES
Radionuclides *(pCi/g)*								
Actinium-228	7.51E+00	---	d	NA	NA	2.69E+00	YES	YES
Americium-241	3.38E-01	1.90E+02	d	1.78E-03	no	3.55E-02	YES	no
Bismuth-212	7.53E+00	---	NA	NA	NA	- -	- -	YES
Bismuth-214	8.10E+00	---	NA	NA	NA	4.53E+00	YES	YES
Cesium-137	1.26E+02	7.20E+02	c	1.74E-01	no	1.89E-01	YES	no
Cobalt-60	5.86E-01	2.10E+02	c	2.79E-03	no	- -	- -	no
Lead-212	6.59E+00	---	NA	NA	NA	2.42E+00	YES	YES
Lead-214	8.15E+00	---	NA	NA	NA	- -	- -	YES
Plutonium-238	3.50E-02	1.10E+02	c	3.18E-04	no	2.83E-02	YES	no
Potassium-40	2.27E+01	---	NA	NA	NA	3.05E+00	YES	YES
Radium-224	4.16E+01	---	NA	NA	NA	- -	- -	YES
Radium-226	1.75E+00	2.10E-01	c	8.33E+00	YES	9.14E+00	no	no
Radium-228	3.07E+00	2.60E-01	c	1.18E+01	YES	4.48E+00	no	no
Thallium-208	3.05E+00	---	NA	NA	NA	- -	- -	YES
Thorium-228	2.32E+00	4.30E+01	d	5.40E-02	no	2.71E+00	no	no
Thorium-230	1.37E+00	5.20E+01	d	2.63E-02	no	2.19E+00	no	no
Thorium-232	2.19E+00	6.20E+00	d	3.53E-01	no	2.10E+00	YES	no

Table C-29. Screening Level Evaluation for Exposure Area 8 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Radionuclides** (pCi/g) **cont'd								
Uranium-233/ -234	1.90E+00	4.40E+02	d	4.32E-03	no	1.28E+00	YES	no
Uranium-238	1.42E+00	4.00E+02	d	3.55E-03	no	1.31E+00	YES	no

1. Maximum detected concentration from Appendix A.1 Table A.1.8.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1, Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-30. Screening Level Evaluation for Exposure Area 8 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Aluminum	1.34E+03	8.70E+01	b	1.54E+01	YES	2.77E+02	YES	YES
Barium	3.54E+01	3.90E+00	c	9.08E+00	YES	1.06E+02	no	no
Beryllium	3.20E-01	6.60E-01	c	4.85E-01	no	5.66E-01	no	no
Cadmium	2.70E-01	1.00E-01	a	2.70E+00	YES	1.72E+00	no	no
Calcium	1.12E+04	1.16E+05	b	9.66E-02	no	4.43E+03	YES	no
Chromium	1.14E+00	1.10E+01	abc	1.04E-01	no	2.82E+00	no	no
Cobalt	1.10E+00	3.00E+00	c	3.67E-01	no	2.48E+01	no	no
Copper	2.92E+00	2.90E+00	a	1.01E+00	YES	6.58E+00	no	no
Cyanide	1.85E+00	5.20E+00	c	3.56E-01	no	---	---	no
Iron	5.99E+03	1.00E+03	bc	5.99E+00	YES	1.14E+03	YES	YES
Lead	1.74E+00	5.40E-01	a	3.22E+00	YES	3.85E+00	no	no
Magnesium	1.04E+03	8.20E+04	b	1.27E-02	no	1.72E+03	no	no
Manganese	4.60E+02	9.30E+01	b	4.95E+00	YES	6.89E+01	YES	YES
Nickel	9.20E-01	1.60E+01	a	5.75E-02	no	6.44E+00	no	no
Potassium	3.97E+02	5.30E+04	b	7.49E-03	no	2.83E+03	no	no
Sodium	2.86E+03	6.80E+05	b	4.21E-03	no	3.73E+03	no	no
Thallium	1.10E+00	3.00E-02	c	3.67E+01	YES	1.35E+01	no	no
Vanadium	1.12E+01	1.90E+01	c	5.89E-01	no	2.49E+01	no	no
Zinc	3.10E+01	3.70E+01	a	8.38E-01	no	2.84E+01	YES	no
Organics *(µg/L)*								
2-Chloronaphthalene	9.62E-01	3.96E-01	d	2.43E+00	YES	---	---	YES
2-Chlorophenol	9.62E+00	3.20E+01	b	3.01E-01	no	---	---	no
2-Methylnaphthalene	9.62E-01	4.70E+00	b	2.05E-01	no	---	---	no
2-Nitroaniline	9.62E+00	---	NA	NA	NA	---	---	YES
2-Nitrophenol	9.62E+00	7.30E+01	b	1.32E-01	no	---	---	no
2,4-Dichlorophenol	9.62E+00	1.10E+01	b	8.75E-01	no	---	---	no
2,4-Dimethylphenol	9.62E+00	1.50E+01	b	6.41E-01	no	---	---	no
2,4-Dinitrophenol	1.92E+01	7.10E+01	b	2.70E-01	no	---	---	no
2,4-Dinitrotoluene	9.62E+00	4.40E+01	b	2.19E-01	no	---	---	no
2,4,5-Trichlorophenol	9.62E+00	1.90E+00	b	5.06E+00	YES	---	---	YES
2,4,6-Trichlorophenol	9.62E+00	4.90E+00	b	1.96E+00	YES	---	---	YES
2,6-Dinitrotoluene	9.62E+00	8.10E+01	b	1.19E-01	no	---	---	no
3-Nitroanaline	9.62E+00	---	NA	NA	NA	---	---	YES
3,3-Dichlorobenzidine	9.62E+00	4.50E+00	b	2.14E+00	YES	---	---	YES
4-Bromophenyl phenyl ether	9.62E+00	1.50E+00	b	6.41E+00	YES	---	---	YES
4-Chloraniline	9.62E+00	1.90E+01	b	5.06E-01	no	---	---	no
4-Chloro-m-cresol	9.62E+00	---	NA	NA	NA	---	---	YES
4-Chlorophenylphenyl ether	9.62E+00	---	NA	NA	NA	---	---	YES
4-Nitroaniline	9.62E+00	---	NA	NA	NA	---	---	YES
4-Nitrophenol	9.62E+00	5.80E+01	b	1.66E-01	no	---	---	no
4,6-Dinitro-2-Methylphenol	9.62E+00	---	NA	NA	NA	---	---	YES
Acenaphthene	9.62E-01	5.80E+00	c	1.66E-01	no	---	---	no
Acenaphthylene	9.62E-01	1.30E+01	b	7.40E-02	no	---	---	no
Acetone	2.33E+00	1.50E+03	c	1.55E-03	no	---	---	no
Acetophenone	9.62E+00	---	NA	NA	NA	---	---	YES
Anthracene	9.62E-01	2.00E-02	b	4.81E+01	YES	---	---	YES
Benzaldehyde	9.62E+00	5.70E+01	b	1.69E-01	no	---	---	no
Benzo[a]anthracene	9.62E-01	2.70E-02	c	3.56E+01	YES	---	---	YES
Benzo[a]pyrene	9.62E-01	1.40E-02	c	6.87E+01	YES	---	---	YES
Benzo[b]fluoranthene	9.62E-01	2.60E+00	b	3.70E-01	no	4.42E+00	no	no
Benzo[g,h,i]perylene	9.62E-01	4.40E-01	b	2.19E+00	YES	---	---	YES
Benzo[k]fluoranthene	9.62E-01	4.10E-03	c	2.35E+02	YES	---	---	YES

Table C-~~32~~30. Screening Level Evaluation for Exposure Area 8 (Surface Water) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Organics (µg/L) cont'd								
Biphenyl	9.62E+00	6.50E+00	b	1.48E+00	YES	---	---	YES
Bis[2-chloroethoxy]methane	9.62E+00	---	NA	NA	NA	---	---	YES
Bis[2-chloroethyl] ether	9.62E+00	---	NA	NA	NA	---	---	YES
Bis[2-chloroisopropyl]ether	9.62E+00	---	NA	NA	NA	---	---	YES
Bis[2-ethylhexyl]phthalate	9.62E+00	3.00E+00	b	3.21E+00	YES	---	---	YES
Butylbenzylphthalate	9.62E+00	1.90E+01	c	5.06E-01	no	---	---	no
Caprolactam	1.08E+01	---	NA	NA	NA	---	---	YES
Carbazole	9.62E+00	---	NA	NA	NA	---	---	YES
Chrysene	9.62E-01	1.80E-03	c	5.34E+02	YES	---	---	YES
Dibenz[a,h]anthracene	9.62E-01	3.40E-03	c	2.83E+02	YES	---	---	YES
Dibenzofuran	9.62E+00	3.70E+00	c	2.60E+00	YES	---	---	YES
Dibutylphthalate	9.62E+00	1.90E+01	bc	5.06E-01	no	---	---	no
Diethylphthalate	9.62E+00	2.20E+02	b	4.37E-02	no	---	---	no
Dimethylphthalate	9.62E+00	3.00E+00	c	3.21E+00	YES	---	---	YES
Dioctylphthalate	9.62E+00	3.00E+00	c	3.21E+00	YES	---	---	YES
Diphenylamine	9.62E+00	4.12E+02	d	2.33E-02	no	NA	NA	no
Fluoranthene	9.62E-01	4.00E-02	c	2.41E+01	YES	---	---	YES
Fluorene	9.62E-01	3.90E+00	c	2.47E-01	no	---	---	no
Hexachlorobenzene	9.62E+00	3.00E-04	b	3.21E+04	YES	---	---	YES
Hexachlorobutadiene	9.62E+00	5.30E-02	b	1.82E+02	YES	---	---	YES
Hexachlorocyclopentadiene	9.62E+00	4.50E-01	b	2.14E+01	YES	---	---	YES
Hexachloroethane	9.62E+00	1.20E+01	b	8.02E-01	no	---	---	no
Indeno[1,2,3-cd]pyrene	9.62E-01	2.80E-01	b	3.44E+00	YES	---	---	YES
Isophorone	9.62E+00	9.20E+02	b	1.05E-02	no	---	---	no
m,p-Cresol	9.62E+00	5.30E+04	b	1.82E-04	no	---	---	no
N-Nitrosodipropylamine	9.62E+00	2.50E+01	b	3.85E-01	no	---	---	no
Naphthalene	9.62E-01	1.10E+00	c	8.75E-01	no	---	---	no
Nitrobenzene	9.62E+00	3.80E+02	b	2.53E-02	no	---	---	no
o-Cresol	9.62E+00	6.70E+01	b	1.44E-01	no	---	---	no
Pentachlorophenol	9.62E+00	1.50E+01	abc	6.41E-01	no	---	---	no
Phenanthrene	9.62E-01	2.30E+00	b	4.18E-01	no	---	---	no
Phenol	9.62E+00	1.60E+02	b	6.01E-02	no	---	---	no
Pyrene	9.62E-01	2.50E-02	c	3.85E+01	YES	---	---	YES
Toluene	3.47E+00	9.80E+00	c	3.54E-01	no	---	---	no
Trichloroethene	3.80E-01	2.10E+01	c	1.81E-02	no	---	---	no
Pesticides (µg/L)								
Atrazine	9.62E+00	1.20E+01	b	8.02E-01	no	---	---	no
DDT	1.42E-02	1.00E-03	ac	1.42E+01	YES	---	---	YES
Radionuclides (pCi/L)								
Lead-214	1.01E+02	---	NA	NA	NA	---	---	YES
Tritium	1.44E+03	1.60E+08	c	9.00E-06	no	---	---	no

1. Maximum detected concentration from Appendix A.1, Table A.1.8.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
   d = EPA Region 5 Ecological Screening Levels (Archived 2003 document)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-31. Refinement Level Evaluation for Exposure Area 8 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(mg/kg)*						
Aluminum	1.39E+04	5.80E+04	a	2.39E-01	no	no
Arsenic	2.89E+00	3.30E+01	ac	8.75E-02	no	no
Barium	6.32E+01	6.00E+01	a	1.05E+00	YES	YES
Cadmium	2.11E-01	2.70E+00	d	7.81E-02	no	no
Chromium	4.90E+01	1.10E+02	c	4.46E-01	no	no
Cobalt	4.49E+00	1.30E+02	d	3.45E-02	no	no
Copper	8.94E+00	4.60E+01	d	1.94E-01	no	no
Cyanide	2.33E+00	1.00E+00	cd	2.33E+00	YES	YES
Iron	1.74E+04	4.00E+04	ac	4.34E-01	no	no
Lead	3.37E+01	2.80E+01	d	1.21E+00	YES	YES
Manganese	9.52E+01	1.10E+03	acd	8.65E-02	no	no
Mercury	3.67E-01	3.50E-03	d	1.05E+02	YES	YES
Nickel	6.88E+00	1.90E+01	d	3.62E-01	no	no
Vanadium	4.29E+01	1.30E+01	d	3.30E+00	YES	YES
Zinc	4.03E+01	4.59E+02	a	8.78E-02	no	no
Organics *(mg/kg)*						
Acetone	4.95E-01	6.50E-01	c	7.62E-01	no	no
Bis[2-ethylhexyl]phthalate	2.20E-01	2.00E-01	d	1.10E+00	YES	YES
Carbon disulfide	3.80E-03	8.20E+00	d	4.63E-04	no	no
Pesticides/PCBs *(mg/kg)*						
DDD	3.70E-01	7.81E-03	a	4.74E+01	YES	YES
DDE	2.62E-01	3.74E-03	a	7.01E+01	YES	YES
DDT	2.24E-01	4.77E-03	a	4.70E+01	YES	YES
PCB-1242	6.38E-02	4.10E-01	d	1.56E-01	no	no
PCB-1254	8.72E-02	4.10E-01	d	2.13E-01	no	no
Radionuclides *(pCi/g)*						
Actinium-228	2.78E+00	---	NA	NA	NA	YES
Bismuth-212	3.25E+00	---	NA	NA	NA	YES
Bismuth-214	3.29E+00	---	NA	NA	NA	YES
Lead-212	2.38E+00	---	NA	NA	NA	YES
Lead-214	3.30E+00	---	NA	NA	NA	YES
Potassium-40	9.05E+00	---	NA	NA	NA	YES
Radium-224	3.00E+01	---	NA	NA	NA	YES
Thallium-208	1.06E+00	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-29.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1 Table A.1.8.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. LTR RSV from Attachment C-1, Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory Ecorisk Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-32. Refinement Level Evaluation for Exposure Area 8 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics *(µg/L)*						
Aluminum	8.53E+02	8.70E+01	b	9.80E+00	YES	YES
Iron	3.76E+03	1.00E+03	bc	3.76E+00	YES	YES
Manganese	2.52E+02	9.30E+01	b	2.71E+00	YES	YES
Organics *(µg/L)*						
2,4,5-Trichlorophenol	9.62E+00	1.90E+00	b	5.06E+00	YES	YES
2,4,6-Trichlorophenol	9.62E+00	4.90E+00	b	1.96E+00	YES	YES
2-Chloronaphthalene	9.62E-01	3.96E-01	d	2.43E+00	YES	YES
2-Nitroaniline	9.62E+00	---	NA	NA	NA	YES
3,3-Dichlorobenzidine	9.62E+00	4.50E+00	b	2.14E+00	YES	YES
3-Nitroanaline	9.62E+00	---	NA	NA	NA	YES
4,6-Dinitro-2-Methylphenol	9.62E+00	---	NA	NA	NA	YES
4-Bromophenyl phenyl ether	9.62E+00	1.50E+00	b	6.41E+00	YES	YES
4-Chloro-m-cresol	9.62E+00	---	NA	NA	NA	YES
4-Chlorophenylphenyl ether	9.62E+00	---	NA	NA	NA	YES
4-Nitroaniline	9.62E+00	---	NA	NA	NA	YES
Acetophenone	9.62E+00	---	NA	NA	NA	YES
Anthracene	9.62E-01	2.00E-02	b	4.81E+01	YES	YES
Benzo[a]anthracene	9.62E-01	2.70E-02	c	3.56E+01	YES	YES
Benzo[a]pyrene	9.62E-01	1.40E-02	c	6.87E+01	YES	YES
Benzo[g,h,i]perylene	9.62E-01	4.40E-01	b	2.19E+00	YES	YES
Benzo[k]fluoranthene	9.62E-01	4.10E-03	c	2.35E+02	YES	YES
Biphenyl	9.62E+00	6.50E+00	b	1.48E+00	YES	YES
Bis[2-chloroethoxy]methane	9.62E+00	---	NA	NA	NA	YES
Bis[2-chloroethyl] ether	9.62E+00	---	NA	NA	NA	YES
Bis[2-chloroisopropyl]ether	9.62E+00	---	NA	NA	NA	YES
Bis[2-ethylhexyl]phthalate	9.62E+00	3.00E+00	b	3.21E+00	YES	YES
Caprolactam	7.80E+00	---	NA	NA	NA	YES
Carbazole	9.62E+00	---	NA	NA	NA	YES
Chrysene	9.62E-01	1.80E-03	c	5.34E+02	YES	YES
Dibenz[a,h]anthracene	9.62E-01	3.40E-03	c	2.83E+02	YES	YES
Dibenzofuran	9.62E+00	3.70E+00	c	2.60E+00	YES	YES
Dimethylphthalate	9.62E+00	3.00E+00	c	3.21E+00	YES	YES
Dioctylphthalate	9.62E+00	3.00E+00	c	3.21E+00	YES	YES
Fluoranthene	9.62E-01	4.00E-02	c	2.41E+01	YES	YES
Hexachlorobenzene	9.62E+00	3.00E-04	b	3.21E+04	YES	YES
Hexachlorobutadiene	9.62E+00	5.30E+01	b	1.82E-01	no	no
Hexachlorocyclopentadiene	9.62E+00	4.50E-01	b	2.14E+01	YES	YES
Indeno[1,2,3-cd]pyrene	9.62E-01	2.80E-01	b	3.44E+00	YES	YES
Pyrene	9.62E-01	2.50E-02	c	3.85E+01	YES	YES
Pesticides *(µg/L)*						
DDT	1.42E-02	1.00E-03	ac	1.42E+01	YES	YES
Radionuclides *(pCi/L)*						
Lead-214	1.01E+02	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-30.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.8.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-33. Screening Level Evaluation for Exposure Area 9 (Sediment/Soil)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(mg/kg)*								
Aluminum	1.80E+04	2.50E+04	a	7.20E-01	no	9.79E+03	YES	no
Ammonia	6.43E+01	2.30E+02	a	2.80E-01	no	- -	- -	no
Arsenic	2.14E+00	6.80E+00	d	3.15E-01	no	3.50E+00	no	no
Barium	8.61E+01	2.00E+01	a	4.31E+00	YES	5.47E+01	YES	YES
Beryllium	7.72E-01	2.50E+00	d	3.09E-01	no	7.73E-01	no	no
Cadmium	5.05E-02	2.70E-01	d	1.87E-01	no	3.69E-01	no	no
Calcium	8.17E+02	EN[7]	NA	NA	NA	1.12E+03	no	no
Chloride	1.51E+01	---	NA	NA	NA	- -	- -	YES
Chromium	3.27E+01	2.80E+01	bd	1.17E+00	YES	1.42E+01	YES	YES
Cobalt	5.50E+00	1.30E+01	bd	4.23E-01	no	2.63E+00	YES	no
Copper	1.41E+01	1.50E+01	d	9.40E-01	no	6.52E+00	YES	no
Cyanide	1.42E-01	1.00E-01	cd	1.42E+00	YES	- -	- -	YES
Iron	1.76E+04	2.00E+04	ac	8.80E-01	no	5.32E+03	YES	no
Lead	1.81E+01	1.10E+01	b	1.65E+00	YES	1.10E+01	YES	YES
Magnesium	3.76E+02	EN[7]	NA	NA	NA	2.75E+02	YES	no
Manganese	1.81E+02	2.20E+02	bd	8.23E-01	no	1.36E+02	YES	no
Mercury	7.66E-02	3.50E-04	d	2.19E+02	YES	9.92E-02	no	no
Nickel	6.29E+00	9.70E+00	d	6.48E-01	no	4.48E+00	YES	no
Orthophosphate	2.62E+00	---	NA	NA	NA	- -	- -	YES
Phosphate	3.75E+02	---	NA	NA	NA	- -	- -	YES
Potassium	3.20E+02	EN[7]	NA	NA	NA	2.39E+02	YES	no
Selenium	3.37E+00	5.20E-01	bd	6.48E+00	YES	3.89E+00	no	no
Sodium	2.72E+01	EN[7]	d	NA	NA	7.33E+01	no	no
Thallium	4.59E+00	5.00E-02	d	9.18E+01	YES	3.77E+00	YES	YES
Vanadium	4.23E+01	6.70E+00	d	6.31E+00	YES	2.48E+01	YES	YES
Zinc	3.11E+01	4.60E+01	b	6.76E-01	no	1.70E+01	YES	no
Organics *(mg/kg)*								
2-Hexanone	2.87E-04	3.60E-01	bd	7.97E-04	no	- -	- -	no
Acetone	3.32E-01	4.00E-02	a	8.30E+00	YES	- -	- -	YES
Benzene	1.06E-03	1.00E-02	c	1.06E-01	no	- -	- -	no
Benzo[a]pyrene	5.29E-03	1.50E-01	c	3.53E-02	no	3.09E-01	no	no
Benzo[b]fluoranthene	5.45E-03	1.90E-01	c	2.87E-02	no	2.89E-01	no	no
Benzo[g,h,i]perylene	4.24E-03	1.70E-01	c	2.49E-02	no	- -	- -	no
Benzoic acid	3.08E-01	1.00E-02	b	3.08E+01	YES	- -	- -	YES
Bis[2-ethylhexyl]phthalate	2.67E-01	2.00E-02	bd	1.34E+01	YES	- -	- -	YES
Camphene	2.50E-03	---	NA	NA	NA	- -	- -	YES
Carbon disulfide	1.76E-02	3.60E-03	a	4.89E+00	YES	- -	- -	YES
Chloroform	8.96E-04	4.50E-02	a	1.99E-02	no	- -	- -	no
Chloromethane	2.98E-04	1.04E+01	e	NA	NA	- -	- -	YES
Chrysene	4.38E-03	1.60E-01	c	2.74E-02	no	- -	- -	no
Dibutylphthalate	2.77E-02	1.10E-02	bcd	2.52E+00	YES	- -	- -	YES
Diethylphthalate	6.01E-03	2.30E-01	b	2.61E-02	no	- -	- -	no
Docosane	5.40E-01	---	NA	NA	NA	- -	- -	YES
Fluoranthene	7.13E-03	4.20E-01	c	1.70E-02	no	- -	- -	no
Methyl ethyl ketone	2.55E-02	9.92E-01	a	2.57E-02	no	- -	- -	no
Methyl isobutyl ketone	5.57E-04	---	NA	NA	NA	- -	- -	YES
Phenol	4.21E-03	1.20E-01	a	3.51E-02	no	- -	- -	no
Pyrene	6.67E-03	1.90E-01	c	3.51E-02	no	- -	- -	no
Styrene	1.49E-04	1.16E-01	a	1.28E-03	no	- -	- -	no
Toluene	3.90E-03	1.00E-02	c	3.90E-01	no	- -	- -	no
Xylenes	4.58E-04	1.00E-01	b	4.58E-03	no	- -	- -	no
Phenols	2.15E-01	1.20E-01	a	1.79E+00	YES	- -	- -	YES
Pesticides/PCBs (mg/kg)								
DDE	8.48E-04	2.07E-03	a	4.10E-01	no	- -	- -	no
PCB-1254	1.90E-03	1.40E-02	b	1.36E-01	no	- -	- -	no

Table C-33. Screening Level Evaluation for Exposure Area 9 (Sediment/Soil) *(Continued/End)*

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Radionuclides (pCi/g)								
Actinium-228	2.51E+00	---	NA	NA	NA	2.69E+00	no	no
Bismuth-214	1.47E+00	---	NA	NA	NA	4.53E+00	no	no
Cesium-137	1.17E+02	7.20E+02	c	1.62E-01	no	1.89E-01	YES	no
Cobalt-60	4.48E-01	2.10E+02	c	2.13E-03	no	- -	- -	no
Lead-212	2.59E+00	---	NA	NA	NA	2.42E+00	YES	YES
Lead-214	1.72E+00	---	NA	NA	NA	- -	- -	YES
Manganese-54	4.76E-02	---	NA	NA	NA	- -	- -	YES
Plutonium-238	1.76E-01	1.10E+02	c	1.60E-03	no	2.83E-02	YES	no
Plutonium-239/240	1.71E-01	1.10E+02	c	1.55E-03	no	5.13E-02	YES	no
Potassium-40	3.22E+00	---	NA	NA	NA	3.05E+00	YES	YES
Radium-226	1.47E+00	2.10E-01	c	7.00E+00	YES	9.14E+00	no	no
Radium-228	1.17E+00	2.60E-01	c	4.50E+00	YES	4.48E+00	no	no
Strontium-89/90	1.30E+00	1.50E+02	c	8.67E-03	no	- -	- -	no
Strontium-90	2.28E+00	1.50E+02	c	1.52E-02	no	7.54E-01	YES	no
Thallium-208	7.60E-01	---	NA	NA	NA	- -	- -	YES
Thorium-228	2.45E+00	4.30E+01	d	5.70E-02	no	2.71E+00	no	no
Thorium-230	1.11E+00	5.20E+01	d	2.13E-02	no	2.19E+00	no	no
Thorium-232	2.48E+00	6.20E+00	d	4.00E-01	no	2.10E+00	YES	no
Thorium-234	3.83E+00	---	NA	NA	NA	8.69E-01	YES	YES
Uranium-233/234	1.22E+00	4.40E+02	d	2.77E-03	no	1.28E+00	no	no
Uranium-238	1.23E+00	4.00E+02	d	3.08E-03	no	1.31E+00	no	no

1. Maximum detected concentration from Appendix A.1, Table A.1.9.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined)
2. LTR ESV from Attachment C-1 Table I.A.
3. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory No Effect ESL for Sediment Media
   d = Los Alamos National Laboratory No Effect ESL for Soil Media
   e = EPA Region 5 Ecological Screening Levels (Archived 2003 document)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration
7. Essential nutrient, not subject to further evaluation

Table C-34. Screening Level Evaluation for Exposure Area 9 (Surface Water)

Analyte	Detected Maximum Concentration[1]	LTR ESV[2]	ESV Source[3]	Screening Level HQ[4]	Maximum Exceeds ESV (HQ >1)?	2X Average Background[5]	Maximum Exceeds Background?	COPEC?[6]
Inorganics *(µg/L)*								
Antimony	4.49E+00	3.00E+01	c	1.50E-01	no	2.76E+01	no	no
Barium	2.91E+01	3.90E+00	c	7.46E+00	YES	1.06E+02	no	no
Calcium	1.24E+04	1.16E+05	b	1.07E-01	no	4.43E+03	YES	no
Chromium	1.19E+00	1.10E+01	abc	1.08E-01	no	2.82E+00	no	no
Iron	1.62E+03	1.00E+03	bc	1.62E+00	YES	1.14E+03	YES	YES
Magnesium	1.13E+03	8.20E+04	b	1.38E-02	no	1.72E+03	no	no
Manganese	1.09E+02	9.30E+01	b	1.17E+00	YES	6.89E+01	YES	YES
Potassium	3.20E+02	5.30E+04	b	6.04E-03	no	2.83E+03	no	no
Silver	2.68E-01	6.00E-02	b	4.47E+00	YES	---	---	YES
Sodium	5.89E+03	6.80E+05	b	8.66E-03	no	3.73E+03	YES	no
Zinc	4.73E+00	3.70E+01	a	1.28E-01	no	2.84E+01	no	no
Organics *(µg/L)*								
Bis[2-ethylhexyl]phthalate	3.51E-01	3.00E+00	b	1.17E-01	no	---	---	no
Chloromethane	4.06E-01	---	NA	NA	NA	---	---	YES
Toluene	5.66E-01	9.80E+00	c	5.78E-02	no	---	---	no
Radionuclides *(pCi/L)*								
Tritium	6.01E+02	1.60E+08	c	3.76E-06	no	---	---	no

1. Maximum detected concentration from Appendix A.1, Table A.1.9.2, Surface Water (unfiltered results)
2. LTR ESV from Attachment C-1, Table II.A.
3. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015)
4. Screening Level Hazard Quotient (HQ) = maximum detected concentration/ESV
5. 2X Average Background Concentration from Appendix A.1, Table A.1.10, IOU Background
6. COPEC = constituent of potential ecological concern. Analyte identified as a COPEC if the maximum detected concentration exceeds the ecological screening value (i.e., HQ >1), if available, and exceeds 2X average background concentration

Table C-35. Refinement Level Evaluation for Exposure Area 9 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics (mg/kg)						
Barium	4.53E+01	6.00E+01	a	7.55E-01	no	no
Chloride	6.98E+00	---	NA	NA	NA	YES
Chromium	1.65E+01	1.10E+02	c	1.50E-01	no	no
Cyanide	1.42E-01	1.00E+00	cd	1.42E-01	no	no
Lead	1.05E+01	2.80E+01	d	3.76E-01	no	no
Orthophosphate	2.62E+00	---	NA	NA	NA	YES
Phosphate	2.10E+02	---	NA	NA	NA	YES
Thallium	2.63E+00	5.00E-01	d	5.27E+00	YES	YES
Vanadium	2.48E+01	1.30E+01	d	1.91E+00	YES	YES
Organics (mg/kg)						
Acetone	1.42E-01	6.50E-01	c	2.18E-01	no	no
Benzoic acid	2.51E-01	3.80E+00	a	6.61E-02	no	no
Bis[2-ethylhexyl]phthalate	1.48E-01	2.00E-01	d	7.40E-01	no	no
Camphene	2.50E-03	---	NA	NA	NA	YES
Carbon disulfide	8.20E-03	8.20E+00	d	1.00E-03	no	no
Chloromethane	2.00E-04	---	NA	NA	NA	YES
Dibutylphthalate	2.77E-02	1.10E-01	cd	2.52E-01	no	no
Docosane	5.40E-01	---	NA	NA	NA	YES
Methyl isobutyl ketone	5.57E-04	---	NA	NA	NA	YES
Phenols	2.15E-01	1.20E-01	a	1.79E+00	YES	YES
Radionuclides (pCi/g)						
Lead-212	1.62E+00	---	NA	NA	NA	YES
Lead-214	1.16E+00	---	NA	NA	NA	YES
Manganese-54	3.89E-02	---	NA	NA	NA	YES
Potassium-40	1.83E+00	---	NA	NA	NA	YES
Thallium-208	4.76E-01	---	NA	NA	NA	YES
Thorium-234	2.73E+00	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-33.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.9.1.1, Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3. - LTR RSV from Attachment C-1 Table I.B.
4. a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
   d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

Table C-36. Refinement Level Evaluation for Exposure Area 9 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	LTR RSV[3]	RSV Source[4]	Refinement Level HQ[5]	EPC Exceeds RSV (HQ >1)?	COPC[6]
Inorganics (µg/L)						
Iron	1.62E+03	1.00E+03	bc	1.62E+00	YES	YES
Manganese	1.09E+02	9.30E+01	b	1.17E+00	YES	YES
Silver	2.68E-01	6.00E-02	B	4.47E+00	YES	YES
Organics (µg/L)						
Chloromethane	4.06E-01	---	NA	NA	NA	YES

1. Analytes identified as COPECs from Table C-34.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.9.2, Surface Water (unfiltered results).
3. LTR RSV from Attachment C-1, Table II.B.
4. a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014).
   b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
   c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
5. Refinement Level Hazard Quotient (HQ) = EPC / RSV.
6. COPC = constituent of potential concern. Analyte identified as a COPC if the refinement level HQ >1.

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Attachment C-1 – Derivation of LTR ESVs and RSVs

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I. SEDIMENT/SOIL MEDIA A. Screening Level (No Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR ESV[5]**
Inorganics (mg/kg)				---	
Aluminum	2.50E+04	---	---		**2.50E+04**
Ammonia	2.30E+02	---	---	---	**2.30E+02**
Antimony	2.00E+00	2.70E-01	5.00E+01	2.40E+00	**2.70E-01**
Arsenic	9.80E+00	1.80E+01	9.70E+00	6.80E+00	**6.80E+00**
Barium	2.00E+01	3.30E+02	1.50E+02	1.10E+02	**2.00E+01**
Beryllium	---	1.00E+01	7.30E+01	2.50E+00	**2.50E+00**
Cadmium	1.00E+00	3.60E-01	3.30E-01	2.70E-01	**2.70E-01**
Calcium	---	---	---	---	---
Chloride	---	---	---	---	---
Chromium	4.34E+01	2.80E+01	4.30E+01	2.80E+01	**2.80E+01**
Chromium VI	---	3.50E-01	6.80E+02	3.40E-01	**3.40E-01**
Cobalt	5.00E+01	1.30E+01	2.30E+02	1.30E+01	**1.30E+01**
Copper	3.16E+01	2.80E+01	2.30E+01	1.50E+01	**1.50E+01**
Cyanide	---	---	1.00E-01	1.00E-01	**1.00E-01**
Iron	2.00E+04	---	2.00E+04	---	**2.00E+04**
Lead	3.58E+01	1.10E+01	2.70E+01	1.40E+01	**1.10E+01**
Magnesium	---	---	---	---	---
Manganese	4.60E+02	2.20E+02	4.60E+02	2.20E+02	**2.20E+02**
Mercury	1.80E-01	5.10E-04[6]	4.60E-04[6]	3.50E-04[6]	**3.50E-04[6]**
Nickel	2.27E+01	3.80E+01	1.30E+01	9.70E+00	**9.70E+00**
Phosphate	---	---	---	---	---
Potassium	---	---		---	---
Selenium	1.10E+01	5.20E-01	7.20E-01	5.20E-01	**5.20E-01**
Silver	1.00E+00	4.20E+00	5.00E-01	2.60E+00	**5.00E-01**
Sodium	---		---	---	---
Thallium	---	2.20E-01	8.20E-01	5.00E-02	**5.00E-02**
Vanadium	---	7.80E+00	3.00E+01	6.70E+00	**6.70E+00**
Zinc	1.21E+02	4.60E+01	6.50E+01	4.80E+01	**4.60E+01**
Organics (mg/kg)					
2-Chlorophenol	6.10E-02	6.00E-02	5.50E-02	3.90E-01	**5.50E-02**

I. SEDIMENT/SOIL MEDIA A. Screening Level (No Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR ESV[5]**
2-Hexanone	2.83E+00	3.60E-01	---	3.60E-01	**3.60E-01**
2-Methylnaphthalene[7]	1.61E+00	2.90E+01	7.60E-02	1.60E+01	**7.60E-02**
Acetone	4.00E-02	1.20E+00	6.50E-02	1.20E+00	**4.00E-02**
Benzaldehyde	4.62E-01	---	---	---	**4.62E-01**
Benzene	1.13E-01	1.20E-01	1.00E-02	2.40E+01	**1.00E-02**
Benzo[a]pyrene[8]	1.61E+00	1.10E+00	1.50E-01	5.30E+01	**1.50E-01**
Benzo[b]fluoranthene[8]	1.61E+00	1.10E+00	1.90E-01	1.80E+01	**1.90E-01**
Benzo[g,h,i]perylene[8]	1.61E+00	1.10E+00	1.70E-01	2.40E+01	**1.70E-01**
Benzoic acid	2.90E+00	1.00E-02	1.30E+00	1.00E+00	**1.00E-02**
Bis[2-chloroethyl] ether	4.76E+00	---	---	---	**4.76E+00**
Bis[2-ethylhexyl]phthalate	1.82E-01	2.00E-02	2.60E-02	2.00E-02	**2.00E-02**
Butylbenzylphthalate	5.92E-01	5.90E-01	1.00E-01	9.00E+01	**1.00E-01**
Camphene	---	---	---	---	--
Carbon disulfide	3.60E-03	5.00E-03	---	8.20E-01	**3.60E-03**
Chloroform	4.50E-02	5.00E-02	1.00E+01	8.00E+00	**4.50E-02**
Chloromethane[9]	---	1.04E+01	---	---	**1.04E+01**
Chrysene[8]	1.61E+00	1.10E+00	1.60E-01	2.40E+00	**1.60E-01**
Cinnamyl Cinnamate	---	---	---	---	---
Dibutylphthalate	2.20E-01	1.10E-02	1.10E-02	1.10E-02	**1.10E-02**
Diethylphthalate	2.31E-01	2.30E-01	---	1.00E+02	**2.30E-01**
Docosane	---	--	---	---	--
Ethylbenzene	2.72E-01	2.70E-01	--	---	**2.70E-01**
Fluoranthene[8]	1.61E+00	1.10E+00	4.20E-01	1.00E+01	**4.20E-01**
Isopropylbenzene	3.30E-02	4.00E-02	---	---	**3.30E-02**
Methyl acetate	---	---	---	---	---
Methyl cyclopentane	---	---	---	---	---
Methyl ethyl ketone	9.92E-01	1.00E+00	3.30E+03	3.60E+02	**9.92E-01**
Methyl isobutyl ketone	---	---	---	---	---
Orthophosphate	---	---	---	---	---
Phenanthrene[7]	1.61E+00	2.90E+01	2.00E-01	5.50E+00	**2.00E-01**
Phenol	1.20E-01	7.90E-01	8.40E+02	7.90E-01	**1.20E-01**
Phenols	1.20E-01	7.90E-01	8.40E+02	7.90E-01	**1.20E-01**

I. SEDIMENT/SOIL MEDIA A. Screening Level (No Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR ESV[5]**
Pyrene[8]	1.61E+00	1.10E+00	1.90E-01	1.00E+01	**1.90E-01**
Styrene	1.16E-01	1.20E+00	--	1.20E+00	**1.16E-01**
Toluene	1.45E-01	1.50E-01	1.00E-02	2.30E+01	**1.00E-02**
Unknown alkane	---	---	---	---	---
Unknown hydrocarbon	---	---	---	---	---
Xylenes	1.03E-01	1.00E-01	1.30E-01	1.40E+00	**1.00E-01**
Pesticides/PCBs (mg/kg)				---	
PCB-1242	---	4.10E-02	5.40E-02	4.10E-02	**4.10E-02**
PCB-1254	--	1.40E-02	5.40E-02	4.10E-02	**1.40E-02**
PCB-1260	---	8.80E-01	5.90E-02	8.80E-01	**5.90E-02**
DDD	1.22E-03	6.30E-03	--	6.30E-03	**1.22E-03**
DDE	2.07E-03	1.10E-01	3.10E-03	1.10E-01	**2.07E-03**
DDT	1.19E-03	4.40E-02	4.10E-03	4.40E-02	**1.19E-03**
Methoxychlor	2.40E-03	5.00E+00	3.00E-02	5.00E+00	**2.40E-03**
Radionuclides (pCi/g)					
Actinium-228	---	--	--	--	--
Americium-241	-	-	2.20E+02	1.90E+02	**1.90E+02**
Americium-243	---	---	--	---	---
Barium-133	---	---	---	---	---
Bismuth-212	---	---	---	---	---
Bismuth-214	---	---	---	---	---
Californium-244	---	---	---	---	---
Carbon-14	---	---	---	---	---
Cesium-134	---	---	3.30E+02	5.50E+02	**3.30E+02**
Cesium-137[10]	---	---	7.20E+02	1.20E+03	**7.20E+02**
Cobalt-58	---	---	---	---	---
Cobalt-60	---	---	2.10E+02	7.60E+02	**2.10E+02**
Curium-243 and Curium-244	---	---	---	---	---
Curium-244	---	---	---	---	---
Curium-245 and Curium-246	---	---	---	---	
Europium-152	---	---	1.70E+01	5.20E+02	**1.70E+01**
Europium-155	---	---	---	---	---

I. SEDIMENT/SOIL MEDIA A. Screening Level (No Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR ESV[5]**
Lead-210	---	---	7.40E+02	1.20E+03	**7.40E+02**
Lead-212	---	---	---	---	---
Lead-214	---	---	---	---	---
Manganese-54	---	---			
Neptunium-237	---	---	1.20E+01	5.00E+01	**1.20E+01**
Neptunium-239	---	---	---	---	---
Plutonium-238	---	---	1.10E+02	8.20E+02	**1.10E+02**
Plutonium-239[11]	---	---	1.10E+02	8.70E+02	**1.10E+02**
Plutonium-239 and Plutonium-240	---	---	1.10E+02	8.70E+02	**1.10E+02**
Potassium-40	---	---	---	---	**---**
Promethium-146	---	---	---	---	**---**
Radium-224	---	---	---	---	**---**
Radium-226	---	---	2.10E-01	1.50E+00	**2.10E-01**
Radium-228	---	---	2.60E-01	1.20E+00	**2.60E-01**
Ruthenium-106	---	---	---	---	**---**
Strontium-89 and Strontium-90[12]	---	---	1.50E+02	3.40E+02	**1.50E+02**
Strontium-90	---	---	1.50E+02	3.40E+02	**1.50E+02**
Thallium-208	---	---	---	---	**---**
Thorium-228	---	---	2.90E+02	4.30E+01	**4.30E+01**
Thorium-230	---	---	1.20E+02	5.20E+01	**5.20E+01**
Thorium-231	---	---	---	---	**---**
Thorium-232	---	---	1.50E+01	6.20E+00	**6.20E+00**
Thorium-234	---	---	---	---	**---**
Tin-113	---	---	---	---	
Uranium-233 and Uranium-234[13]	---	---	6.20E+02	4.40E+02	**4.40E+02**
Uranium-234	---	---	6.20E+02	4.40E+02	**4.40E+02**
Uranium-235	---	---	6.70E+02	4.40E+02	**4.40E+02**
Uranium-238			6.90E+02	4.40E+02	**4.00E+02**
Zinc-65			---	---	---
Zirconium-95			---	---	---

I. SEDIMENT/SOIL MEDIA A. Screening Level (No Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR ESV[5]**

1 - Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (ESV) (2015)
2 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3 - Los Alamos National Laboratory No Effect ESL for Sediment Media
4 - Los Alamos National Laboratory No Effect ESL for Soil Media
5 - Lower Three Runs Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
6 – Value is the lowest of the available mercury screening values (methylmercury)
7 - Values for EPA Region 4 sediment are for total PAHs; values for EPA Region 4 soil are for total Low Molecular Weight PAHs
8 - Values for EPA Region 4 sediment are for total PAHs; values for EPA Region 4 soil are for total High Molecular Weight PAHs
9 - EPA Region 5 Ecological Screening Levels (Archived 2003 document)
10 – Screening value is for Cesium-137 + Barium-137
11 – Screening value is for Plutonium-239 + Plutonium-240
12 – Screening value is for Strontium-90 + Yittrium-90
13 – Screening value is for Uranium-234

II. SURFACE WATER MEDIA A. Screening Level (Chronic/No Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR ESV[4]**
Inorganics *(µg/L)*				
Aluminum	---	8.70E+01	5.30E+02	8.70E+01
Antimony	---	1.90E+02	3.00E+01	3.00E+01
Arsenic	1.50E+02	1.50E+02	1.50E+02	1.50E+02
Barium	---	2.20E+02	3.90E+00	3.90E+00
Beryllium	---	1.10E+01	6.60E-01	6.60E-01
Cadmium	1.00E-01	2.50E-01	2.80E-01	1.00E-01
Calcium	---	1.16E+05	---	1.16E+05
Chromium[5]	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Cobalt	---	1.90E+01	3.00E+00	3.00E+00
Copper	2.90E+00	9.00E+00	5.00E+00	2.90E+00
Cyanide	---	---	5.20E+00	5.20E+00
Iron	---	1.00E+03	1.00E+03	1.00E+03
Lead	5.40E-01	2.50E+00	1.00E+00	5.40E-01
Magnesium	---	8.20E+04	---	8.20E+04
Manganese	---	9.30E+01	1.30E+03	9.30E+01
Mercury	9.10E-01	1.30E-03[6]	2.80E-03[7]	1.30E-036
Nickel	1.60E+01	5.20E+01	2.90E+01	1.60E+01
Potassium	---	5.30E+04	---	5.30E+04
Selenium	5.00E+00	5.00E+00	5.00E+00	5.00E+00
Silver	---	6.00E-02	1.00E-01	6.00E-02
Sodium	---	6.80E+05	---	6.80E+05
Thallium	---	6.00E+00	3.00E-02	3.00E-02
Vanadium	---	2.70E+01	1.90E+01	1.90E+01
Zinc	3.70E+01	1.20E+02	6.50E+01	3.70E+01
Organics *(µg/L)*				
1,4-Dichlorobenzene	---	9.40E+00	1.50E+01	9.40E+00
2,4,5-Trichlorophenol	---	1.90E+00	---	1.90E+00
2,4,6-Trichlorophenol	---	4.90E+00	---	4.90E+00
2,4-Dichlorophenol	---	1.10E+01	---	1.10E+01

II. SURFACE WATER MEDIA A. Screening Level (Chronic/No Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR ESV[4]**
2,4-Dimethylphenol	---	1.50E+01	---	1.50E+01
2,4-Dinitrophenol	---	7.10E+01	---	7.10E+01
2,4-Dinitrotoluene	---	4.40E+01	6.50E+01	4.40E+01
2,6-Dinitrotoluene	---	8.10E+01	2.30E+02	8.10E+01
2-Chloronaphthalene[8]	---	3.96E-01	---	3.96E-01
2-Chlorophenol	---	3.20E+01	4.90E+02	3.20E+01
2-Methylnaphthalene	---	4.70E+00	3.30E+02	4.70E+00
2-Nitroaniline	---	---	---	---
2-Nitrophenol	---	7.30E+01	---	7.30E+01
3,3-Dichlorobenzidine	---	4.50E+00	---	4.50E+00
3-Nitroanaline	---	---	---	---
4,6-Dinitro-2-Methylphenol	---	---	---	---
4-Bromophenyl phenyl ether	---	1.50E+00	---	1.50E+00
4-Chloraniline	---	1.90E+01	---	1.90E+01
4-Chloro-m-cresol	---	---	---	---
4-Chlorophenylphenyl ether	---	---	---	---
4-Nitroaniline	---	---	---	---
4-Nitrophenol	---	5.80E+01	---	5.80E+01
Acenaphthene	---	1.50E+01	5.8E+00	5.80E+00
Acenaphthylene	---	1.30E+01	4.8E+03	1.30E+01
Acetone	---	1.70E+03	1.50E+03	1.50E+03
Acetophenone	---	---	---	---
Anthracene	---	2.00E-02	7.30E-01	2.00E-02
Benzaldehyde	---	5.70E+01	---	5.70E+01
Benzo[a]anthracene	---	4.70E+00	2.70E-02	2.70E-02
Benzo[a]pyrene	---	6.00E-02	1.40E-02	1.40E-02
Benzo[b]fluoranthene	---	2.60E+00	9.00E+00	2.60E+00
Benzo[g,h,i]perylene	---	4.40E-01	7.60E+00	4.40E-01
Benzo[k]fluoranthene	---	6.40E-01	4.10E-03	4.10E-03
Biphenyl	---	6.50E+00	---	6.50E+00
Bis[2-chloroethoxy]methane	---	---	---	---
Bis[2-chloroethyl] ether	---	---	---	---

II. SURFACE WATER MEDIA A. Screening Level (Chronic/No Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR ESV[4]**
Bis[2-chloroisopropyl]ether	---	---	---	---
Bis[2-ethylhexyl]phthalate	---	3.00E+00	3.20E+01	3.00E+00
Bromoform	---	2.30E+02	---	2.30E+02
Butylbenzylphthalate	---	2.30E+01	1.90E+01	1.90E+01
Caprolactam	---	---	---	---
Carbazole	---	---	---	---
Chloromethane	---	---	---	---
Chrysene	---	4.70E+00	1.80E-03	1.80E-03
Dibenz[a,h]anthracene	---	2.80E-01	3.40E-03	3.40E-03
Dibenzofuran	---	4.00E+00	3.70E+00	3.70E+00
Dibromochloromethane	---	3.20E+02	---	3.20E+02
Dibutylphthalate	---	1.90E+01	1.90E+01	1.90E+01
Diethylphthalate	---	2.20E+02	---	2.20E+02
Dimethylphthalate	---	1.10E+03	3.00E+00	3.00E+00
Dioctylphthalate		---	3.00E+00	3.00E+00
Diphenylamine[8]	---	4.12E+02	---	4.12E+02
Fluoranthene	---	8.00E-01	4.00E-02	4.00E-02
Fluorene	---	1.90E+01	3.90E+00	3.90E+00
Hexachlorobenzene	---	3.00E-04	---	3.00E-04
Hexachlorobutadiene	---	5.30E-02	---	5.30E-02
Hexachlorocyclopentadiene	---	4.50E-01	---	4.50E-01
Hexachloroethane	---	1.20E+01	---	1.20E+01
Indeno[1,2,3-cd]pyrene	---	2.80E-01	4.30E+00	2.80E-01
Isophorone	---	9.20E+02	---	9.20E+02
m,p-Cresol[9]	----	5.30E+04	---	5.30E+04
Methylene chloride	----	1.50E+03	2.10E+02	2.10E+02
Naphthalene	---	2.10E+01	1.10E+00	1.10E+01
Nitrobenzene	---	3.80E+02	5.50E+02	3.80E+02
N-Nitrosodipropylamine	---	2.50E+01	---	2.50E+01
o-Cresol	---	6.70E+01	---	6.70E+01
Pentachlorophenol	1.50E+01	1.50E+01	1.50E+01	1.50E+01
Phenanthrene	---	2.30E+00	6.30E+00	2.30E+00

II. SURFACE WATER MEDIA A. Screening Level (Chronic/No Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR ESV[4]**
Phenol	---	1.60E+02	3.20E+02	1.60E+02
Pyrene	----	4.60E+00	2.50E-02	2.50E-02
Styrene	---	3.20E+01	---	3.20E+01
Toluene	---	6.20E+01	9.80E+00	9.80E+00
Trichloroethene	---	2.00E+02	2.10E+01	2.10E+01
Xylenes	---	2.70E+01	1.30E+01	1.30E+01
Pesticides/PCBs *(µg/L)*				
Atrazine	---	1.20E+01	---	1.20E+01
DDE	---	4.10E-01	1.00E+02	4.10E-01
DDT	1.00E-03	3.20E-03	1.00E-03	1.00E-03
Endrin ketone	3.60E-02	3.60E-02	3.60E-02	3.60E-02
Radionuclides *(pCi/L)*				
Americium-241	---	---	5.80E+00	5.80E+00
Bismuth-214	---	---	---	---
Cesium-137[10]	---	---	1.10E+03	1.10E+03
Cobalt-60	---	---	3.80E+02	3.80E+02
Curium-244	---	---	---	---
Iodine-129	---	---	---	---
Lead-212	---	---	---	---
Lead-214	---	---	---	---
Plutonium-238	---	---	1.90E+01	1.90E+01
Plutonium-239[11]	---	---	2.00E+01	2.00E+01
Plutonium-239 and Plutonium-240	---	---	2.00E+01	2.00E+01
Potassium-40	---	---	---	---
Radium-226		---	1.00E-01	1.00E-01
Radium-228	---	---	9.00E-02	9.00E-02
Strontium-89 and Strontium-90[12]	---	---	5.70E+02	5.70E+02
Technetium-99	---	---	---	---
Thorium-232	---	---	8.10E-01	8.10E-01
Thorium-234	---	---	---	---
Tritium	---	---	1.60E+08	1.60E+08
Uranium-234	---	---	2.20E+01	2.20E+01

II. SURFACE WATER MEDIA A. Screening Level (Chronic/No Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR ESV[4]**
Uranium-235	---	---	2.40E+01	2.40E+01
Uranium-238	---	---	2.40E+01	2.40E+01

1 - SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
2 - Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3 - Los Alamos National Laboratory for No Effect ESL for Surface Water Media
4 - Lower Three Runs Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow 5 - Screening value is for Chromium VI
6 - Value is the lowest of the available mercury screening values (wildlife based)
7 - Value is the lowest of the available mercury screening values (methylmercury)
8 - EPA Region 5 Ecological Screening Levels (Archived 2003 document)
9 – Screening value is for p-Cresol
10 - Screening value is for Cesium-137 + Barium-137
11 – Screening value is for Plutonium-239 and Plutonium-240
12 – Screening value is for Strontium-90 + Yittrium-90

I. SEDIMENT/SOIL MEDIA B. Refinement Level (Low Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR RSV[5]**
Inorganics *(mg/kg)*					
Aluminum	5.80E+04	---	---	---	**5.80E+04**
Ammonia	3.00E+02	---	---	---	**3.00E+02**
Antimony	2.50E+01	NA	5.00E+02	2.40E+01	**2.40E+01**
Arsenic	3.30E+01	NA	3.30E+01	6.80E+01	**3.30E+01**
Barium	6.00E+01	NA	3.00E+02	2.60E+02	**6.00E+01**
Beryllium	---	NA	7.30E+02	2.50E+01	**2.50E+01**
Cadmium	5.00E+00	NA	3.30E+00	2.70E+00	**2.70E+00**
Calcium	---	---	---	---	---
Chloride	---	---	---	---	---
Chromium	1.11E+02	NA	1.10E+02	2.80E+02-	**1.10E+02**
Chromium VI	---	NA	6.80E+03	3.40E+00	**3.40E+00**
Cobalt	---		2.30E+03	1.30E+02	**1.30E+02**
Copper	1.49E+02	NA	7.00E+01	4.60E+01	**4.60E+01**
Cyanide	---	---	1.00E+00	1.00E+00	**1.00E+00**
Iron	4.00E+04		4.00E+04	---	**4.00E+04**
Lead	1.28E+02	NA	5.40E+01	2.80E+01	**2.80E+01**
Magnesium	---	---	---	---	---
Manganese	1.10E+03	NA	1.10E+03	1.10E+03	**1.10E+03**
Mercury	1.10E+00	NA	4.60E-03[6]	3.50E-03[6]	**3.50E-03[6]**
Nickel	4.86E+01	NA	2.70E+01	1.90E+01	**1.90E+01**
Phosphate	---	---	---	---	---
Potassium	---	---	---	---	---
Selenium	2.00E+01	NA	2.90E+00	3.090E+00	**2.90E+00**
Silver	2.20E+00	NA	5.00E+00	2.60E+01	**2.20E+00**
Sodium	---	---	---	---	---
Thallium	---	NA	8.20E+00	5.00E+01	**5.00E-01**
Vanadium	---		6.10E+01	1.30E+01	**1.30E+01**
Zinc	4.59E+02		6.50E+02	4.80E+02	**4.59E+02**
Organics *(mg/kg)*					
2-Chlorophenol	---	NA	5.50E-01	3.90E+00	**3.90E+00**
2-Hexanone	---	NA	---	3.60E+00	**3.60E+00**
2-Methylnaphthalene	4.47E-01	NA	7.60E-01	1.60E+02	**4.47E-01**
Acetone	---	NA	6.50E-01	6.30E+00	**6.50E-01**
Benzaldehyde	---	---	---	---	---

I. SEDIMENT/SOIL MEDIA B. Refinement Level (Low Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR RSV[5]**
Benzene	---	NA	1.00E-01	2.40E+02	**1.00E-01**
Benzo[a]pyrene	9.65E-01	NA	1.40E+00	1.70E+02	**9.65E-01**
Benzo[b]fluoranthene	9.79E-01	NA	1.90E+00	1.80E+02	**9.79E-01**
Benzo[g,h,i]perylene	1.10E+00	NA	1.70E+00	2.40E+02	**1.10E+00**
Benzoic acid	3.80E+00	NA	1.30E+01	1.00E+01	**3.80E+00**
Bis[2-chloroethyl] ether	---	---	---	---	---
Bis[2-ethylhexyl]phthalate	2.65E+00	NA	2.60E-01	2.00E-01	**2.00E-01**
Butylbenzylphthalate	---	NA	1.00E+00	9.00E+02	**1.00E+00**
Camphene	---	---	---	---	---
Carbon disulfide	---	NA	---	8.20E+00	**8.20E+00**
Chloroform	---	NA	---	---	**---**
Chloromethane	---	NA	---	---	---
Chrysene	8.44E-0	NA	1.20E+00	2.40E+01	**8.44E-01**
Cinnamyl Cinnamate	---	NA	---	---	**---**
Dibutylphthalate	1.00E+00	NA	1.10E-01	1.10E-01	**1.10E-01**
Diethylphthalate	---	NA	---	1.00E+03	**1.00E+03**
Docosane	---	NA	---	---	---
Ethylbenzene	---	NA	---	---	---
Fluoranthene	7.07E-01	NA	2.20E+00	2.30E+01	**7.07E-01**
Isopropylbenzene	---	---	---	---	---
Methyl acetate	---	---	---	---	---
Methyl cyclopentane	---	---	---	---	---
Methyl ethyl ketone	---	NA	---	---	---
Methyl isobutyl ketone	---	---	---	---	---
Orthophosphate	---	---	---	---	---
Phenanthrene	5.96E-01	NA	1.10E+00	1.20E+01	**5.96E-01**
Phenol	1.20E-01	NA	8.40E+03	8.00E+00	**1.20E-01**
Phenols	1.20E-01	NA	8.40E+03	8.00E+00	**1.20E-01**
Pyrene	6.97E-01	NA	1.50E+00	2.00E+01	**6.97E-01**
Styrene	---	NA	---	---	---
Toluene	---	NA	1.00E-01	2.30E+02	**1.00E-01**
Unknown alkane	---		---	---	---
Unknown hydrocarbon	---	NA	---	---	---
Xylenes	---	NA	1.30E+00	1.70E+00	**1.30E+00**
Pesticides*/PCBs (mg/kg)*					

I. SEDIMENT/SOIL MEDIA B. Refinement Level (Low Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR RSV[5]**
PCB-1242	---	NA	5.40E-01	4.10E-01	**4.10E-01**
PCB-1254	---	NA	5.40E-01	4.10E-01	**4.10E-01**
PCB-1260	---	NA	5.90E-01	1.20E+00	**5.90E-01**
DDD	7.81E-03	NA	---	3.30E-02	**7.81E-03**
DDE	3.74E-03	NA	3.10E-02	5.50E-01	**3.74E-03**
DDT	4.77E-03	NA	4.10E-02	2.20E-01	**4.77E-03**
Methoxychlor	---	NA	3.00E-01	1.00E+01	**3.00E-01**
Radionuclides *(pCi/g)*					
Actinium-228	---	---	---	---	---
Americium-241	---	---	2.20E+03	1.90E+03	**1.90E+03**
Americium-243	---	---	---	---	---
Barium-133	---	---	---	---	---
Bismuth-212	---	---	---	---	---
Bismuth-214	---	---	---	---	---
Californium-244	---	---	---	---	---
Carbon-14	---	---	---	---	---
Cesium-134	---	---	3.30E+03	5.50E+03	**3.30E+03**
Cesium-137[7]	---	---	7.20E+03	1.20E+04	**7.20E+03**
Cobalt-58	---	---	---	---	---
Cobalt-60	---	---	2.10E+03	7.60E+03	**2.10E+03**
Curium-243 and Curium-244	---	---	---	---	---
Curium-244	---	---	---	---	---
Curium-245 and Curium-246	---	---	---	---	---
Europium-152	---	---	1.70E+02	5.20E+03	**1.70E+02**
Europium-155	---	---	---	---	---
Lead-210	---	---	7.40E+03	1.20E+04	**7.40E+03**
Lead-212	---	---	---	---	---
Lead-214	---	---	---	---	---
Manganese-54	---	---	---	---	---
Neptunium-237	---	---	1.20E+02	5.00E+02	**1.20E+02**
Neptunium-239	----	---	---	---	---
Plutonium-238	---	---	1.10E+03	8.20E+03	**1.10E+03**
Plutonium-239[8]	---	---	1.10E+03	8.70E+03	**1.10E+03**
Plutonium-239 and Plutonium-240	---	---	1.10E+03	8.70E+03	**1.10E+03**
Potassium-40	---	---	---	---	---
Promethium-146	---	---	---	---	---

I. SEDIMENT/SOIL MEDIA B. Refinement Level (Low Effect Screening Level)					
Analyte	**EPA R4 Sediment[1]**	**EPA R4 Soil[2]**	**LANL Sediment[3]**	**LANL Soil[4]**	**LTR RSV[5]**
Radium-224	--- ---	--- ---	---	---	---
Radium-226	---	---	2.10E+00	1.50E+01	**2.10E+00**
Radium-228	---	---	2.60E+00	1.20E+01	**2.60E+00**
Ruthenium-106	---	---	---	---	---
Strontium-89 and Strontium-90[9]	---	---	1.50E+03	3.40E+03	**1.50E+03**
Strontium-90[9]	---	---	1.50E+03	3.40E+03	**1.50E+03**
Thallium-208	---	---	---	---	---
Thorium-228	---	---	2.90E+03	4.30E+02	**4.30E+02**
Thorium-230	---	---	1.20E+03	5.20E+02	**5.20E+02**
Thorium-231	---	---	---	---	---
Thorium-232	---	---	1.50E+02	6.20E+01	**6.20E+01**
Thorium-234	---	---	---	---	---
Tin-113	---	---	---	---	---
Uranium-233 and Uranium-234[10]	---	---	6.20E+03	4.40E+03	**4.40E+03**
Uranium-234	---	---	6.20E+03	4.40E+03	**4.40E+03**
Uranium-235	---	---	6.70E+03	4.40E+03	**4.40E+03**
Uranium-238	---	---	6.90E+03	4.00E+03	**4.00E+03**
Zinc-65	---	---	---	---	---
Zirconium-95	---	---	---	---	---

1 - Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (RSV) (2015)
2 - Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3 - Los Alamos National Laboratory Low Effect ESL for Sediment Media
4 - Los Alamos National Laboratory Low Effect ESL for Soil Media
5 - Lower Three Runs Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
6 – Value is the lowest of the available mercury screening values (methylmercury)
7 – Screening value is for Cesium-137 + Barium-137
8 – Screening value is for Plutonium-239 + Plutonium-240
9 – Screening value is for Strontium-90 + Yittrium-90

II. SURFACE WATER MEDIA B. Refinement Level (Chronic/Low Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR RSV[4]**
Inorganics *(µg/L)*				
Aluminum	---	8.70E+01	5.30E+02	8.70E+01
Antimony	---	1.90E+02	3.00E+01	3.00E+01
Arsenic	1.50E+02	1.50E+02	1.50E+02	1.50E+02
Baium	---	2.20E+02	3.90E+00	3.90E+00
Beryllium	---	1.10E+01	6.60E-01	6.60E-01
Cadmium	1.00E-01	2.50E-01	2.80E-01	1.00E-01
Calcium	---	1.16E+05	---	1.16E+05
Chromium[5]	1.10E+01	1.10E+01	1.10E+01	1.10E+01
Cobalt	---	1.90E+01	3.00E+00	3.00E+00
Copper	2.90E+00	9.00E+00	5.00E+00	2.90E+00
Cyanide	---	---	5.20E+00	5.20E+00
Iron	--	1.00E+03	1.00E+03	1.00E+03
Lead	5.40E-01	2.50E+00	1.00E+00	5.40E-01
Magnesium	---	8.20E+04	---	8.20E+04
Manganese	---	9.30E+01	1.30E+03	9.30E+01
Mercury	9.10E-01	1.30E-03[6]	2.80E-03[7]	1.30E-03[6]
Nickel	1.60E+01	5.20E+01	2.90E+01	1.60E+01
Potassium	---	5.30E+04	---	5.30E+04
Selenium	5.00E+00	5.00E+00	5.00E+00	5.00E+00
Silver	---	6.00E-02	1.00E-01	6.00E-02
Sodium	---	6.80E+05	---	6.8E+05
Thallium	---	6.00E+00	3.00E-02	3.00E-02
Vanadium	---	2.70E+01	1.90E+01	1.90E+01
Zinc	3.70E+01	1.20E+02	6.50E+01	3.70E+01
Organics *(µg/L)*				
1,4-Dichlorobenzene	---	9.40E+00	1.50E+01	9.40E+00
2,4,5-Trichlorophenol	---	1.90E+00	---	1.90E+00
2,4,6-Trichlorophenol	---	4.90E+00	---	4.90E+00
2,4-Dichlorophenol	---	1.10E+01	---	1.10E+01
2,4-Dimethylphenol	---	1.50E+01	---	1.50E+01
2,4-Dinitrophenol	---	7.10E+01	---	7.10E+01
2,4-Dinitrotoluene	---	4.40E+01	6.50E+01	4.40E+01
2,6-Dinitrotoluene	---	8.10E+01	2.30E+02	8.10E+01
2-Chloronaphthalene[8]	---	3.96E-01	---	3.96E-01
2-Chlorophenol	---	3.20E+01	4.90E+02	3.20E+01

II. SURFACE WATER MEDIA B. Refinement Level (Chronic/Low Effect Screening Level)				
Analyte	**SCDHEC WQS[1]**	**EPA R4 Surface Water[2]**	**LANL Surface Water[3]**	**LTR RSV[4]**
2-Methylnaphthalene	---	4.70E+00	3.30E+02	4.70E+00
2-Nitroaniline	---	---	---	---
2-Nitrophenol	---	7.30E+01		7.30E+01
3,3-Dichlorobenzidine	---	4.50E+00	---	4.50E+00
3-Nitroanaline	---	---	---	---
4,6-Dinitro-2-Methylphenol	---	---	---	---
4-Bromophenyl phenyl ether	---	1.50E+00	---	1.50E+00
4-Chloraniline	---	1.90E+01	---	1.90E+01
4-Chloro-m-cresol	---	---	---	---
4-Chlorophenylphenyl ether	---	---	---	---
4-Nitroaniline	---	---	---	---
4-Nitrophenol	---	5.80E+01	---	5.80E+01
Acenaphthene	---	1.50E+01	5.80E+00	5.80E+00
Acenaphthylene	---	1.30E+01	4.80E+03	1.30E+01
Acetone	---	1.70E+03	1.50E+03	1.50E+03
Acetophenone	---	---	---	---
Anthracene	---	2.00E-02	7.30E-01	2.00E-02
Benzaldehyde	---	5.70E+01	---	5.70E+01
Benzo[a]anthracene	---	4.70E+00	2.70E-02	2.70E-02
Benzo[a]pyrene	---	6.00E-02	1.40E-02	1.40E-02
Benzo[b]fluoranthene	---	2.60E+00	9.00E+00	2.60E+00
Benzo[g,h,i]perylene	---	4.40E-01	7.60E+00	4.40E-01
Benzo[k]fluoranthene		6.40E-01	4.10E-03	4.10E-03
Biphenyl		6.50E+00	---	6.50E+00
Bis[2-chloroethoxy]methane	---	---	---	---
Bis[2-chloroethyl] ether	---	---	---	---
Bis[2-chloroisopropyl]ether	---	---	---	---
Bis[2-ethylhexyl]phthalate	---	3.00E+00	3.20E+01	3.00E+00
Bromoform	---	2.30E+02	---	2.30E+02
Butylbenzylphthalate	---	2.30E+01	1.90E+01	1.90E+01
Caprolactam	---	---	---	---
Carbazole	---	---	---	---
Chloromethane	---	---	---	---
Chrysene	---	4.70E+00	1.80E-03	1.80E-03
Dibenz[a,h]anthracene	---	2.80E-01	3.40E-03	3.40E-03
Dibenzofuran	---	4.00E+00	3.70E+00	3.70E+00
Dibromochloromethane	---	3.20E+02	---	3.20E+02

II. SURFACE WATER MEDIA B. Refinement Level (Chronic/Low Effect Screening Level) Analyte	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	LTR RSV[4]
Dibutylphthalate	---	1.90E+01	1.90E+01	1.90E+01
Diethylphthalate	---	2.20E+02	---	2.20E+02
Dimethylphthalate	---	1.10E+03	3.00E+00	3.00E+00
Dioctylphthalate	---	---	3.00E+00	3.00E+00
Diphenylamine[8]	---	4.12E+02	---	4.12E+02
Fluoranthene	---	8.00E-01	4.00E-02	4.00E-02
Fluorene	---	1.90E+01	3.90E+00	3.90E+00
Hexachlorobenzene	---	3.00E-04[9]	---	---
Hexachlorobutadiene	---	5.30E+01[9]	---	---
Hexachlorocyclopentadiene	---	4.50E-01	---	4.50E-01
Hexachloroethane	---	1.2E+01E	---	1.2E+01
Indeno[1,2,3-cd]pyrene	---	2.80E-01	4.30E+00	2.80E-01
Isophorone	---	9.20E+02	---	9.20E+02
m,p-Cresol[10]	---	5.30E+01	---	5.30E+01
Methylene chloride	---	1.50E+03	2.10E+02	2.10E+02
Naphthalene	---	2.10E+01	1.10E+00	1.10E+00
Nitrobenzene	---	3.80E+02	5.50E+02	3.80E+02
N-Nitrosodipropylamine	---	2.50E+01	---	2.50E+01
o-Cresol	---	6.70E+01	---	6.70E+01
Pentachlorophenol	1.50E+01	1.50E+01	1.50E+01	1.50E+01
Phenanthrene	---	2.30E+00	6.30E+00	2.30E+00
Phenol	---	1.60E+02	3.20E+02	1.60E+02
Pyrene	---	4.60E+00	2.50E-02	2.50E-02
Styrene	---	3.20E+01	---	3.20E+01
Toluene	---	6.20E+01	9.80E+00	9.80E+00
Trichloroethene	---	2.00E+02	2.10E+01	2.10E+01
Xylenes	---	2.70E+01	1.30E+01	1.30E+01
Pesticides/PCBs *(µg/L)*				
Atrazine	---	1.20E+01	---	1.20E+01
DDE	---	4.10E-01	1.00E+02	4.10E-01
DDT	1.00E-03	3.20E-03	1.00E-03	1.00E-03
Endrin ketone	3.60E-02	3.60E-02	3.60E-02	3.60E-02
Radionuclides *(pCi/L*				
Americium-241	---	---	5.80E+01	5.80E+01
Bismuth-214	---	---	---	---
Cesium-137[11]	---	---	1.10E+04	1.10E+04
Cobalt-60	---	---	3.80E+03	3.80E+03

II. SURFACE WATER MEDIA
B. Refinement Level (Chronic/Low Effect Screening Level)

Analyte	SCDHEC WQS[1]	EPA R4 Surface Water[2]	LANL Surface Water[3]	LTR RSV[4]
Curium-244	---	---	---	---
Iodine-129	---	---	---	---
Lead-212	---	---	---	---
Lead-214	---	---	---	---
Plutonium-238	---	---	1.90E+02	1.90E+02
Plutonium-239[12]			2.00E+02	2.00E+02
Plutonium-239 and Plutonium-240	---	---	2.00E+02	2.00E+02
Potassium-40	---	---	---	---
Radium-226	---		1.00E+00	1.00E+00
Radium-228	---	---	9.00E-01	9.00E-01
Strontium-89 and Strontium-90[13]	---	---	5.70E+03	5.70E+03
Technetium-99	---	---	---	---
Thorium-232			8.10E+00	8.10E+00
Thorium-234	---	---	---	---
Tritium	---	---	1.60E+09	1.60E+09
Uranium-234			2.20E+02	2.20E+02
Uranium-235	---	---	2.20E+02	2.40E+02
Uranium-238	---	---	2.40E+02	2.40E+02

1 SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (Attachment C-4) (2014)
2 - Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015)
3 - Los Alamos National Laboratory for Low Effect ESL for Surface Water Media
4 - Lower Three Runs Ecological Screening Value= lowest (most conservative) screening value highlighted in yellow
5 - Screening value is for Chromium VI
6 - Value is the lowest of the available mercury screening values (wildlife based)
7 - Value is the lowest of the available mercury screening values (methylmercury)
8 - EPA Region 5 Ecological Screening Levels (Archived 2003 document)
9 - This is a wildlife based chronic value. There is no acute value available in EPA Table 1a.
10 – Screening value is for p-Cresol
11 - Screening value is for Cesium-137 + Barium 134
12 – Screening value is for Plutonium-239 and Plutonium-240
13 – Screening value is for Strontium-90 + Yittrium-90

Attachment C-2 – EPA Region 4 Screening Tables for Surface Water, Sediment, and Soil

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Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Inorganic Compounds							
Metals							
Aluminum (pH 6.5 -9.0)	7429-90-5	87	750	a	1,900	3,288	c
Antimony	7440-36-0	190	900	b	30	180	c
Arsenic (unfiltered) ^	7440-38-2	150	340	a	36	69	a
Arsenic III (unfiltered) ^	22541-54-4	148	340	b	36	69	f
Barium	7440-39-3	220	2,000	b			
Beryllium	7440-41-7	11	93	b	0.66	35	c
Boron	7440-42-8	7,200	34,000	b	1,000		l
Cadmium (unfiltered) ^ *	7740-43-9	0.25	2	a	8.8	40	a
Calcium	7440-70-2	116,000	-	c	116,000		c
Chromium III (unfiltered) ^ *	16065-83-1	74	570	a	20		e
Chromium VI (unfiltered) ^	18540-29-9	11	16	a	50	1,100	a
Cobalt	7440-48-4	19	120	b	23	1,500	c
Copper (unfiltered) ^ *	7740-50-8	9	13	a	3.1	4.8	a
Iron	7439-89-6	1,000		a			
Lead (unfiltered) ^ *	7439-92-1	2.5	65	a	8.1	210	a
Lithium	7439-93-2	440	910	b	14	260	c
Magnesium	7439-95-4	82,000		c	82,000		c
Manganese	7439-96-5	93	1,680	b	120	2,300	d, c
Mercury (unfiltered) ^ (aquatic)	7439-97-6	0.77	1.4	a	0.94	1.8	a
Mercury (wildlife based)	7439-97-6	0.0013	0.012	b, a	0.00053	0.025	a
Methylmercury (aquatic life)	22967-92-6	0.0028	0.099	c	0.0028	0.099	c
Molybdenum	7439-98-7	800	7,200	b	370	16,000	c
Nickel (unfiltered) ^ *	7440-02-0	52	470	a	8.2	74	a
Phosphorus (elemental)	7723-14-0	1,000		m	100		d
Potassium	7440-09-7	53,000		c	53,000		c
Selenium (unfiltered) ^ (aquatic)	7782-49-2	5	20	a	71	290	a
Silver (unfiltered) ^ *	7740-22-4	0.06	3.2	b	0.1	1.9	e, a
Sodium	7440-23-5	680,000		c	680,000		c
Strontium	7440-24-6	5,300	48,000	b	1,500	15,000	c
Thallium	7740-28-0	6	54	b	12	110	c
Tin	7440-31-5	180	1,600	b	73	2,700	c
Uranium	7440-61-1	2.6	46	c	2.6	46	c
Vanadium	7440-62-2	27	79	b	20	280	c
Zinc (unfiltered) ^ *	7740-66-6	120	120	a	81	90	a
Zirconium	7440-67-7	17	310	c	17	310	c
Other Inorganics							
Chloride	16887-00-6	230,000	860,000	a			
Chlorine	7782-50-5	11	19	a	7.5	13	a
Cyanide (free)	57-12-5	5.2	22	a	1	1	a
Fluorides	16984-48-8	2,700	9,800	b	5,000		d
Hydrogen sulfide (S^{2-}, HS^-)	7783-06-4	2	3.2	a	2		a
Sulfite	14265-45-3	200		b			
Volatile Organic Compounds (VOCs)							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	85	770	b	10.8		d
1,1,2,2-Tetrachloroethane	79-34-5	200	910	b	610	2,100	c
1,1,1-Trichloroethane	71-55-6	76	690	b	11	200	c
1,1,2-Trichloroethane	79-00-5	730	3,200	b	1,200	5,200	c
1,1-Dichloroethane	75-34-3	410	3,700	b	47	830	c
1,2-Dichloroethane	107-06-2	2,000	8,200	b	910	8,800	c
1,2-Dichloropropane	78-87-5	520	3,300	b		3,400	g
Dichloromethane (Methylene chloride)	75-09-2	1,500	8,500	b	2,200	26,000	c
Trichloromethane (Chloroform)	67-66-3	140	1,300	b	28	490	c
Tetrachloromethane (Carbon tetrachloride)	56-23-5	77	690	b	9.8	180	c

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	130	1,200	b	25	450	c
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	970	8,800	b	590	1,100	c
1,2-cis-Dichloroethyene	156-59-2	620	5,500	b			
1,2-trans-Dichloroethylene	156-60-5	558	10,046	b			
1,3-Dichloropropene (cis and trans)	542-75-6	1.7	15	b	0.06	0.99	c
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	53	430	b	98	830	c
1,1,2-Trichloroethylene (TCE)	79-01-6	200	2,000	b	47	440	c
Chloroethene (Vill chloride)	75-01-4	930	8,400	b			
Chlorobenzenes							
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
1,2-Dichlorobenzene	95-50-1	23	130	b	14	260	c
1,3-Dichlorobenzene	541-73-1	22	79	b	71	630	c
1,4-Dichlorobenzene	106-46-7	9.4	57	b	15	180	c
1,2,3-Trichlorobenzene	87-61-6	5	195	l, i	5		l
1,2,4-Trichlorobenzene	120-82-1	130	420	b	110	700	c
1,3,5-Trichlorobenzene	108-70-3	5	195	l, i	5		l
Trichlorobenzene (mixed isomers)	12002-48-1	5	555	b, i	5		l
Monoaromatic hydrocarbons							
1,2,4-Trimethylbenzene	95-63-6	15	140	b			
1,3,5-Trimethylbenzene	108-67-8	26	230	b			
Benzene	71-43-2	160	700	b	71.3		d
Cymene, p- (4-Isopropyltoluene)	99-87-6	16	150	b			
Ethylbenzene	100-41-4	61	550	b	7.3	130	c
Isopropylbenzene (Cumene)	98-82-8	4.8	43	b			
Styrene (vinyl benzene)	100-42-5	32	290	b			
Toluene	108-88-3	62	560	b	9.8	120	c
Xylenes (total)	1330-20-7	27	240	b	13	230	c
Energetic VOAs							
Acetonitrile	75-05-8	12,000	100,000	b			
Acrylonitrile	107-13-1	78	650	b			
1,2-Diphenylhydrazine	122-66-7	1.1	9.6	b			
Hydrazine	302-01-2	2	16	b			
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	22,000	200,000	b	14,000	240,000	c
2-Hexanone (methyl butyl ketone)	591-78-6	99	1,800	c	99	1,800	c
2-Octanone (methyl hexyl ketone)	111-13-7	8.3	150	c	8.3	150	c
4-Methyl-2-pentanone (MIBK)	108-10-1	170	2,200	c	170	2,200	c
Acetone	67-64-1	1,700	15,000	b	1,500	28,000	c
Other VOCs							
1-Pentanol	71-41-0	110	2,000	c	110	2,000	c
2-Propanol	67-63-0	7.5	130	c	7.5	130	c
Acetaldehyde	75-07-0	130	1,200	b	1.4		e
Acrolein	107-02-8	3	3	a			
Bromoform (tribromomethane)	75-25-2	230	1,100	b	320	2,300	c
Bromomethane (methyl bromide)	74-83-9	16	38	b			
Carbon disulfide	75-15-0	15	130	b	0.92	17	c
Cyclohexane	110-82-7	230		e	120		e
Dibromochloromethane	124-48-1	320	2,900	b	34		d
Dichlorobromomethane	75-27-4	340	3,100	b			
Ethylene glycol	107-21-1	140,000	1,300,000	b			
Hexane	110-54-3	0.58	10	c	0.58	10	c
Hexachloroethane	67-72-1	12	210	c	12	210	c
Methanol	67-56-1	330	3,000	b			
Methylamine	74-89-5	860	7,700	b			

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Volatile Organic Compounds (VOCs)							
Other VOCs							
Methyl tert-butyl ether (MTBE)	1634-04-4	730	6,500	b	18,000	53,000	m
Propylene glycol	57-55-6	71	640	b			
Tetrahydrofuran	109-99-9	11,000	74,000	b			
Vinyl acetate	108-05-4	16	280	c	16	280	c
Semivolatile Organic Compounds							
Chloroanilines							
4-Chloroaniline	106-47-8	19	459	j			
2,4-Dichloroaniline	554-00-7	15	575	j			
Pentachloroaniline	527-20-8	5	429	j			
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	3.4	18	n			
1,2,4,5-Tetrachlorobenzene	95-94-3	8.3	75	b			
Chlorobenzene	108-90-7	25	220	b	64	1,100	c
Hexachlorobenzene (wildlife based)	118-74-1	0.0003		n			
Pentachlorobenzene (aquatic only)	608-93-5	3.1	16	b	0.47	8.4	c
Pentachlorobenzene (wildlife based)	608-93-5	0.019		n			
Chlorophenols							
2-Chlorophenol	95-57-8	32	290	b	400		d
2,4-Dichlorophenol	120-83-2	11	110	b	790		d
2,4,5-Trichlorophenol	95-95-4	1.9	17	b	12	259	o
2,4,6-Trichlorophenol	88-06-2	4.9	39	b	6.5		d
2,3,4,6-Tetrachlorophenol	58-90-2	1.2	11	n			
3-Methyl-4-Chlorophenol	59-50-7	7.4	67	n			
Other Phenols							
2-Methylphenol (Cresol, o-)	95-48-7	67	600	b	13	230	c
3-Methylphenol (Cresol, m-)	108-39-4	62	560	b			
4-Methylphenol (Cresol, p-)	106-44-5	53	480	b			
2,3-Dimethylphenol	526-75-0	120	1,100	n			
2,4-Dimethylphenol	105-67-9	15	140	b			
2-Nitrophenol	88-75-5	73	650	b			
4-Nitrophenol	100-02-7	58	530	b	300	1,200	c
2,4-Dinitrophenol	51-28-5	71	379	b	14.3		d
2,4,6-Tribromophenol	118-79-6	5.6	50	b			
Nonylphenol	84852-15-3	6.6	28	o	1.7	7	o
Pentachlorophenol # (aquatic)	87-86-5	15	19	a	7.9	13	a
Phenol	108-95-2	160	4,700	b	58	300	p
Semivolatile Organic Compounds							
Energetic SVOAs							
2-Amino-4,6-dinitrotoluene	35572-78-2	18	160	b	20	180	k
4-Amino-2,6-dinitrotoluene	19406-51-0	11	98	b			
1,3-Dinitrobenzene (DNB)	99-65-0	22	100	b	20	110	k
2,3-Dinitrotoluene	602-01-7	2.3	21	b			
2,4-Dinitrotoluene	121-14-2	44	390	b	9.1	200	d, g
2,5-Dinitrotoluene	619-15-8	5.6	50	b			
2,6-Dinitrotoluene	606-20-2	81	730	b		200	g
3,5-Dinitrotoluene	618-85-9	95	860	b			
3,5-Dinitroanaline (DNA)	618-87-1	60	230	k	60	230	k
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	220	1,200	b	330	1,880	k
Nitroglycerine	55-63-0	18	160	b			
2-Nitrotoluene	88-72-2	71	640	b			
3-Nitrotoluene	99-08-1	42	380	b			
4-Nitrotoluene	99-99-0	46	410	b			
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	79	520	b	190	700	k
1,3,5-Trinitrobenzene (TNB)	99-35-4	11	27	b	10	30	k
2,4,6-Trinitrotoluene (TNT)	118-96-7	13	120	b	90	570	k

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Semivolatile Organic Compounds							
Phthalates							
bis(2-Ethylhexyl) Phthalate	117-81-7	3	27	c	3	27	c
Butylbenzyl Phthalate	85-68-7	23	130	b	19		c
Diethyl Phthalate	84-66-2	220	980	b	210	1,800	c
Dimethyl Phthalate	131-11-3	1,100	3,200	b	2,900		e
Di-n-Butyl Phthalate	84-74-2	19	34	b	35	190	c
Polycyclic Aromatic Hydrocarbons (PAHs)							
1-Methylnaphthalene	90-12-0	2.1	37	c	2.1	37	c
2-Methylnaphthalene	91-57-6	4.7	42	b	72	86, i	q
Acenaphthene	83-32-9	15	19	b	20	86, i	l
Acenaphthylene	208-96-8	13	120	b	307	582, i	q
Anthracene	120-12-7	0.02	0.18	b	0.73	13	c
Benz(a)anthracene	56-55-3	4.7	42	b	0.027	0.49	c
Benzo(a)pyrene	50-32-8	0.060	0.54	b	0.3	2, i	c
Benzo(b)fluoranthene	205-99-2	2.6	23	b	0.68	2, i	q
Benzo(g,h,i)perylene	191-24-2	0.44	6	q, j	0.44	0.5, i	q
Benzo(k)fluoranthene	207-08-9	0.64	2	q, i	0.64	2, i	q
Chrysene	218-01-9	4.7	42	b	2	6.5, i	q
Dibenz(a,h)anthracene	53-70-3	0.28	6	q, j	0.28	1.2 i	q
Fluoranthene	206-44-0	0.8	3.7	b	7.1	21, i	q
Fluorene	86-73-7	19	110	b	3.9	70	c
Indeno(1,2,3-cd)pyrene	193-39-5	0.28	6	q, j	0.28	0.5, i	q
Naphthalene	91-20-3	21	170	b	12	190	c
Phenanthrene	85-01-8	2.3	31	b	4.6	7.7	o
Pyrene	129-00-0	4.6	42	b	10	21, i	q
Other SVOCs							
1,1-Biphenyl	92-52-4	6.5	26	b	14		c
2,2-Dibromo-3-nitrilopropionamide	10222-01-2	20	50	b			
3,3'-Dichlorobenzidine	91-94-1	4.5	41	n			
4-Bromophenyl Phenyl Ether	101-55-3	1.5	0	c	1.5		c
Aniline	62-53-3	4.1	30	b			
Benzaldehyde	100-52-7	57	547	j			
Benzidine	92-87-5	1.5	14	b	3.9	70	c
Benzoic Acid	65-85-0	42	740	c	42	740	c
Benzyl alcohol	100-51-6	8.6	150	c	8.6	150	c
Decane	124-18-5	49	880	c	49	880	c
Dibenzofuran	132-64-9	4	36	b	3.7	66	c
Hexachlorobutadiene (Aquatic Life)	87-68-3	1	10	b	0.3	3	l
Hexachlorobutadiene (Wildlife Based)	87-68-3	0.053		n			
Hexachlorocyclopentadiene	77-47-4	0.45	4.5	b	0.07	0.7	l
Hydroquinone	123-31-9	2.2	4.4	b			
Isodecyl diphenyl phosphate	29761-21-5	1.73	22	b			
Isophorone	78-59-1	920	7,500	b		4,300	g
N-Nitrosodiphenylamine	86-30-6	25	220	b	210	3,800	c
Nitrobenzene	98-95-3	380	2,000	b		2,000	g
Propylene glycol	57-55-6	71	640	b			
Quinoline	91-22-5	3.4		h			
Triphenyl phosphate	115-86-6	4	40	b			
Pesticides, Herbicides, Fungicides							
2,4-D	94-75-7	79.2	130	r	70		d
4,4'-DDT (Aquatic Life Only)	50-29-3	0.0032	1.1	a	0.001	0.13	a
4,4'-DDE	72-55-9	0.41	7	j			
4,4'-DDD	72-54-8	0.011	0.19	c	0.011	0.19	c
Acephate	30560-19-1	150	550	r			
Aldrin	309-00-2	0.035	3.0	b	0.00014	1.3	d
Atrazine	1912-24-9	12	330	b			
Azinphos-methyl (Guthion)	86-50-0	0.01	0.08	a, r	0.01		a

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source
Pesticides, Herbicides, Fungicides							
BHC (beta)	319-84-6	0.046		d	0.046		d
BHC-gamma (Lindane) (Aquatic Life)	58-89-9	0.11	0.95	b, a	0.063	0.16	d, a
BHC-gamma (Lindane) (Wildlife Based)	58-89-9	0.026		n			
Carbaryl	63-25-2	0.5	0.85	r		1.6	a
Carbofuran	1563-66-2	0.75	1.12	r			
Captan	133-06-2		13.1	r			
Chlordane	57-74-9	0.0043	2.4	a	0.00059	0.004	d
Chlorothalonil	1897-45-6	0.6	1.8	r			
Chloropyrifos	2921-88-2	0.041	0.05	a, r	0.0056	0.011	a
Cyanazine	21725-46-2	270	2420	b			
Demeton	8065-48-3	0.1	-	b, a	0.1		a
Diazinon	333-41-5	0.17	0.17	a	0.82	0.82	a
Dicamba	1918-00-9	3,898	216	b			
Dieldrin	60-57-1	0.056	0.24	a	0.0019	0.71	a
Dimethoate	60-51-5	0.5	21.5	r			
Dinoseb	88-85-7	0.48	9.5	n			
Diquat	2764-72-9	6	54	b			
Endosulfan-alpha	959-98-8	0.01	0.11	r	0.0087	0.034	a
Endosulfan-beta	33213-65-9	0.01	0.11	r	0.0087	0.034	a
Endosulfan Sulfate	1031-07-8	0.056	0.22	p	0.0087	0.034	p
Endrin	72-20-8	0.036	0.086	a	0.0023	0.037	a
Heptachlor	76-44-8	0.0038	0.52	a	0.0036	0.053	a
Heptachlor Epoxide	1024-57-3	0.0038	0.52	a	0.0036	0.053	a
Malathion	121-75-5	0.035	0.295	r	0.1		a
MCPA (2-methyl-4-chlorophenoxyacetic acid)	94-74-6	2.6		h	4.2		h
Pesticides, Herbicides, Fungicides							
Methoxychlor	72-43-5	0.03	0.7	a	0.019		c
Metolachlor	51218-45-2	15	110	n			
Mirex (Aquatic Life)	2385-85-5	0.001	0.001	a	0.001	0.001	a
Mirex (Wildlife Based)	2385-85-5	0.000016	-	n			
Parathion	56-38-2	0.013	0.065	a	0.04		d
Silvex (2,4,5-TP)	93-72-1	30	270	n	50		f
Simazine	122-34-9	9	80	b			
Toxaphene	8001-35-2	0.0002	0.73	a	0.0002	0.21	a
Trifluralin	1582-09-8	1.14	20.5	r			
Polychlorinated Biphenyls (PCBs) and Dioxin/Furans							
2,3,7,8-TCDD (Dioxin)	1746-01-6	3.10E-09		b			
Dioxins (TEQ)			0.003	g			
Total PCBs (Wildlife Based)	1336-36-3	0.000074	0.014	b	0.000072	0.03	m
Other							
Alkalinity	-	20,000		a			
Ammonia ^^	7664-41-7	Varies	Varies	a	0.024	0.094	m
Formaldehyde	50-00-0	74	660	b			
Nitrite (warm water)	14797-65-0	20	100	b			
pH	-	6.5 - 9.0		a	6.5 - 8.5		a
Selenate	14124-68-6	9.5	12.5	b			
Selenite	14124-67-5	27.6	186	b			
Tributyltin	688-73-3	0.072	0.46	a	0.0074	0.42	a
Urea	57-13-6	17,000	150,000	b			

Table 1a
Region 4 Surface Water Screening Values for Hazardous Waste Sites

Chemical	CAS	Freshwater Screening Values (µg/L)			Saltwater Screening Values (µg/L)		
		Chronic	Acute	Source	Chronic	Acute	Source

Table 1a Notes:

Red font indicates a bioaccumulative chemical.

- Chemical that should be evaluated with the SUM Toxic Unit Approach as discussed in Text Section 3.1.5.

^ - Screening value is for total metals. A conversion factor (CF) was used to convert the screening value for total metals in surface water to a screening value for dissolved metals in surface water. CMC (dissolved) = CMC (total) × CF. See Table 1b for screening values for dissolved metals.

* - The freshwater screening value is hardness dependent. The screening value shown in Table 1a is for total metals assuming a hardness of 50 mg/L as $CaCO_3$. A correction for site-specific hardness was based on equations listed in Tables 1b and 1c. If hardness data are unavailable hardness may be estimated as: H = 2.497 × Ca (mg/L) + 4.118 × Mg (mg/L).

- Freshwater criteria for pentachlorophenol are pH Dependent. Values displayed are for a pH of 7.8.

^^ - Criteria for ammonia are pH, temperature, and lifestage dependent.

Table 1a Sources:

a - National Recommended Water Quality Criteria http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

b - Great Lakes Initiative (GLI) Clearinghouse resources Tier II criteria revised 2013 http://www.epa.gov/gliclearinghouse/

c - Suter, G.W. II, and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 Revision. ES/ER/TM-96/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm96r2.pdf

d - Florida State Criteria for Surface Water Quality Classifications http://www.dep.state.fl.us/legal/Rules/shared/62-302/302-Table.pdf

e - North Carolina Department of Natural Resources (NCDNR) Surface Water Standards http://portal.ncdenr.org/web/wq/ps/csu/swstandards

f - Georgia Department of Natural Resources (GADNR) Water Use Classifications and Water Quality Standards http://rules.sos.state.ga.us/docs/391/3/6/03.pdf

g - Hawaii Department of Health (HDOH) Environmental Action Levels, Chronic and Acute Surface Water (Aquatic Habitat) Standards http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/environmental-hazard-evaluation-and-environmental-action-levels

h - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at: http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html

i - Region 4 Surface Water Model - See text Section 6.1.4 Equation 1.

j - ECOSAR program predicted lowest chronic or acute value. See Section 6.1.4 in text.

k - Talmadge et al. (1999)

l - New York Ambient Water Quality Criteria and Guidance Values: http://www.dec.ny.gov/docs/water_pdf/togs111.pdf

m - New Jersey Department of Environmental Protection (NJDEP) Ecological Screening Criteria http://www.nj.gov/dep/srp/guidance/ecoscreening/esc_table.pdf

n - Michican Water Quality Values - Rule 57: http://www.michigan.gov/deq/0,4561,7-135-3313_3686_3728-11383--,00.html

o - Texas Surface Water Quality Standards: https://www.tceq.texas.gov/waterquality/standards/2014standards.html

p - Mississippi Water Quality Standards: http://www.deq.state.ms.us/mdeq.nsf/page/WQSB_Water_Quality_Standards

q - EPA. 2003. Equilibrium Partitioning Sediment Benchmarks for Protection of Benthic Organisms: PAH Mixtures. EPA-600-R-02-013. http://www.epa.gov/nheerl/download_files/publications/PAHESB.pdf

r - Office of Pesticide Programs (OPP) Aquatic Life Benchmarks: http://www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Inorganic Compounds mg/kg dry weight								
Metals mg/kg dw								
Aluminum		7429-90-5	25,000	58,000	i			
Antimony		7440-36-0	2	25	a	2	25	a
Arsenic		7440-38-2	9.8	33	b	7.24	41.6	c
Barium		7440-39-3	20	60	b	-	-	-
Cadmium		7440-43-9	1	5	b	0.68	4.21	c
Chromium (Total)		7440-47-3	43.4	111	b	52.3	160	c
Cobalt		7440-48-4	50		g			
Copper		7440-50-8	31.6	149	b	18.7	108	c
Iron		7439-89-6	20,000	40,000	g			
Lead		7439-92-1	35.8	128	b	30.2	112	c
Manganese		7439-96-5	460	1,100	h			
Mercury		7439-97-6	0.18	1.1	b	0.13	0.7	c
Nickel		7440-02-0	22.7	48.6	b	15.9	42.8	c
Selenium		7782-49-2	11	20	h			
Silver		7440-22-4	1	2.2	b	0.73	1.77	c
Uranium		7440-61-1	100	1,000	i			
Zinc		7440-66-6	121	459	b	124	271	c
Other Inorganics mg/kg								
Ammonia		7664-41-7	230	300	h			
Sulfides (Total)		18946-25-8	39	61	h			
Volatile Organic Compounds (VOCs) µg/kg @1% OC								
Acetaldehyde	R	75-07-0	1.6	12	d	342		e
Acrylonitrile	R	107-13-1	6.9	55	d			
1,2-Diphenylhydrazine	R	122-66-7	3.8	31	d			
Methylamine	R	74-89-5	34	298	d			
Vinyl acetate	N3	108-05-4	1.2	16	d	1.2	16	d
Semivolatile Organic Compounds (SVOCs)								
Phenols µg/kg @1% OC unles denoted by shading								
2-Chlorophenol	N2	95-57-8	61		d	764		d
2-Methylphenol (o-cresol)	N2	95-48-7	100		d	19	63	d, h
2,3-Dimethylphenol	N2	526-75-0	349		d			
2,4-Dimethylphenol	N2	105-67-9	35		c	29	29	h
3-Methylphenol (Cresol, m-)	N2	108-39-4	93		d			
4-Methylphenol (p-Cresol)	N2	106-44-5	78	260	d, h	670	670	h
2-Nitrophenol	N2	88-75-5	146		d			
4-Nitrophenol	N2	100-02-7	135		d	699		d
2,4-Dinitrophenol	U	51-28-5	202		d	41		d
2-Methyl-4,6-Dinitrophenol	U	534-52-1	2,477		e			
2,4,5-Trichlorophenol	N2	95-95-4	34		d	213		d
2,4,6-Trichlorophenol	N2	88-06-2	87		d	116		d
3-Methyl-4-Chlorophenol	N2	59-50-7	37		d			
Pentachlorophenol	U	87-86-5	744	1,200	d, h	360	690	h
Phenol	N2	108-95-2	120	120	h	420	1,200	h
Energetic SVOAs µg/kg @ 1% OC								
2-Amino-4,6-dinitrotoluene	U	35572-78-2	41		d			
4-Amino-2,6-dinitrotoluene	U	19406-51-0	25		d			
1,3-Dinitrobenzene	U	99-65-0	34		d	795		e
2,3-Dinitrotoluene	R	602-01-7	8.8		d	1,168		e
2,4-Dinitrotoluene	R	121-14-2	127		d	26		d
2,5-Dinitrotoluene	R	619-15-8	21		d	1,168		e
2,6-Dinitrotoluene	R	606-20-2	271		d	1,084		e
3,5-Dinitrotoluene	R	618-85-9	353		d	1,168		e
HMX (Octahydro-tetranitro-1,3,5...)	C	2691-41-0	42		d			
Nitroglycerine	R	55-63-0	4.9		d			
RDX (Hexahydro-1,3,5-trinitro-1,3,5...)	R	121-82-4	41		d			
1,3,5-Trinitrobenzene	R	99-35-4	12		d	782		e
2,4,6-Trinitrotoluene (TNT)	R	118-96-7	23		d	888		e

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Semivolatile Organic Compounds (SVOCs)								
Other SVOCs µg/kg @ 1% OC								
4-Chloroaniline	N2	106-47-8	316		d			
2,4-Dichloroaniline	N2	554-00-7	328		d			
Pentachloroaniline	U	527-20-8	920		d			
2,2-Dibromo-3-nitrilopropionamide	R	10222-01-2	1.4		d	304		e
3,3'-Dichlorobenzidine	N2	91-94-1	30		d			
Aniline	N2	62-53-3	1.3		d			
Benzaldehyde	R	100-52-7	462		e			
Benzidine	N2	92-87-5	0.9		d	1.6		d
bis(2-Chloroethyl) Ether	R	111-44-4	4,761		e			
Decane	N2	124-18-5	491		e	308		d
Hexachlorobutadiene (aquatic life)	R	87-68-3	8.8		d	2.5		d
Hexachlorobutadiene (wildlife-based)	R	87-68-3	0.7		d			
Hexachlorocyclopentadiene	R	77-47-4	6.6		d	1.0		d
Hydroquinone	R	123-31-9	1.1		d			
Pesticides µg/kg @ 1% OC unless denoted by shading								
2,4-D	H	94-75-7	24		d			
4,4'-DDD	C	72-54-8	1.22	7.81	c	1.22	7.81	c
Total DDD	C	-	4.88	28	b	2	20	a
4,4'-DDE	C	72-55-9	2.07	3.74	c	2.07	3.74	c
Total DDE	C	-	3.16	31.3	b	2	15	a
4,4'-DDT (aquatic life)	C	50-29-3	5.7		d	1.7		d
4,4'-DDT (wildlife-based)	C	50-29-3	0.32		d	0.01		d
4,4'-DDT	C	50-29-3	1.19	4.77	c	1.19	4.77	c
Total DDT	C	-	4.16	62.9	b	3.89	51.7	c
DDT/DDE/DDD (total)	C	-	5.28	572	b			
Acephate	A	30560-19-1	5.7		d	300		d
Acrolein	R	107-02-8	0.33		d			
Aldrin	C	309-00-2	29		d	0.11		d
Atrazine	H	1912-24-9	18		d	1,289		e
BHC (alpha)	C	319-84-6	1.6		d	1.3		d
BHC (beta)	C	319-85-7	6,665		f			
BHC-gamma (Lindane)	C	58-89-9	2.37	4.99	b	0.32	0.99	c
BHC-gamma (Lindane) (aquatic life)	C	58-89-9	3.4		d			
BHC-gamma (Lindane) (wildlife-based)	C	58-89-9	1.0		d			
Carbaryl	A	63-25-2	1.0		d			
Carbofuran	A	1563-66-2	1.0		d			
Captan	F	133-06-2	346		d			
Chlordane	C	57-74-9	3.24	17.6	b	2.26	4.79	c
Chlorothalonil	R	1897-45-6	6.5		d	301		f
Chloropyrifos	A	2921-88-2	3.3		d	0.41		d
Cyanazine	H	21725-46-2	362		d	2,790		e
Demeton	A	126-75-0	0.44		d	300		e
Diazinon	A	333-41-5	4.0		d	18		d
Dicamba	H	1918-00-9	1,060		d			
Dieldrin	C	60-57-1	1.9	9.3	b, h	0.715	4.3	c
Dieldrin (aquatic life)	C	60-57-1	3.2		d	0.1		d
Dieldrin (wildlife-based)	C	60-57-1	0.3		d			
Dimethoate	A	60-51-5	0.36		d			
Dinoseb	H	88-85-7	15		d			
Diquat	H	2764-72-9	23		d			
Endosulfan-alpha	C	959-98-8	0.46		d	0.14		d
Endosulfan-beta	C	33213-65-9	0.46		d	0.14		d
Endosulfan Sulfate	C	1031-07-8	1.0		d	0.11		d
Endrin	C	72-20-8	2.22	207	b	2.67	62	j
Guthion	A	86-50-0	0.31		d	0.005		d
Heptachlor	C	76-44-8	1.9		d	1.5		d
Heptachlor epoxide	C	1024-57-3	2.47	16	b	0.6	2.7	j
Malathion	A	121-75-5	0.31		d	0.03		d

Table 2a
Region 4 Sediment Screening Values for Hazardous Waste Sites
Non-Narcotic Modes of Action

Chemical		CAS	Freshwater Sediment Screening Value		Source	Marine/Estuarine Sediment Screening Value		Source
			ESV	RSV		ESV	RSV	
Pesticides µg/kg @ 1% OC								
MCPA (2-methyl-4-chlorophenoxyacetic acid)	H	94-74-6	1,000		f	1,000		f
Methoxychlor	C	72-43-5	2.4		d	1.34		d
Metolachlor	H	51218-45-2	37		d	3,840		f
Mirex (aquatic life)	C	2385-85-5	3.9		d	3.6		d
Mirex (wildlife-based)	C	2385-85-5	0.36		d			
Parathion	A	56-38-2	0.5		d	0.6		d
Silvex (2,4,5-TP)	H	93-72-1	53		d	88		d
Simazine	H	122-34-9	7.8		d			
Toxaphene	C	8001-35-2	0.45		d	0.15		d
Trifluralin	H	1582-09-8	187		d			
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans µg/kg @ 1% OC unless denoted by shading								
Total PCBs	E	1336-36-3	59.8	676	b	21.6	12	c, h
Total PCBs (wildlife-based)	E	1336-36-3	0.33		d	0.025		d
Dioxins/Furans	E	1746-01-6	0.0025	0.025	k	0.0025	0.025	k
2,3,7,8-TCDD (Dioxin) (wildlife-based)	E	1746-01-6	0.3		d			
Other mg/kg dw								
Butyl tins mg/kg dw								
Monobutyltin		78763-54 -9	0.54	4.8	h			
Dibutyltin		818-08-6	0.91	130	h			
Tributyltin		688-73-3	0.047	0.32	h			
Tetrabutyltin		1461-25-2	0.097	0.097	h			
Bulk Petroleum Hydrocarbons mg/kg dw								
Total Petroleum Hydrocarbons - Diesel		68334-30-5	340	510	h			
Total Petroleum Hydrocarbons - Residual		68476-53-9	3,600	4,400	h			

Table 2 Notes:
Red font indicates a bioaccumulative chemical.
Shaded gray cells indicate units in µg/kg dry weight.
CAS = chemical abstract service registry number
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
R - Reactive electrophiles/proelectrophiles
N2 - Polar Narcosis
N3 - Diesters
U - Oxidative phosphorylation uncouplers
H - Herbicides
C - Central nervous system seizure agents
A - Acetylcholinesterase inhibitors
F - Fungicide
E - Endocrine disrupters or reproductive and developmental toxicants

Table 2a Sources:

a - Long, Edward R., and Lee G. Morgan. 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. Used effects range low (ER-L) for chronic and effects range medium (ER-M) for acute.

b - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for the ESV and probable effect concentration (PEC) for the RSV.

c - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.

d - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a. See Equation 3 in text Section 6.2.2.

e - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.

f - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.

g - Persaud, D., R. Jaagumagi and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario.

h - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

i - Los Alamos National Laboratory ECORISK Database. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

j - CCME (Canadian Council of Ministers of the Environment). 2003. Canadian Environmental Quality Guidelines: Summary Table December 2003. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba. Available at http://www.ccme.ca/publications/ceqg_rcqe.html

k - USEPA. 1993. Interim Report on Data and Methods for Assessment of 2,3,7,8 - Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. EPA/600/R-93/055. Available from the National Service Center for Environmental Publications (NSCEP) Document Number 600R93055. http://www.epa.gov/nscep/

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action

Chemical	CAS	Freshwater Sediment Screening Value (µg/kg 1% OC)		Source	Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)		Source
		ESV	RSV		ESV	RSV	
Other VOCs							
Ethylene glycol	107-21-1	314		a	1,921		b
Hexachloroethane	67-72-1	24		a	24		a
Methanol	67-56-1	3.6		a	1,941		b
Methyl tert-butyl ether (MTBE)	1634-04-4	84		a	2,911		b
Propylene glycol	57-55-6	0.6		a	2,199		b
Tetrahydrofuran	109-99-9	1,183		a	4,372		b
Semivolatile Organic Compounds (SVOCs) µg/kg @ 1% OC							
Chlorobenzenes							
1,2,3,4-Tetrachlorobenzene	634-66-2	77		a	436		c
1,2,4,5-Tetrachlorobenzene	95-94-3	185		a	434		c
Hexachlorobenzene	118-74-1	0.32		a	310		c
Pentachlorobenzene	608-93-5	115		a	18		a
Phenols							
2,4-Dichlorophenol	120-83-2	54		a	3,885		b
2,4,6-Tribromophenol	118-79-6	45		a			
2,3,4,6-Tetrachlorophenol	58-90-2	36		a			
Nonylphenol	25154-52-3	1,268		a	327		a
Energetic SVOAs							
2-Nitrotoluene	88-72-2	185		a	8,315		b
3-Nitrotoluene	99-08-1	133		a	10,000		b
4-Nitrotoluene	99-99-0	131		a	9,065		b
Phthalates µg/kg @ 1% OC unless denoted by shading							
Bis(2-ethylhexyl)phthalate	117-81-7	182	2,647	d	182	2,647	d
Butyl benzyl phthalate	85-68-7	592		a	489		a
Diethyl phthalate	84-66-2	231		a	221		a
Dimethyl phthalate	131-11-3	348		a	3,000		b
Di-n-butyl phthalate	84-74-2	220	1,000	a, e	405		a
Di-n-octyl phthalate	117-84-0	513	1,100	e	300		b
PAHs µg/kg dw							
Low molecular weight PAHs (LMW-PAHs)							
1-Methylnaphthalene	90-12-0	*			*		
2-Methylnaphthalene	91-57-6	*			*		
Acenaphthene	83-32-9	*			*		
Acenaphthylene	208-96-8	*			*		
Anthracene	120-12-7	*			*		
Fluorene	86-73-7	*			*		
Naphthalene	91-20-3	*			*		
Phenanthrene	85-01-8	*			*		
Total LMW-PAHs		*			312		d
High molecular weight PAHs (HMW-PAHs)							
Benz(a)anthracene	56-55-3	*			*		
Benzo(a)pyrene	50-32-8	*			*		
Benzo(b)fluoranthene	205-99-2	*			*		
Benzo(g,h,i)perylene	191-24-2	*			*		
Benzo(k)fluoranthene	207-08-9	*			*		
Chrysene	218-01-9	*			*		
Dibenz(a,h)anthracene	53-70-3	*			*		
Fluoranthene	206-44-0	*			*		
Indeno(1,2,3-cd)pyrene	193-39-5	*			*		
Phenanthrene	85-01-8	*			*		
Pyrene	129-00-0	*			*		
Total HMW-PAHs		*		d	655		d
Total PAHs		1,610		f	1,684		d

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites
for Narcotic Mode of Action

Chemical	*CAS*	*Freshwater Sediment Screening Value (µg/kg 1% OC)*		*Source*	*Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)*		*Source*
		ESV	*RSV*		*ESV*	*RSV*	
Volatile Organic Compounds (VOCs) - µg/kg @ 1% OC							
Chlorinated alkanes							
1,1,1,2-Tetrachloroethane	630-20-6	73		a	9.6		a
1,1,2,2-Tetrachloroethane	79-34-5	190		a	579		a
1,1,1-Trichloroethane	71-55-6	34		a	5.1		a
1,1,2-Trichloroethane	79-00-5	319		a	524		a
1,1-Dichloroethane	75-34-3	131		a	15		a
1,2-Dichloroethane	107-06-2	385		a	175		a
1,2-Dichloropropane	78-87-5	272		a	1,900		b
Dichloromethane (methylene chloride)	75-09-2	183		a	268		a
Trichloromethane (Chloroform)	67-66-3	45		a	9.2		a
Tetrachloromethane (Carbon tetrachloride)	56-23-5	34		a	4.6		a
Chlorinated alkenes							
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	41		a	8.3		a
1,2-Dichloroethene (1,2-Dichloroethylene)	540-59-0	338		a	234		a
1,2-cis-Dichloroethyene	156-59-2	246		a			-
1,2-trans-Dichloroethylene	156-60-5	221		a			-
1,3-Dichloropropene	542-75-6	1.0		a	0.33		a
1,1,2,2-Tetrachloroethylene (PCE)	127-18-4	50		a	93		a
1,1,2-Trichloroethylene (TCE)	79-01-6	134		a	29		a
chloroethene (Vinyl chloride)	75-01-4	202		a			-
Chlorobenzenes							
Chlorobenzene	108-90-7	58		a	150		a
1,2-Dichlorobenzene	95-50-1	88		a	54		a
1,3-Dichlorobenzene	541-73-1	83		a	267		a
1,4-Dichlorobenzene	106-46-7	35		a	57		a
1,2,3-Trichlorobenzene	87-61-6	69		a	70		a
1,2,4-Trichlorobenzene	120-82-1	1,700		c	775		b
1,3,5-Trichlorobenzene	108-70-3	66		a	67		a
Trichlorobenzene (mixed isomers)	12002-48-1	66		a	67		a
Monoaromatic hydrocarbons							
1,2,3-Trimethylbenzene	526-73-8	2,074		c	652		b
1,2,4-Trimethylbenzene	95-63-6	92		a	645		b
1,3,5-Trimethylbenzene	108-67-8	157		a	638		b
Benzene	71-43-2	113		a	4,038		b
Cymene, p- (4-Isopropyltoluene)	99-87-6	179		a	536		b
Ethylbenzene	100-41-4	272		a	33		a
Isopropylbenzene (Cumene)	98-82-8	33		a	984		b
Styrene (Vinyl benzene)	100-42-5	116		a	1,959		b
Toluene	108-88-3	145		a	23		a
Xylenes (total)	1330-20-7	103		a	50		a
Ketones							
2-Butanone (methyl ethyl ketone)	78-93-3	992		a	631		a
2-Hexanone (methyl butyl ketone)	591-78-6	2,828		b	15		a
2-Octanone (methyl hexyl ketone)	111-13-7	4.1		a	4.4		a
4-Methyl-2-pentanone (MIBK)	108-10-1	2,712		b	22		a
Acetone	67-64-1	40		a	36		a
Other VOCs							
1-Pentanol	71-41-0	7.3		a	7.3		a
2-Propanol	67-63-0	0.42		a	0.42		a
Acetonitrile	75-05-8	561		a	5,144		b
4-Bromophenyl phenyl ether	101-55-3	46		a	46		a
Bromoform (Tribromomethane)	75-25-2	73		a	102		a
Bromomethane (methyl bromide)	74-83-9	2.0		a	3,107		b
Carbon disulfide	75-15-0	3.6		a	0.5		a
Dibromochloromethane	124-48-1	102		a	11.1		a
Dichlorobromomethane	75-27-4	108		a	5,915		b

Table 2b
Region 4 Sediment Screening Values for Hazardous Waste Sites for Narcotic Mode of Action

Chemical	CAS	Freshwater Sediment Screening Value (µg/kg 1% OC)		Source	Marine/Estuarine Sediment Screening Value (µg/kg 1% OC)		Source
		ESV	RSV		ESV	RSV	
Other SVOCs µg/kg @ 1% OC unless denoted by shading							
1,1-Biphenyl	92-52-4	197		a	423		a
4-Bromophenyl Phenyl Ether	101-55-3	46		a	46		a
Benzoic Acid	65-85-0	2,900	3,800	e	650	650	e
Benzyl alcohol	100-51-6	1.4		a	57	73	e
Carbazole	86-74-8	900	1,100	e			-
Dibenzofuran	132-64-9	151	680	a, e	139		a
Isodecyl diphenyl phosphate	29761-21-5	89		a	301		b
Isophorone	78-59-1	600		a	2,177		b
N-Nitrosodiphenylamine	86-30-6	35		a	295		a
Nitrobenzene	98-95-3	559		a	21,670		b
Propylene glycol	57-55-6	0.6		a	2,198		b
Quinoline	91-22-5	2,774		c	2,774		c
Triphenyl phosphate	115-86-6	69		a	301		b

Table 2 Notes:
* see Total below.
Red font indicates a bioaccumulative chemical.
Gray shaded cells indicate concentration in µg/kg dry weight
ESV - Ecological Screening Value for Step 2
RSV - Refinement Screening Value for Step 3a
CAS = chemical abstract service registry number

Table 2a Sources:
a - Region 4 Sediment Model based on highest ranked surface water quality ESV from Table 1a See Equation 3 in text Section 6.2.2.
b - Region 4 Sediment Model based on: (ECOSAR minimum chronic value). See text.
c - Region 4 Sediment Model based on: (lowest predicted surface water value from McGrath & Di Toro (2009). See text.
d - MacDonald, D.D. 1994. Approach to the Assessment of Sediment Quality in Florida Coastal Waters. Florida Department of Environmental Protection. 1994 Florida Sediment Quality Assessment Guidelines for Florida Coastal Waters.
e - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm
f - MacDonald, D.D.; Ingersoll, C.G.; Smorong, D.E.; Lindskoog, R.A.; Sloane, G; and T. Biernacki. 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Florida Department of Environmental Protection, Tallahassee, FL. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters. Used threshold effect concentration (TEC) for ESV.

Table 2c
Region 4 Step 3a Sediment Screening Values
for Polycyclic Aromatic Hydrocarbons (PAHs) at Hazardous Waste Sites

Chemical	*CAS*	*Freshwater Sediment Screening Values (µg/kg OC)*	*Source*	*Marine/Estuarine Sediment Screening Values (µg/kg OC)*	*Source*
		RSV		RSV	
Low Molecular Weight PAHs (LMW-PAHs)					
Acenaphthene	83-32-9	491	a	16	c
Acenaphthylene	208-96-8	452	a	66	c
Anthracene	120-12-7	594	a	220	c
Fluorene	86-73-7	538	a	23	c
C1-Fluorenes	-	611	a	-	-
C2-Fluorenes	-	686	a	-	-
C3-Fluorenes	-	769	a	-	-
1-Methyl naphthalene	90-12-0	446	a	131	b
2-Methyl naphthalene	91-57-6	447	a	116	b
2,6-Dimethyl naphthalene	581-42-0	513	a	44	b
2,3,5-Trimethylnaphthalene	2245-38-7	584	a	13	b
Naphthalene	91-20-3	385	a	99	c
C1-Naphthalenes	-	444	a	-	-
C2-Naphthalenes	-	510	a	-	-
C3-Naphthalenes	-	581	a	-	-
C4-Naphthalenes	-	657	a	-	-
1-Methyl phenanthrene	832-69-9	670	a	50	b
Phenanthrene	85-01-8	596	a	100	c
C1-Phenatherene/anthracenes	-	670	a	-	-
C2-Phenatherene/anthracenes	-	746	a	-	-
C3-Phenatherene/anthracenes	-	829	a	-	-
C4-Phenatherene/anthracenes	-	913	a	-	-
Thiophenes					
Benzothiophene	11095-43-5	569	b	226	b
Dibenzothiophene	132-65-0	1,860	b	156	b
C1-Dibenzothiophenes	-	1,146	b	-	-
C2-Dibenzothiophenes	-	898	b	-	-
C3-Dibenzothiophenes	-	664	b	-	-
C4-Dibenzothiophenes	-	466	b	-	-
Naphthothiophene	233-02-3	1,803	b	151	b
High Molecular Weight PAHs (HMW-PAHs)					
Benzo(a)anthracene	56-55-3	841	a	110	c
C1-Benzanthracene/chrysenes	-	929	a	-	-
C2-Benzanthracene/chrysenes	-	1,008	a	-	-
C3-Benzanthracene/chrysenes	-	1,112	a	-	-
C4-Benzanthracene/chrysenes	-	1,214	a	-	-
Benzo(b)fluoranthene	205-99-2	979	a	38	b
Benzo(k)fluoranthene	-	981	a	38	b
Benzo(g,h,i)perylene	191-24-2	1,095	a	230	c
Benzo(a)pyrene	50-32-8	965	a	31	c
Benzo(e)pyrene	192-97-2	967	a	99	b
Chrysene	218-01-9	844	a	25	c
Dibenz(a,h) anthracene	53-70-3	1,123	a	12	c
Fluoranthene	206-44-0	707	a	160	c
C1-Fluoranthene/pyrenes	-	770	a	-	-
Indeno(1,2,3-cd)pyrene	193-39-5	1,115	a	34	c
Perylene	198-55-0	967	a	17	b
Pyrene	129-00-0	697	a	1,000	c

Notes:
RSV - Refinement Screening Value

a - EPA (2003). Procedures for the Derivation of Equlibrium Partitioning Sediment Benchmarks(ESBs) for the Protection of Benthic Orgamisms: PAH Mixtures. EPA/600/R-02/013. The value listed represents the C_{OC},PAH_i,FCV_i from the document. See text section 6.2.4.

b - Region 4 Sediment model using ECOSAR.

c - Washington State Sediment Management Standards, Cleanup Objectives. http://www.ecy.wa.gov/programs/tcp/smu/sed_standards.htm

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Inorganic Compounds												
Metals												
Aluminum	7429-90-5	Narrative	a	All			Narrative	a				
Antimony	7440-36-0	0.27	a	All	11	c	78	a	0.27	a		
Arsenic	7440-38-2	18	a	All	18	a	60	b	46	a	43	a
Barium	7440-39-3	330	a	All	110	c	330	a	2,000	a	1,000	c
Beryllium	7440-41-7	10	b	All	10	b	40	a	18	c		
Boron	7440-42-8	7.5	c	All	36	c			56	c	7.5	c
Cadmium	7440-43-9	0.36	a	All	32	a	140	a	0.36	a	0.77	a
Chromium - Total	7440-47-3	28	c	All					45	c	28	c
Chromium III	16065-83-1	18	a	All			18	a	34	a	26	a
Chromium VI	18540-29-9	0.35	c	All	0.35	c	7.8	a	81	a	190	c
Cobalt	7440-48-4	13	a	All	13	a			230	a	120	a
Copper	7440-50-8	28	a	All	70	a	80	a	49	a	28	a
Iron	7439-89-6	Narrative	a	All			Narrative	a				
Lead	7439-92-1	11	a	All	120	a	1,700	a	56	a	11	a
Lithium	7439-93-2	2	b	P, M	2	b			38	c		
Manganese	7439-96-5	220	a	All	220	a	450	a	4,000	a	4,300	a
Mercury (total)	7439-97-6	0.1	b	All	0.3	b	0.1	b	1.7	c	0.013	c
Methylmercury	22967-92-6	0.00051	b	All	0.3	b	0.1	b	0.0031	c	0.00035	c
Molybdenum	7439-98-7	2	b	All	2	b			4.8	b	17	c
Nickel	7440-02-0	38	a	All	38	a	280	a	130	a	210	a
Selenium	7782-49-2	0.52	a	All	0.52	a	4.1	a	0.63	a	1.2	a
Silver	7440-22-4	4.2	a	All	560	a			14	a	4.2	a
Strontium	7440-24-6	96	c	M					96	c		
Thallium	7440-28-0	0.22	c	All	1	b			0.22	c	6.3	c
Tin	7440-31-5	50	b	P	50	b						
Uranium	7440-61-1	25	c	All	25	c			220	c	1,600	c
Vanadium	7440-62-2	7.8	a	All	60	c			280	a	7.8	a
Zinc	7440-66-6	46	a	All	160	a			79	a	46	a
Other Inorganics												
Ammonia	7664-41-7											
Bromine (total)	7726-95-6	10	b	P	10	b						
Cyanide (free)	57-12-5	0.1	c	SI, A			0.9	f			0.1	c
Fluoride	16984-48-8	32	c	M, A					580	c	32	c
Fluorine[†]	7782-41-4	200	b	P	200	b						
Iodine	7553-56-2	4	b	P	4	b						

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Chlorinated Alkanes												
1,1,1,2-Tetrachloroethane	630-20-6	0.07	d	SI			0.07	d				
1,1,2,2-Tetrachloroethane	79-34-5	0.19	d	SI			0.19	d				
1,1,1-Trichloroethane	71-55-6	0.04	d	All			0.04	d	260	c		
1,1,2-Trichloroethane	79-00-5	0.32	d	All			0.32	d				
1,1-Dichloroethane	75-34-3	0.14	d	All			0.14	d	210	c		
1,2-Dichloroethane	107-06-2	0.4	d	All			0.40	d	27	c	1.4	c
1,2 Dichloropropane	78 87 5	0.28	d	All			0.28	d				
Dichloromethane (Methylene chloride)	75-09-2	0.21	d	All	1,600	c	0.21	d	2.6	c		
Trichloromethane (chloroform)	67-66-3	0.05	d	All			0.05	d	8	c		
Tetrachloromethane (Carbon tetrachloride)	56-23-5	0.05	d	All			0.05	d				
Chlorinated Alkenes												
1,1-Dichloroethene/ethylene	75-35-4	0.04	d	All			0.04	d	11	c		
1,2-Dichloroethene (cis and trans)	540-59-0	0.04	d	All			0.04	d	23	c		
1,2-cis-Dichloroethyene	156-59-2	0.04	d	All			0.04	d				
1,2-trans-Dichloroethylene	156-60-5	0.04	d	All			0.04	d				
1,3-Dichloropropene	542-75-6	0.0	d	All			0.001	d				
Tetrachloroethene	127-18-4	0.06	d	All	10	c	0.06	d	0.18	c		
1,1,2-Trichloroethylene (TCE)	79-01-6	0.06	d	All			0.06	d	42	c		
Vinyl chloride	75-01-4	0.03	d	All			0.03	d	0.12	c		
Chlorobenzenes												
Chlorobenzene	108-90-7	2.4	c	All			2.4	c	43	c		
1,2-Dichlorobenzene	95-50-1	0.09	d	All			0.09	d	0.92	c		
1,3-Dichlorobenzene	541-73-1	0.1	d	All			0.08	d	0.73	c		
1,4-Dichlorobenzene	106-46-7	0.88	c	SI, M			1.2	c	0.88	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,4-Trichlorobenzene	120-82-1	0.27	c	All			1.2	c	0.27	c		
1,3,5-Trichlorobenzene	108-70-3	0.07	d	All			0.07	d				
Monoaromatic Hydrocarbons												
1,2,4-Trimethylbenzene	95-63-6	0.09	d	All			0.09	d				
1,3,5-Trimethylbenzene	108-67-8	0.16	d	All			0.16	d				
Benzene	71-43-2	0.12	d	All			0.12	d	24	c		
Cymene, p- (4-Isopropyltoluene)	99-87-6	0.18	d	All			0.18	d				
Ethylbenzene	100-41-4	0.27	d	All			0.27	d				
Isopropylbenzene (Cumene)	98-82-8	0.04	d	All			0.04	d				
Styrene (Vinyl benzene)	100-42-5	1.2	c	All	3.2	c	1.2	c				
Toluene	108-88-3	0.15	d	All	200	c	0.15	d	23	c		
Xylenes (total)	1330-20-7	0.1	d	All	100	c	0.1	d	1.4	c	41	c

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Volatile Organic Compounds (VOCs)												
Ketones												
2-Butanone (Methyl Ethyl Ketone)	78-93-3	1.0	d	All			1.0	d	360	c		
2-Hexanone	591-78-6	0.36	c	SI, M, A			2.5	d	5.4	c	0.36	c
Acetone	67-64-1	1.2	c	M, A			0.04	d	1.2	c	14	c
Other VOCs												
Tribromomethane (Bromoform)	75-25-2	0.07	d	All			0.07	d				
Bromomethane (methyl bromide)	74-83-9	0.002	d	All			0.002	d				
Carbon Disulfide	75-15-0	0.005	d	All			0.005	d	0.82	c		
Ethylene glycol	107-21-1	0.31	d	All			0.31	d				
Hexachloroethane	67-72-1	0.024	d	All			0.024	d				
Hexane	110-54-3	0.007	d	All			0.007	d				
Tert-butyl methyl ether (MTBE)	1634-04-4	12.5	c	SI			12.5	c				
Semivolatile Organic Compounds (SVOCs)												
Chloroanilines												
3-Chloroaniline	108-42-9	20	b	P, SI	20	b	30	b				
4-Chloroaniline	106-47-8	1.0	c	P, SI	1	c	1.8	c				
3,4-Dichloroaniline	95-76-1	20	b	SI			20	b				
2,4,5-Trichloroaniline	636-30-6	20	b	P, SI	20	b	20	b				
Pentachloroaniline	527-20-8	0.62	d	SI			0.62	d				
Chlorobenzenes												
1,3-Dichlorobenzene	99-65-0	0.08	d	All			0.08	d	0.73	c		
1,2,3-Trichlorobenzene	87-61-6	0.07	d	All			0.07	d				
1,2,3,4-Tetrachlorobenzene	634-66-2	0.08	d	All			0.08	d				
1,2,4,5-Tetrachlorobenzene	95-94-3	0.18	d	All			0.18	d				
Hexachlorobenzene	118-74-1	0.079	c	All	10	c	10	c	0.2	c	0.079	c
Pentachlorobenzene	608-93-5	0.11	d	All			0.11	d				
Dichlorophenols												
Dichlorophenols (2,3-), (2,4-), (2,5-), (2,6-)	120-83-2	0.05	d	All			0.05	d				
3,4-Dichlorophenols (3,4-), (3,5-)	95-77-2	20	b	P, SI	20	b	20	b				
Trichlorophenols												
2,4,5-Trichlorophenol	95-95-4	0.03	d	All	4	b	0.03	d				
2,4,6-Trichlorophenol	88-06-2	0.09	d	All			0.09	d				
Tetrachlorophenols												
2,3,4,5-Tetrachlorophenol	4901-51-3	20	b	SI			20	b				
Tetrachlorophenols (2,3,4,6-), (2,3,5,6-)	58-90-2	0.04	d	All			0.04	d				

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Other Phenols												
Chlorophenols (2-), (4-)	95-57-8	0.06	d	All			0.06	d	0.54	c	0.69	c
3-Chlorophenol	108-43-0	7	b	P, SI	7	b	10	b				
2,4-Dimethylphenol	105-67-9	0.04	d	SI			0.04	d				
2,4-Dinitrophenol	51-28-5	0.15	d	All	20	b	0.15	d				
4-Nitrophenol	100-02-7	7	b	SI			7	b				
2-Methylphenol (Cresol, o-)	95-48-7	0.1	d	All	0.67	c	0.1	d	590	c		
3-Methylphenol (Cresol, m-)	108-39-4	0.09	d	All	0.69	c	0.09	d				
4-Methylphenol (Cresol, p-)	106-44-5	0.08	d	All			0.08	d				
Nonylphenol	25154-52-3	1.27	d	SI			1.27	d				
Pentachlorophenol (PCP)	87-86-5	2.1	a	All	5	a	31	a	2.8	a	2.1	a
Phenol	108-95-2	0.79	c	All	0.79	c	1.8	c	38	c		
Energetic SVOCs												
2-Amino-4,6-dinitrotoluene	35572-78-2	14	c	SI, M, P	14	c	43	c	15	c		
4-Amino-2,6-dinitrotoluene	19406-51-0	12	c	SI, M, P	33	c	18	c	12	c		
1,3- Dinitrobenzene	99-65-0	0.073	d	All			0.034	d	0.073	c	0.15	c
2,4-Dinitrotoluene	121-14-2	6	c	SI, M, P	6	c	18	c	13	c		
2,6-Dinitrotoluene	606-20-2	4.1	c	All			30	c	4.1	c	52	c
HMX (Octahydro-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	16	c	SI, M, P	2,700	c	16	c	300	c		
Nitroglycerine	55-63-0	13	c	SI, M			13	c	71	c		
2-Nitrotoluene	88-72-2	0.19	d	All			0.19	d	9.9	c		
3-Nitrotoluene	99-08-1	0.13	d	All			0.13	d	12	c		
4-Nitrotoluene	99-99-0	0.14	d	All			0.14	d	22	c		
PETN (Pentaerythrite-tetranitrate)	78-11-5	100	c	M					100	c		
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	2.3	c	All			8.4	c	16	c	2.3	c
Tetryl (Methyl-2,4,6-trinitrophenylnitroamine)	479-45-8	1.5	c	M					1.5	c		
1,3,5-Trinitrobenzene	99-35-4	10	c	SI, M			10	c	120	c		
2,4,6-Trinitrotoluene (TNT)	118-96-7	7.6	c	All	62	c	32	c	96	c	7.6	c
Other SVOCs												
1,1'-Biphenyl	92-52-4	0.2	d	All	60	b	0.2	d				
3,3'- Dichlorobenzidine	91-94-1	0.03	d	All			0.03	d				
Benzoic acid	65-85-0	0.01	d	All			0.01	d	1	c		
Benzyl Alcohol	100-51-6	0.001	d	All			0.001	d	120	c		
Carbazole	86-74-8	0.16	d	All			0.16	d	80	c		
Dibenzofuran	132-64-9	0.15	d	All	6.1	c	0.15	d				
Hexachlorobutadiene	87-68-3	0.1	d	SI			0.1	d				
Hexachlorocyclopentadiene	77-47-4	0.001	d	All	10	b	0.001	d				
N-Nitrosodiphenylamine	86-30-6	0.12	d	All			0.12	d				
Nitrobenzene	98-95-3	2.2	c	SI, M			2.2	c	4.9	c		
Pentachloronitrobenzene	82-68-8	0.7	c	M, A					11	c	0.7	c

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Semivolatile Organic Compounds (SVOCs)												
Phthalates												
Bis(2-ethylhexyl) phthalate	117-81-7	0.02	c	All			0.23	d	0.59	c	0.02	c
Butylbenzyl phthalate	85-68-7	0.59	d	All			0.59	d	90	c		
Diethylphthalate	84-66-2	0.23	d	All	100	c	0.23	d	3,600	c		
Dimethylphthalate	131-11-3	0.35	d	All			10	c	38	c		
Di-n-butyl phthalate	84-74-2	0.011	c	All	160	c	0.22	d	180	c	0.011	c
Di-n-octyl phthalate	117-84-0	0.21	c	All			0.21	d	0.91	c		
Polycyclic Aromatic Hydrocarbons (PAHs)												
Low Molecular Weight PAHs												
Acenaphthene	83-32-9	See Total			0.25	c			120	c		
Acenaphthylene	208-96-8	See Total							120	c		
Anthracene	120-12-7	See Total			6.8	c			210	c		
Fluorene	86-73-7	See Total					3.7	c	250	c		
1-Methyl naphthalene	90-12-0	See Total										
2-Methylnaphthalene	91-57-6	See Total							16	c		
2,6-Dimethyl naphthalene	581-42-0	See Total										
2,3,5-Trimethylnaphthalene	2245-38-7	See Total										
Naphthalene	91-20-3	See Total			1.0	c			9.7	c	5.7	c
1-Methyl phenanthrene	832-69-9	See Total										
Phenanthrene	85-01-8	See Total					5.5	c	10	c		
Total LMWPAHs	-	29	a	All			29	a	100	a		
High Molecular Weight PAHs												
Benzo(a)anthracene	56-55-3	See Total			18	c			3	c	1	c
Benzo(b)fluoranthene	205-99-2	See Total			18	c			38	c		
Benzo(k)fluoranthene	207-08-9	See Total							62	c		
Benzo(ghi)perylene	191-24-2	See Total							24	c		
Benzo(a)pyrene	50-32-8	See Total							53	c		
Benzo(e)pyrene	192-97-2	See Total										
Chrysene	218-01-9	See Total							2.4	c		
Dibenzo(a,h)anthracene	53-70-3	See Total							12	c		
Fluoranthene	206-44-0	See Total					10	c	22	c		
Indeno(1,2,3-cd)pyrene	193-39-5	See Total							62	c		
Perylene	198-55-0	See Total										
Pyrene	129-00-0	See Total					10	c	22	c	34	c
Total HMWPAHs	-	1.1	a	M			18	a	1.1	a		

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Pesticides/Herbicides												
Acrolein	107-02-8	0.0001	d	All			0.0001	d				
Aldrin	309-00-2	0.037	c	SI, M			0.048	d	0.037	c		
Atrazine	1912-24-9	0.073	d	SI			0.073	d				
BHC - alpha	319-84-6	0.34	d	SI, M			0.34	d	58	c		
BHC - beta	319-85-7	0.27	c	M, A			0.0003	d	0.27	c	14	c
BHC - gamma (Lindane)	58-89-9	0.0094	c	P, M, A	0.1	c	0.0013	d	0.0094	c	0.21	c
Carbaryl	63-25-2	0.0025	d	All			0.0025	d				
Carbofuran	1563-66-2	0.0001	d	All			0.0001	d				
Chlordane - alpha	5103-71-9	0.27	c	P, M, A	2.2	c	0.17	d	0.27	c	0.28	c
Chlordane - gamma	12789-03-6	2.2	c	P, M, A	2.2	c	0.17	d	2.2	c	2.3	c
Chloropyrifos	2921-88-2	0.0035	d	All			0.0035	d				
Dinoseb	88-85-7	0.0054	d	All			0.0054	d				
DDD (sum 4,4- & 2,4-DDD)	50-29-3	0.0063	c	M, A			0.0001	d	4.1	c	0.0063	c
DDE (sum 4,4- & 2,4-DDE)	72-55-9	0.11	c	M, A			0.0038	d	3.7	c	0.11	c
DDT (sum 4,4- & 2,4-DDT)	72-54-8	0.044	c	All	4.1	c	3.37	d	0.044	c	0.36	c
DDT/DDE/DDD (total)	--	0.021	a	All					0.021	a	0.093	a
Diazinon	333-41-5	0.002	d	All			0.002	d				
Dieldrin	60-57-1	0.0049	a	All	10	c	0.1	d	0.0049	a	0.021	a
Endosulfan - alpha	959-98-8	0.64	c	M, A			0.0009	d	0.64	c	22	c
Endosulfan (alpha and beta)	115-29-7	0.0009	d	All			0.0009	d				
Endosulfan sulfate	1031-07-8	0.0065	d	All			0.0065	d				
Endrin	72-20-8	0.0014	c	All	0.0034	c	0.025	d	0.023	c	0.0014	c
Guthion	86-50-0	0.0006	d	All			0.0006	d				
Heptachlor	76-44-8	0.059	c	All	0.4	c	0.29	d	0.059	c	0.3	c
Heptachlor epoxide	1024-57-3	0.0004	d	All			0.0004	d				
Hexachlorocyclopentadiene	77-47-4	0.0008	d	All			0.0008	d				
Kepone (Chlordecone)	143-50-0	0.021	c	All			17	d	0.021	c	1.3	c
Malathion	121-75-5	0.0001	d	All			0.0001	d				
Methoxychlor	72-43-5	5	c	M, A			0.0025	d	5	c	18	c
Mirex	2385-85-5	0.014	d	All			0.014	d				
Parathion	56-38-2	0.0005	d	All			0.0005	d				
2,4,5-TP (Silvex)	93-72-1	12	d	SI			12	d				
Simazine	122-34-9	0.0001	d	All			0.0001	d				
Toxaphene	8001-35-2	4.1	d	M, A			0.38	d	5.9	c	4.1	c
Trifluralin	1582-09-8	0.0002	d	All			0.0002	d				

Table 3
Region 4 Soil Screening Values for Hazardous Waste Sites

CHEMICAL	CAS	Screening Level (mg/kg)	Ref.	Receptor	Plants	Ref.	Soil Invertebrates	Ref.	Mammalian	Ref.	Avian	Ref.
Polychlorinated Biphenyls (PCBs) and Dioxins/Furans												
PCDDs, PCDFs (TEQ)	1746-01-6	0.0088	d	All			0.0088	d				
PCBs (sum) (Wildlife Based)	1336-36-3	0.33	d	All	40	b	0.33	d				
Aroclor-1016	12674-11-2	1	c	All					1	c		
Aroclor-1242	53469-21-9	0.041	c	All					0.38	c	0.041	c
Aroclor-1248	12672-29-6	0.0072	c	All					0.0072	c	0.041	c
Aroclor-1254	11097-69-1	0.014	c	All	160	c			0.44	c	0.041	c
Aroclor-1260	11096-82-5	0.88	c	All					10	c	0.88	c
Other												
2-Nitroaniline	88-74-4	5.4	c	M					5.4	c		
Diphenylamine	122-39-4	10	c	M, A					10	c	73	c
Trichlorofluoromethane	75-69-4	52	c	M					52	c		

Notes:
Sreening values in mg/kg.
All - ESV for protection of all receptors
A - ESV for protection of Avians
M - ESV for protection of Mammals
P - ESV for protection of Plants
SI - ESV for protection of soil invertebrates

LMWPAHs have less than 4 rings
HMWPAHs have 4 or more rings

Table 3 Sources:
a - USEPA (2007): Ecological Soil Screening Levels. http://www.epa.gov/ecotox/ecossl/
b - Oak Ridge National Laboratory:

Efroymson, R.A., M.E. Will, and G.W. Suter. 1997a. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-126/R2. http://www.esd.ornl.gov/programs/ecorisk/documents/tm126r21.pdf

Efroymson, R.A., M.E. Will, G.W. Suter, and A.C. Wooten. 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-95/R4. http://www.esd.ornl.gov/programs/ecorisk/documents/tm85r3.pdf

Efroymson, R.A., G.W. Suter, II, B.E. Sample, and D.S. Jones. 1997. Preliminary Remediation Goals for Ecological Endpoints. Oak Ridge National Laboratory, Oak Ridge, TN. 50 pp. ES/ER/TM-162/R2

c - Los Alamos National Laboratory (LANL). 2012. ECORISK Database Release 3.2. Environmental Programs, Engineering and Technology Division. September 2013. http://www.lanl.gov/community-environment/environmental-stewardship/protection/eco-risk-assessment.php

d - ECOSAR & Region 4 soil model. See text Section 6.3.

Attachment C-3 –
Los Alamos National Laboratory ECORSIK Database Tables of No Effects Ecological Screening Levels and Low Effects Ecological Screening Level (accessed 11-04-2016)

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Analyte Name	Units	No Effect ESL		Low Effect ESL	
		SEDIMENT	SOIL	SEDIMENT	SOIL
Acenaphthene	mg/kg	0.076	0.25	0.76	2
Acenaphthylene	mg/kg	0.076	120	0.76	1200
Acetone	mg/kg	0.065	1.2	0.65	6.3
Aldrin	mg/kg		0.037		0.18
Aluminum	mg/kg				
Americium-241	pCi/g	220	190	2,200	1,900
Amino-2,6-dinitrotoluene[4-]	mg/kg	15	12	150	120
Amino-4,6-dinitrotoluene[2-]	mg/kg	20	14	200	140
Anthracene	mg/kg	0.057	6.8	0.57	9
Antimony	mg/kg	50	2.4	500	24
Aroclor-1016	mg/kg	0.059	1	0.59	3.1
Aroclor-1242	mg/kg	0.054	0.041	0.54	0.41
Aroclor-1248	mg/kg	0.009	0.0072	0.09	0.072
Aroclor-1254	mg/kg	0.054	0.041	0.54	0.41
Aroclor-1260	mg/kg	0.059	0.88	0.59	1.2
Arsenic	mg/kg	9.7	6.8	33	68
Barium	mg/kg	150	110	300	260
Benzene	mg/kg	0.01	24	0.1	240
Benzo(a)anthracene	mg/kg	0.1	0.8	1	8
Benzo(a)pyrene	mg/kg	0.15	53	1.4	170
Benzo(b)fluoranthene	mg/kg	0.19	18	1.9	180
Benzo(g,h,i)perylene	mg/kg	0.17	24	1.7	240
Benzo(k)fluoranthene	mg/kg	0.24	62	2.4	620
Benzoic Acid	mg/kg	1.3	1	13	10
Benzyl Alcohol	mg/kg	330	120	3,300	1,200
Beryllium	mg/kg	73	2.5	730	25
BHC[alpha-]	mg/kg		58		580
BHC[beta-]	mg/kg	0.005	0.27	0.05	1.3
BHC[gamma-]	mg/kg	0.0023	0.0094	0.0049	0.094
Bis(2-ethylhexyl)phthalate	mg/kg	0.026	0.02	0.26	0.2
Boron	mg/kg	10	2	54	10
Butanone[2-]	mg/kg	3,300	360	8,700	930
Butyl Benzyl Phthalate	mg/kg	0.1	90	1	900
Cadmium	mg/kg	0.33	0.27	3.3	2.7
Carbazole	mg/kg		80		800
Carbon Disulfide	mg/kg		0.82		8.2
Cesium-134	pCi/g	330	550	3,300	5,500
Cesium-137 + Barium-137	pCi/g	720	1,200	7,200	12,000
Chlordane[alpha-]	mg/kg	0.0032	0.27	0.017	2.7
Chlordane[gamma-]	mg/kg	0.0032	2.2	0.017	22
Chloroaniline[4-]	mg/kg		1		10
Chlorobenzene	mg/kg	0.03	2.4	0.3	24
Chloroform	mg/kg	10	8	28	22
Chlorophenol[2-]	mg/kg	0.055	0.39	0.55	3.9
Chromium (total)	mg/kg	43	28	110	280
Chromium(+6)	mg/kg	680	0.34	6,800	3.4
Chrysene	mg/kg	0.16	2.4	1.2	24
Cobalt	mg/kg	230	13	2,300	130
Cobalt-60	pCi/g	210	760	2,100	7,600
Copper	mg/kg	23	15	70	46

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		SEDIMENT	SOIL	SEDIMENT	SOIL
Cyanide (total)	mg/kg	0.1	0.1	1	1
DDD[4,4'-]	mg/kg		0.0063		0.033
DDE[4,4'-]	mg/kg	0.0031	0.11	0.031	0.55
DDT[4,4'-]	mg/kg	0.0041	0.044	0.041	0.22
Dibenzo(a,h)anthracene	mg/kg	0.033	12	0.33	120
Dibenzofuran	mg/kg	0.51	6.1	5.1	61
Dichlorobenzene[1,2-]	mg/kg		0.92		9.2
Dichlorobenzene[1,3-]	mg/kg		0.73		7.3
Dichlorobenzene[1,4-]	mg/kg	0.03	0.88	0.3	3.5
Dichloroethane[1,1-]	mg/kg	0.02	210	0.2	2,100
Dichloroethane[1,2-]	mg/kg	6.3	0.85	12	1.6
Dichloroethene[1,1-]	mg/kg	0.1	11	1	110
Dichloroethene[cis/trans-1,2-]	mg/kg	0.2	23	2	230
Dieldrin	mg/kg	0.0019	0.0045	0.019	0.009
Diethyl Phthalate	mg/kg		100		1000
Dimethyl Phthalate	mg/kg	100	10	1000	100
Di-n-Butyl Phthalate	mg/kg	0.011	0.011	0.11	0.11
Dinitrobenzene[1,3-]	mg/kg	1.2	0.073	2.9	0.17
Dinitrotoluene[2,4-]	mg/kg	0.29	6	2.9	60
Dinitrotoluene[2,6-]	mg/kg	9.7	4.1	97	41
Di-n-octylphthalate	mg/kg	1.1	0.91	11	9.1
Diphenylamine	mg/kg		10		17
Endosulfan	mg/kg	0.00001	0.64	0.0001	6.4
Endrin	mg/kg	0.0019	0.0014	0.019	0.014
Europium-152	pCi/g	17	520	170	5,200
Fluoranthene	mg/kg	0.42	10	2.2	23
Fluorene	mg/kg	0.077	3.7	0.53	19
Fluoride	mg/kg	360	150	3,600	1,500
Heptachlor	mg/kg	0.0024	0.059	0.016	0.59
Hexachlorobenzene	mg/kg		0.079		0.79
Hexanone[2-]	mg/kg		0.36		3.6
HMX	mg/kg	130	16	170	160
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	62	2	620
Iodomethane	mg/kg		0.038		0.077
Iron	mg/kg	20,000		40,000	
Kepone	mg/kg	0.027	0.021	0.13	0.1
Lead	mg/kg	27	14	54	28
Lead-210	pCi/g	740	1,200	7,400	12,000
Lithium	mg/kg	150	38	730	180
Manganese	mg/kg	460	220	1,100	1,100
Mercury (inorganic)	mg/kg	0.018	0.013	0.18	0.13
Mercury (methyl)	mg/kg	0.00046	0.00035	0.0046	0.0035
Methoxychlor[4,4'-]	mg/kg	0.03	5	0.3	10
Methyl-2-pentanone[4-]	mg/kg		9.8		98
Methylene Chloride	mg/kg	0.018	2.6	0.18	22
Methylnaphthalene[2-]	mg/kg	0.076	16	0.76	160
Methylphenol[2-]	mg/kg		0.67		7
Methylphenol[3-]	mg/kg		0.69		7
Molybdenum	mg/kg	27	17	270	170
Naphthalene	mg/kg	0.17	1	0.56	10
Neptunium-237	pCi/g	12	50	120	500

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		SEDIMENT	SOIL	SEDIMENT	SOIL
Nickel	mg/kg	13	9.7	27	19
Nitroaniline[2-]	mg/kg		5.4		10
Nitrobenzene	mg/kg	27	2.2	270	22
Nitroglycerine	mg/kg	1,700	13	1,8000	130
Nitrotoluene[2-]	mg/kg	28	9.9	280	99
Nitrotoluene[3-]	mg/kg	24	12	240	120
Nitrotoluene[4-]	mg/kg	52	22	520	220
Pentachloronitrobenzene	mg/kg	0.92	0.7	9.2	7
Pentachlorophenol	mg/kg	0.01	0.36	0.1	3.6
PETN	mg/kg	1,400	100	14,000	1,000
Phenanthrene	mg/kg	0.2	5.5	1.1	12
Phenol	mg/kg	840	0.79	8,400	8
Plutonium-238	pCi/g	110	820	1,100	8,200
Plutonium-239, 240	pCi/g	110	870	1,100	8,700
Plutonium-241	pCi/g	280,000	17,000	2,800,000	170,000
Pyrene	mg/kg	0.19	10	1.5	20
Radium-226	pCi/g	0.21	1.5	2.1	15
Radium-228	pCi/g	0.26	1.2	2.6	12
RDX	mg/kg	3.3	2.3	6.3	4.4
Selenium	mg/kg	0.72	0.52	2.9	3
Silver	mg/kg	0.5	2.6	5	26
Sodium-22	pCi/g	11,000	4,000	110,000	40,000
Strontium (stable)	mg/kg	1,700	96	17,000	960
Strontium-90 + Yittrium-90	pCi/g	150	340	1,500	3400
Styrene	mg/kg		1.2		12
Tetrachlorodibenzodioxin[2,3, 7,8-]	mg/kg	0.00000036	0.00000029	0.0000024	0.0000019
Tetrachloroethene	mg/kg	0.002	0.18	0.02	0.94
Tetryl	mg/kg	100	1.5	490	7.2
Thallium	mg/kg	0.82	0.05	8.2	0.5
Thorium-228	pCi/g	290	43	2,900	430
Thorium-229	pCi/g	110	47	1,100	470
Thorium-230	pCi/g	120	52	1,200	520
Thorium-232	pCi/g	15	6.2	150	62
Titanium	mg/kg	98	72	980	720
Toluene	mg/kg	0.01	23	0.1	230
Toxaphene (Technical Grade)	mg/kg	0.0001	4.1	0.001	41
Trichlorobenzene[1,2,4-]	mg/kg	0.011	0.27	0.11	2.7
Trichloroethane[1,1,1-]	mg/kg	0.07	260	0.7	2,600
Trichloroethene	mg/kg	0.078	42	0.78	420
Trichlorofluoromethane	mg/kg		52		350
Trinitrobenzene[1,3,5-]	mg/kg	1.1	10	1.5	28
Trinitrotoluene[2,4,6-]	mg/kg	25	7.6	32	13
Tritium	pCi/g	660,000	36,000	6,600,000	360,000
Uranium	mg/kg	100	25	1,000	250
Uranium-233	pCi/g	620	440	6,200	4,400
Uranium-234	pCi/g	620	440	6,200	4,400
Uranium-235	pCi/g	670	440	6,700	4,400
Uranium-236	pCi/g	660	470	6,600	4,700
Uranium-238	pCi/g	690	400	6,900	4,000
Vanadium	mg/kg	30	6.7	61	13
Vinyl Chloride	mg/kg		0.12		1.2

Analyte Name	Units	No Effect ESL		Low Effect ESL	
		SEDIMENT	SOIL	SEDIMENT	SOIL
Xylene (Total)	mg/kg	0.13	1.4	1.3	1.7
Zinc	mg/kg	65	48	650	480

Analyte Name	Units	No Effect ESL WATER	Low Effect ESL WATER
Acenaphthene	µg/L	5.8	58
Acenaphthylene	µg/L	4,800	48,000
Acetone	µg/L	1,500	15,000
Aluminum	µg/L	530	1,300
Americium-241	pCi/L	5.8	58
Amino-2,6-dinitrotoluene[4-]	µg/L	43,000	430,000
Amino-4,6-dinitrotoluene[2-]	µg/L	62,000	620,000
Anthracene	µg/L	0.73	7.3
Antimony	µg/L	30	88
Aroclor-1016	µg/L	0.014	0.14
Aroclor-1242	µg/L	0.014	0.14
Aroclor-1248	µg/L	0.014	0.14
Aroclor-1254	µg/L	0.014	0.14
Aroclor-1260	µg/L	0.014	0.14
Arsenic	µg/L	150	340
Barium	µg/L	3.9	39
Benzene	µg/L	46	460
Benzo(a)anthracene	µg/L	0.027	0.27
Benzo(a)pyrene	µg/L	0.014	0.14
Benzo(b)fluoranthene	µg/L	9	90
Benzo(g,h,i)perylene	µg/L	7.6	76
Benzo(k)fluoranthene	µg/L	0.0041	0.041
Benzoic Acid	µg/L	42	420
Beryllium	ug/L	0.66	6.6
BHC[beta-]	µg/L	2.2	22
BHC[gamma-]	µg/L	0.095	0.95
Bis(2-ethylhexyl)phthalate	µg/L	32	320
Boron	µg/L	1.6	16
Butanone[2-]	µg/L	7,200	71,000
Butyl Benzyl Phthalate	µg/L	19	190
Cadmium	µg/L	0.28	0.91
Cesium-134	pCi/L	470	4,700
Cesium-137 + Barium-137	pCi/L	1,100	11,000
Chlordane[alpha-]	µg/L	0.0043	0.043
Chlordane[gamma-]	µg/L	0.0043	0.043
Chloride	µg/L	230	860
Chlorobenzene	µg/L	130	1,300
Chloroform	µg/L	1.8	18
Chlorophenol[2-]	µg/L	490	4,300
Chromium (total)	µg/L	11	16
Chromium(+6)	µg/L	11	16
Chrysene	µg/L	0.0018	0.018
Cobalt	µg/L	3	30
Cobalt-60	pCi/L	380	3,800
Copper	µg/L	5	7

Analyte Name	Units	No Effect ESL WATER	Low Effect ESL WATER
Cyanide (total)	µg/L	5.2	22
DDE[4,4'-]	µg/L	100	1,000
DDT[4,4'-]	µg/L	0.001	0.01
Dibenzo(a,h)anthracene	µg/L	0.0034	0.034
Dibenzofuran	µg/L	3.7	37
Dichlorobenzene[1,4-]	µg/L	15	150
Dichloroethane[1,1-]	µg/L	47	470
Dichloroethane[1,2-]	µg/L	100	1,000
Dichloroethene[1,1-]	µg/L	25	250
Dichloroethene[cis/trans-1,2-]	µg/L	590	1,100
Dieldrin	µg/L	0.056	0.24
Dimethyl Phthalate	µg/L	3	30
Di-n-Butyl Phthalate	µg/L	19	190
Dinitrobenzene[1,3-]	µg/L	16	160
Dinitrotoluene[2,4-]	µg/L	65	330
Dinitrotoluene[2,6-]	µg/L	230	330
Di-n-octylphthalate	µg/L	3	30
Endosulfan	µg/L	0.056	0.22
Endrin	µg/L	0.036	0.086
Europium-152	pCi/L	100	1,000
Fluoranthene	µg/L	0.04	0.4
Fluorene	µg/L	3.9	39
Fluoride	µg/L	20	200
Heptachlor	µg/L	0.0038	0.038
HMX	µg/L	330,000	890,000
Indeno(1,2,3-cd)pyrene	µg/L	4.3	43
Iron	µg/L	1,000	10,000
Kepone	µg/L	350	1,700
Lead	µg/L	1	10
Lead-210	pCi/L	250	2,500
Manganese	µg/L	1,300	2,300
Mercury (inorganic)	µg/L	0.77	1.4
Mercury (methyl)	µg/L	0.0028	0.028
Methoxychlor[4,4'-]	µg/L	0.03	0.3
Methylene Chloride	µg/L	210	2,100
Methylnaphthalene[2-]	µg/L	330	3,300
Molybdenum	µg/L	1,800	7,900
Naphthalene	µg/L	1.1	11
Neptunium-237	pCi/L	7.9	79
Nickel	µg/L	29	260
Nitrobenzene	µg/L	550	2,200
Nitroglycerine	µg/L	430,000	4,500,000
Nitrotoluene[2-]	µg/L	39,000	390,000
Nitrotoluene[3-]	µg/L	47,000	470,000
Nitrotoluene[4-]	µg/L	87,000	870,000
Pentachloronitrobenzene	µg/L	10	100
Pentachlorophenol	µg/L	15	19
Perchlorate Ion	µg/L	35,000	120,000
PETN	µg/L	310,000	3,100,000
Phenanthrene	µg/L	6.3	30
Phenol	µg/L	320	3,200

Analyte Name	Units	No Effect ESL WATER	Low Effect ESL WATER
Plutonium-238	pCi/L	19	190
Plutonium-239, 240	pCi/L	20	200
Plutonium-241	pCi/L	420	4,200
Pyrene	µg/L	0.025	0.25
Radium-226	pCi/L	0.1	1
Radium-228	pCi/L	0.09	0.9
RDX	µg/L	44,000	440,000
Selenium	µg/L	5	20
Silver	µg/L	0.1	1
Sodium-22	pCi/L	90,000	900,000
Strontium (stable)	µg/L	1,500	15,000
Strontium-90 + Yittrium-90	pCi/L	570	5700
Tetrachlorodibenzodioxin[2,3,7,8-]	µg/L	0.000002	0.00002
Tetrachloroethene	µg/L	98	830
Tetryl	µg/L	5,800	2,7000
Thallium	µg/L	0.03	0.3
Thorium-228	pCi/L	5.9	59
Thorium-229	pCi/L	6.3	63
Thorium-230	pCi/L	6.8	68
Thorium-232	pCi/L	0.81	8.1
Titanium	µg/L	70,000	700,000
Toluene	µg/L	9.8	98
Toxaphene (Technical Grade)	µg/L	0.0002	0.002
Trichlorobenzene[1,2,4-]	µg/L	24	240
Trichloroethane[1,1,1-]	µg/L	11	110
Trichloroethene	µg/L	21	210
Trinitrobenzene[1,3,5-]	µg/L	60,000	600,000
Trinitrotoluene[2,4,6-]	µg/L	40,000	73,000
Tritium	pCi/L	160,000,000	1,600,000,000
Uranium	µg/L	5	50
Uranium-233	pCi/L	22	220
Uranium-234	pCi/L	22	220
Uranium-235	pCi/L	24	240
Uranium-236	pCi/L	23	230
Uranium-238	pCi/L	24	240
Vanadium	µg/L	19	190
Xylene (Total)	µg/L	13	130
Zinc	µg/L	65	85

Attachment C-4 –
South Carolina Department of Health and Environmental Control, R.61-68 Water Classifications and Standards Table for Protection of Freshwater Aquatic Life

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APPENDIX: WATER QUALITY NUMERIC CRITERIA FOR THE PROTECTION OF AQUATIC LIFE AND HUMAN HEALTH

This appendix contains three charts (priority pollutants, nonpriority pollutants, and organoleptic effects) of numeric criteria for the protection of human health and aquatic life. The appendix also contains three attachments which address hardness conversions and application of ammonia criteria. Footnotes specific to each chart follow the chart. General footnotes pertaining to all are at the end of the charts prior to the attachments. The numeric criteria developed and published by EPA are hereby incorporated into this regulation. Please refer to the text of the regulation for other general information and specifications in applying these numeric criteria.

PRIORITY TOXIC POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
1	Antimony	7440360					5.6 B, ee	640 B, ee	6 ee	65FR66443 SDWA
2	Arsenic	7440382	340 A, D, K	150 A, D, K	69 A, D, Y	36 A, D, Y	10 C	10 C	10 C	65FR31682 57FR60848 SDWA
3	Beryllium	7440417					J, ee	J, ee	4 ee	65FR31682 SDWA
4	Cadmium	7440439	0.53 D, E, K	0.10 D, E, K	43 D, Y	9.3 D, Y	J, ee	J, ee	5 ee	65FR31682 SDWA
5a	Chromium III	16065831	580 D, E, K	28 D, E, K			J, ee	J, ee	100 Total ee	EPA820/B-96-001 65FR31682 SDWA
5b	Chromium VI	18540299	16 D, K	11 D, K	1,100 D, Y	50 D, Y	J, ee	J, ee	100 Total ee	65FR31682 SDWA
6	Copper	7440508	3.8 D, E, K, Z, ll	2.9 D, E, K, Z, ll	5.8 D, Z, Y, cc	3.7 D, Z, Y, cc	1,300 T, ee			65FR31682

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
7	Lead	7439921	14 D, E, Y	0.54 D, E, Y	220 D, Y	8.5 D, Y				63FR31682
8	Mercury	7439976	1.6 D, K, dd	0.91 D, K, dd	2.1 D, bb, dd	1.1 D, bb, dd	0.050 B, ee	0.051 B, ee	2 ee	65FR31682 SDWA
9	Nickel	7440020	150 D, E, K	16 D, E, K	75 D, Y	8.3 D, Y	610 B, ee	4, 600 B, ee		63FR31682
10	Selenium	7782492	L, Q, S	5.0 S	290 D, aa	71 D, aa	170 Z, ee	4,200 ee	50 ee	65FR31682 65FR66443 SDWA
11	Silver	7440224	0.37 D, E, G		2.3 D, G					65FR31682
12	Thallium	7440280					0.24	0.47	2 ee	68FR75510 SDWA
13	Zinc	7440666	37 D, E, K	37 D, E, K	95 D, Y	86 D, Y	7,400 T, ee	26,000 T, ee		63FR31682 65FR66443
14	Cyanide	57125	22 K, P	5.2 K, P	1 P, Y	1 P, Y	140 ee, jj	140 ee, jj	200 ee	EPA820/B-96-001 57FR60848 68FR75510 SDWA
15	Asbestos	1332214							7 million fibers/L L ee	57FR60848
16	2, 3, 7, 8-TCDD (Dioxin)	1746016						0.046 ppq O, C	30ppq O, C	State Standard SDWA
17	Acrolein	107028	3	3			6 ee, mm	9 ee, mm		74FR27535 74FR46587
18	Acrylonitrile	107131					0.051 B, C	0.25 B, C		65FR66443

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
19	Benzene	71432					2.2 B, C	51 B, C	5 C	IRIS 01/19/00 63FR66443 SDWA
20	Bromate	15541454							10 C	SDWA
21	Bromoform	75252					4.3 B, C	140 B, C	80 Total THMs C	63FR66443 SDWA
22	Bromoacetic acid	79083							60 Total HAA5 C,mm	SDWA
23	Carbon Tetrachloride	56235					0.23 B, C	1.6 B, C	5 C	63FR66443 SDWA
24	Chlorite	67481							100	SDWA
25	Chlorobenzene	108907					130T, ee	1,600 T, ee	100 T, ee	68FR75510 SDWA
26	Chlorodibromomethane	124481					0.40 B, C	13 B, C	80 Total THMs C	63FR66443 SDWA
27	Chloroform	67663					5.7 B, C, hh	470 B, C, hh	80 Total THMs C	62FR42160 SDWA
28	Dibromoacetic acid	631641							60 Total HAA5 C, mm	SDWA
29	Dichloroacetic acid	79436							60 Total HAA5 C,mm	SDWA
30	Dichlorobromomethane	75274					0.55 B, C	17 B, C	80 Total THMs C	65FR66443 SDWA
31	1, 2-Dichloroethane	107062					0.38 B, C	37 B, C	5 C	63FR66443 SDWA

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
32	1, 1-Dichloroethylene	75354					330 ee	7,100 ee	7 c	68FR75510 SDWA
33	1, 2-Dichloropropane	78875					0.50 B, C	15 B, C	5 c	65FR66443 SDWA
34	1, 3-Dichloropropene	542756					0.34 ee	21 ee		68FR75510
35	Ethylbenzene	100414					530 ee	2,100 ee	700 ee	68FR75510 SDWA
36	Methyl Bromide	74839					47 B, ee	1,500 B, ee		65FR66443
37	Methylene Chloride	75092					4.6 B, C	590 B, C	5 c	65FR66443 SDWA
38	Monochloroacetic acid	79118							60 Total HAA5 Comm	SDWA
39	1, 1, 2, 2-Tetrachloroethane	79345					0.17 B, C	4.0 B, C		65FR66443
40	Tetrachloroethylene	127184					0.69 C	3.3 C	5 c	65FR66443 SDWA
41	Toluene	108883					1,300 ee	15,000 ee	1000 ee	68FR75510 SDWA
42	1,2-Trans-Dichloroethylene	156605					140 ee	10,000 ee	100 ee	68FR75510 SDWA
43	Trichloroacetic acid	79039							60 Total HAA5 Comm	SDWA

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
44	1, 1, 1-Trichloroethane	71556					J, ee	J, ee	200 ee	63FR31682 SDWA
45	1, 1, 2-Trichloroethane	79005					0.59 B, C	16 B, C	5 C	65FR66443 SDWA
46	Trichloroethylene	79016					2.5 C	30 C	5 C	65FR66443 SDWA
47	Vinyl Chloride	75014					0.025 kk	2.4 kk	2 C	68FR75510 SDWA
48	2-Chlorophenol	95578					81 D, T, ee	150 B, T, ee		65FR66443
49	2, 4-Dichlorophenol	120832					77 B, T, ee	290 B, T, ee		65FR66443
50	2, 4-Dimethylphenol	105679					380 D, T, ee	850 D, T, ee		65FR66443
51	2-Methyl- 4, 6-Dinitrophenol	534521					13 ee	280 ee		65FR66443
52	2, 4-Dinitrophenol	51285					69 D, ee	5,300 B, ee		65FR66443
53	Pentachlorophenol	87865	19 F, K	15 F, K	13 Y	7.9 Y	0.27 B, C	3.0 B, C, H	1 C	65FR31682 65FR66443 SDWA
54	Phenol	108952					10,000 T, ee, mm	860,000 T, ee, mm		74FR27535 74FR46587
55	2, 4, 6-Trichlorophenol	88062					1.4 B, C, T	2.4 B, C		65FR66443

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
56	Acenaphthene	83329					670 B, T, ee	990 B, T, ee		65FR66443
57	Anthracene	120127					8,300 B, ee	40,000 B, ee		65FR66443
58	Benzidine	92875					0.000086 D, C	0.00020 B, C		65FR66443
59	Benzo (a) Anthracene	56553					0.0038 B, C	0.018 B, C		65FR66443
60	Benzo (a) Pyrene	50328					0.0038 D, C	0.018 B, C	0.2 C	65FR66443 SDWA
61	Benzo (b) Fluoranthene	205992					0.0038 B, C	0.018 B, C		65FR66443
62	Benzo (k) Fluoranthene	207089					0.0038 D, C	0.018 D, C		65FR66443
63	Bis-2-Chloroethyl Ether	111444					0.030 B, C	0.53 B, C		65FR66443
64	Bis-2-Chloroisopropyl Ether	108601					1,400 B, ee	65,000 D, ee		65FR66443
65	Bi-s2-Ethylhexyl Phthalate (DE1IP)	117817	v	v	v	v	1.2 B, C	2.2 B, C	6 C	65FR66443 SDWA
66	Butylbenzene Phthalate	85687	ii	ii	ii	ii	1,500 D, ee	1,900 D, ee		65FR66443
67	2-Chloronaphthalene	91587					1,000 B, ee	1,600 B, ee		65FR66443

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
68	Chrysene	218019					0.0038 B, C	0.018 B, C		65FR66443
69	Dibenzo(a,h)Anthracene	53703					0.0038 B, C	0.018 B, C		65FR66443
70	1, 2-Dichlorobenzene	95501					420 ee	1,300 ee	600 ee	68FR75510 SDWA
71	1, 3-Dichlorobenzene	541731					320 ee	960 ee		65FR66443
72	1, 4-Dichlorobenzene	106467					63 ee	190 ee	75 ee	68FR75510 SDWA
73	3, 3'-Dichlorobenzidine	91941					0.021 B, C	0.028 B, C		65FR66443
74	Diethyl Phthalate	84662	ii	ii	ii	ii	17,000 B, ee	44,000 B, ee		65FR66443
75	Dimethyl Phthalate	13113	ii	ii	ii	ii	270,000 B, ee	1,100,000 B, ee		64FR66443
76	Di-n-butyl Phthalate	84742	ii	ii	ii	ii	2,000 D, ee	4,500 D, ee		65FR66443
77	2, 4-Dinitrotoluene	121142					0.11 C	3.4 C		65FR66443
78	1, 2-Diphenylhydrazine	122667					0.036 D, C	0.20 D, C		65FR66443
79	Fluoranthene	206440					130 B, ee	140 B, ee		65FR66443

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
80	Fluorene	86737					1,100 B, cc	5,300 B, cc		65FR66443
81	Hexachlorobenzene	118741					0.00028 B, C	0.00029 B, C	1 C	65FR66443 SDWA
82	Hexachlorobutadiene	87683					0.44 n, C	18 n, C		65FR66443
83	Hexachlorocyclo-pentadiene	77474					40 T, ee	1100 T, ee	50 ee	68FR75510 SDWA
84	Hexachloroethane	67721					1.4 n, C	3.3 n, C		65FR66443
85	Indeno (1,2,3-cd) Pyrene	193395					0.0038 B, C	0.018 B, C		65FR66443
86	Isophorone	78591					35 n, C	960 n, C		65FR66443
87	Nitrobenzene	98953					17 B, ee	690 B, H, T, ee		65FR66443
88	N-Nitrosodimethylamine	62759					0.00069 n, C	3.0 n, C		65FR66443
89	N-Nitrosodi-n-Propylamine	621647					0.0050 B, C	0.51 B, C		65FR66443
90	N-Nitrosodiphenylamine	86306					3.3 B, C	6.0 B, C		65FR66443
91	Pyrene	129000					830 B, ee	4,000 B, ee		65FR66443

	Priority Pollutant	CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
92	1, 2, 4-Trichlorobenzene	120821					35 ee	70 ee	70 ee	68FR75510 SDWA
93	Aldrin	309002	3.0 G, X		1.3 G, X		0.000049 B, C	0.000050 B, C		65FR31682 65FR66443
94	alpha-BHC	319846					0.0026 B, C	0.0049 B, C		65FR66443
95	beta-BHC	319857					0.0091 B, C	0.017 B, C		65FR66443
96	gamma-BHC (Lindane)	58899	0.95 K		0.16 G		0.98 ee	1.8 ee	0.2 C	65FR31682 68FR75510 SDWA
97	Chlordane	57749	2.4 G	0.0043 G, X	0.09 G	0.004 G, X	0.00080 B, C	0.00081 B, C	2 C	65FR31682 65FR66443 SDWA
98	4, 4'-DDT	50293	1.1 G, gg	0.001 G, X, gg	0.13 G, gg	0.001 G, X, gg	0.00022 B, C	0.00022 B, C		65FR31682 65FR66443
99	4, 4'-DDE	72559					0.00022 B, C	0.00022 B, C		65FR66443
100	4, 4'-DDD	72548					0.00031 B, C	0.00031 B, C		65FR66443
101	Dieldrin	60571	0.24 K	0.056 K, N	0.71 G	0.0019 G, X	0.000052 B, C	0.000054 B, C		65FR31682 65FR66443
102	alpha-Endosulfan	959988	0.22 G, W	0.056 G, W	0.034 G, W	0.0087 G, W	62 B, ee	89 B, ee		65FR31682 65FR66443

Priority Pollutant		CAS Number	Freshwater Aquatic Life		Saltwater Aquatic Life		Human Health			FR Cite/ Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	For Consumption of: Water & Organism (µg/L)	Organism Only (µg/L)	MCL (µg/L)	
103	beta-Endosulfan	33213659	0.22 G, W	0.056 G, W	0.034 G, W	0.0087 G, W	62 B, ee	89 B, ee		65FR31682 65FR66443
104	Endosulfan Sulfate	1031078					62 B, ee	89 B, ee		65FR31682 65FR66443
105	Endrin	72208	0.086 K	0.036 K, N	0.037 G	0.0023 G, X	0.059 ee	0.060 ee	2 ee	68FR75510 SDWA
106	Endrin Aldehyde	7421934					0.29 B, ee	0.30 B, H, ee		65FR66443
107	Heptachlor	76448	0.52 G	0.0038 G, X	0.053 G	0.0036 G, X	0.000079 B, C	0.000079 B, C	0.4 C	65FR31682 65FR66443 SDWA
108	Heptachlor Epoxide	1024573	0.52 G, U	0.0038 G, U, X	0.053 G, U	0.0036 G, U, X	0.000039 B, C	0.000039B, C	0.2 C	65FR31682 65FR66443 SDWA
109	Polychlorinated Biphenyls PCBs	--		0.014 M, X		0.03 M, X	0.000064 B, C, M	0.000064 B, C, M	0.5 C	65FR31682 65FR66443 SDWA
110	Toxaphene	8001352	0.73	0.0002 X	0.21	0.0002 X	0.00028 B, C	0.00028 B, C	3 C	65FR31682 65FR66443 SDWA

Footnotes:

A This water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

C This criterion is based on carcinogenicity of 10^{-6} risk. As prescribed in Section E of this regulation, application of this criterion for permit effluent limitations requires the use annual average flow or comparable tidal condition as determined by the Department.

D Freshwater and saltwater criteria for metals are expressed in terms of total recoverable metals. As allowed in Section E of this regulation, these criteria may be expressed as dissolved metal for the purposes of deriving permit effluent limitations. The dissolved metal water quality criteria value may be calculated by using these 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria", October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR§131.36(b)(1). Conversion Factors can be found in Attachment 1 – Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 25 mg/L as expressed as $CaCO_3$. Criteria values for other hardness may be calculated from the following: CMC (dissolved) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$ (CF), or CCC (dissolved) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$ (CF) and the parameters specified in Attachment 2 – Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent. As noted in footnote D above, the values in this appendix are expressed as total recoverable, the criterion may be calculated from the following: CMC (total) = $\exp\{m_A [\ln(\text{hardness})] + b_A\}$, or CCC (total) = $\exp\{m_C [\ln(\text{hardness})] + b_C\}$.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = $\exp(1.005(\text{pH}) - 4.869)$; CCC = $\exp(1.005(\text{pH}) - 5.134)$. Values displayed in table correspond to a pH of 7.8.

G This criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA) and the National Primary Drinking Water Regulation (NPDWR).

J EPA has not calculated a 304(a) human health criterion for this contaminant. The criterion is the Maximum Contaminant Level developed under the Safe Drinking Water Act (SDWA) and the National Primary Drinking Water Regulation (NPDWR).

K This criterion is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*, (EPA-820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995, 40CFR132 Appendix A), the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/l and 12.82 µg/l, respectively.

M This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)

N The derivation of the CCC for this pollutant did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

O This state criterion is also based on a total fish consumption rate of 0.0175 kg/day.

P This water quality criterion is expressed as µg/L free cyanide (as CN)/L.

Q This value was announced (61FR58444-58449, November 14, 1996) as a proposed GLI 303 I aquatic life criterion

S This water quality criterion for selenium is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor (0.996 – CMC or 0.922 – CCC) that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.

T The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.

U This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

V There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.

W This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.
X This criterion is based on a 304(a) aquatic life criterion issued in 1980 or 1986, and was issued in one of the following documents: Aldrin/Dieldrin (EPA440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endrin (EPA 440/5-80-047), Heptachlor (EPA 440/5-80-052), Polychlorinated Biphenyls (EPA 440/5- 80-068), Toxaphene (EPA 440/5-86-006). This CCC is based on the Final Residue value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life Criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the EPA no longer uses the Final Residue value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.
Y This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA 440/5-84-032), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5-84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87- 003)
Z When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.
aa The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 □g/L in salt water because the saltwater CCC does not take into account uptake via the food chain.
bb This water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 ug/L given on page 23 of the criteria document is based on the Final Residue value procedure in the 1985 Guidelines. Since the publication of the Great Lakes Aquatic Life criteria Guidelines in 1995 (60FR15393-15399, March 23, 1995), the EPA no longer uses the Final Residue value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.
cc This water quality criterion was derived in *Ambient Water Quality Criteria Saltwater Copper Addendum* (Draft, April 14, 1995) and was promulgated in the Interim Final National Toxics Rule (60FR22228-222237, May 4, 1995).
dd This water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.
ee This criterion is a noncarcinogen. As prescribed in Section E of this regulation, application of this criterion for determining permit effluent limitations requires the use of 7Q10 or comparable tidal condition as determined by the Department.
ggg This criterion applies to DDT and its metabolites (i.e., the total concentration of DDT and its metabolites should not exceed this value).
hh Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.
ii Although EPA has not published a completed criteria document for phthalate, it is EPA's understanding that sufficient data exist to allow calculation of aquatic life criteria.
jj This recommended water quality criterion is expressed as total cyanide, even though the IRIS RfD the EPA used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g.,$Fe_4[Fe(CN_6)_3$), this criterion may be overly conservative.
kk This recommended water quality criterion was derived using the cancer slope factor of 1.4 (Linear multi-stage model (LMS) exposure from birth).
ll Freshwater copper criteria may be calculated utilizing the procedures identified in EPA-822-R-07-001.
mm HAA5 means five haloacetic acids (monochloracitic acid, dichloroacetic acid, trichloroacetic acid, bromoacetic acid and dibromoacetic acid).
nn This criterion has been revised to reflect the EPA's cancer slope factor (CSF) or reference dose (RfD), as contained in the Integrated Risk Information System (IRIS) as of (Final FR Notice June 10, 2009). The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

Attachment C-5 –
EPA Region 5 Ecological Screening Levels
(Archived 2003 document)

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U.S. EPA, Region 5, RCRA Ecological Screening Levels August 22, 2003

Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Acenaphthene	83-32-9		**38**[a]	6.71[r]	6.82 e+5
Acenaphthylene	208-96-8		4.84 e+3[b]	5.87[r]	6.82 e+5
Acetone	67-64-1	959	**1700**[a,s,z]	9.9[z]	2500[w]
Acetonitrile	75-05-8	17.1	**12** e+3[d,z]	**56**[z]	1370[w]
Acetophenone	98-86-2		—	—	3 e+5
Acetylaminofluorene [2-]	53-96-3		535[b]	15.3	596
Acrolein	107-02-8	0.578	0.19[s,z]	**1.52** e-3[z]	5270[w]
Acrylonitrile	107-13-1	0.797	**66**[a]	**1.2**	23.9[w]
Aldrin	309-00-2		**1.7** e-2[a,z]	2[t]	3.32[x]
Allyl chloride	107-05-1	1.22		—	13.4
Aminobiphenyl [4-]	92-67-1			—	3.05
Aniline	62-53-3		**4.1**[d]	0.31	56.8[w]
Anthracene	120-12-7		0.035[f]	**57.2**[u]	1.48 e+6
Antimony (Total)	7440-36-0		**80**[c]		142
Aramite	140-57-8		3.09[g]	1.11 e-3	1.66 e+5
Arsenic (Total)	7440-38-2		**148**[f]	9790[u]	5700
Azobenzene [p-(dimethylamino)]	60-11-7		1.65[b]	318	40
Barium (Total)	7440-39-3		**220**[d,z]		1040
Benzene	71-43-2	9.76	114[f]	142	255
Benzo[a]anthracene	56-55-3		0.025[s,z]	**108**[u]	5210

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Benzo[a]pyrene	50-32-8		0.014[h]	**150**[u]	1520
Benzo[b]fluoranthene	205-99-2		9.07[h]	1.04 e+4	5.98 e+4
Benzo[ghi]perylene	191-24-2		7.64[h]	170[t]	1.19 e+5
Benzo[k]fluoranthene	207-8-9		——	240[t]	1.48 e+5
Benzyl alcohol	100-51-6		**8.6**[h,z]	**1.04**[z]	6.58 e+4
Beryllium (Total)	7440-41-7		**3.6**[d,k,z]		1060
BHC [alpha-]	319-84-6		12.4[h]	6[t]	99.4
BHC [beta-]	319-85-7		0.495[h]	5[t]	3.98[w]
BHC [delta-]	319-86-8		667[n]	7.15 e+4	9940
BHC [gamma-]	58-89-9		0.026[a]	**2.37**[u]	5[w]
Bromodichloromethane	75-27-4			——	540
Bromoform	75-25-2	9.11	**230**[d,z]	**492**[z]	1.59 e+4
Bromophenyl phenyl ether [4-]	101-55-3		1.5[h]	1550	
Butylamine [N-Nitrosodi-n-]	924-16-3		——	——	267
Butylbenzyl phthalate	85-68-7		**23**[d,z]	**1970**[z]	239
Cadmium (Total)	7440-43-9		**0.15**[b,i,k]	**990**[u]	2.22
Carbon disulfide	75-15-0	3.67	**15**[d,z]	**23.9**[z]	94.1
Carbon tetrachloride	56-23-5	1.41	**240**[d]	**1450**	2980
Chlordane	57-74-9		**4.3 e-3**[j]	**3.24**[b,z]	224[w]
Chlorethyl ether [bis(2-]	111-44-4		**19 e+3**[j]	**3520**	2.37 e+4[w]

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Chloro-1-methylethyl)ether [bis(2-]	108-60-1		—	—	1.99 e+4
Chloroaniline [p-]	106-47-8		232[s]	146	1100
Chlorobenzene	108-90-7	120	**47**[a]	**291**	1.31 e+4
Chlorobenzilate	510-15-6		7.16[s]	860	5050
Chloroethane	75-0-3	20	—	—	
Chloroform	67-66-3	1.34	**140**[d]	**121**	1190
Chloronaphthalene [2-]	91-58-7		0.396[b]	417	12.2
Chlorophenol [2-]	95-57-8		**24**[a]	**31.9**	243
Chlorophenyl phenyl ether [4-]	7005-72-3			—	
Chloroprene	126-99-8	4.16 E-2		—	2.9
Chromium+3 (Total)	7440-47-3		42[j,k]	**4.34 e+4**[u]	400[y]
Chrysene	218-1-9		—	**166**[u]	4730
Cobalt (Total)	7440-48-4		**24**[d]	5.00 e+4[t]	140
Copper (Total)	7440-50-8		**1.58**[j,k,z]	**3.16 e+4**[u]	**5400**
Cresol [4,6-dinitro-o-]	534-52-1		**23**[m]	**104**	144
Cresol [m-]	108-39-4		**62**[d]	**52.4**	3490
Cresol [o-]	95-48-7		**67**[c]	**55.4**	4.04 e+4
Cresol [p-chloro-m-]	59-50-7		34.8[s]	388	7950
Cresol [p-]	106-44-5		**25**[a]	**20.2**	1.63 e+5
Cyanide	57-12-5		5.2[a]	0.1[t]	1330[w]

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
DDD [4,4'-]	72-54-8		—	**4.88**[bv,z]	758
DDE [4,4'-]	72-55-9		4.51 e-9[c]	**3.16**[bv]	596
DDT [4,4'-]	50-29-3		**1.1 e-5**[bv,z]	**4.16**[bv]	**3.5**[z]
Di-n-butyl phthalate	84-74-2		**9.7**[bv]	**1114**	150
Di-n-octyl phthalate	117-84-0		30[f]	4.06 e+4	7.09 e+5
Diallate	2303-16-4		—	—	452[w]
Dibenzofuran	132-64-9		**4**[bv,z]	**449**[z]	
Dibenz[a,h]anthracene	53-70-3		—	**33**[bv]	1.84 e+4
Dibromo-3-chloropropane [1,2-]	96-12-8	0.32	—	—	35.2
Dibromochloromethane	124-48-1		—	—	2050
Dibromoethane [1,2-]	106-93-4	176	—	—	1230
Dichloro-2-butene [trans-1,4-]	110-57-6	4.03		—	
Dichlorobenzene [m-]	541-73-1	273	**38**[bv,z]	**1315**[z]	3.77 e+4
Dichlorobenzene [o-]	95-50-1	270	**14**[bv]	**294**	2960
Dichlorobenzene [p-]	106-46-7	275	**9.4**[bv,z]	**318**[z]	546
Dichlorobenzidine [3,3'-]	91-94-1		**4.5**[bv,z]	**127**	646
Dichlorodifluoromethane	75-71-8	1550		—	3.95 e+4
Dichloroethane [1,1-]	75-34-3	1240	47[h]	0.575	2.01 e+4
Dichloroethane [1,2-]	107-6-2	29.7	**910**[bv]	**260**	2.12 e+4
Dichloroethene [1,1-]	75-35-4	0.303	**65**[bv,z]	**19.4**[z]	8280

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Dichloroethylene [trans-1,2-]	156-60-5	29.1	970[d]	**654**	784
Dichlorophenol [2,4-]	120-83-2		**11**[d,z]	**81.7**[z]	8.75 e+4
Dichlorophenol [2,6-]	87-65-0			—	1170
Dichloropropane [1,2-]	78-87-5	70.6	360[b,z]	**333**[z]	3.27 e+4
Dichloropropene [cis-1,3-]	10061-1-5	5.89	—	—	398
Dichloropropene [trans-1,3-]	10061-2-6	5.89	—	—	398
Dieldrin	60-57-1		**7.1 e-5**[a]	**1.9**[b,z]	2.38
Diethyl O-2-pyrazinyl phosphorothioate [O,O-]	297-97-2			—	799
Diethyl phthalate	84-66-2		**110**[a]	**295**	2.48 e+4
Dimethoate	60-51-5		—	—	218
Dimethyl phthalate	131-11-3		—	—	7.34 e+5
Dimethylbenzidine [3,3'-]	119-93-7			—	104
Dimethylbenz[a]anthracene [7,12-]	57-97-6		0.548[b]	6.64 e+4	1.63 e+4
Dimethylphenethylamine [alpha,alpha-]	122-9-8			—	300
Dimethylphenol [2,4-]	105-67-9		100[b]	304	10[e]
Dinitrobenzene [m-]	99-65-0		**22**[d]	**8.61**	655
Dinitrophenol [2,4-]	51-28-5		**19**[a]	**6.21**	60.9
Dinitrotoluene [2,4-]	121-14-2		**44**[d,z]	**14.4**[z]	1280
Dinitrotoluene [2,6-]	606-20-2		**81**[d]	**39.8**	32.8

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Dinoseb	88-85-7		0.48[a]	**14.5**	21.8
Dioxane [1,4-]	123-91-1	367	**22 e+3**[a]	**119**	2050[w]
Diphenylamine	122-39-4		412[b]	34.6	1010
Disulfoton	298-4-4		4.02 e-2[c]	324	19.9
D [2,4-]	94-75-7		**220**[a]	**1273**	27.2
Endosulfan I	959-98-8		0.056[j]	**3.26**	119
Endosulfan II	33213-65-9		0.056[j]	**1.94**	119
Endosulfan sulfate	1031-7-8		2.22[b]	34.6	35.8
Endrin	72-20-8		0.036[a]	**2.22**[b, z]	10.1
Endrin aldehyde	7421-93-4		0.15[b]	**480**[z]	10.5
Ethyl methacrylate	97-63-2	356		—	3 e+4
Ethyl methane sulfonate	62-50-0			—	
Ethylbenzene	100-41-4	304	**14**[b, z]	**175**	5160
Famphur	52-85-7			—	49.7
Fluoranthene	206-44-0		**1.9**[f, z]	**423**[u]	1.22 e+5
Fluorene	86-73-7		**19**[u]	**77.4**[u]	1.22 e+5
Heptachlor	76-44-8		3.8 e-3[j]	0.6[t]	5.98
Heptachlor epoxide	1024-57-3		3.8 e-3[j]	**2.47**[u]	152
Hexachlorobenzene	118-74-1		3 e-4[a]	20[t]	199
Hexachlorobutadiene	87-68-3		0.053[b, z]	**26.5**[z]	39.8

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Hexachlorocyclopentadiene	77-47-4		77[b]	901	755
Hexachloroethane	67-72-1		**8**[a,z]	**584**[z]	596
Hexachlorophene	70-30-4		0.228[e]	2.31 e+5	199
Hexachloropropene	1888-71-7		—	—	
Hexanone [2-]	591-78-6	105	**99**[a,z]	**58.2**[z]	1.26 e+4
Indeno (1,2,3-cd) pyrene	193-39-5		4.31[b]	200[t]	1.09 e+5
Isobutyl alcohol	78-83-1	32.8	—	—	2.08 e+4[w]
Isodrin	465-73-6		3.09 e-2[e]	55.2	3.32[e]
Isophorone	78-59-1		**920**[d]	**432**	1.39 e+5
Isosafrole	120-58-1			—	9940
Kepone	143-50-0		0.132[e]	3.31	32.7
Lead (Total)	7439-92-1		**1.17**[k,k,z]	**3.58 e+4**[u]	53.7
Mercury (Total)	7439-97-6		1.3 e-3[g]	174[e]	100[y]
Methacrylonitrile	126-98-7	3.38		—	57[w]
Methane [bis(2-chloroethoxy)]	111-91-1		—	—	302[w]
Methapyrilene	91-80-5			—	2780[w]
Methoxychlor	72-43-5		0.019[k]	**13.6**	19.9
Methyl bromide	74-83-9	26.5	**16**[d]	**1.37**	235[w]
Methyl chloride	74-87-3	2.63		—	1.04 e+4[w]
Methyl ethyl ketone	78-93-3	642	**2200**[a,z]	**42.4**[z]	8.96 e+4[w]

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Methyl iodide	74-88-4	11.7		—	1230
Methyl mercury	22967-92-6		2.46 e-3[e]	0.01	1.58
Methyl methacrylate	80-62-6	87.1	2800[g]	168	9.84 e+5[w]
Methyl methanesulfanate	66-27-3			—	315[w]
Methyl parathion	298-0-0			—	0.292
Methyl-2-pentanone [4-]	108-10-1	45.9	**170**[b,z]	**25.1**[z]	4.43 e+5
Methylcholanthrene [3-]	56-49-5		8.91 e-2[b]	8.19 e+6	77.9
Methylene bromide	74-95-3	344		—	6.5 e+4[w]
Methylene chloride	75-9-2	4780	**940**[a]	**159**[z]	4050[w]
Methylnaphthalene [2-]	91-57-6		330[b]	20.2[c]	3240
Naphthalene	91-20-3	80.1	**13**[a,z]	**176**[u]	99.4
Naphthoquinone [1,4-]	130-15-4		—	—	1670
Naphthylamine [1-]	134-32-7		—	—	9340
Naphthylamine [2-]	91-59-8			—	3030
Nickel (Total)	7440-2-0		**28.9**[i,k,z]	**2.27 e+4**[u]	1.36 e+4
Nitroaniline [m-]	99-9-2			—	3160
Nitroaniline [o-]	88-74-4			—	7.41 e+4
Nitroaniline [p-]	100-1-6			—	2.19 e+4
Nitrobenzene	98-95-3		**220**[a,z]	**145**[z]	1310
Nitrophenol [o-]	88-75-5		—	—	1600

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Nitrophenol [p-]	100-2-7		60[a]	13.3	5120
Nitroquinoline-1-oxide [4-]	56-57-5			—	122
Nitrosodiethylamine [N-]	55-18-5		768[s]	22.8	69.3[w]
Nitrosodimethylamine [N-]	62-75-9			—	0.0321[w]
Nitrosodiphenylamine [N-]	86-30-6		—	—	545
Nitrosomethylethylamine [N-]	10595-95-6			—	1.66[w]
Nitrosomorpholine [N-]	59-89-2			—	70.6[w]
Nitrosopiperidine [N-]	100-75-4			—	6.65[w]
Nitrosopyrrolidine [N-]	930-55-2			—	12.6[w]
Parathion	56-38-2		0.013[a,d]	0.757	0.34[y]
Pentachlorobenzene	608-93-5		0.019[a,z]	24[z]	497
Pentachloroethane	76-1-7	0.68	56.4[s]	689	1.07 e+4
Pentachloronitrobenzene	82-68-8		—	—	7090
Pentachlorophenol	87-86-5		4.0[b,s,z]	2.3 e+4[z]	119
Phenacetin	62-44-2		—	—	1.17 e+4
Phenanthrene	85-1-8		3.6[f]	204[u]	4.57 e+4
Phenol	108-95-2	4.31	180[c]	49.1	1.2 e+5
Phenylenediamine [p-]	106-50-3			—	6160[w]
Phorate	298-02-2		3.62[s]	0.861	0.496
Phthalate [bis(2-ethylhexyl)]	117-81-7		0.3[a,z]	182[c]	925

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Picoline [2-]	109-6-8	140	—	—	9900[w]
Polychlorinated biphenyls	1336-36-3		**1.2 e-4**[a,z]	**59.8**[u]	0.332
Polychlorinated dibenzo-p-dioxins	PCDD-S		2.78 e-7[b]	**0.011**	1.99 e-4
Polychlorinated dibenzofurans	51207-31-9		—	—	0.0386
Pronamide	23950-58-5		—	—	13.6[x]
Propionitrile	107-12-0	1.87	—	—	49.8[w]
Propylamine [N-nitrosodi-n-]	621-64-7			—	544
Pyrene	129-0-0		0.3[s]	**195**[u]	7.85 e+4
Pyridine	110-86-1	13.7	2380[s]	106	1030[w]
Safrole	94-59-7		—	—	404
Selenium (Total)	7782-49-2		5[j]		27.6
Silver (Total)	7440-22-4		**0.12**[f,z]	500[t]	4040
Silvex	93-72-1		**30**[a,z]	**675**[z]	109[x]
Styrene	100-42-5	0.946	**32**[q,z]	**254**[z]	4690
Sulfide	18496-25-8				3.58
Tetrachlorobenzene [1,2,4,5-]	95-94-3		**3**[a,z]	**1252**[z]	2020
Tetrachlorodibenzo-p-dioxin [2,3,7,8-]	1746-1-6		3 e-9[a,z]	**1.2 e-4**[z]	1.99 e-4
Tetrachloroethane [1,1,1,2-]	630-20-6	22.5	—	—	2.25 e+5
Tetrachloroethane [1,1,2,2-]	79-34-5	353	**380**[z]	**850**	127
Tetrachloroethene	127-18-4	69	**45**[z]	990	9920

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Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[v] ug/kg
Tetrachlorophenol [2,3,4,6-]	58-90-2		**1.2**[a,z]	**129**[z]	199
Tetraethyl dithiopyrophosphate	3689-24-5		13.9[b]	560	596
Thallium (Total)	7440-28-0		**10**[a]		56.9
Tin (Total)	7440-31-5		**180**[d]		7620
Toluene	108-88-3	1040	253[f]	**1220**[z]	5450
Toluidine [5-nitro-o-]	99-55-8			—	8730
Toluidine [o-]	95-53-4			—	2970[w]
Toxaphene	8001-35-2		**1.4 e-4**[a,z]	0.077[z]	119
Trichlorobenzene [1,2,4-]	120-82-1		**30**[a,z]	**5062**[z]	1.11 e+4
Trichloroethane [1,1,1-]	71-55-6	4170	**76**[d,z]	**213**[z]	2.98 e+4
Trichloroethane [1,1,2-]	79-0-5	11.6	**500**[a,z]	**518**[z]	2.86 e+4
Trichloroethylene	79-1-6	1220	**47**[b,z]	**112**[z]	1.24 e+4
Trichlorofluoromethane	75-69-4	5150		—	1.64 e+4
Trichlorophenol [2,4,5-]	95-95-4			—	1.41 e+4
Trichlorophenol [2,4,6-]	88-6-2		**4.9**[d]	**208**	9940
Trichloropropane [1,2,3-]	96-18-4	3.32	—	—	3360
Trichlorphenoxyacetic acid [2,4,5-]	93-76-5		686[g]	5.87 e+4	596
Triethyl phosphorothioate [O,O,O-]	126-68-1		58.2[b]	189	818
Trinitrobenzene [Sym-]	99-35-4			—	376[w]
Vanadium (Total)	7440-62-2		**12**[a,z]		1590

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U.S. EPA, Region 5, RCRA Ecological Screening Levels August 22, 2003

Chemical	CAS No.	Air mg/m³	Water ug/l	Sediment[c] ug/kg	Soil[b] ug/kg
Vinyl acetate	108-5-4	359	248[g]	13	1.27 e+4[w]
Vinyl chloride	75-1-4	0.221	930[a]	202	646
Xylenes (total)	1330-20-7	135	27[d,z]	433[z]	1 e+4[x]
Zinc (Total)	7440-66-6		65.7[h,k,z]	1.21 e+5[u]	6620[y]

[a] Michigan water quality standards, Rule 57 water quality values, July 23, 2003. Available at: http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-11383--,00.html. The water **ESL** data for acenaphthene, BHC (gamma), cyanide and parathion are Michigan (final chronic value or FCV) Tier **I** criteria. Likewise, water **ESL** data for dieldrin, dioxin, DDT, endrin, hexachlorobenzene, hexachlorobutadiene, mercury, PCB's and toxaphene represent wildlife values (see Notes at end of these footnotes for dioxin, DDT, mercury and PCB's). All of the remaining data are Tier **II** values.

[b] Water **E**cological **S**creening **L**evel (**ESL**) based on exposure to a mink (*Mustela vison*).

[c] **I**ndiana water quality standards, Title 327, Article 2, of the **I**ndiana **A**dministrative Code, Feb. 4, 2002. Available at: http://www.ai.org/legislative/iac/t03270/a00020.pdf The water **ESL** for toxaphene is from the **I**ndiana chronic aquatic criterion for all waters outside of mixing zones (see Table 1 under Rule 1 of 327 **I**AC 2-1-6 Minimum Surface Water Quality Standards at the above **I**nternet site). The remaining water **ESL** data are either wildlife values (for dioxin, DDT, mercury and PCB's) or Tier **II** values for the **I**ndiana Great **L**akes Basin (see Great **L**akes Basin Criteria and Values Table as developed under Rule 1.5 of 327 **I**AC Article 2 as referenced above).

[d] Ohio water quality standards, Chapter 3745-1 of the Ohio Administrative Code, Dec. 30, 2002. Available at: http://www.epa.state.oh.us/dsw/rules/3745-1.html The water **ESL** data for endrin and parathion are Ohio aquatic life Tier **I** criteria from the Outside Mixing Zone Average (OMZA). Wildlife values are available for dioxin, DDT, mercury and PCB's. All of the remaining data are Ohio aquatic life Tier **II** values from the OMZA. See Ohio summary tables for water quality criteria and values along with reference on the development of Tier **I** criteria and Tier **II** values.

[e] Water **ESL** based on exposure to a belted kingfisher (*Ceryle alcyon*).

[f] Minnesota water quality standards, Rule 7052.0100, Subpart 2 (water **ESL** data for arsenic & benzene represents aquatic life chronic standards and dioxin, DDT, mercury and PCB's represents wildlife values), April 13, 2000. Rule 7050.0222, Subpart 2, Feb. 12, 2003. Available at: http://www.revisor.leg.state.mn.us/arule/7050/0100.html and http://www.revisor.leg.state.mn.us/arule/7052/0222.html

[g] Region 5, RCRA Interim Criteria, based on Aquire database with acceptable review codes and endpoints (life cycle). Must have eight or more acceptable studies (i.e., chronic and/or acute).

[h] **GLWQI** Tier **II** value as presented in: Suter, G.W. II and Tsao, C.L. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota, 1996 Revision. ES/ER/TM-96/R2. Available at: http://www.esd.ornl.gov/programs/ecorisk/ecorisk.html

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i U.S. EPA 2001 Update of Ambient Water Quality Criteria for Cadmium (EPA 822-R-01-001).

j U.S. EPA National Recommended Water Quality Criteria: 2002 (EPA 822-R-02-047)

k For hardness-dependent metals (beryllium, cadmium, chromium^{+3}, copper, lead, nickel and zinc), freshwater chronic criteria are based on soft water with a total hardness of 50 mg/L as $CaCO_3$. Soft water is common within Region 5 and this water ESL may be recalculated when site specific water hardness is less than 50 mg/L.

l U.S. EPA Ambient Water Quality for Chloroalkyl Ethers (EPA 440/5-80-030). No definitive data available concerning chronic toxicity. The water ESL is based on no adverse effects for a chronic toxicity embryo-larval test of the fathead minnow.

m U.S. EPA Ambient Water Quality for Nitrophenols (EPA 440/5-80-063). The acute value of 230 ug/l was adjusted with an uncertainty factor of ten for 2,4-dinitrophenol and 4,6-dinitro-o-cresol since no chronic criteria are available.

n Wisconsin Surface Water Quality Criteria and Secondary Values for Toxic Substances, NR 105.07(1)(b), Sept.1, 1997. Available at: http://www.legis.state.wi.us/rsb/code/nr/nr100.html

o Illinois water quality standards, Title 35, Part 302.208, Dec. 20, 2002. Available at: http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.asp

p The criterion for pentachlorophenol is pH dependent and is based on a pH of 6.5.

q U.S. EPA Ambient Water Quality for Phthalate Esters (EPA 440/5-80-067). A chronic value of 3 ug/L that resulted in significant reproductive impairment was adjusted with an uncertainty factor of ten.

r Environment Canada. September 1994. Interim Sediment Quality Assessment Values. Ecosystem Conservation Directorate. Evaluation and Interpretation Branch.

s Unless noted otherwise, all Sediment ESLs were derived using equilibrium partitioning (EqP) equation and the corresponding water ESL. Note: Sediment ESL K_{oc} x Water ESL x 0.01.

t Ontario Ministry of the Environment. August 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario.

u Consensus based threshold effect concentrations (TEC) as presented in MacDonald et. al. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch Environ Contam Toxicol 39:20-31 (see Table 2). The TEC for mercury had a high incidence of toxicity and was not used. These values do not consider bioaccumulation nor biomagnification.

v Unless noted otherwise, all Soil ESLs are based on exposure to a masked shrew (*Sorex cinerus*).

w Soil ESL is based on exposure to a meadow vole (*Microtus pennsylvanicus*).

x Soil ESL is based on exposure to a plant.

y Soil ESL is based on exposure to soil invertebrates (e.g., earthworms).

z New ESL data is lower than the previous table.

Notes: New ESL data are displayed in bold font and a dashed line (e.g., ——) is used to show when data was deleted from the previous table (i.e., supporting data was inadequate). All six states in EPA Region 5 have the same water ESL's for dioxin, DDT, mercury and PCB's which are based on a wildlife value. A summary report will be created on the development of soil benchmarks including equations, criteria and references. Likewise, a report will be prepared on the development of water benchmarks that are based on mink and belted kingfisher exposure.

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Attachment C-6 – Uncertainty Tables

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Table 1.A. Uncertainty Evaluation for Exposure Area 1 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)			
			RSV	HQ	RSV	HQ	RSV	HQ		
Vanadium	3.21E+01	d	1.70E+01	1.89E+00	1.50E+01	2.14E+00	1.30E+01	2.47E+00		
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**American Robin (Avian Omnivore)**		**American Robin (Avian Insectivore)**		**Violet-Green Swallow (Avian Aerial Insectivore)**		**American Kestrel (Avian Intermediate Carnivore)**	
			RSV	**HQ**	**RSV**	**HQ**	**RSV**	**HQ**	RSV	HQ
Bis[2-ethylhexyl]phthalate	3.57E+00	d	4.00E-01	8.93E+00	2.00E-01	1.79E+01	2.60E-01	1.37E+01	1.00E+00	3.57E+00

1 Analytes identified as COPCs from Table C-3.
2 - EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1 Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 1.B. Uncertainty Evaluation for Exposure Area 1 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Aluminum	1.06E+03	b	8.70E+01	1.22E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Iron	7.17E+03	bc	1.00E+03	7.17E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Manganese	7.64E+02	b	9.30E+01	8.21E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
DDT	1.37E-01	ac	1.00E-03	1.37E+02

1 Analytes identified as COPCs from Table C-4.
2 EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1 Table A.1.1.2 Surface Water (unfiltered results).
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 2.A. Uncertainty Evaluation for Exposure Area 2 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	4.38E+01	d	1.70E+01	2.58E+00	1.50E+01	2.92E+00	1.30E+01	3.37E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms - Sediment	
			RSV	HQ
Toluene	1.90E-01	c	1.00E-01	1.90E+00

1 Analytes identified as COPCs from Table C-7.
2 EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 2.B. Uncertainty Evaluation for Exposure Area 2 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Aluminum	2.36E+02	b	8.70E+01	2.71E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Iron	3.16E+03	bc	1.00E+03	3.16E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Manganese	4.67E+02	b	9.30E+01	5.02E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Mercury	4.49E-01	b	1.30E-03	3.45E+02

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic life	
			RSV	HQ
Anthracene	4.05E-01	b	2.00E-02	2.03E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic life	
			RSV	HQ
Bis[2-ethylhexyl]phthalate	1.60E+01	b	3.00E+00	5.33E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic life	
			RSV	HQ
Fluoranthene	3.35E-01	c	4.00E-02	8.38E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic life	
			RSV	HQ
Pyrene	3.02E-01	c	2.50E-02	1.21E+01

1 - Analytes identified as COPCs from Table C-8.
2 - EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 3.A. Uncertainty Evaluation for Exposure Area 3 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Barium	6.47E+01	a	6.00E+01	1.08E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	5.40E+01	d	1.70E+01	3.17E+00	1.50E+01	3.60E+00	1.30E+01	4.15E+00

1. Analytes identified as COPCs from Table C-11.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 3.B. Uncertainty Evaluation for Exposure Area 3 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Mercury	4.49E-01	b	1.30E-03	3.45E+02

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Anthracene	4.05E-01	b	2.00E-02	2.03E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Fluoranthene	3.35E-01	c	4.00E-02	8.38E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Pyrene	3.02E-01	c	2.50E-02	1.21E+01

1. Analytes identified as COPCs from Table C-12.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).

3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 4.A. Uncertainty Evaluation for Exposure Area 4 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	3.10E+01	d	1.70E+01	1.83E+00	1.50E+01	2.07E+00	1.30E+01	2.39E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDT	4.90E-03	a	4.77E-03	1.03E+00

1 - Analytes identified as COPCs from Table C-15.
2 - EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 4.B. Uncertainty Evaluation for Exposure Area 4 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Aluminum	1.83E+02	b	8.70E+01	2.10E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic I Community Organisms Life	
			RSV	HQ
Iron	3.23E+03	Bc	1.00E+03	3.23E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Manganese	1.65E+02	b	9.30E+01	1.77E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Anthracene	2.31E-01	b	2.00E-02	1.16E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Benzo[a]anthracene	3.09E-01	c	2.70E-02	1.14E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Bis[2-ethylhexyl]phthalate	5.51E+00	b	3.00E+00	1.84E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Fluoranthene	2.59E-01	c	4.00E-02	6.48E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Pyrene	3.05E-01	c	2.50E-02	1.22E+01

1 Analytes identified as COPCs from Table C-16.
2 EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A, 1 Table A.1.1.2 Surface Water (unfiltered results).
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 5.A. Uncertainty Evaluation for Exposure Area 5 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Barium	9.58E+01	a	6.00E+01	1.60E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms - Sediment		American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Cyanide	1.28E+00	cd	1.00E+00	1.28E+00	1.00E+00	1.28E+00	1.00E+00	1.28E+00	1.00E+00	1.28E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Deer Mouse (Mammalian Omnivore)		Montane Shrew (Mammalian Insectivore)		Occult Little Brown Myotis Bat (Mammalian Aerial Insectivore)		American Robin (Avian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	2.05E-01	d	3.10E-02	6.61E+00	1.50E-02	1.37E+01	1.90E-02	1.08E+01	7.10E-03	2.89E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)		Violet-Green Swallow (Avian Aerial Insectivore)		American Kestrel (Avian Intermediate Carnivore)		American Kestrel (Avian Top Carnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	2.05E-01	d	3.50E-03	5.86E+01	4.60E-03	4.46E+01	1.70E-02	1.21E+01	7.80E-02	2.63E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	3.58E+01	d	1.70E+01	2.10E+00	1.50E+01	2.39E+00	1.30E+01	2.75E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDE	4.41E-03	a	3.74E-03	1.18E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDT	1.14E-02	a	4.77E-03	2.39E+00

1 Analytes identified as COPCs from Table C-19.
2 EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).
3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 5.B. Uncertainty Evaluation for Exposure Area 5 (Surface Water)

Analyte1	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Iron	1.31E+03	bc	1.00E+03	1.31E+00

Analyte1	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
DDT	6.60E-02	ac	1.00E-03	6.60E+01

1. Analytes identified as COPCs from Table C-20.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).
3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 6.A. Uncertainty Evaluation for Exposure Area 6 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Deer Mouse (Mammalian Omnivore)		Montane Shrew (Mammalian Insectivore)		Occult Little Brown Myotis Bat (Mammalian Aerial Insectivore)		American Robin (Avian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	8.13E-02	d	3.10E-02	2.62E+00	1.50E-02	5.42E+00	1.90E-02	4.28E+00	7.10E-03	1.15E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)		Violet-Green Swallow (Avian Aerial Insectivore)		American Kestrel (Avian Intermediate Carnivore)		American Kestrel (Avian Top Carnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	8.13E-02	d	3.50E-03	2.32E+01	4.60E-03	1.77E+01	1.70E-02	4.78E+00	7.80E-02	1.04E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms - Sediment		Generic Plant (Terrestrial Autotroph - Producer)		Desert Cottontail (Mammalian Herbivore)		Deer Mouse (Mammalian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Selenium	4.15E+00	c	2.90E+00	1.43E+00	3.00E+00	1.38E+00	2.90E+00	1.43E+00	1.20E+00	3.46E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Montane Shrew (Mammalian Insectivore)		Occult Little Brown Myotis Bat (Mammalian Aerial Insectivore)		American Robin (Avian Herbivore)		American Robin (Avian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Selenium	4.15E+00	c	9.90E-01	4.19E+00	1.30E+00	3.19E+00	2.00E+00	2.07E+00	1.70E+00	2.44E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)		Violet-Green Swallow (Avian Aerial Insectivore)	
			RSV	HQ	RSV	HQ
Selenium	4.15E+00	c	1.50E+00	2.77E+00	2.10E+00	1.98E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Generic Plant (Terrestrial Autotroph - Producer)		Montane Shrew (Mammalian Insectivore)	
			RSV	HQ	RSV	HQ
Thallium	2.76E+00	d	5.00E-01	5.53E+00	2.20E+00	1.26E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	2.12E+01	d	1.70E+01	1.25E+00	1.50E+01	1.41E+00	1.30E+01	1.63E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Phenols	2.13E-01	a	1.20E-01	1.78E+00

1. Analytes identified as COPCs from Table C-23.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory Ecorisk Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 6.B. Uncertainty Evaluation for Exposure Area 6 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Dibenz[a,h]anthracene	4.20E-01	c	3.40E-03	1.24E+02
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Indeno[1,2,3-cd]pyrene	3.20E-01	b	2.80E-01	1.14E+00

1. Analytes identified as COPCs from Table C-24.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).

3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 7.A. Uncertainty Evaluation for Exposure Area 7 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Barium	1.14E+02	a	6.00E+01	1.90E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms - Sediment		American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Cyanide	1.15E+00	cd	1.00E+00	1.15E+00	1.00E+00	1.15E+00	1.00E+00	1.15E+00	1.00E+00	1.15E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Deer Mouse (Mammalian Omnivore)		Montane Shrew (Mammalian Insectivore)		Occult Little Brown Myotis Bat (Mammalian Aerial Insectivore)		American Robin (Avian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	2.97E-01	d	3.10E-02	9.58E+00	1.50E-02	1.98E+01	1.90E-02	1.56E+01	7.10E-03	4.18E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)		Violet-Green Swallow (Avian Aerial Insectivore)		American Kestrel (Avian Intermediate Carnivore)		American Kestrel (Avian Top Carnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	2.97E-01	d	3.50E-03	8.49E+01	4.60E-03	6.46E+01	1.70E-02	1.75E+01	7.80E-02	3.81E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	2.69E+01	d	1.70E+01	1.58E+00	1.50E+01	1.79E+00	1.30E+01	2.07E+00

1. Analytes identified as COPCs from Table C-27.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory Ecorisk Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 7.B. Uncertainty Evaluation for Exposure Area 7 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Aluminum	**2.36E+03**	**b**	**8.70E+01**	**2.72E+01**

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Iron	5.08E+03	bc	1.00E+03	5.08E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Lead	1.81E+00	a	5.40E-01	3.36E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Manganese	1.28E+03	b	9.30E+01	1.38E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
DDT	2.08E-02	ac	1.00E-03	2.08E+01

1. Analytes identified as COPCs from Table C-28.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).

3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory Ecorisk Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 8.A. Uncertainty Evaluation for Exposure Area 8 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Barium	6.32E+01	a	6.00E+01	1.05E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms - Sediment		American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Cyanide	2.33E+00	cd	1.00E+00	2.33E+00	1.00E+00	2.33E+00	1.00E+00	2.33E+00	1.00E+00	2.33E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Violet-Green Swallow (Avian Aerial Insectivore)	
			RSV	HQ
Cyanide	2.33E+00	cd	1.40E+00	1.67E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ
Lead	3.37E+01	d	3.30E+01	1.02E+00	2.80E+01	1.21E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Deer Mouse (Mammalian Omnivore)		Montane Shrew (Mammalian Insectivore)		Occult Little Brown Myotis Bat (Mammalian Aerial Insectivore)		American Robin (Avian Omnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	3.67E-01	d	3.10E-02	1.18E+01	1.50E-02	2.45E+01	1.90E-02	1.93E+01	7.10E-03	5.17E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)		Violet-Green Swallow (Avian Aerial Insectivore)		American Kestrel (Avian Intermediate Carnivore)		American Kestrel (Avian Top Carnivore)	
			RSV	HQ	RSV	HQ	RSV	HQ	RSV	HQ
Mercury	3.67E-01	d	3.50E-03	1.05E+02	4.60E-03	7.98E+01	1.70E-02	2.16E+01	7.80E-02	4.71E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	4.29E+01	d	1.70E+01	2.52E+00	1.50E+01	2.86E+00	1.30E+01	3.30E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Insectivore)	
			RSV	HQ
Bis[2-ethylhexyl]phthalate	2.20E-01	d	2.00E-01	1.10E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDD	3.70E-01	a	7.81E-03	4.74E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDE	2.62E-01	a	3.74E-03	7.01E+01

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
DDT	2.24E-01	a	4.77E-03	4.70E+01

1. Analytes identified as COPCs from Table C-31.
2. -EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 8.B. Uncertainty Evaluation for Exposure Area 8 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Aluminum	8.53E+02	b	8.70E+01	9.80E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Iron	3.76E+03	bc	1.00E+03	3.76E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Manganese	2.52E+02	b	9.30E+01	2.71E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
2,4,5-Trichlorophenol	9.62E+00	b	1.90E+00	5.06E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
2,4,6-Trichlorophenol	9.62E+00	b	4.90E+00	1.96E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
2-Chloronaphthalene	9.62E-01	d	3.96E-01	2.43E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
3,3-Dichlorobenzidine	9.62E+00	b	4.50E+00	2.14E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
4-Bromophenyl-phenyl ether	9.62E+00	b	1.50E+00	6.41E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Anthracene	9.62E-01	b	2.00E-02	4.81E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Benzo[a]anthracene	9.62E-01	c	2.70E-02	3.56E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Benzo[a]pyrene	9.62E-01	c	1.40E-02	6.87E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Benzo[g,h,i]perylene	9.62E-01	b	4.40E-01	2.19E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Benzo[k]fluoranthene	9.62E-01	c	4.10E-03	2.35E+02
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Biphenyl	9.62E+00	b	6.50E+00	1.48E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Bis[2-ethylhexyl]phthalate	9.62E+00	b	3.00E+00	3.21E+00

Table 8.B. Uncertainty Evaluation for Exposure Area 8 (Surface Water) *(Continued/End)*

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Chrysene	9.62E-01	c	1.80E-03	5.34E+02
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Dibenz[a,h]anthracene	9.62E-01	c	3.40E-03	2.83E+02
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Dibenzofuran	9.62E+00	c	3.70E+00	2.60E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Dimethylphthalate	9.62E+00	c	3.00E+00	3.21E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Dioctylphthalate	9.62E+00	c	3.00E+00	3.21E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Fluoranthene	9.62E-01	c	4.00E-02	2.41E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Hexachlorobenzene	9.62E+00	b	3.00E-04	3.21E+04
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Hexachlorobutadiene	9.62E+00	b	5.30E-02	1.82E+02
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Hexa-chlorocyclopentadiene	9.62E+00	b	4.50E-01	2.14E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Life**	
			RSV	**HQ**
Indeno[1,2,3-cd]pyrene	9.62E-01	b	2.80E-01	3.44E+00
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
Pyrene	9.62E-01	c	2.50E-02	3.85E+01
Analyte[1]	**Exposure Point Concentration[2]**	**RSV Source[3]**	**Aquatic Community Organisms**	
			RSV	**HQ**
DDT	1.42E-02	ac	1.00E-03	1.42E+01

1. Analytes identified as COPCs from Table C-32.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).

3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 9.A. Uncertainty Evaluation for Exposure Area 9 (Sediment/Soil)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Generic Plant (Terrestrial Autotroph - Producer)		Montane Shrew (Mammalian Insectivore)	
			RSV	HQ	RSV	HQ
Thallium	2.63E+00	d	5.00E-01	5.27E+00	2.20E+00	1.20E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	American Robin (Avian Herbivore)		American Robin (Avian Omnivore)		American Robin (Avian Insectivore)	
			RSV	HQ	RSV	HQ	RSV	HQ
Vanadium	2.48E+01	d	1.70E+01	1.46E+00	1.50E+01	1.65E+00	1.30E+01	1.91E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Benthic Organisms	
			RSV	HQ
Phenols	2.15E-01	a	1.20E-01	1.79E+00

1. Analytes identified as COPCs from Table C-35.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.1.1 Surface Interval (0- to 0.5-ft and 0- to 1-ft intervals combined).

3: a = Tables 2a, 2b, and 2c in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: b = Table 3 in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) for sediment (2015).
3: d = Los Alamos National Laboratory ECORISK Database for soil (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Table 9.B. Uncertainty Evaluation for Exposure Area 9 (Surface Water)

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Community Organisms	
			RSV	HQ
Iron	1.62E+03	bc	1.00E+03	1.62E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Manganese	1.09E+02	b	9.30E+01	1.17E+00

Analyte[1]	Exposure Point Concentration[2]	RSV Source[3]	Aquatic Life	
			RSV	HQ
Silver	2.68E-01	b	6.00E-02	4.47E+00

1. Analytes identified as COPCs from Table C-36.
2. EPC = Reasonable maximum exposure (RME) exposure point concentration (EPC) is the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) on the mean concentration. RME from Appendix A.1, Table A.1.1.2 Surface Water (unfiltered results).

3: a = SCDHEC, R61-68, Water Classifications and Standards, chronic values for freshwater aquatic life (2014).
3: b = Table 1a in EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft (2015).
3: c = Los Alamos National Laboratory ECORISK Database (Release 3.3) (2015).
Hazard Quotient (HQ) = EPC / RSV.

Attachment C-7 –
RESRAD Biota Table of Biota Concentration Guidelines

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Table 1. Sediment/Soil

Radionuclide	Tier 3 Terrestrial Animal Soil	Tier 3 Aquatic Animal Sediment	Tier 3 Riparian Animal Sediment	Minimum of Tier 3
	BCG *(pCi/g)*			
Actinium-228	---	---	---	---
Americium-243	---	---	---	---
Barium-133	---	---	---	---
Bismuth-212	---	---	---	---
Bismuth-214	---	---	---	---
Californium-244	---	---	---	---
Carbon-14	4,760	789,000	59,000	4,760
Cobalt-58	1,790	38,600	3,790	1,790
Curium-244	4,060	4,000,000	5,200	4,060
Curium-245 and Curium-246	---	---	---	---
Europium-155	15,800	318,000	31,600	15,800
Lead-212	---	---	---	---
Lead-214	---	---	---	---
Manganese-54	---	---	---	---
Neptunium-239	---	---	---	---
Potassium-40	119	57,900	4,420	119
Promethium-146	---	---	---	---
Radium-224	---	---	---	---
Ruthenium-106	---	---	---	---
Thallium-208	---	---	---	---
Thorium-231	---	---	---	---
Thorium-234	2,160	43,200	4,320	2,160
Tin-113	---	---	---	---
Zinc-65	413	65,800	1,430	413
Zirconium-95	1,170	23,500	2,330	1,170

Table 2. Surface Water

Radionuclide	Tier 3 Aquatic Animal Water	Tier 3 Riparian Animal Water	Minimum of Tier 3
	BCG *(pCi/L)*		
Bismuth-214	---	---	---
Cesium-137	1,050	42.7	42.7
Curium-244	66.4	1,390	66.4
Iodine-129	1,000,000	38,500	38,500
Lead-212	---	---	---
Lead-214	---	---	---
Potassium-40	2,900	249	249
Technetium-99	2,470,000	667,000	667,000
Thorium-234	266,000	3,800,000	266,000

Attachment C-8 – Los Alamos National Laboratory Receptor-specific Low Effect ESLs (accessed 11-04-2016)

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Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph-producer)	Aquatic snails (Aquatic herbivore-grazer)	Daphnids (Aquatic omnivore/herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph-producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Acenaphthene	7.60E-01					2.00E+00		4.40E+03	1.60E+03	1.20E+03	1.60E+03							2.50E+05
Acenaphthylene	7.60E-01							4.40E+03	1.60E+03	1.20E+03	1.50E+03							2.50E+05
Acetone	6.50E-01							6.50E+00	6.30E+00	7.70E+01	9.80E+01	7.50E+01	1.40E+02	1.70E+03	2.30E+03	9.70E+03	7.60E+05	3.90E+04
Aldrin								6.00E-01	3.70E-01	1.80E-01	2.30E-01							5.10E+01
Aluminum	5.80E+04																	
Americium-241		6.60E+05	6.60E+05	6.60E+05	6.60E+05	5.00E+03	1.90E+03	2.00E+05	3.30E+05	3.30E+05	2.60E+03	5.00E+04	6.90E+04	1.10E+05	2.20E+03	4.70E+05	5.90E+05	2.60E+05
Amino-2,6-dinitrotoluene[4-]						3.30E+02	1.80E+02	2.90E+03	2.30E+02	1.20E+02	1.50E+02							6.40E+04
Amino-4,6-dinitrotoluene[2-]						1.40E+02	4.30E+02	9.20E+02	2.40E+02	1.50E+02	2.00E+02							9.40E+04
Anthracene	5.70E-01					9.00E+00		1.00E+04	3.10E+03	2.10E+03	2.70E+03							3.40E+05
Antimony						5.80E+01	7.80E+02	2.60E+01	2.40E+01	2.60E+01	5.00E+02							4.60E+02
Aroclor-1016	5.90E-01							1.20E+02	6.00E+00	3.10E+00	3.90E+00							5.80E+02
Aroclor-1242	5.90E-01							1.00E+02	3.00E+00	1.50E+00	1.90E+00	1.00E+01	7.90E-01	4.10E-01	5.40E-01	2.20E+00	5.70E+01	3.30E+02
Aroclor-1248	5.90E-01							5.20E+00	1.40E-01	7.20E-02	9.00E-02	1.00E+01	7.90E-01	4.10E-01	5.40E-01	2.20E+00	5.80E+01	1.50E+01
Aroclor-1254	3.40E-01					6.20E+02		2.50E+02	4.90E+00	2.40E+00	3.00E+00	1.30E+01	8.00E-01	4.10E-01	5.40E-01	2.20E+00	7.10E+01	5.90E+01
Aroclor-1260	5.90E-01							6.40E+03	4.80E+01	2.40E+01	3.00E+01	6.60E+01	2.40E+00	1.20E+00	1.60E+00	6.80E+00	5.70E+02	1.40E+02
Arsenic	3.30E+01					9.10E+01	6.80E+01	2.30E+02	5.10E+01	2.40E+01	4.30E+01	4.20E+02	2.60E+02	1.80E+02	3.50E+02	1.20E+03	8.50E+03	1.30E+03
Barium	3.00E+02					2.60E+02	3.20E+03	2.90E+04	1.80E+04	1.30E+04	3.50E+04	1.40E+03	1.60E+03	1.90E+03	5.30E+03	1.50E+04	5.00E+04	4.10E+05
Benzene	1.00E-01							3.10E+02	2.40E+02	4.70E+02	6.10E+02							1.70E+05
Benzo(a)anthracene	1.00E+00					1.80E+02		5.50E+01	3.40E+01	3.00E+01	5.90E+01	8.00E+00	9.10E+00	1.00E+01	2.20E+01	7.40E+01	3.40E+02	1.10E+03
Benzo(a)pyrene	1.40E+00							7.90E+02	2.70E+02	1.70E+02	2.60E+02							1.10E+04
Benzo(b)fluoranthene	1.90E+00					1.80E+02		1.10E+03	5.20E+02	3.80E+02	5.90E+02							2.40E+04
Benzo(g,h,i)perylene	1.70E+00							4.80E+03	4.70E+02	2.40E+02	3.20E+02							3.30E+04
Benzo(k)fluoranthene	2.40E+00							3.10E+03	1.00E+03	6.20E+02	9.30E+02							4.30E+04
Benzoic Acid								3.70E+01	1.30E+01	1.00E+01	1.30E+01							1.80E+04
Benzyl Alcohol								1.50E+03	1.20E+03	2.60E+03	3.30E+03							1.10E+06
Beryllium						2.50E+01	4.00E+02	1.50E+03	5.60E+02	1.80E+02	7.30E+02							4.20E+03
BHC [alpha-]	5.00E-02							6.70E+03	1.00E+03	5.80E+02	7.30E+02							1.40E+05
BHC [beta-]	4.90E-03							1.50E+01	2.30E+00	1.30E+00	1.60E+00	8.00E+02	2.40E+02	1.40E+02	1.90E+02	7.90E+02	2.40E+04	3.40E+02
BHC [gamma-]						1.00E+00		1.00E+00	1.60E-01	5.90E+00	1.10E-01	4.70E+00	1.40E+00	8.60E-01	1.10E+00	4.60E+00	1.40E+02	2.30E+01
Bis(2-ethylhexyl)phthalate								2.40E+04	1.10E+01	7.40E+00	7.40E+00	2.00E+02	4.00E-01	2.00E-01	2.60E-01	1.00E+00	8.10E+01	3.80E+03
Boron						8.60E+01		6.80E+02	5.60E+02	1.20E+03	1.70E+03	1.00E+01	1.50E+01	3.70E+01	5.40E+01	2.10E+02	5.40E+03	2.10E+05
Butanone[2-]								9.80E+02	9.30E+02	6.80E+03	8.70E+03							3.50E+06
Butyl Benzyl Phthalate	1.00E+00							2.00E+04	1.60E+03	9.00E+02	1.10E+03							1.80E+05
Cadmium	4.90E+00					1.60E+02	7.60E+02	8.80E+01	5.10E+00	2.70E+00	3.30E+00	4.40E+01	5.40E+00	2.90E+00	3.80E+00	1.50E+01	4.70E+03	5.30E+03
Carbazole								1.10E+03	8.00E+02	1.00E+03	1.40E+03							1.30E+05
Carbon Disulfide								1.20E+01	8.20E+00	1.10E+01	1.50E+01							1.90E+03
Cesium-134		2.20E+04	2.20E+04	2.20E+04	2.20E+04	7.00E+03	1.00E+04	5.50E+03	1.10E+04	1.10E+04	1.40E+04	6.90E+03	1.20E+04	2.10E+04	3.30E+03	1.00E+04	1.00E+04	7.30E+03
Cesium-137 + Barium-137		5.00E+04	5.00E+04	5.00E+04	5.00E+04	1.50E+04	2.30E+04	1.20E+04	2.30E+04	2.40E+04	3.20E+04	1.40E+04	2.60E+04	4.60E+04	7.20E+03	4.30E+04	3.90E+04	1.50E+04
Chlordane[alpha-]	1.70E-02					2.20E+01		5.10E+02	5.40E+00	2.70E+00	3.30E+00	9.90E+01	2.70E+00	1.40E+00	1.80E+00	7.40E+00	2.00E+02	6.30E+02
Chlordane[gamma-]	1.70E-02					2.20E+01		6.10E+02	4.40E+01	2.20E+01	2.90E+01	1.10E+02	2.10E+01	1.10E+01	1.50E+01	6.40E+01	1.30E+03	3.70E+03
Chloroaniline[4-]						1.00E+01	1.80E+01											
Chlorobenzene	3.00E-01						2.40E+01	1.30E+03	5.40E+02	4.30E+02	5.40E+02							2.20E+05
Chloroform								4.20E+01	2.20E+01	2.20E+01	2.80E+01							2.20E+04
Chlorophenol[2-]	5.50E-01							6.00E+00	5.40E+00	2.20E+01	3.00E+01	3.90E+00	6.90E+00	2.80E+01	4.00E+01	1.60E+02	3.40E+03	3.30E+03
Chromium (total)	1.10E+02							7.50E+03	1.10E+03	4.50E+02	9.30E+02	6.80E+02	4.00E+02	2.80E+02	6.10E+02	2.00E+03	1.00E+04	1.80E+04
Chromium(+6)						4.00E+00	3.40E+00	2.90E+04	8.60E+03	2.80E+03	9.60E+03	2.80E+03	2.20E+03	1.90E+03	6.80E+03	1.70E+04	4.20E+04	7.30E+04
Chrysene	1.20E+00							5.80E+01	3.10E+01	2.40E+01	4.40E+01							1.10E+03

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph. producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph. producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Cobalt		1.40E+04	1.40E+04	1.40E+04	1.40E+04	1.30E+02		1.60E+04	4.00E+03	1.60E+03	3.70E+03	1.70E+03	1.20E+03	9.60E+02	2.30E+03	7.20E+03	2.70E+04	5.50E+04
Cobalt-60						7.60E+03	7.60E+03	7.60E+03	7.60E+03	7.60E+03	9.60E+03	1.50E+04	1.50E+04	1.50E+04	2.10E+03	1.50E+04	1.50E+04	7.60E+03
Copper	1.40E+02					4.90E+02	5.30E+02	4.10E+02	1.00E+02	6.30E+01	9.10E+01	1.10E+02	6.60E+01	4.60E+01	7.00E+01	2.70E+02	4.00E+03	6.60E+03
Cyanide	1.00E+00							6.60E+03	3.40E+03	3.10E+03	4.20E+03	1.00E+00	1.00E+00	1.00E+00	1.40E+00	4.00E+00	5.90E+00	2.80E+04
DDD								4.70E+02	1.60E+01	8.20E+00	1.00E+01	7.30E-01	6.30E-02	3.30E-02	4.30E-02	1.70E-01	4.20E+00	1.60E+03
DDE	3.10E-02							1.30E+03	1.80E+01	9.30E+00	1.10E+01	2.80E+01	1.00E+00	5.90E-01	7.30E-01	2.90E+00	9.00E+01	2.30E+03
DDT	4.10E-02					6.00E+00		5.70E+01	4.40E-01	2.20E-01	2.70E-01	8.50E+01	2.10E+00	1.00E+00	1.40E+00	5.80E+00	2.20E+02	7.20E+01
Dibenz(a,h)anthracene	3.30E-01							8.50E+02	2.20E+02	1.20E+02	1.90E+02							8.50E+03
Dibenzofuran	5.10E+00					6.10E+01												
Dichlorobenzene[1,2-]								9.90E+01	1.50E+01	9.20E+00	1.10E+01							3.90E+03
Dichlorobenzene[1,3-]								1.00E+02	1.30E+01	7.30E+00	9.20E+00							3.00E+03
Dichlorobenzene[1,4-]	3.00E-01						1.20E+01	4.00E+01	6.00E+00	3.50E+00	4.40E+00							1.50E+03
Dichloroethane[1,1-]	2.00E-01							3.30E+03	2.10E+03	2.90E+03	3.70E+03							2.40E+06
Dichloroethane[1,2-]								3.20E+02	2.70E+02	8.90E+02	1.10E+03	1.60E+00	2.80E+00	9.20E+00	1.20E+01	5.10E+01	2.90E+03	3.50E+05
Dichloroethene[1,1-]	1.00E+00							3.50E+02	1.40E+02	1.10E+02	1.40E+02							1.30E+05
Dichloroethene[cis/trans-1,2-]	2.00E+00							5.20E+02	2.50E+02	2.30E+02	2.90E+02							2.30E+05
Dieldrin	1.90E-02					1.00E+02		6.00E-01	1.70E-02	9.00E-03	1.10E-02	1.80E+01	1.20E+00	6.40E-01	8.40E-01	3.40E+00	8.30E+01	1.80E+00
Diethyl Phthalate						1.00E+03		7.20E+04	3.60E+04	3.60E+04	4.50E+04							2.20E+07
Dimethyl Phthalate							1.00E+02	6.00E+02	4.60E+02	9.70E+02	1.00E+03							5.80E+05
Di-n-Butyl Phthalate	1.10E-01					6.00E+02		3.40E+04	8.70E+02	4.40E+02	5.50E+02	3.90E+00	2.10E-01	1.10E-01	1.40E-01	5.90E-01	1.70E+01	1.10E+05
Dinitrobenzene[1,3-]								1.70E-01	1.70E-01	1.90E+00	2.90E+00	7.90E-01	1.50E+00	1.70E+01	2.70E+01	1.00E+02	1.30E+03	1.80E+02
Dinitrotoluene[2,4-]	2.90E+00					6.00E+01	1.80E+02	6.60E+02	2.00E+02	1.30E+02	1.80E+02							2.00E+04
Dinitrotoluene[2,6-]							4.40E+01	5.50E+01	4.10E+01	7.10E+01	9.70E+01	5.20E+02	7.60E+02	1.30E+03	1.90E+02	7.80E+03	2.10E+05	1.30E+04
Di-n-octylphthalate								1.10E+05	1.80E+01	9.10E+00	1.10E+01							1.00E+04
Diphenylamine												1.40E+02	3.00E+01	1.70E+01	2.20E+01	9.30E+01	7.20E+03	
Endosulfan	1.00E-04							8.60E+00	6.40E+00	1.00E+01	1.50E+01	1.50E+02	2.20E+02	4.00E+02	6.10E+02	2.30E+03	2.80E+04	9.30E+02
Endrin	2.20E-02					3.40E-02		1.80E+01	4.60E-01	2.30E-01	2.90E-01	4.90E-01	2.80E-02	1.40E-02	1.90E-02	7.70E-02	1.90E+00	4.90E+01
Europium-152		1.00E+04	1.00E+04	1.00E+04	1.00E+04	5.20E+03	5.30E+03	5.20E+03	5.30E+03	5.30E+03	7.40E+02	1.00E+04	1.00E+04	1.00E+04	1.70E+02	1.00E+04	1.00E+04	5.20E+03
Fluoranthene	2.20E+00						2.30E+01	2.30E+03	3.80E+02	2.20E+02	2.80E+02							3.30E+04
Fluorene	5.30E-01						1.90E+01	1.90E+03	6.80E+02	5.00E+02	6.40E+02							8.90E+04
Fluoride								5.70E+03	2.20E+03	1.00E+03	2.40E+03	2.10E+03	1.70E+03	1.50E+03	3.60E+03	1.00E+04	3.10E+04	2.80E+04
Heptachlor	1.60E-02					4.00E+00		4.40E+01	1.10E+00	5.90E-01	7.40E-01	8.60E+01	5.90E+00	3.00E+00	4.00E+00	1.60E+01	4.10E+02	1.20E+02
Hexachlorobenzene						1.00E+02	1.00E+02	1.20E+04	4.00E+00	2.00E+00	2.40E+00	1.00E+03	1.50E+00	7.90E-01	1.00E+00	4.20E+00	1.10E+02	4.40E+02
Hexanone[2-]								5.30E+01	2.30E+01	2.00E+01	2.50E+01	4.70E+00	4.10E+00	3.60E+00	4.80E+00	2.00E+01	3.20E+03	2.20E+04
HMX	1.70E+02					3.50E+03	1.60E+02	9.10E+02	8.00E+02	2.40E+03	3.90E+03							1.50E+05
Indeno(1,2,3-cd)pyrene	2.00E+00							5.30E+03	1.10E+03	6.20E+02	9.30E+02							4.60E+04
Iodomethane												7.70E-02	9.30E-02	1.20E-01	1.60E-01	6.80E-01	9.70E+01	
Iron	4.00E+04							9.60E+00	2.10E-01	1.00E-01	1.30E-01	9.90E+01	5.10E+00	2.60E+00	3.40E+00	1.40E+01	3.40E+02	2.20E+01
Kepone																		
Lead	1.20E+02					5.70E+02	8.40E+03	6.20E+02	2.30E+02	1.30E+02	2.40E+02	4.20E+01	3.30E+01	2.80E+01	5.40E+01	1.90E+02	1.20E+03	7.00E+03
Lead-210		9.00E+04	9.00E+04	9.00E+04	9.00E+04	3.40E+04	1.20E+04	4.30E+04	4.50E+04	4.50E+04	2.50E+04	6.10E+04	5.80E+04	6.30E+04	7.40E+03	8.70E+04	8.90E+04	4.40E+04
Lithium								1.00E+03	4.90E+02	1.80E+02	7.30E+02							4.20E+03
Manganese	1.10E+03					1.10E+03	4.50E+03	1.80E+04	1.40E+04	1.50E+04	5.30E+04	1.40E+04	1.90E+04	3.10E+04	1.10E+05	2.70E+05	6.90E+05	4.10E+05
Mercury (inorganic)	1.00E+00					6.40E+01	5.00E-01	2.00E+02	3.00E+01	1.70E+01	2.20E+01	7.00E-01	2.20E-01	1.30E-01	1.80E-01	6.60E-01	2.90E+00	6.10E+02
Mercury							1.20E+01	9.80E+00	3.10E-02	1.50E-02	1.90E-02	7.50E-01	7.10E-03	3.50E-03	4.60E-03	1.70E-02	7.80E-02	5.60E-01
Methoxychlor[4,4-]								1.40E+02	1.80E+01	1.00E+01	1.20E+01	1.10E+03	3.20E+02	1.80E+02	2.50E+02	1.00E+03	2.00E+04	1.70E+03
Methyl-2-pentanone[4-]	3.00E-01							1.30E+02	9.80E+01	1.50E+02	1.90E+02							1.70E+05

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph. producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph. producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Methylene Chloride	1.80E-01					1.60E+04		2.60E+01	2.20E+01	7.70E+01	9.80E+01							3.60E+04
Methylnaphthalene[2-]	7.60E-01							9.50E+02	2.40E+02	1.60E+02	2.00E+02							4.20E+04
Methylphenol[2-]						7.00E+00		7.20E+03	5.90E+03	1.30E+04	1.90E+04							1.60E+06
Methylphenol[3-]						7.00E+00												
Molybdenum	5.60E-01					1.00E+01		3.20E+01	2.70E+01	7.70E+01	9.90E+01	1.90E+02	1.80E+02	1.70E+02	2.70E+02	1.00E+03	1.30E+04	
Naphthalene												3.40E+01	5.70E+01	1.60E+02	2.20E+02	8.90E+02	2.10E+04	1.40E+04
Neptunium-237		7.60E+04	7.60E+04	7.60E+04	7.60E+04	2.70E+04	5.00E+02	3.20E+04	3.30E+04	3.20E+04	1.30E+02	7.50E+03	2.20E+03	2.20E+03	1.20E+02	1.30E+04	1.70E+04	5.90E+03
Nickel	4.80E+01					2.70E+02	1.30E+03	8.90E+02	4.10E+01	1.90E+01	2.70E+01	1.60E+03	3.80E+02	2.10E+02	3.20E+02	1.20E+03	2.30E+04	2.30E+03
Nitroaniline[2-]								1.80E+01	1.00E+01	1.20E+01	1.60E+01							4.30E+03
Nitrobenzene							2.20E+01	5.40E+01	4.90E+01	2.00E+02	2.70E+02							4.00E+04
Nitroglycerine							2.10E+02	7.50E+02	7.50E+02	1.10E+04	1.80E+04							7.10E+05
Nitrotoluene[2-]							1.30E+02	1.20E+02	9.90E+01	2.10E+02	2.80E+02							5.80E+04
Nitrotoluene[3-]								1.70E+02	1.20E+02	1.90E+02	2.40E+02							6.70E+04
Nitrotoluene[4-]								2.90E+02	2.20E+02	4.00E+02	5.20E+02							1.20E+05
Pentachlorobenzene	3.60E+01							7.80E+03	2.20E+02	1.10E+02	1.40E+02	2.20E+02	1.30E+01	7.00E+00	9.20E+00	3.70E+01	1.00E+03	2.70E+04
Pentachlorophenol	1.00E-01					5.00E+01	1.50E+02	1.50E+03	1.60E+01	8.10E+00	1.00E+01	3.10E+02	7.20E+00	3.60E+00	4.80E+00	1.90E+01	4.90E+02	1.70E+03
PETN								1.00E+03	1.00E+03	8.70E+03	1.40E+04							4.50E+05
Phenanthrene	1.10E+00						1.20E+01	5.20E+02	1.50E+02	1.00E+02	1.40E+02							1.70E+04
Phenols						8.00E+00	1.80E+01	3.80E+02	3.80E+02	5.50E+03	8.40E+03							4.20E+05
Plutonium-238		4.00E+06	4.00E+06	4.00E+06	4.00E+06	1.80E+04	8.20E+03	5.30E+05	1.70E+06	1.60E+06	1.20E+03	5.20E+04	7.70E+04	1.40E+05	1.10E+03	1.20E+06	1.30E+06	4.50E+05
Plutonium-239, 240		7.10E+06	7.10E+06	7.10E+06	7.10E+06	1.90E+04	8.70E+03	6.20E+05	2.80E+06	2.70E+06	1.20E+03	5.40E+04	7.90E+04	1.40E+05	1.10E+03	1.40E+06	1.60E+06	5.10E+05
Plutonium-241		7.60E+06	7.60E+06	7.60E+06	7.60E+06	3.60E+05	1.70E+05	3.60E+06	3.70E+06	3.70E+06	1.20E+07	7.10E+06	7.20E+06	7.20E+06	2.80E+06	7.30E+06	7.30E+06	3.60E+06
Pyrene	1.50E+00					2.00E+01		9.90E+02	3.20E+02	2.20E+02	2.90E+02	7.10E+02	4.60E+02	3.40E+02	4.70E+02	1.90E+03	3.10E+04	2.80E+04
Radium-226		1.40E+04	1.40E+04	1.40E+04	1.40E+04	5.40E+02	1.50E+01	2.10E+03	3.80E+03	3.40E+03	3.00E+00	3.70E+02	8.50E+01	8.30E+01	2.10E+00	7.90E+02	9.50E+03	3.70E+03
Radium-228		2.80E+04	2.80E+04	2.80E+04	2.80E+04	4.80E+02	1.20E+01	2.30E+03	4.90E+03	4.20E+03	7.70E+00	5.00E+02	1.10E+02	1.10E+02	2.60E+00	1.00E+03	1.60E+04	5.60E+03
RDX	3.50E+02						1.50E+01	9.90E+01	5.20E+01	5.20E+01	6.70E+01	4.40E+00	4.50E+00	4.60E+00	6.30E+00	2.60E+01	1.60E+03	2.20E+04
Selenium	2.90E+00					3.00E+00	4.10E+01	2.90E+00	1.20E+00	9.90E-01	1.30E+00	2.00E+00	1.70E+00	1.50E+00	2.10E+00	8.60E+00	1.60E+02	1.30E+02
Silver	5.00E+00					2.80E+03		1.40E+03	2.40E+02	1.40E+02	1.80E+02	1.10E+02	4.30E+01	2.60E+01	3.60E+01	1.40E+02	6.70E+03	4.30E+04
Sodium-22		1.80E+05	1.80E+05	1.80E+05	1.80E+05	8.90E+04	6.50E+04	8.90E+04	9.00E+04	9.00E+04	4.90E+05	1.70E+05	1.60E+05	1.60E+05	1.10E+05	1.40E+05	1.10E+05	4.00E+04
Strontium (stable)								9.80E+02	9.60E+02	6.60E+03	1.70E+04							1.90E+05
Strontium-90 + Yttrium-90		3.40E+04	3.40E+04	3.40E+04	3.40E+04	1.10E+04	1.70E+04	1.00E+04	1.60E+04	1.70E+04	2.30E+03	3.40E+03	8.10E+03	3.00E+04	1.50E+03	2.50E+04	2.00E+04	8.00E+03
Styrene						3.20E+01	1.20E+01											
Tetrachlorodibenzodioxin[2,3,7,8-]	8.50E-06						1.00E+01	2.80E-04	3.90E-06	1.90E-06	2.40E-06							5.50E-04
Tetrachloroethene	2.00E-02					1.00E+02		3.90E+01	1.80E+00	9.40E-01	1.10E+00							4.80E+02
Tetryl								7.20E+00	7.30E+00	1.70E+02	4.90E+02							4.50E+03
Thallium						5.00E-01		2.50E+01	7.30E+00	2.20E+00	8.20E+00	9.20E+01	7.50E+01	6.30E+01	2.40E+02	5.60E+02	1.20E+03	5.30E+01
Thorium-228		1.60E+04	1.60E+04	1.60E+04	1.60E+04	1.40E+03	4.30E+02	7.70E+03	8.20E+03	8.30E+03	1.20E+04	1.10E+04	1.20E+04	1.30E+04	2.90E+03	1.60E+04	1.60E+04	8.30E+03
Thorium-229		3.20E+04	3.20E+04	3.20E+04	3.20E+04	1.70E+03	4.70E+02	1.30E+04	1.50E+04	1.50E+04	1.20E+03	8.80E+03	9.90E+03	1.30E+04	1.10E+03	2.70E+04	3.10E+04	1.50E+04
Thorium-230		2.70E+06	2.70E+06	2.70E+06	2.70E+06	2.00E+03	5.20E+02	9.90E+04	7.80E+05	8.10E+05	1.30E+03	1.30E+04	1.50E+04	2.30E+04	1.20E+03	2.30E+05	1.80E+06	6.80E+05
Thorium-232		3.20E+06	3.20E+06	3.20E+06	3.20E+06	2.40E+02	6.20E+01	1.20E+04	1.90E+05	2.00E+05	1.60E+02	1.50E+03	1.80E+03	2.80E+03	1.50E+02	2.90E+04	5.70E+05	1.40E+05
Titanium								5.30E+04	1.50E+03	7.20E+02	9.80E+02							8.20E+04
Toluene	1.00E-01							5.40E+02	2.50E+02	2.30E+02	2.90E+02							1.10E+05
Toxaphene (Technical Grade)	1.00E-03					2.00E+03		2.60E+03	1.10E+02	5.90E+01	7.40E+01	7.50E+02	7.90E+01	4.10E+01	5.50E+01	2.20E+02	5.10E+03	1.10E+04
Trichlorobenzene[1,2,4-]	1.10E-01						1.20E+01	1.00E+02	5.10E+00	2.70E+00	3.30E+00							8.60E+02
Trichloroethane[1,1,1-]	7.00E-01							1.60E+04	4.00E+03	2.60E+03	3.20E+03							2.60E+06
Trichloroethene	7.80E-01							1.50E+03	5.50E+02	4.20E+02	5.20E+02							3.70E+05
Trichlorofluoromethane								1.00E+04	6.60E+02	3.50E+02	4.30E+02							3.50E+05

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Sediment and Soil

Analyte	Aquatic community organisms	Algae (Aquatic autotroph. producer)	Aquatic snails (Aquatic herbivore - grazer)	Dap hnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	Generic plant (Terrestrial autotroph - producer)	Earthworm (Soil-dwelling invertebrate)	Desert cottontail (Mammalian herbivore)	Deer mouse (Mammalian omnivore)	Montane shrew (Mammalian insectivore)	Occult little brown myotis bat (Mammalian aerial insectivore)	American robin (Avian herbivore)	American robin (Avian omnivore)	American robin (Avian insectivore)	Violet-green Swallow (Avian aerial insectivore)	American kestrel (Avian intermediate carnivore)	American kestrel (Avian top carnivore)	Red fox (Mammalian top carnivore)
Tetrabromoethane[1,1,2,2-]	1.50E+00					1.20E+02	2.80E+01	1.20E+03	1.20E+03	4.00E+03	1.30E+04							
Tetrachloroethene[2,4,6-]	3.20E+01					1.20E+02	5.80E+01	4.40E+02	4.40E+02	4.90E+03	1.70E+04	1.30E+01	2.60E+01	3.10E+02	1.10E+03	2.70E+03	6.50E+03	1.20E+05
Tritium		6.60E+06	6.60E+06	6.60E+06	6.60E+06	3.60E+05	4.80E+05	2.10E+06	3.30E+06	3.40E+06	1.30E+10	3.00E+06	4.40E+05	6.00E+06	3.80E+09	6.10E+06	5.50E+06	2.20E+06
Uranium	1.00E+03					2.30E+02		4.60E+03	1.80E+03	5.60E+02	2.80E+03	1.90E+04	1.70E+04	1.60E+04	8.80E+04	1.60E+05	3.00E+05	1.20E+04
Uranium-233		1.00E+07	1.00E+07	1.00E+07	1.00E+07	4.40E+03	2.20E+04	2.00E+05	2.90E+06	4.20E+06	2.70E+04	1.50E+05	3.30E+05	1.10E+06	5.20E+03	7.10E+06	7.30E+06	2.30E+06
Uranium-234		3.00E+06	3.00E+06	3.00E+06	3.00E+06	4.40E+03	2.20E+04	1.80E+05	1.20E+06	1.40E+06	2.70E+04	1.50E+05	3.10E+05	9.20E+05	6.20E+03	2.60E+06	2.60E+06	1.10E+06
Uranium-235		1.00E+05	1.00E+05	1.00E+05	1.00E+05	4.40E+03	1.60E+04	4.20E+04	5.20E+04	5.20E+04	3.00E+04	6.50E+04	8.20E+04	9.80E+04	5.70E+03	1.00E+05	1.00E+05	5.20E+04
Uranium-236						4.70E+03	2.40E+04	2.30E+05	7.20E+06	2.30E+07	2.90E+04	1.70E+05	3.70E+05	1.40E+06	5.60E+03	2.40E+07	2.50E+07	4.40E+06
Uranium-238		4.30E+04	4.33E+04	4.30E+04	4.30E+04	4.00E+03	1.10E+04	1.90E+04	2.10E+04	2.10E+04	3.00E+04	3.40E+04	3.80E+04	4.10E+04	5.90E+03	4.20E+04	4.20E+04	2.10E+04
Vanadium						9.80E+01		2.70E+03	9.50E+02	2.80E+02	1.20E+03	1.70E+01	1.50E+01	1.30E+01	6.10E+01	1.30E+02	2.60E+02	6.60E+03
Vinyl Chloride								2.80E+00	1.30E+00	1.20E+00	1.50E+00							1.10E+03
Xylene (Total)	1.30E+00					1.00E+03		7.70E+00	2.40E+00	1.70E+00	2.20E+00	9.00E+02	5.60E+02	4.10E+02	5.50E+02	2.20E+03	1.20E+05	8.00E+02
Zinc	4.50E+02					8.10E+02	9.30E+02	1.60E+04	1.70E+03	9.80E+02	1.20E+03	3.50E+03	8.50E+02	4.20E+02	6.50E+02	2.50E+03	2.40E+04	7.80E+04

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Surface Water

Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Acenaphthene	5.80E+00	5.80E+01							7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Acenaphthylene	4.80E+03	4.80E+04							7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Acetone	1.50E+03	1.50E+04					1.60E+07	1.40E+07	5.10E+05	2.60E+05	2.20E+05	8.30E+06	3.10E+05	5.80E+05
Aluminum	5.30E+02	1.30E+03					9.10E+06	7.80E+06	1.90E+05	1.00E+05	8.60E+04	4.50E+06	1.20E+05	2.20E+05
Americium-241			5.80E+01	1.70E+03	1.70E+03	1.70E+03	7.60E+08	7.50E+08	9.10E+08	1.30E+10	7.80E+09	1.80E+09	1.70E+09	5.70E+07
Amino-2,6-dinitrotoluene[4-]									9.80E+05	5.00E+05	4.30E+05		6.00E+05	1.10E+06
Amino-4,6-dinitrotoluene[2-]									1.40E+06	7.30E+05	6.20E+05		8.70E+05	1.60E+06
Anthracene	7.30E-01	7.30E+00							1.00E+07	5.20E+06	4.40E+06		6.20E+06	1.10E+07
Antimony	3.00E+01	8.80E+01							5.40E+03	2.70E+03	2.30E+03		3.30E+03	6.10E+03
Aroclor-1016	1.40E-02	1.40E-01							3.60E+03	1.80E+03	1.50E+03		2.20E+03	4.00E+03
Aroclor-1242	1.40E-02	1.40E-01					8.30E+03	7.10E+03	9.60E+03	4.90E+03	4.20E+03	4.10E+03	5.90E+03	1.00E+04
Aroclor-1248	1.40E-02	1.40E-01					8.30E+03	7.10E+03	1.00E+03	5.20E+02	4.40E+02	4.10E+03	6.20E+02	1.10E+03
Aroclor-1254	1.40E-02	1.40E-01					8.30E+03	7.10E+03	3.10E+03	1.60E+03	1.30E+03	4.10E+03	1.90E+03	3.60E+03
Aroclor-1260	1.40E-02	1.40E-01					8.90E+04	7.60E+04	3.10E+03	1.60E+03	1.30E+03	4.40E+04	1.90E+03	3.60E+03
Arsenic	1.50E+02	3.40E+02					1.00E+05	9.10E+04	1.20E+04	6.60E+03	5.60E+03	5.20E+04	7.90E+03	1.40E+04
Barium	3.90E+00	3.90E+01					1.50E+06	1.30E+06	2.00E+04	1.00E+04	8.80E+03	7.60E+05	1.20E+04	2.30E+04
Benzene	4.60E+01	4.60E+02							2.70E+06	1.30E+06	1.10E+06		1.60E+06	3.00E+06
Benzo[a]anthracene	2.70E-02	2.70E-01							1.70E+04	8.90E+03	7.60E+03		1.00E+04	1.90E+04
Benzo[a]pyrene	1.40E-02	1.40E-01							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Benzo[b]fluoranthene	9.00E+00	9.00E+01							4.10E+05	2.10E+05	1.70E+05		2.50E+05	4.60E+05
Benzo[g,h,i]perylene	7.60E+00	7.60E+01							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Benzo[k]fluoranthene	4.10E-03	4.10E-02							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Benzoic Acid	4.20E+01	4.20E+02							4.10E+05	2.10E+05	1.70E+05		2.50E+05	4.60E+05
Beryllium	6.60E-01	6.60E+00							6.80E+04	3.40E+04	2.90E+04		4.10E+04	7.60E+04
BHC[beta-]	2.20E+00	2.20E+01					3.10E+06	2.70E+06	2.00E+04	1.00E+04	8.90E+03	1.50E+06	1.20E+04	2.30E+04
BHC[gamma-]	9.50E-02	9.50E-01					1.80E+04	1.60E+04	1.40E+03	7.30E+02	6.20E+02	9.20E+03	8.80E+02	1.60E+03
Bis[2-ethylhexyl]phthalate	3.20E+01	3.20E+02					9.10E+04	7.80E+04	1.80E+06	9.60E+05	8.20E+05	4.50E+04	1.10E+06	2.10E+06
Boron	1.60E+00	1.60E+01					1.50E+06	1.30E+06	2.80E+06	1.40E+06	1.20E+06	7.70E+05	1.70E+06	3.20E+06
Butanone[2-]	7.20E+03	7.10E+04							4.70E+07	2.40E+07	2.00E+07		2.80E+07	5.30E+07
Butyl Benzyl Phthalate	1.90E+01	1.90E+02							1.60E+07	8.30E+06	7.10E+06		1.00E+07	1.80E+07
Cadmium	2.80E-01	9.10E-01					1.60E+05	1.40E+05	4.00E+04	2.00E+04	1.70E+04	8.20E+04	2.40E+04	4.50E+04
Cesium-134			1.90E+04	9.40E+04	9.40E+04	4.70E+03	1.40E+09	1.40E+09	2.70E+08	3.30E+09	3.00E+09	2.70E+09	9.90E+09	7.50E+07
Cesium-137 + Barium-137			4.60E+04	2.30E+05	2.30E+05	1.10E+04	3.10E+09	3.10E+09	5.90E+08	7.30E+09	6.50E+09	5.80E+09	2.10E+10	1.60E+08
Chlordane[alpha-]	4.30E-03	4.30E-02					8.90E+04	7.60E+04	1.20E+05	6.20E+04	5.20E+04	4.40E+04	7.40E+04	1.30E+05
Chlordane[gamma-]	4.30E-03	4.30E-02					8.90E+04	7.60E+04	1.20E+05	6.20E+04	5.20E+04	4.40E+04	7.40E+04	1.30E+05
Chloride	2.30E+02	8.60E+02												
Chlorobenzene	1.30E+02	1.30E+03							6.10E+06	3.10E+06	2.60E+06		3.70E+06	6.90E+06
Chloroform	1.80E+00	1.80E+01							4.20E+05	2.10E+05	1.80E+05		2.50E+05	4.70E+05
Chlorophenol[2-]	4.90E+02	4.30E+03					9.40E+04	8.00E+04	5.10E+04	2.60E+04	2.20E+04	4.60E+04	3.10E+04	5.80E+04
Chromium [total]	1.10E+01	1.60E+01					1.40E+05	1.20E+05	1.40E+06	7.40E+05	6.30E+05	7.10E+04	8.90E+05	1.60E+06

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Surface Water

Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Chromium[+6]	1.10E+01	1.60E+01					1.40E+05	1.20E+05	1.40E+06	7.40E+05	6.30E+05	7.10E+04	8.90E+05	1.60E+06
Chrysene	1.80E-03	1.80E-02							1.70E+04	8.90E+03	7.60E+03		1.00E+04	1.90E+04
Cobalt	3.00E+00	3.00E+01					4.10E+03	3.50E+03	5.10E+03	2.60E+03	2.20E+03	2.00E+03	3.10E+03	5.80E+03
Cobalt-60			7.60E+03	3.80E+03	3.80E+03	2.30E+04	1.90E+10	1.80E+10	3.30E+09	3.90E+10	3.70E+10	3.40E+10	1.20E+11	9.70E+08
Copper	5.00E+00	7.00E+00					2.60E+05	2.20E+05	7.60E+04	3.90E+04	3.30E+04	1.30E+05	4.60E+04	8.60E+04
Cyanide [total]	5.20E+00	2.20E+01					3.30E+03	2.80E+03	7.00E+06	3.60E+06	3.00E+06	1.60E+03	4.30E+06	7.90E+06
DDE	1.00E+02	1.00E+03					1.00E+04	9.20E+03	1.00E+06	5.20E+05	4.40E+05	5.30E+03	6.20E+05	1.10E+06
DDT	1.00E-03	1.00E-02					2.00E+04	1.70E+04	1.60E+05	8.40E+04	7.10E+04	9.90E+03	1.00E+05	1.80E+05
Dibenz[a,h]anthracene	3.40E-03	3.40E-02							1.30E+05	7.00E+04	5.90E+04		8.30E+04	1.50E+05
Dibenzofuran	3.70E+00	3.70E+01												
Dichlorobenzene[1,4-]	1.50E+01	1.50E+02							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Dichloroethane[1,1-]	4.70E+01	4.70E+02							3.90E+07	2.00E+07	1.70E+07		2.40E+07	4.40E+07
Dichloroethane[1,2-]	1.00E+02	1.00E+03					7.50E+04	6.50E+04	5.10E+06	2.60E+06	2.20E+06	3.70E+04	3.10E+06	5.70E+06
Dichloroethene[1,1-]	2.50E+01	2.50E+02							3.00E+06	1.50E+06	1.30E+06		1.80E+06	3.40E+06
Dichloroethene[cis/trans-1,2-]	5.90E+02	1.10E+03							4.60E+06	2.30E+06	2.00E+06		2.80E+06	5.20E+06
Dieldrin	5.60E-02	2.40E-01					6.40E+03	5.50E+03	2.00E+03	1.00E+03	8.90E+02	3.10E+03	1.20E+03	2.30E+03
DimethylPhthalate	3.00E+00	3.00E+01							7.00E+06	3.50E+06	3.00E+06		4.20E+06	7.90E+06
Di-n-Butyl Phthalate	1.90E+01	1.90E+02					1.10E+04	1.00E+04	2.00E+07	1.00E+07	8.90E+06	5.70E+03	1.20E+07	2.30E+07
Dinitrobenzene[1,3-]	1.60E+01	1.60E+02					3.50E+04	3.00E+04	2.70E+03	1.30E+03	1.10E+03	1.70E+04	1.60E+03	3.00E+03
Dinitrotoluene[2,4-]	6.50E+01	3.30E+02							2.70E+05	1.40E+05	1.20E+05		1.60E+05	3.10E+05
Dinitrotoluene[2,6-]	2.30E+02	3.30E+02							1.80E+05	9.30E+04	7.90E+04		1.10E+05	2.00E+05
Dioctylphthalate	3.00E+00	3.00E+01							6.70E+06	3.40E+06	2.90E+06		4.00E+06	7.50E+06
Endosulfan	5.60E-02	2.20E-01					8.30E+05	7.10E+05	1.50E+04	7.80E+03	6.70E+03	4.10E+05	9.40E+03	1.70E+04
Endrin	3.60E-02	8.60E-02					8.30E+02	7.10E+02	9.40E+03	4.80E+03	4.10E+03	4.10E+02	5.70E+03	1.00E+04
Europium-152			1.00E+03	1.70E+03	1.70E+03	1.70E+04	2.20E+09	2.20E+09	9.00E+08	1.20E+10	8.30E+09	4.20E+09	1.40E+10	1.20E+08
Fluoranthene	4.00E-02	4.00E-01							1.20E+06	6.50E+05	5.60E+05		7.80E+05	1.40E+06
Fluorene	3.90E+00	3.90E+01							2.50E+06	1.30E+06	1.10E+06		1.50E+06	2.90E+06
Fluoride	2.00E+01	2.00E+02					1.00E+06	8.70E+05	5.00E+05	2.50E+05	2.10E+05	5.00E+05	3.00E+05	5.60E+05
Heptachlor	3.80E-03	3.80E-02					7.60E+04	6.50E+04	1.00E+04	5.20E+03	4.40E+03	3.80E+04	6.20E+03	1.10E+04
HMX									2.00E+06	1.00E+06	8.90E+05		1.20E+06	2.30E+06
Indeno[1,2,3-cd]pyrene	4.30E+00	4.30E+01							7.40E+05	3.70E+05	3.20E+05		4.50E+05	8.30E+05
Iron	1.00E+03	1.00E+04												
Kepone							1.40E+05	1.20E+05	4.10E+03	2.10E+03	1.70E+03	7.00E+04	2.50E+03	4.60E+03
Lead	1.00E+00	1.00E+01					1.30E+06	1.10E+06	3.80E+04	1.90E+04	1.60E+04	6.40E+05	2.30E+04	4.30E+04
Lead-210			2.50E+03	1.00E+04	1.00E+04	2.50E+03	2.90E+09	2.80E+09	1.90E+09	2.70E+10	1.60E+10	5.90E+09	1.60E+10	1.70E+08
Manganese	1.30E+03	2.30E+03					4.80E+07	4.10E+07	1.60E+06	8.30E+05	7.00E+05	2.40E+07	9.90E+05	1.80E+06
Mercury	7.70E-01	1.40E+00					1.50E+03	1.30E+03	1.40E+05	7.40E+04	6.30E+04	7.80E+02	8.80E+04	1.60E+05
Mercury [methyl]	2.80E-03	2.80E-02					5.30E+02	4.50E+02	1.60E+03	8.40E+02	7.10E+02	2.60E+02	1.00E+03	1.80E+03
Methoxychlor[4,4'-]	3.00E-02	3.00E-01					2.10E+06	1.80E+06	8.20E+04	4.20E+04	3.50E+04	1.00E+06	5.00E+04	9.30E+04
Methylene Chloride	2.10E+02	2.10E+03							5.10E+05	2.60E+05	2.20E+05		3.10E+05	5.80E+05

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Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Methylnaphthalene[2-]	3.30E+02	3.30E+03							1.60E+06	8.40E+05	7.10E+05		1.00E+06	1.80E+06
Molybdenum	1.80E+03	7.90E+03												
Naphthalene	1.10E+00	1.10E+01					1.10E+03	9.90E+02	5.10E+04	2.60E+04	2.20E+04	5.70E+02	3.10E+04	5.80E+04
Neptunium-237			6.50E+02	6.50E+03	6.50E+03	7.90E+01	4.10E+07	4.00E+07	5.10E+07	7.50E+08	4.30E+08	9.90E+07	8.90E+07	3.10E+06
Nickel	2.90E+01	2.60E+02					3.20E+05	2.70E+05	7.10E+03	3.60E+03	3.00E+03	1.60E+05	4.30E+03	8.00E+03
Nitrobenzene	5.50E+02	2.20E+03							6.00E+05	3.10E+05	2.60E+05		3.70E+05	6.80E+05
Nitroglycerine									1.00E+07	5.30E+06	4.50E+06		6.40E+06	1.10E+07
Nitrotoluene[2-]									9.10E+05	4.60E+05	3.90E+05		5.60E+05	1.00E+06
Nitrotoluene[3-]									1.10E+06	5.60E+05	4.70E+05		6.70E+05	1.20E+06
Nitrotoluene[4-]									2.00E+06	1.00E+06	8.70E+05		1.20E+06	2.20E+06
Pentachloronitrobenzene	1.00E+01	1.00E+02					5.80E+05	5.00E+05	6.70E+06	3.40E+06	2.90E+06	2.90E+05	4.00E+06	7.50E+06
Pentachlorophenol	1.50E+01	1.90E+01					2.70E+05	2.30E+05	2.40E+04	1.20E+04	1.00E+04	1.30E+05	1.50E+04	2.70E+04
Perchlorate Ion							2.10E+07	1.80E+07	2.90E+05	1.40E+05	1.20E+05	1.00E+07	1.70E+05	3.30E+05
PETN									7.20E+06	3.60E+06	3.10E+06		4.40E+06	8.10E+06
Phenanthrene	6.30E+00	3.00E+01							5.20E+05	2.70E+05	2.30E+05		3.20E+05	5.90E+05
Phenol	3.20E+02	3.20E+03							6.10E+06	3.10E+06	2.60E+06		3.70E+06	6.90E+06
Plutonium-238			1.90E+02	1.70E+03	1.70E+03	6.90E+02	3.70E+08	3.70E+08	4.50E+08	6.60E+09	3.80E+09	8.90E+08	8.50E+08	2.80E+07
Plutonium-239, 240			2.00E+02	1.80E+03	1.80E+03	7.40E+02	3.80E+08	3.70E+08	4.80E+08	7.00E+09	4.00E+09	9.20E+08	8.10E+08	2.90E+07
Plutonium-241			4.20E+03	3.70E+04	3.70E+04	1.50E+04	1.20E+12	1.20E+12	2.20E+11	2.50E+12	2.40E+12	2.20E+12	8.40E+12	6.40E+10
Pyrene									7.70E+05	3.90E+05	3.30E+05		4.70E+05	8.70E+05
Radium-226	2.50E-02	2.50E-01	1.00E+00	3.20E+01	3.20E+01	6.40E+02	7.50E+06	7.40E+06	8.50E+06	1.20E+08	7.20E+07	1.70E+07	2.00E+07	5.50E+05
Radium-228			9.00E-01	2.70E+01	2.70E+01	5.40E+02	1.00E+07	9.90E+06	7.60E+06	1.10E+08	6.70E+07	2.10E+07	5.10E+07	6.40E+05
RDX									1.00E+06	5.20E+05	4.40E+05		6.20E+05	1.10E+06
Selenium	5.00E+00	2.00E+01					1.20E+04	1.00E+04	3.40E+03	1.70E+03	1.40E+03	6.10E+03	2.00E+03	3.80E+03
Silver	1.00E-01	1.00E+00					4.50E+05	3.80E+05	1.90E+06	1.00E+06	8.50E+05	2.20E+05	1.10E+06	2.20E+06
Sodium-22			9.00E+05	9.00E+05	9.00E+05	9.00E+05	4.80E+10	4.70E+10	8.50E+09	1.00E+11	9.60E+10	8.80E+10	3.20E+11	2.40E+09
Strontium [stable]	1.50E+04	1.50E+04							2.50E+06	1.30E+06	1.10E+06		1.50E+06	2.90E+06
Strontium-90 + Yttrium-90			5.70E+03	1.70E+05	1.70E+05	3.30E+05	5.20E+08	5.10E+08	5.70E+08	8.30E+09	4.80E+09	1.20E+09	1.50E+09	3.80E+07
Tetrachlorodibenzodioxin[2,3,7,8-]	2.00E-06	2.00E-05							1.00E-01	5.20E-02	4.40E-02		6.20E-02	1.10E-01
Tetrachloroethene	9.80E+01	8.30E+02							1.00E+05	5.20E+04	4.40E+04		6.20E+04	1.10E+05
Tetryl									6.30E+04	3.20E+04	2.70E+04		3.80E+04	7.20E+04
Thallium	3.00E-02	3.00E-01					2.90E+04	2.50E+04	7.30E+02	3.70E+02	3.10E+02	1.40E+04	4.40E+02	8.20E+02
Thorium-228			5.90E+01	1.70E+03	1.70E+03	1.70E+03	1.20E+09	1.20E+09	5.70E+08	8.00E+09	5.20E+09	2.30E+09	8.00E+09	6.80E+07
Thorium-229			6.30E+01	1.80E+03	1.80E+03	1.80E+03	3.90E+08	3.90E+08	4.90E+08	7.20E+09	4.10E+09	9.50E+08	8.50E+08	3.00E+07
Thorium-230			6.80E+01	2.00E+03	2.00E+03	2.00E+03	4.20E+08	4.20E+08	5.30E+08	7.80E+09	4.50E+09	1.00E+09	9.00E+08	3.20E+07
Thorium-232			8.10E+00	2.40E+02	2.40E+02	2.40E+02	5.00E+07	5.00E+07	6.30E+07	9.20E+08	5.30E+08	1.20E+08	1.00E+08	3.80E+06
Titanium									1.60E+06	8.30E+05	7.00E+05		9.90E+05	1.80E+06
Toluene	9.80E+00	9.80E+01							2.60E+06	1.30E+06	1.10E+06		1.60E+06	3.00E+06
Toxaphene [Technical Grade]	2.00E-04	2.00E-03					8.30E+05	7.10E+05	8.20E+05	4.20E+05	3.50E+05	4.10E+05	5.00E+05	9.30E+05
Trichlorobenzene[1,2,4-]	2.40E+01	2.40E+02							1.50E+05	7.70E+04	6.60E+04		9.30E+04	1.70E+05

Los Alamos National Laboratory (LANL) Low Effect Screening Levels for Surface Water

Analyte	No Effect Aquatic community organisms	Low Effect Aquatic community organisms	Algae (Aquatic autotroph - producer)	Aquatic snails (Aquatic herbivore - grazer)	Daphnids (Aquatic omnivore/ herbivore)	Fish (Aquatic intermediate carnivore)	American kestrel	American robin	Desert cottontail	Deer mouse	Montane shrew	Violet-green Swallow	Occult little brown myotis bat	Red fox
Trichloroethane[1,1,1-]	1.10E+01	1.10E+02							1.00E+08	5.20E+07	4.40E+07		6.20E+07	1.10E+08
Trichloroethene	2.10E+01	2.10E+02							1.00E+07	5.20E+06	4.40E+06		6.20E+06	1.10E+07
Trinitrobenzene[1,3,5-]									1.30E+06	7.00E+05	6.00E+05		8.40E+05	1.50E+06
Trinitrotoluene[2,4,6-]							1.40E+05	1.20E+05	1.60E+06	8.40E+05	7.10E+05	7.30E+04	1.00E+06	1.80E+06
Tritium			1.60E+09	1.60E+09	1.60E+09	1.60E+09	1.30E+13	1.30E+13	2.30E+12	2.70E+13	2.60E+13	2.40E+13	9.00E+13	6.80E+11
Uranium	5.00E+00	5.00E+01					6.50E+06	5.50E+06	1.50E+05	7.80E+04	6.70E+04	3.20E+06	9.40E+04	1.70E+05
Uranium-233			2.20E+02	1.90E+03	1.90E+03	3.90E+02	2.70E+09	2.60E+09	5.00E+08	6.10E+09	5.50E+09	5.00E+09	1.80E+10	1.40E+08
Uranium-234			2.20E+02	1.90E+03	1.90E+03	3.90E+02	2.70E+09	2.60E+09	5.00E+08	6.10E+09	5.50E+09	5.00E+09	1.80E+10	1.40E+08
Uranium-235			2.40E+02	2.10E+03	2.10E+03	4.30E+02	2.90E+09	2.90E+09	5.40E+08	6.60E+09	6.00E+09	5.40E+09	2.00E+10	1.50E+08
Uranium-236			2.30E+02	2.10E+03	2.10E+03	4.20E+02	2.90E+09	2.80E+09	5.30E+08	6.50E+09	5.90E+09	5.30E+09	1.90E+10	1.50E+08
Uranium-238			2.40E+02	2.20E+03	2.20E+03	4.40E+02	3.00E+09	2.90E+09	5.50E+08	6.80E+09	6.10E+09	5.50E+09	2.00E+10	1.50E+08
Vanadium	1.90E+01	1.90E+02					9.10E+04	7.80E+04	4.30E+04	2.20E+04	1.80E+04	4.50E+04	2.60E+04	4.80E+04
Xylene [Total]	1.30E+01	1.30E+02					8.90E+06	7.60E+06	2.60E+06	1.30E+06	1.10E+06	4.40E+06	1.60E+06	3.00E+06
Zinc	6.50E+01	8.50E+01					1.00E+07	8.50E+06	1.20E+07	6.60E+06	5.60E+06	4.90E+06	7.90E+06	1.40E+07

Attachment C-9 –
Trophic Level Modeling Report

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Risks to Ecological Receptors Posed by Contaminants of Potential Concern in the Lower Three Runs Cooling Ponds and Canals

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ABSTRACT

The upper portion of Lower Three Runs includes several ponds, reservoirs, and canals that were formerly used as a cooling system for nuclear production reactors. This area was divided into nine exposure areas (EAs) for the assessment of environmental contamination resulting from past reactor operations and other industrial processes. A tiered screening process identified several contaminants of potential concern including aluminum, cyanide, lead, manganese, mercury, DDD, DDE, and DDT. Risks posed by these contaminants to ecological receptors (river otter, belted kingfisher, raccoon, and blue heron) were assessed using contaminant exposure models that estimated contaminant intake resulting from ingestion of food, water, and sediment/ soil and compared these intakes with low-effect toxicity reference values (TRVs).

The contaminant exposure models showed that the low-effect TRVs were not exceeded in the otter model, exceeded by aluminum in EA 7 (Pond 2 and associated canals) in the raccoon model, and exceeded by mercury in EAs 2, 3 (Pond B), 6 (PAR Pond), and 8 (Ponds 4 and 5 and Canal to Pond C) in both the kingfisher and blue heron models. Hazard quotients (total exposure dose divided by the TRV) were 2.8 for aluminum and 1.7-3.6 for mercury. The primary route of exposure for aluminum was the ingestion of soil, and the primary route of exposure for mercury was the ingestion of mercury contaminated fish.

Elevated levels of mercury in fish were at least partly the result of the aerial deposition of mercury onto Lower Three Runs and its watershed. The atmospheric deposition of mercury creates pervasive contamination in fish throughout the Savannah River basin. Another possible source of mercury was the discharge of mercury contaminated Savannah River water into the Lower Three Runs cooling ponds and canals during previous years of reactor operation. This contamination originated from industries located upstream of the SRS.

The aluminum exceedance for the raccoon was likely the result of naturally high aluminum levels in SRS soils rather than SRS operations. Aluminum exceedances have previously been observed in relatively undisturbed background locations as well as areas affected by SRS operations. Aluminum exceedances are more likely with the raccoon than the other receptors because it consumes more soil as a result of its feeding habits.

Sensitivity analysis showed that model uncertainty can be reduced by adequate sampling of key variables (e.g., fish and sediments). Although sediment samples were collected from all EAs, fish samples were not collected from three EAs and some analytes (pesticides and cyanide) were not measured in fish. Water-to-fish concentration ratios were used to estimate contaminant levels in fish when direct measurements from fish were unavailable; however, such estimates are potentially less accurate than direct measurements.

INTRODUCTION

The Department of Energy (DOE) has conducted industrial operations at the Savannah River Site (SRS) near Aiken, South Carolina since the early 1950s resulting in the release of contaminants into some SRS streams. To better understand the effects of these contaminants, the 780 km^2 SRS has been partitioned into Integrator Operable Units (IOUs) that correspond to the SRS tributaries that drain into the Savannah River. IOUs are surface water bodies (e.g., streams, ponds, and lakes) and associated wetlands, including sediment/soil, surface water, and associated biota. They are "integrators" because they have the potential to receive contaminants transported by surface or subsurface flow from all the potential sources (Operable Units) within their watersheds. Animals (i.e., ecological receptors) feeding within stream-based food chains are exposed to these contaminants, and their health can be considered an integrative indicator of the severity of contamination within the stream watershed.

The SRS has six IOUs that are subdivided into IOU subunits that correspond to portions of a stream that may differ in exposure to potential sources of contamination. Lower Three Runs (LTR) is one of the six SRS IOUs. It consists of several subunits including the upper, middle, and lower portions of LTR plus ponds, reservoirs, and canals that were formerly used for reactor cooling. All have had the potential to be affected by contamination associated with past SRS operations except for the portion of LTR located upstream from the cooling ponds. These areas may also be affected by other sources of contamination including historical land uses (e.g., the application of pesticides) and the atmospheric deposition of pollutants.

The SRS has a comprehensive process for assessing the ecological effects of contaminants in the IOUs. The process involves 1) the collection of contaminant data from a variety of environmental media with an emphasis on sediment, fish, and surface water; 2) the use of contaminant exposure models that estimate potential contaminant doses to ecological receptors (EPA 1993); and 3) field bioassessments of the fish and invertebrate assemblages inhabiting SRS streams. The data generated by these studies provide a broad and integrative basis for a weightof-evidence characterization of the extent and severity of contaminant related ecological impacts on SRS aquatic ecosystems. The LTR IOU was evaluated with this process in 2009 (Paller and Dyer 2009); however, this evaluation did not specifically assess ecological risks in each of the cooling ponds and canals formerly used for reactor cooling.

In 2015, the risks to ecological receptors posed by metals were assessed in the LTR cooling ponds and canals plus four reference areas that were largely unaffected by SRS operations (Paller and Blas 2015). This was accomplished with contaminant exposure models that estimated potential doses to the river otter *Lontra canadensis*, belted kingfisher *Ceryle alcyon*, raccoon *Procyon lotor,* and blue heron *Ardea Herodias* from metals ingested in food, water, sediment, and soil within the study area (Paller et al. 2008). The main findings of the 2015 study are listed below:

1) Metals in the LTR cooling ponds were not present at levels sufficient to harm mammals and birds with the exceptions of mercury and aluminum.

2) The primary route of mercury exposure for all receptors was the consumption of contaminated fish, which was at least partly caused by the aerial deposition of mercury from non-SRS sources. A second possible cause was the discharge of mercury contaminated Savannah River used for reactor cooling into the LTR cooling ponds during previous years of reactor operation. This contamination originated from industries located upstream of the SRS.

3) The primary route of aluminum exposure was the incidental consumption of soil, as a likely result of naturally high aluminum levels in soils rather than SRS operations.

The risks posed by contaminants in the cooling ponds and canals in the uppermost portion of LTR were reevaluated in 2017 based on a thorough screening study that identified several new constituents of potential concern (COPCs) within the study area. The 2017 study employed contaminant exposure models like those used in the previous 2015 study except that the models were updated with newer toxicity reference values (TRVs), hereafter termed LANL TRVs (LANL 2015). These low-effect TRVs were compared with the metal doses predicted by the contaminant uptake models to identify contaminants that may pose risks to the river otter, belted kingfisher, blue heron, and raccoon.

MATERIALS AND METHODS

Study Area

Lower Three Runs is a large blackwater creek that drains about 460 km^2 in the southeastern SRS. It is low gradient, generally neutral in pH, and has a sandy bottom covered with woody debris in some places (Paller and Dyer 2004). Its upper reaches were dammed to form PAR Pond, a 1012 ha reservoir formerly used for cooling P and R Reactors. Several additional pre-cooler ponds were constructed in the headwaters above PAR Pond. Pond B, the largest, is about 73 ha (180 acres). Smaller ponds include Pond A, Pond 2, and Ponds 4 and 5. Pond C, a pre-cooling pond for PAR Pond, is separated from PAR Pond by an earthen dam and is about the size of Pond B. These cooling ponds and the canal system that connects them were divided into nine exposure areas (EAs) for computation of potential ecological risks (see SRS 2017a for details) (Figure 1). The EAs are listed in Table 1 and briefly described below:

EA 1 – Pond A and R Discharge Canal;
EA 2 – Canal between Pond A and Pond B; EA 3 – Pond B;
EA 4 – Canal between Pond B and PAR Pond;
EA 5 – Joyce Branch/Old Discharge Canal;
EA 6 – PAR Pond;
EA 7 – Pond 2 and associated canals;
EA 8 – Ponds 4 and 5 and Canal to Pond C; and EA 9 – Pond C.

Environmental Samples and Contaminant Measurements

The contaminant data under analysis included inorganic and organic compounds in wetland soils and sediments, surface water, and fish measured primarily during 2009 and 2010. Sediment and

sediment/soil (floodplain sediments) were evaluated as a single medium and identified as "sediment/soil." Much of the contaminant data were collected by the IOU program, supplemented by medium and high pedigree data from the IOU data base, including data collected by the SRS Environmental Monitoring Program, Savannah River National Laboratory, Savannah River Ecology Laboratory (SREL), and others. The IOU data base is described further in EGIS (2007), Paller et al. (2008), and SRS (2017a).

Contaminant concentrations in biota were usually derived from whole organisms, sediment concentrations from bulk sediment, and water concentrations from unfiltered water. Sediment and surface water were available for all EAs, although not all constituents were measured in all surface water samples, and some constituents were below detection limits (Table 2). Fish data were collected by the IOU program from EA 3 (Pond B), EA 6 (PAR Pond), EA 8 (Pond 4), and EA 9 (Pond C). Additional fish and crayfish (and limited tadpole) data were available from the Savannah River Ecology Laboratory for EA 1 (Pond A and R-Discharge Canal) and EA 7 (Pond 2).

Differences in metal speciation that could affect metal toxicity were not evaluated because supporting environmental information needed to assess metal chemistry was usually unavailable. Constituents were assumed to be present in the most toxic state likely to occur. For example, all mercury in fish was conservatively assumed to be methylmercury because methylmercury rather than inorganic mercury predominates in the bodies of fish and other aquatic organisms.

Mercury concentrations in fish are usually correlated with size, age, and trophic level (higher in predators). The fish collected from the LTR cooling system ponds and canals were typical of the larger species and size ranges occupying these waters. For example, most of the fish collected from the ponds were large specimens of largemouth bass, which likely represented the highest mercury concentrations likely to occur in LTR fish.

Contaminant Exposure Models

Multiple constituents in sediments/soils, water, and fish were screened in each EA using a tiered process described in the LTR Remedial Investigation/Baseline Risk Assessment (RI/BRA) report (SRNS 2017a) to identify contaminants present at concentrations high enough to be of concern. The initial ecological screening process conducted to support the RI/BRA was documented in the scoping summary for the LTR IOU (SRNS, 2017b). The screening consisted of comparing maximum concentrations in sediment/soil and surface water to No Adverse Effect Level (NOAEL) ecological screening values (ESVs) followed by a refined screen against Lowest Observed Adverse Effect Levels. Sediment/soil or surface water constituents that failed the initial and refined screening were evaluated in an uncertainty evaluation that considered mean values, background levels, frequency of detections, and age/quality of the data to determine refined constituent of potential concern (RCOPCs). Ultimately, the screening process identified nine constituents in seven of the nine EAs as RCOPCs for further evaluation using the contaminant exposure models (Table 1). These constituents are the focus of this report.

The contaminant exposure models calculated exposure doses resulting from the ingestion of contaminants in fish, crayfish, water, and sediment/soil. Exposure point concentrations (EPCs)

represented the doses of contaminants in each of these media for each contaminant in each EA (Table 2). The EPCs were calculated from the environmental data by a process described in detail in the LTR RI/BRA report (SRNS 2017a). EPCs were represented by the lesser of the maximum detected concentration and the 95% upper confidence limit (UCL) of the mean concentration. Some EPCs were calculated using concentration ratios, as described later.

The EPCs for each of the four media served as inputs to contaminant exposure models developed for the river otter, belted kingfisher, blue heron, and raccoon. The first three species are representative of the aquatic environments under study, locally common, vulnerable to contaminants because they feed largely on aquatic organisms, and are near the apex of the aquatic food chain. The raccoon is an omnivore that commonly forages in wetland and floodplain habitats. The duration of exposure for all receptors was assumed to be long-term, and the receptors were assumed to spend all of their time in the evaluation areas. Ingestion of food, surface water, and soil were assumed to be the primary exposure pathways. Dermal and inhalation pathways are generally insignificant compared with ingestion pathways and insufficiently understood to properly evaluate.

The diet of the river otter consists largely of fish but includes invertebrates (assumed to be crayfish), amphibians and reptiles (collectively termed herptiles), birds, and mammals. Estimated dietary composition was 65% fish, 15% crayfish, 10% herptiles, 5% birds, and 5% mammals. The belted kingfisher has a more restricted diet consisting of 70% fish, 15% amphibians and reptiles, and 15% crayfish. The blue heron diet was estimated to be 95% fish, 1% crayfish, 3% amphibian, and 1% birds and mammals. The diverse diet of the raccoon includes animal and vegetable matter derived from both aquatic and terrestrial environments. Estimated composition was 43% fruit, 20% grains and nuts, 18% insects, 8% crayfish, 4% herptiles, 3% rodents, 2% molluscs, 1% fish, and 1% birds and mammals. Dietary estimates are derived from EPA (1993).

No assumptions were made regarding the species and size of fish consumed; however, as previously described, the fish were generally among the larger specimens characteristic of the EAs. Metal concentrations in herptiles were unmeasured but assumed to be the same as in fish because both types of organisms are ectothermic and feed mainly on aquatic/riparian invertebrates and small vertebrates. Birds and mammals consumed by the otter, raccoon, and blue heron were assumed to be mainly waterfowl and rodents, which may have different contaminant body burdens than fish because they are homeothermic and may feed outside of aquatic food chains.

The contaminant exposure models required information on the ingestion rates for different food sources, water, and sediment/soil for each receptor. Ingestion of sediment/soil was included because soil or sediment is often ingested inadvertently while feeding or intentionally to meet trace mineral needs (EPA 1993). Ingestion rates were computed on the basis of dietary composition (previously described), gross energy content, assimilation efficiency for each food, and the metabolic rates of the receptors. These computations and associated parameters are shown in detail in Appendices 1-4. The metabolic rates of the receptors were computed on the basis of body weight using allometric models (EPA 1993). Allometric models (EPA 1993) were also used to compute water ingestion rates for each receptor (Appendices 1-4). The soil ingestion rate for the otter was assumed to be 2.8%, which is the soil consumption rate of the red fox (EPA 1993), another

mammalian carnivore of approximately comparable size. The soil consumption rates of the kingfisher and blue heron, species for which soil consumption data for comparable species were lacking, was assumed to be 2%. The soil ingestion rate for the raccoon was 9.4% (EPA 1993). Ingestion rates for all pathways were summed as follows:

$$ED_{total} = \sum_{i}^{n} ED_{food\ i} + ED_{water} + ED_{soil},$$

where:

ED_{total} = total exposure dose from all sources (mg/kg/d)
$ED_{food\ i}$ = exposure dose from ingestion of food
source i ED_{water} = exposure dose from
ingestion of water ED_{soil} = exposure dose from ingestion of soil.

The exposure dose resulting from each pathway was represented as a daily intake normalized to body weight (mg/kg/d) (Appendices 1-4). Total daily exposure (ED_{total}) was subsequently compared with the LANL TRVs (LANL 2015) to identify potentially hazardous constituents (Table 3). A hazard quotient (HQ) was calculated by dividing ED_{total} by the low-effect TRV. The percent contribution of each pathway (each food source, water, and soil) to ED_{total} was also computed.

A TRV for the ingestion of iron by mammals and birds was unavailable. Therefore, this constituent, which exceeded screening levels in EA 7 (Table 1), was not evaluated with the contaminant exposure models.

Concentration ratios

Concentration data needed to calculate EPCs for use in the contaminant exposure models were unavailable for some environmental media. For example, concentrations of DDE, DDD, DDT, aluminum and iron were not measured in fish because these constituents were not associated with reactor operations. Also, constituents were sometimes below detection levels making it impossible to compute EPCs for some media in some EAs. Last, data to calculate EPCs were unavailable for receptor foods that were difficult or impossible to collect (small mammals, birds, fruits, insects). In the absence of EA specific EPCs, concentration ratios (CRs) were used to estimate contaminant levels needed as input for the contaminant exposure models. CRs express the relationship between the concentration of a contaminant in one environmental medium

(e.g., sediment/soil) and the concentration of the same contaminant in another medium (e.g., animal tissue). These relationships made it possible to estimate the contaminant concentration in a medium that was unmeasured (e.g., small mammal tissue) from the contaminant concentration in another medium that was measured (e.g., sediment). Six types of CRs were used: soil/sediment-to- mammal, soil/sediment-to- bird, fish-to-crayfish, water-to-fish, soil/sediment-to-plant reproductive tissue, and soil/sediment-to-invertebrate (Table 4).

Soil-to-mammal CRs were used to compute contaminant concentrations in the tissues (whole body) of small mammals potentially consumed by the ecological receptors. CRs for metals were computed from metal concentrations in cotton rats *Sigmodon hispidus* and soil collected from five sample sites on the PAR Pond lake bed after it had been exposed during an extended drawdown (Paller and Wike 1996). The CRs were computed as follows:

$$CR = C_{animal}/C_{soil\ or\ sediment}$$

where:

CR = the tissue to soil CR for a particular metal
C_{animal} = average metal concentration in animal whole body (wet weight)
$C_{soil\ or\ sediment}$ = average metal concentration in sediment (dry weight).

Average CRs for the metals, computed from the five sites in PAR Pond, were used in the contaminant exposure models (Table 4).

Soil-to-tissue CRs computed from SRS data, as described above, are termed SRS-specific CRs. SRS-specific data were unavailable to compute soil/sediment-to-mammal CRs for cyanide, DDD and DDT. CRs for these contaminants were obtained from "Table 1. Biouptake Factors" shown in the ACP Regulatory Document Handbook (ERD 1999).

With the exception of mercury, the soil/sediment-to- mammal CRs for metals described above were also used for birds. Mercury data collected by SREL from PAR Pond waterfowl were divided by the average mercury levels in PAR Pond sediments (sediment data from the IOU data bases) to compute a bird-specific CR for mercury (Table 4). Soil-to-bird CRs for cyanide and pesticides were taken from ERD (1999) and shown in Table 4).

Water-to-fish CRs were used to estimate contaminant concentrations in fish for EAs that lacked fish data for some or all constituents (Table 4). Water- to-fish CRs for aluminum, cyanide, DDD, DDT, and lead were taken from ERD (1999). Water-to-fish CRs for DDE were computed by averaging the CRs for DDE reported in the "Health Effects Support Document for DDE" (EPA 2008). An SRS-specific water-to-fish CR was calculated for mercury from environmental data in the SGCP data bases.

Fish-to-crayfish CRs were used to compute aluminum, mercury, manganese, and lead levels in crayfish. These CRs were estimated from fish and crayfish data collected in five SRS IOU subunits including lower Fourmile Branch, lower Lower Three Runs, middle Lower Three Runs, lower Pen Branch, and lower Steel Creek (see Paller et al. 2008 for a description of locations). The fish-to-crayfish CRs were calculated as follows:

$CR = C_{crayfish}/C_{fish}$

where:

CR	=	the tissue to tissue concentration ratio for a particular metal
$C_{crayfish}$	=	average metal concentration in crayfish whole body (wet weight)
C_{fish}	=	average metal concentration in fish (whole body wet weight).

CRs were averaged across the five subunits to produce a final CR for each metal (Table 4). Crayfish-to-water and crayfish-to-soil/sediment CRs were also examined but not used because they were more variable than fish-to-crayfish CRs. Fish-to-crayfish CRs were unavailable for organic contaminants necessitating the use of water-to-fish CRs to compute DDD, DDE, and DDT levels in crayfish.

Soil/sediment-to-plant reproductive tissue (i.e., fruits and grains) CRs and soil/sediment-toinvertebrate CRs were used only in the contaminant exposure models for the raccoon to estimate contaminant concentrations in the fruit, grains and nuts, and insects consumed by this organism (Table 4). These CRs were obtained from ERD (1999). Concentrations in the crayfish, herptiles, mammals, and birds consumed by raccoons were estimated as previously described. Concentrations in molluscs consumed by raccoons were assumed to be the same as in fish.

Contaminant Exposure Model Uncertainty

Like similar models, the contaminant exposure models presented herein, are underpinned by various assumptions that contribute to uncertainty in model output. Some can only be evaluated qualitatively, but other sources of uncertainty can be analyzed rigorously using a quantitative sensitivity analysis. Sensitivity analyses based on Monte Carlo simulations were used to evaluate uncertainty in exposure model results resulting from variability in metal concentrations and CRs.

These analyses, which were initially reported in Paller et al. (2008), made use of data from Lower Three Runs and Fourmile Branch (Paller et al. 2008). Both streams have been impacted by reactor operations and industrial processes on the SRS and are representative of locations with relatively high contaminant concentrations that resulted in TRV exceedances (Paller et al. 2008). Representative models were used in the sensitivity analysis to identify environmental media that had the greatest influence on total exposure and examine the impact of the concentration ratios (CRs) on model results.

The sensitivity analysis employed a Monte Carlo simulation approach in which contaminant concentrations and CRs were represented as probability distributions rather than point estimates. The probability distributions for each contaminant described the range of values that the contaminants could take and the likelihood of occurrence of each value within the range. The probability distribution for each contaminant in each medium was based on the distribution of the contaminant data in the IOU subunit under analysis with goodness of fit determined by a chisquare test. In cases where data distributions did not correspond with commonly used probability models (e.g., log-normal, normal, exponential, etc.), the probability model used in the simulation was

modeled after a histogram of the concentration data. Contaminant probability distributions were truncated at the maximum observed concentration to avoid unrealistically high exposure scenarios. Model realism was also maintained by measuring correlations among contaminant concentrations in different media (soil/sediment, water, fish, and crayfish) and constraining the simulation so that values for each variable were selected based on the correlations among variables rather than independently. This precluded unrealistic situations in which, for example, a very high value for one medium (e.g., aluminum levels in crayfish) would be selected in conjunction with a very low value for an associated determinative medium (e.g., aluminum levels in sediment). Model results were expressed as histograms showing the probability of different levels of exposure. Variables that had the greatest influence on model output were identified by calculating regression coefficients (R^2s) describing the strength of the relationships between input variable values and model output values. All Monte Carlo simulations and associated analyses were conducted with @RISK software (Palisade Corp. 2004).

RESULTS AND DISCUSSION

Contaminant Exposure Models

No exposure doses for the potentially problematic contaminants identified by the screening process exceeded the low-effect TRVs for the otter (Table 5). These results differed from those of the 2015 study on the LTR cooling ponds, which showed exceedances for mercury in several EAs (Paller and Blas 2015). The reason for this difference is that the mammalian TRV for methlmercury used in the 2015 study (0.025 mg/kg/day) was substantially lower than the updated TRV for mammals now being used (0.16 mg/kg/day).

The only low-effect TRV exceedance for the raccoon was aluminum in EA 7 (Table 6). Most of the aluminum intake was associated with incidental soil consumption followed by insect consumption. Aluminum exceedances have been observed before in a number of IOU subunits, including reference subunits (Paller et al. 2008). These exceedances are likely related to naturally high aluminum levels in SRS soils rather than to SRS operations.

Low-effect TRV exceedances for mercury occurred in EAs 2, 3, 6, and 8 for both the kingfisher and the blue heron (Tables 7 and 8). Hazard quotients for the kingfisher ranged from 2.9-3.6, and HQs for the blue heron ranged from 1.7-2.1. Hazard quotients were somewhat lower for the blue heron than for the kingfisher because it consumed fish at a lower rate (14% of body weight per day compared with 22% for the kingfisher). Birds exhibited exceedances for mercury and mammals did not because the TRV for birds (0.064 mg/kg/day) was lower than the TRV for mammals (0.16 mg/kg/day).

The principal route of mercury exposure in all EAs was the consumption of fish (Tables 5, 6, 7, and 8). Mercury typically reaches higher levels in fish tissues than in sediment or water as a result of bioaccumulation (Bahnick et al. 1994). Relatively high levels of mercury in fish have been observed in many water bodies on the SRS including reference areas not directly affected by SRS operations. A contributing factor is the atmospheric deposition of mercury from nonSRS sources, which has resulted in relatively high levels of mercury in fish throughout the Savannah River basin

(EPA 2000). However, Savannah River water contaminated with substantial amounts of mercury from industries located upstream of the SRS was formerly pumped through the LTR cooling ponds (Paller and Littrell 2007). SRS water bodies that received reactor cooling water from the Savannah River typically have elevated levels of mercury in biota compared with those that were not used for reactor cooling (Newman and Messier 1994). Thus, elevated mercury levels in the LTR cooling ponds are probably unrelated to ongoing SRS industrial processes but may be associated with the former use of contaminated Savannah River water by the SRS.

It is well known that mercury levels in fish are directly correlated with trophic level and size/age (Bahnick et al. 1994). With the exception of EA 7, most of the fish collected from the LTR EAs were relatively large (up to about 30 cm total length) specimens of largemouth bass *Micropterus salmoides*. These fish were probably among the most contaminated fish in LTR, and mercury levels in them were likely higher than in the smaller and lower trophic level fish that are usually eaten by the blue heron and kingfisher. Therefore, it is possible that the contaminant exposure models overestimated mercury intake for both receptors.

Contaminant Exposure Model Uncertainty

Monte Carlo simulations showed that the distribution of total exposures for mercury ingestion by the otter was positively skewed, with less than half of the total exposure estimates exceeding the TRV for methylmercury (Figure 2). Concentrations of mercury in fish had a much greater influence on the estimates of total exposure (R^2=0.84) than concentrations of mercury in the other environmental media (R^2=<0.01 to 0.18, Table 9) because of relatively high and variable mercury concentrations in fish combined with a high proportion of fish in the diet of the otter. In contrast, concentrations of mercury in water, which were very low, had almost no influence on the total exposure estimates. The CRs used to determine mercury levels in mammals and bird consumed by otters had comparatively small effects on the total exposure estimates (R^2s of 0.06 and 0.18, respectively), with the CR for birds being somewhat more influential because of its greater magnitude (Table 9). These results suggest that moderate errors in CR estimates and in sediment, water, and crayfish methylmercury concentrations resulting from analytical problems, unrepresentative sampling or other factors were unlikely to strongly affect the results of the mercury exposure model. Of greater potential importance were errors in estimating fish mercury concentrations.

Mercury is a constituent for which fish ingestion was a dominant exposure pathway. In contrast, sediment/soil ingestion was an important exposure pathway for aluminum. The distribution of total exposures for aluminum ingestion in the FMB-lower subunit was positively skewed with 60% of the total exposure estimates exceeding the TRV (Figure 2). Concentrations of aluminum in sediment had the greatest influence (R^2=0.69) on the exposure model results because of the relatively high concentrations of aluminum that occurred in the sediment/soil (Table 9), but concentrations of aluminum in crayfish (R^2=0.54) and fish (R^2=0.44) were also important. Concentrations in water and the CR for aluminum uptake by mammals had almost no influence on the model output.

CRs were calculated from data collected on the SRS where possible; however, such data were unavailable for some contaminants necessitating the use of a default CR derived from literature sources. Sensitivity analysis was used to evaluate the use of default CRs by comparing aluminum model results based on the default value of one (ERD 1999) with model results based on a calculated SRS-specific CR of 0.0016. Sixty percent of the exposure estimates for aluminum in the FMB-lower subunit exceeded the LOAEL when a calculated CR was used (Figure 2) compared with 80% when the default CR of one was used in the same model. The default CR also resulted in highly skewed model results almost completely determined by aluminum concentrations in sediment (R^2>0.99, Table 9) as a result of both high concentrations of aluminum in ingested sediment and high calculated uptake of aluminum in mammal and bird prey items resulting from the use of the default CR. These results show that the use of default CRs can strongly influence model output for contaminants in which the default CR differs substantially from the site-specific CR and suggest greater uncertainty concerning exceedances associated with exposure models that employed default CRs.

These sensitivity analyses showed that input variables with high and varying values were usually the most important determinants of exposure model output. Thus, errors in fish mercury levels strongly affected mercury exposure model output because mercury levels were higher in fish than in other media. In contrast, the accuracy of the aluminum exposure model was strongly dependent on representative measurements of aluminum concentrations in sediment because aluminum levels were much higher in sediment than in other media.

The preceding results indicate that adequate sampling of key variables (e.g., fish and sediments) is necessary for model results with high certainty. Sediment sampling was adequate; however, fish samples were not collected from some EAs (Table 2) creating a problem for constituents like mercury that can reach high levels in fish and strongly influence model output. Water-to-fish CRs were used to estimate contaminant levels in fish when fish measurements were unavailable, thereby contributing uncertainty related to the accuracy of the CRs. Water-to-fish CRs could not be used to estimate concentrations in fish when water concentrations were below detection limits. This resulted in an absence of fish data that produced underestimates of total exposure, as was the case for DDD and DDE in EA 8 (Table 2). However, it is unlikely that DDD and DDE were an appreciable concern in EA 8 considering that these constituents were below detection limits in surface waters.

A number of additional factors can contribute to uncertainty in the contaminant exposure model results. These are listed and discussed qualitatively below:

1) *Temporal changes in contaminant concentrations.* The use of data collected in 2009 and 2010 ensures that the exposure model results reported for the LTR cooling ponds are indicative of recent conditions.

2) *Uncertainty in contaminant ingestion rates*. Data are unavailable to fully evaluate the uncertainty associated with this factor. However, information regarding diet, physiology, and behavior used to compute ingestion rates for the otter and belted kingfisher were taken from the Wildlife Exposure Factors Handbook (EPA 1993), which provided specific dietary and

physiological information for each species. Where possible, data for southeastern populations were used to estimate dietary intake to produce more realistic estimates of exposure. The greatest source of this type of uncertainty likely stemmed from the estimates of soil ingestion, which were unavailable for all receptors except the raccoon and, therefore, extrapolated from other species. Uncertainty in this parameter could have affected the aluminum exposure estimates which were strongly influenced by the soil ingestion pathway, but it is unlikely that uncertainty in contaminant ingestion rates strongly affected the results for the other contaminants.

3) *Individual variation in receptor exposure*. Contaminant ingestion rates were computed for average individuals and may not encompass the full range of variation in the diets of the receptors under study. However, the primary goal of ecological risk assessments is protection of the population rather than the individual, which is also the goal of this exposure dose assessment for the SRS IOUs. In addition, the conservatism associated with the use of upper 95% confidence limits (or maxima where data were too sparse to compute upper 95% confidence limits) serves to protect individuals that experience atypical exposure situations or are unusually susceptible.

4) *TRV accuracy*. The accuracy of TRVs can be affected by a number of factors including extrapolating between species and exposure scenarios (acute to chronic) and from laboratory to field conditions. In general, TRVs are computed using appropriate safety factors with the objective of evaluating the potential for long-term effects including impaired reproduction. However, the TRVs were extrapolated from related species because toxicity data were unavailable for the receptors, thus introducing an element of uncertainty that cannot be directly evaluated.

5) *No investigation of dermal and inhalation pathways*. Dermal contact and inhalation pathways were not investigated because the information needed to evaluate these pathways are largely unavailable for wildlife. However, it is unlikely that dermal contact and inhalation contributed substantially to total exposure in most IOU subunits when compared with ingestion.

6) *Assumptions concerning contaminant concentrations in herptiles*. Lack of data describing contaminant concentrations in herptile tissues necessitated the assumption that herptile contaminant burdens were the same as fish contaminant burdens. This assumption is reasonable because fish and herptiles are both ectothermic and because the amphibious herptiles of interest probably consume much the same food as fish.

7) *Use of concentration ratios to estimate contaminant concentrations*. Lack of data describing contaminant levels in some media necessitated the use of CRs to estimate these values. There were three types of uncertainty affecting the CRs: 1) uncertainty associated with the SRSspecific CRs, 2) uncertainty associated with the extrapolation of the mammalian CRs to metal uptake by birds, and 3) uncertainty resulting from the use of default CRs (equaling one) when SRS-specific CRs were unavailable. The uncertainty associated with the extrapolation of mammalian CRs to birds cannot be evaluated with existing data. Uncertainty associated with the other two factors was addressed by the previously described sensitivity analysis.

8) *Interactions among contaminants*. Exposure to multiple contaminants involves the risk of synergistic or antagonistic interactions that can change toxicity. Generally, data are unavailable to permit quantitative adjustments for interactions among chemicals, and the addition of effects is not advocated unless there is strong evidence for a similar mode of action on the same tissues.

9) *Environmental factors affecting toxicity*. Environmental conditions can alter the physical and chemical state of a contaminant with resulting effects on toxicity and bioavailability. For example, mercury occurs in several forms in the environment including methylmercury, which is significantly more toxic than inorganic mercury. All mercury consumed by the receptors was assumed to be methylmercury, and the mercury total exposure dose was compared with a TRV for methylmercury rather than a higher TRV for inorganic mercury. Total exposure doses for other contaminants were likewise compared with TRVs for the more toxic chemical species when appropriate.

10) *Failure to include all relevant contaminants in the assessment*. Most contaminants likely to be associated with SRS operations or other anthropogenic sources were measured in the SRS IOUs, although TRVs were unavailable for some (e.g., iron) resulting in an inability to evaluate their toxicological significance. An absence of toxicity data for a particular metal generally implies that this metal is not particularly hazardous. Therefore, omitting it is unlikely to constitute a major source of error when calculating ecological risk.

11) *Representativeness of the receptors*. The otter, belted kingfisher, and blue heron are relatively common on the SRS and are integral components of aquatic habitats and food chains in the IOU subunits. They rely heavily on aquatic food sources throughout their lives and feed near the top of the food chain making them vulnerable to contaminants that may collect and bioaccumulate within aquatic habitats. The raccoon is a more versatile feeder that often makes use of food sources derived from wetland and stream environments. These species are appropriate ecological receptors for the purposes of this study although it is possible that other ecological receptors on the SRS could be more sensitive to some types of contamination. This source of uncertainty is difficult to evaluate but is unlikely to be a major source of error.

12) *Representativeness of contaminant measurements*. A failure to accurately characterize contaminant concentrations as a result of unrepresentative or insufficient sampling can produce inaccurate exposure model results. Such failures will have especially large effects if they involve variables that strongly influence the exposure model results as discussed more fully in the sensitivity analysis.

CONCLUSIONS

1. Preliminary screening identified several contaminants of concern in the LTR cooling ponds and canals including aluminum, cyanide, DDD, DDE, DDT, iron, lead, manganese, and mercury. Further evaluation of these constituents by contaminant exposure models showed that only mercury and aluminum were present at levels sufficient to be potentially harmful to birds and mammals.

2. The primary route of mercury exposure for all receptors was the consumption of contaminated fish, which was at least partly caused by the aerial deposition of mercury from non-SRS sources. A second possible cause was the discharge of mercury contaminated Savannah River used for reactor cooling into the LTR cooling ponds during previous years of reactor operation. This contamination originated from industries located upstream of the SRS.

3. The primary route of aluminum exposure was the incidental consumption of soil, as a likely result of naturally high aluminum levels in soils rather than SRS operations.

4. Sensitivity analysis showed that model uncertainty is reduced by adequate sampling of key variables (e.g., fish and sediments). Sediment sampling was adequate. Fish samples were not collected from three EAs, and some analytes (pesticides and cyanide) were not measured in fish. Water-to-fish concentration ratios were used to estimate contaminant levels in fish when direct measurements were unavailable; however, such estimates are potentially less accurate than direct measurements.

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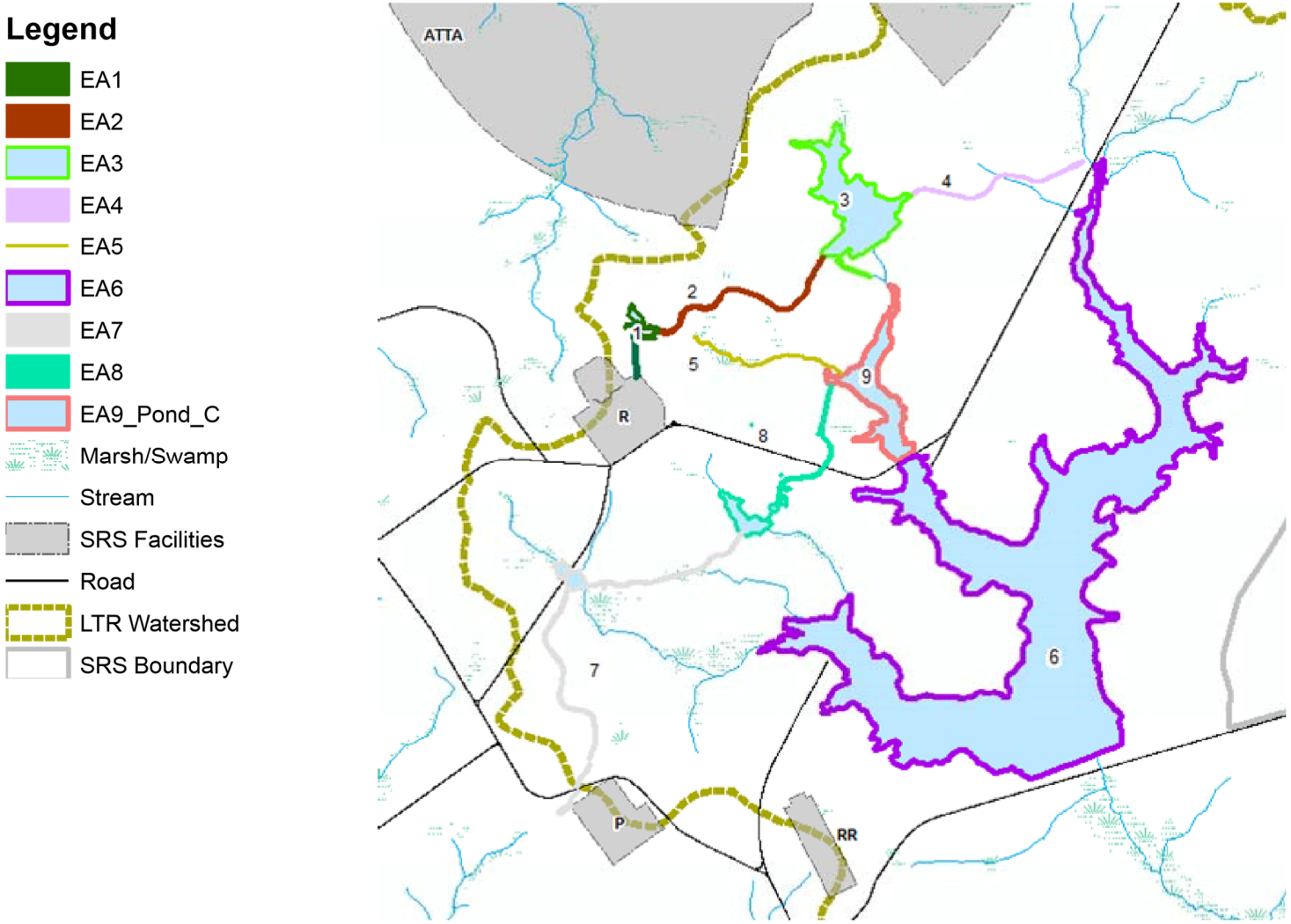


Figure 1. Nine Exposure Areas in the Former Reactor Cooling Ponds and Canals in the Upper Portion of Lower Three Runs

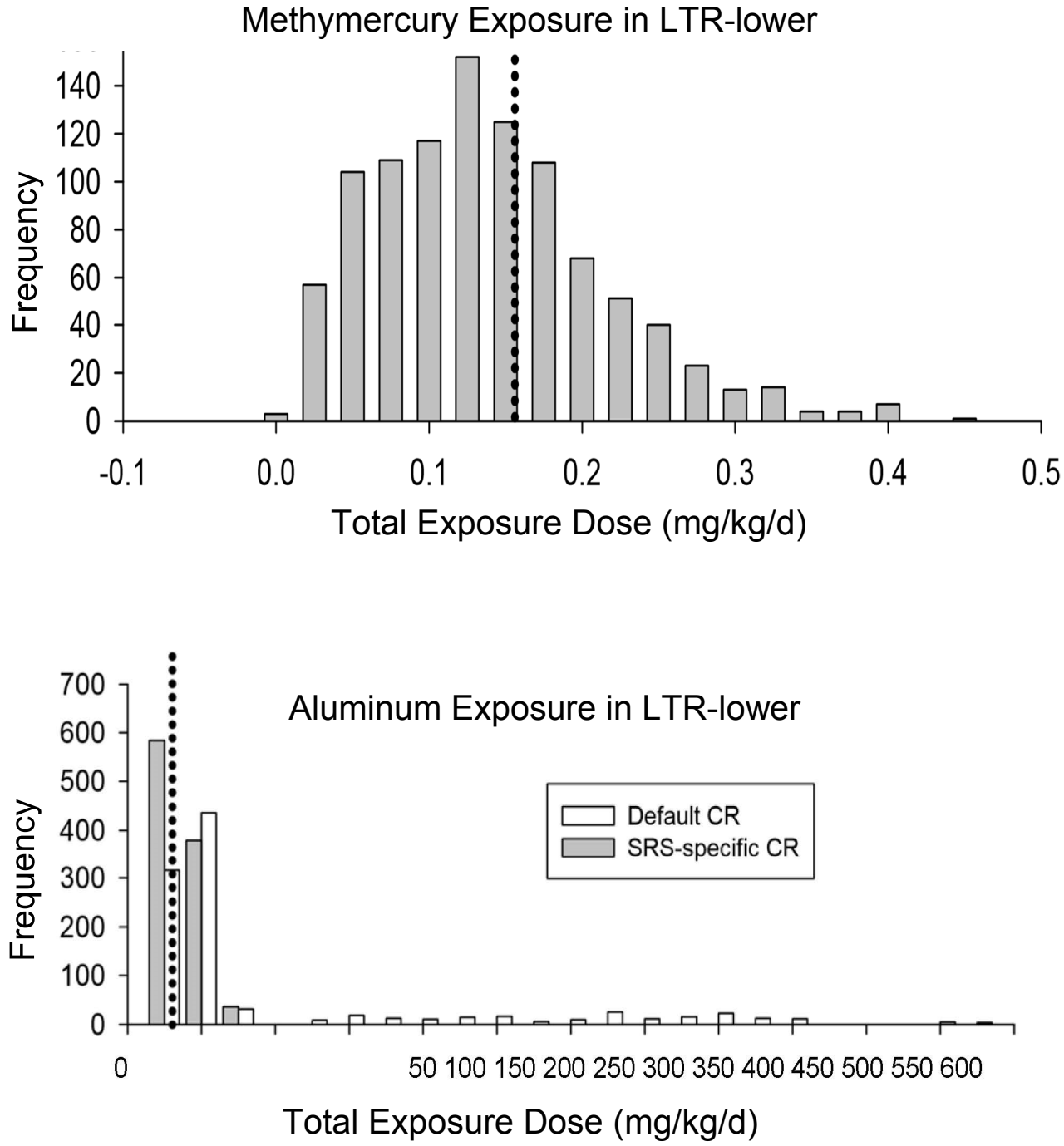


Figure 2. Results of Monte Carlo Simulations for the River Otter Contaminant Exposure Models. Dotted Lines Represent TRVs

Table 1. Contaminants Exceeding Screening Level Exposure Criteria for Each Exposure Area (EA)

EA	Description	Contaminants								
		Aluminum	Cyanide	DDD	DDE	DDT	Iron	Lead	Manganese	Mercury
1	Pond A and R Discharge Canal					X				
2	Canal between Pond A and Pond B									X
3	Pond B									X
4	Canal between Pond B and PAR Pond									
5	Joyce Branch/Old Discharge Canal					X				
6	PAR Pond									X
7	Pond 2 and associated canals	X				X	X		X	X
8	Ponds 4 and 5 and Canal to Pond C		X	X	X	X		X		X
9	Pond C									

Table 2. Exposure point concentrations (EPCs) for the four types of environmental media that served as inputs to the contaminant exposure models. EPCs for fish and crayfish that are followed by a "CR" were calculated from concentration ratios (see text for explanation)

Location	Analyte	Fish *(mg/kg)*	n	Crayfish *(mg/kg)*	n	Sediment *(mg/kg)*	n	Water *(mg/l)*	n
EA 1	DDT	4.658 CR	0	4.658 CR	0	0.003	12	0.00014	6
EA 2	Mercury	0.804 CR	0	0.225 CR	0	0.021	16	0.00045	12
EA 3	Mercury	0.734	81	0.206 CR	0	0.061	7	0.00045	3
EA 5	DDT	2.244 CR	0	2.244 CR	0	0.011	4	0.00007	7
EA 6	Mercury	0.689	227	0.193 CR	0	0.081	371	BDL[b]	0
EA 7	Aluminum	23.640 CR	0	168.918 CR	0	8605.000	36	2.36400	24
EA 7	DDT	0.707 CR	0	0.707 CR	0	0.001	34	0.00002	24
EA 7	Iron	NMC[a]	0	NMC	0	10908.000	36	5.08100	24
EA 7	Manganese	156.000	71a	1114.841 CR	0	109.000	36	1.28000	24
EA 7	Mercury	0.228	71a	0.064 CR	0	0.297	76	0.00007	24
EA 8	Cyanide	0 CR	0	0 CR	0	2.331	4	0.00185	4
EA 8	DDD	NMC	0	NMC	0	0.370	18	BDL	0
EA 8	DDE	NMC	0	NMC	0	0.262	18	BDL	0
EA 8	DDT	0.483 CR	0	0.483 CR	0	0.224	18	0.00001	9
EA 8	Lead	0.522 CR	0	1.821 CR	0	10.530	65	0.00174	9
EA 8	Mercury	0.854	1b	0.240 CR	0	0.367	65	BDL	0

[a]NMC – not measured or calculated from a concentration ratio.
[b]BDL – below detection limits or not measured.

Table 3. Low-effect Toxicity reference values (TRVs taken from LANL 2015) used for mammals and birds in the contaminant exposure models

Analyte	TRV mammals	TRV birds	TRV units
Aluminum	19.3	1100	mg/kg/day
Cyanide	687	0.4	mg/kg/day
DDD	11.7	0.083	mg/kg/day
DDE	22.7	2.4	mg/kg/day
DDT	0.694	5.96	mg/kg/day
Mercury	0.16	0.064	mg/kg/day
Lead	8.9	3.26	mg/kg/day
Manganese	515	1790	mg/kg/day
Nickel	3.4	67.1	mg/kg/day

Table 4. Concentration ratios and source references (Refs) used to estimate exposure point concentrations for receptor foods when direct measurements were unavailable. For example, the concentration of aluminum in crayfish was estimated by multiplying the concentration of aluminum in fish by 7.145.

	Water-to-Fish		Soil/Sediment-to-Mammal		Soil/Sediment-to-Bird		Fish-to-Crayfish		Soil/Sediment-to-Plant Reproductive Tissue		Soil/Sediment-to-Invertebrate	
Constituent	**CR**	**Ref**	**CR**	**Ref**	**CR**	**Ref**	**CR**	**Ref**	**CR**	**Ref**	**CR**	**Ref**
Aluminum	10	a	0.0016	d	0.0016	d	7.145	c	0.0001	a	0.0750	a
Cyanide	0	a	1	a	1	a			1.0000	a	0.0000	a
DDD	0	a	1	a	1	a			0.0013	a	3.3000	a
DDE	161764	b	1	a	1	a			0.0020	a	1.7000	a
DDT	34000	a	1	a	1	a			0.0008	a	0.5700	a
Lead	300	a	0.2535	d	0.2535	d	3.489	c	0.0018	a	0.3270	a
Manganese			0.0144	d	0.0144	d	7.146	c	0.0100	a	0.0200	a
Mercury	1790	c	0.1243	d	0.3630	d	0.281	c	0.0400	a	0.3400	a

a ERD-AG-003
b EPA (2008)
c Computed from unpublished SRS data (IOU data base)
d Paller and Wike (1996)

Table 5. Contaminant exposure model results for the otter. Abbreviations are as follows: TRV= low-effect toxicity reference value (mg/kg/day), EXP =total exposure dose (mg/kg/day), HQ= hazard quotient (EXP/TRV), FIR=fish ingestion rate, IIR=crayfish ingestion rate, HIR=herptile ingestion rate, MIR=mammal ingestion rate, BIR=bird ingestion rate, SIR=soil ingestion rate, and WIR=water ingestion rate. Ingestion rates are expressed as a percentage of EXP

Location	Analyte	TRV	EXP	>TRV	HQ	FIR	IIR	HIR	MIR	BIR	SIR	WIR
EA 1	DDT	0.694	0.68	No	0.99	72.2	16.7	11.1	0.0	0.0	0.0	0.0
EA 2	Mercury	0.16	0.104	No	0.65	82.0	5.3	12.6	0.0	0.1	0.0	0.0
EA 3	Mercury	0.16	0.10	No	0.59	81.9	5.3	12.6	0.1	0.2	0.0	0.0
EA 5	DDT	0.694	0.33	No	0.48	72.2	16.7	11.1	0.0	0.0	0.0	0.0
EA 6	Mercury	0.16	0.09	No	0.56	81.8	5.3	12.6	0.1	0.3	0.0	0.0
EA 7	Aluminum	19.3	17.87	No	0.93	14.0	23.2	2.2	0.6	0.6	58.3	1.1
EA 7	DDT	0.694	0.10	No	0.15	72.2	16.7	11.1	0.0	0.0	0.0	0.0
EA 7	Manganese	515	46.66	No	0.09	35.5	58.5	5.4	0.0	0.0	0.3	0.2
EA 7	Mercury	0.16	0.03	No	0.19	78.9	5.1	12.1	1.0	2.9	0.1	0.0
EA 8	Cyanide	687	0.04	No	0.00	0.0	0.0	0.0	46.4	46.4	6.9	0.4
EA 8	DDD	11.7	0.001	No	0.00	0.0	0.0	0.0	46.5	46.5	6.9	0.0
EA 8	DDE	22.7	0.01	No	0.00	0.0	0.0	0.0	46.5	46.5	6.9	0.0
EA 8	DDT	0.694	0.08	No	0.11	68.7	15.9	10.5	2.4	2.4	0.0	0.0
EA 8	Lead	8.9	0.17	No	0.02	33.6	27.1	5.2	13.2	13.2	7.7	0.1
EA 8	Mercury	0.16	0.11	No	0.70	81.0	5.2	12.4	0.3	1.0	0.0	0.0

Table 6. Contaminant exposure model results for the raccoon. Abbreviations are as follows: TRV= low effect toxicity reference value (mg/kg/day), EXP =total exposure dose (mg/kg/day), HQ= hazard quotient (EXP/TRV), CIR=crayfish ingestion rate, FRIR=fruit ingestion rate, FSIR=fish ingestion rate, GIR=grain ingestion rate, HIR=herptile ingestion rate, NIR=insect ingestion rate, LIR=molluSC ingestion rate, MIR=mammal ingestion rate, BIR=bird ingestion rate, SIR=soil ingestion rate, and WIR=water ingestion rate. Ingestion rates are expressed as a percentage of EXP.

Location	Analyte	TRV	EXP	>TRV	HQ	CIR	FRIR	FSIR	GIR	HIR	NIR	LIR	MIR	BIR	SIR	WIR
EA 1	DDT	0.694	0.361	No	0.5	92.6	0.0	1.8	0.0	1.8	0.0	3.8	0.0	0.0	0.0	0.0
EA 2	Mercury	0.16	0.005	No	0.0	0.0	0.9	22.1	0.4	22.1	3.0	46.9	1.4	0.7	1.8	0.7
EA 3	Mercury	0.16	0.029	No	0.2	81.4	0.4	3.5	0.2	3.5	1.5	7.4	0.7	0.4	0.9	0.1
EA 5	DDT	0.694	0.275	No	0.4	95.3	0.0	1.1	0.0	1.1	0.0	2.4	0.0	0.0	0.0	0.0
EA 6	Mercury	0.16	0.034	No	0.2	83.6	0.5	2.8	0.2	2.8	1.7	6.0	0.8	0.4	1.1	0.0
EA 7	Aluminum	19.3	53.149	Yes	2.8	3.2	0.1	0.1	0.0	0.1	25.6	0.1	0.1	0.0	70.3	0.4
EA 7	DDT	0.694	0.010	No	0.0	60.5	0.0	9.5	0.0	9.5	0.1	20.3	0.0	0.0	0.0	0.0
EA 7	Manganese	515	12.787	No	0.0	87.5	0.4	1.7	0.2	1.7	0.4	3.6	0.0	0.0	3.7	0.8
EA 7	Mercury	0.16	0.008	No	0.0	25.4	7.6	4.0	3.5	4.0	27.1	8.5	2.3	1.2	16.4	0.1
EA 8	Cyanide	687	0.209	No	0.0	0.0	56.3	0.0	25.8	0.0	0.0	0.0	8.5	4.5	4.8	0.1
EA 8	DDD	11.7	0.028	No	0.0	0.0	0.1	0.0	0.0	0.0	91.7	0.0	1.6	0.8	5.7	0.0
EA 8	DDE	22.7	0.011	No	0.0	0.0	0.2	0.0	0.1	0.0	86.1	0.0	2.1	1.1	10.4	0.0
EA 8	DDT	0.694	0.008	No	0.0	16.9	0.1	8.3	0.0	8.3	33.5	17.6	2.0	1.1	12.1	0.0
EA 8	Lead	8.9	0.151	No	0.0	12.1	0.6	0.5	0.3	0.5	45.7	1.0	5.8	3.1	30.3	0.1
EA 8	Mercury	0.16	0.139	No	0.9	91.5	0.5	0.8	0.2	0.8	1.9	1.8	0.8	0.4	1.1	0.0

Table 7. Contaminant exposure model results for the kingfisher. Abbreviations are as follows: TRV= low-effect toxicity reference value (mg/kg/day), EXP =total exposure dose (mg/kg/day), HQ= hazard quotient (EXP/TRV), FIR=fish ingestion rate, IIR=crayfish ingestion rate, HIR=herptile ingestion rate, SIR=soil ingestion rate, and WIR=water ingestion rate. Ingestion rates are expressed as a percentage of EXP.

Location	Analyte	TRV	EXP	>TRV	HQ	FIR	IIR	HIR	SIR	WIR
EA 1	DDT	5.96	1.439	No	0.2	70.0	15.0	15.0	0.0	0.0
EA 2	Mercury	0.064	0.218	Yes	3.4	79.9	3.0	17.1	0.0	0.0
EA 3	Mercury	0.064	0.198	Yes	3.1	80.1	2.7	17.1	0.0	0.0
EA 5	DDT	5.96	0.693	No	0.1	70.0	15.0	15.0	0.0	0.0
EA 6	Mercury	0.064	0.186	Yes	2.9	80.3	2.6	17.2	0.0	0.0
EA 7	Aluminum	1100	26.051	No	0.0	19.6	30.0	4.2	44.9	1.2
EA 7	DDT	5.96	0.218	No	0.0	70.0	15.0	15.0	0.0	0.0
EA 7	Manganese	1790	92.857	No	0.1	36.3	55.5	7.8	0.2	0.2
EA 7	Mercury	0.064	0.060	No	0.9	81.6	0.9	17.5	0.0	0.0
EA 8	Cyanide	0.4	0.003	No	0.0	0.0	0.0	0.0	92.6	7.4
EA 8	DDD	0.083	0.001	No	0.0	0.0	0.0	0.0	100.0	0.0
EA 8	DDE	2.4	0.000	No	0.0	0.0	0.0	0.0	100.0	0.0
EA 8	DDT	5.96	0.149	No	0.0	70.0	15.0	15.0	0.0	0.0
EA 8	Lead	3.26	0.236	No	0.1	47.9	35.7	10.2	6.1	0.1
EA 8	Mercury	0.064	0.232	Yes	3.6	79.8	3.2	17.1	0.0	0.0

Table 8. Contaminant exposure model results for the blue heron. Abbreviations are as follows: TRV= low-effect toxicity reference value (mg/kg/day), EXP =total exposure dose (mg/kg/day), HQ= hazard quotient (EXP/TRV), FIR=fish ingestion rate, IIR=crayfish ingestion rate, HIR=herptile ingestion rate, MIR=mammal ingestion rate, BIR=bird ingestion rate, SIR=soil ingestion rate, and WIR=water ingestion rate. Ingestion rates are expressed as a percentage of EXP

Location	Analyte	TRV	EXP	>TRV	HQ	FIR	IIR	HIR	MIR	BIR	SIR	WIR
EA 1	DDT	5.96	0.698	No	0.1	96.0	1.0	3.0	0.0	0.0	0.0	0.0
EA 2	Mercury	0.064	0.128	Yes	2.0	90.3	6.8	2.9	0.0	0.0	0.0	0.0
EA 3	Mercury	0.064	0.117	Yes	1.8	90.3	6.8	2.9	0.0	0.0	0.0	0.0
EA 5	DDT	5.96	0.336	No	0.1	96.0	1.0	3.0	0.0	0.0	0.0	0.0
EA 4 ???												
EA 6	Mercury	0.064	0.110	Yes	1.7	90.3	6.8	2.9	0.0	0.0	0.1	0.0
EA 7	Aluminum	1100	10.414	No	0.0	32.6	2.5	1.0	0.1	0.1	62.7	1.0
EA 7	DDT	5.96	0.106	No	0.0	96.0	1.0	3.0	0.0	0.0	0.0	0.0
EA 7	Manganese	1790	24.958	No	0.0	89.8	6.8	2.8	0.0	0.0	0.3	0.2
EA 7	Mercury	0.064	0.036	No	0.6	89.8	6.8	2.8	0.0	0.0	0.6	0.0
EA 8	Cyanide	0.4	0.010	No	0.0	0.0	0.0	0.0	40.8	40.8	17.6	0.8
EA 8	DDD	0.083	0.000	No	0.0	0.0	0.0	0.0	21.2	21.2	57.5	0.0
EA 8	DDE	2.4	0.000	No	0.0	0.0	0.0	0.0	17.2	17.2	65.7	0.0
EA 8	DDT	5.96	0.073	No	0.0	95.6	1.0	3.0	0.1	0.1	0.2	0.0
EA 8	Lead	3.26	0.092	No	0.0	81.3	3.0	2.6	2.2	2.2	8.7	0.1
EA 8	Mercury	0.064	0.136	Yes	2.1	90.2	6.8	2.8	0.0	0.0	0.2	0.0

Table 9. Sensitivity analysis of selected river otter exposure models for data collected from the lower Lower Three Runs (LTR) and lower Fourmile Branch (FMB) Integrator Operable Unit (IOU) subunits. Values in the table are regression coefficients (R^2s) that represent the strength of the relationship between input distributions representing different sources of contaminant ingestion and model output.

Input Distribution	Mercury exposure in LTR Lower IOU subunit (SRS-specific CR)[a]	Aluminum exposure in FMB Lower IOU subunit (SRS-specific CR)[a]	Aluminum exposure in FMB Lower IOU subunit (default CR of 1)
Fish	0.84	0.44	0.05
Crayfish	0.02	0.54	0.06
Sediment	0.18	0.69	>0.99
Water	<0.01	<0.01	<0.01
CR mammal	0.06	<0.01	<0.01
CR bird	0.18	NA[b]	NA[b]

[a] SRS-specific soil to animal concentration ratios (CRs) were calculated from data collected on the SRS (Paller and Wike 1996). A default CR of 1 (ERD 1999) was used for metals that lacked data to calculate SRS-specific CRs.

[b] Data were available to compute a CR for birds only in the case of mercury. Mammal CRs were used to represent birds for Al and other metals (see text for more explanation).

Appendix 1 – River Otter Contaminant Exposure Model

A. Computations for Food Ingestion Rates (modified from USEPA 1993)

Food Source*	Proportion (P) in diet (wet weight)*	Gross Energy Content (GE) (kcal/g wet)*	Assimilation Efficiency (EA) (unitless)*	Metabolizable Energy (ME=GExAE) (kcal/g wet)	ME Weighted by P (PxME) (kcal/g wet)	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Ingestion Rate Symbol
Fish	0.65	1.2	0.91	1.09	0.71	0.788	FIR
Invertebrates	0.15	1.0	0.87	0.87	0.13	0.182	CIR
Herptiles	0.10	1.3	0.84	1.09	0.11	0.121	HIR
Birds	0.05	2.0	0.84	1.68	0.08	0.061	BIR
Mammals	0.05	1.7	0.84	1.43	0.07	0.061	MIR

TIR (g/day) = total ingestion rate = BW** x NFMR*** / WAME) = 1212.11
WAME = weighted average metabolizable energy = (Sum PxME for all prey / Sum P) = 1.105

* Otter food source P, GE, and AE values taken from USEPA 1993
** BW (g) = average adult body (BW) for otters in GA and AL (USEPA 1993) = 7430
***NFMR (kcal/g/day) = normalized field metabolic rate = 0.6167 BW^0.862 (g) / BW (USEPA 1993, equation 3-47) = 0.1803

B. Computations for Sediment/Soil Ingestion Rate (estimated as percentage of dry weight food intake following USEPA 1993)

Food Source*	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Percent Moisture	IR (kg/d-dry)
Fish	0.788	75.0	0.197
Invertebrates	0.182	75.5	0.045
Herptiles	0.121	71.3	0.035

Total dry weight food ingestion rate (kg/d) = 0.315
% soil in diet (dry weight assuming red fox) (USEPA 1993) = 2.8
SIR = soil ingestion rate (kg dry/d) = 0.0088

Food Source*	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Percent Moisture	IR (kg/d-dry)
Birds	0.061	68.0	0.019
Mammals	0.061	68.0	0.019

C. Computations for Water Ingestion

WIR (L/d) = water ingestion rate = 0.099 BW^0.90 (kg) (USEPA 1993, equation 3-17) =0.60

D. Contaminant Exposure Computations

Exposure Source	Contaminant exposure *(mg/kg/d)*
Fish (FE)	FE = fish concentration (mg/kg) x FIR (kg/day) / BW (kg)
Invertebrates (IE)	IE = crayfish concentration (mg/kg) x IIR (kg/day) / BW (kg)*
Herptiles (HE)	HE = fish concentration (mg/kg) x HIR (kg/day) / BW (kg)**
Birds (BE)	BE = sediment concentration (mg/kg) x TF (soil to tissue) x BIR (kg/day) / BW (kg)***
Mammals (ME)	ME = sediment concentration (mg/kg) x TF (soil to tissue) x MIR (kg/day) / BW (kg)***
Sediment/soil (SE)	SE = sediment concentration (mg/kg) x SIR (kg/day) / BW (kg)****
Water (WE)	WE = water concentration (mg/kg) x WIR (kg/day) / BW (kg)*****
Total Exposure (TE)	TE = FE + IE + HE + BE + ME + SE + WE

* All invertebrates assumed to be crayfish
** Herptile concentration assumed same as fish concentrations because frogs, snakes, baby alligators, turtles, and salamanders potentially consumed by otters resemble fish in being ectothermic and feeding in the aquatic food chain. Actual herptile concentrations were unavailable.
*** Birds and mammals consumed by otters are assumed to be primarily water fowl and rodents. These organisms may be largely herbivorous, are homeothermic, and may not feed entirely within the aquatic food chain. Therefore, unlike herptiles, their body burdens may differ from fish. Levels in these food sources are computed from sediment levels (either average or maximum) using a tissue to soil concentration ratio computed from the data in Paller and Wike (1996) or from default TF values given in ERD-AG---3
**** For MeHG computations, sediment MeHg concentrations are assumed to be 5% of the total Hg concentration (USEPA 1997, Vol. III, Table 3-10).
***** For MeHg computations, water MeHg concentrations are assumed to be 7.6% of the total Hg concentration (SRS Mercury report: Bowers et al. 2003)

Appendix 2 – Belted Kingfisher Contaminant Exposure Model

A. Computations for Food Ingestion Rates (modified from USEPA 1993)

Food Source*	Proportion (P) in diet (wet weight)*	Gross Energy Content (GE) (kcal/g wet)*	Assimilation Efficiency (EA) (unitless)*	Metabolizable Energy (ME=GExAE) (kcal/g wet)	ME Weighted by P (PxME) (kcal/g wet)	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Ingestion Rate Symbol
Fish	0.7	1.2	0.91	1.00	0.76	0.0318	FIR
Invertebrates	0.15	1.0	0.87	0.87	0.13	0.0068	CIR
Herptiles	0.15	1.3	0.84	1.09	0.16	0.0068	HIR

WAME = weighted average metabolizable energy = (Sum PxME for all prey / Sum P) = 1.059
TIR (g/day) = total ingestion rate = BW** x NFMR*** / WAME) = 45.47

* Kingfisher food source P, GE, and AE values taken from USEPA 1993
** BW (g) = average adult body (BW) (USEPA 1993) = 147
***NFMR (kcal/g/day) = kingfisher normalized field metabolic rate = 1.146 BW^0.749 (g) / BW (USEPA 1993, equation 3-37) = 0.3275

B. Computations for Sediment/Soil Ingestion Rate (estimated as percentage of dry weight food intake following USEPA 1993)

Food Source*	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Percent Moisture	IR (kg/d-dry)
Fish	0.032	75.0	0.008
Invertebrates	0.007	75.5	0.002
Herptiles	0.007	71.3	0.002

Total dry weight food ingestion rate (kg/d) = 0.012
Estimated % soil in diet = 2% (no similar spp in (USEPA 1993) = 2
SIR = soil ingestion rate (kg dry/d) = 0.0002

C. Computations for Water Ingestion

WIR (L/d) = water ingestion rate = 0.059 BW^0.67 (kg) (USEPA 1993, equation 3-15) =0.02

D. Contaminant Exposure Computations

Exposure Source	Contaminant exposure *(mg/kg/d)*
Fish (FE)	FE = fish concentration (mg/kg) x FIR (kg/day) / BW (kg)
Invertebrates (IE)	IE = crayfish concentration (mg/kg) x IIR (kg/day) / BW (kg)*
Herptiles (HE)	HE = fish concentration (mg/kg) x HIR (kg/day) / BW (kg)**
Sediment/soil (SE)	SE = sediment concentration (mg/kg) x SIR (kg/day) / BW (kg)***
Water (WE)	WE = water concentration (mg/kg) x WIR (kg/day) / BW (kg)****
Total Exposure (TE)	TE = FE + IE + HE + BE + ME + SE + WE

* All invertebrates assumed to be crayfish
** Herptile concentration assumed same as fish concentrations because frogs, snakes, baby alligators, turtles, and salamanders potentially consumed by otters resemble fish in being ectothermic and feeding in the aquatic food chain. Actual herptile concentrations were unavailable.
*** For MeHG computations, sediment MeHg concentrations are assumed to be 5% of the total Hg concentration (USEPA 1997, Vol. III, Table 3-10).
**** For MeHg computations, water MeHg concentrations are assumed to be 7.6% of the total Hg concentration (SRS Mercury report: Bowers et al. 2003)

Appendix 3 – Raccoon Contaminant Exposure Model

A. Computations for Food Ingestion Rates (modified from USEPA 1993)

Food Source*	Proportion (P) in diet (wet weight)*	Gross Energy Content (GE) (kcal/g wet)*	Assimilation Efficiency (EA) (unitless)*	Metabolizable Energy (ME=GExAE) (kcal/g wet)	ME Weighted by P (PxME) (kcal/g wet)	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Ingestion Rate Symbol
Crayfish	0.08	1.0	0.87	0.87	0.07	0.058	CIR
Fruit	0.43	1.1	0.76	0.84	0.36	0.292	RIR
Fish	0.01	1.2	0.91	1.09	0.01	0.008	FIR
Grain/nut	0.20	4.6	0.85	3.91	0.76	0.134	GIR
Herptiles	0.04	1.3	0.84	1.09	0.04	0.027	HIR
Insects	0.18	1.6	0.87	1.39	0.25	0.122	NIT
Molluscs	0.02	0.8	0.87	0.70	0.02	0.017	LIR
Mammals	0.03	1.7	0.84	1.43	0.04	0.019	MIR
Birds	0.01	1.9	0.84	1.60	0.02	0.010	BIR

TIR (g/day) = total ingestion rate = BW** x NFMR*** / WAME) = 685.37
WAME = weighted average metabolizable energy = (Sum PxME for all prey / Sum P) = 1.574

* Raccoon food source P, GE, and AE values taken from USEPA 1993
** BW (g) = average adult body (BW) for raccoons in Il, Ms, and AL (USEPA 1993) = 5782
***NFMR (kcal/g/day) = normalized field metabolic rate = 0.6167 BW^0.862 (g) / BW (USEPA 1993, equation 3-47) = 0.1866

B. Computations for Sediment/Soil Ingestion Rate (estimated as percentage of dry weight food intake following USEPA 1993)

Food Source*	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Percent Moisture*	IR (kg/d-dry)
Crayfish	0.058	74.0	0.015
Fruit	0.292	77.0	0.167
Fish	0.008	75.0	0.002
Grain/nut	0.134	9.3	0.121
Herptiles	0.027	75.5	0.007
Insects	0.122	65.0	0.043
Molluscs	0.017	82.0	0.003
Mammals	0.019	68.0	0.006
Birds	0.010	68.0	0.003

Total dry weight food ingestion rate (kg/d) = 0.267
% soil in diet (USEPA 1993) = 9.4
SIR = soil ingestion rate (kg dry/d) = 0.0251

C. Computations for Water Ingestion Rate

WIR (L/d) = water ingestion rate = 0.099 BW^0.90 (kg) (USEPA 1993, equation 3-17) =0.48

D. Contaminant Exposure Computations

Exposure Source	Contaminant Exposure *(mg/kg/d)*	
Crayfish (CE)	CE = crayfish concentration (mg/kg) x CIR (kg/day)/ BW (kg)	CIR
Fruit (RE)	RE = sediment concentration (mg/kg) x TF(soil to tissue) x RIR (kg/day) / BW (kg)[1]	FRIR
Fish (FE)	FE = fish concentration (mg/kg) x FIR (kg/day) / BW (kg)	FSIR

Appendix 3 – Raccoon Contaminant Exposure Model *(Continued/End)*

Exposure Source	Contaminant Exposure *(mg/kg/d)*	
Grain/nut (GE)	GE = sediment concentration (mg/kg) x TF (soil to tissue) x GIR (kg.day) / BW (kg)[1]	GIR
Herptiles (HE)	HE = fish concentration (mg/kg) x HIR (kg.day) / BW (kg)[2]	HIR
Insects (NE)	NE = sediment concentration (mg/kg) x TF (soil to tissue) x NIR (kg.day) / BW (kg)[3]	NIR
Molluscs (LE)	LE = fish concentration (mg/kg) x LIR (kg.day) / BW (kg)[4]	LIR
Mammals (ME)	ME = sediment concentration (mg/kg) x TF (soil to tissue) x MIR (kg.day) / BW (kg)[5]	MIR
Birds (BE)	BE = sediment concentration (mg/kg) x TF (soil to tissue) x BIR (kg.day) / BW (kg)[5]	BIR
Sediment/soil (SE)	SE = sediment concentration (mg/kg) x SIR (kg/day) / BW (kg)[6]	SIR
Water (WE)	WE = water concentration (mg/kg) x WIR (kg/day) / BW (kg)[7]	WIR
Total Exposure (TE)	TE = CE + RE+ FE + GE + HE + NE + LE + ME + BE + SE + WE	EXP

1. Soil to plant reproductive tissue transfer factors (TF) from ERD (1999).
2. Herptile concentration assumed same as fish concentrations because frogs, snakes, salamanders, etc. potentially consumed by raccoons resemble fish in being ectothermic and feeding (usually) in the aquatic food chain. Actual herptile concentrations were unavailable.
3. Soil to invertebrate transfer factors (TF) from ERD (1999).
4. Concentrations in molluscs assumed to be the same as in fish
5. Concentrations in birds and mammals (primarily rodents) were computed from sediment levels (either average or maximum) using a tissue to soil concentration ratio computed from the data in Paller and Wike (1996) or from default TF values given in ERD-AG---3
6. For MeHG computations, sediment MeHg concentrations are assumed to be 5% of the total Hg concentration (USEPA 1997, Vol. III, Table 3-10).
7. For MeHg computations, water MeHg concentrations are assumed to be 7.6% of the total Hg concentration (SRS Mercury report: Bowers et al. 2003)

Appendix 4 – Blue Heron Contaminant Exposure Model

A. Computations for Food Ingestion Rates (modified from USEPA 1993)

Food Source*	Proportion (P) in diet (wet weight)*	Gross Energy Content (GE) (kcal/g wet)*	Assimilation Efficiency (EA) (unitless)*	Metabolizable Energy (ME=GExAE) (kcal/g wet)	ME Weighted by P (PxME) (kcal/g wet)	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Ingestion Rate Symbol
Fish	0.950	1.2	0.91	1.09	1.04	0.320	FIR
Crayfish	0.010	1	0.87	0.87	0.01	0.003	CIR
Herptiles	0.030	1.3	0.84	1.09	0.03	0.010	HIR
Birds	0.005	1.4	0.84	1.43	0.01	0.002	BIR
Mammals	0.005	1.9	0.84	1.60	0.01	0.002	MIR

WAME = weighted average metabolizable energy = (Sum PxME for all prey / Sum P) = 1.094
TIR (g/day) = total ingestion rate = BW** x NFMR*** / WAME) = 337.22

* Blue heron food source P, GE, and AE values taken from USEPA 1993
** BW (g) = average adult body (BW) (USEPA 1993) = 2229
***NFMR (kcal/g/day) = Blue Heron normalized field metabolic rate = 1.146 BW^0.749 (g) / BW (USEPA 1993, equation 3-37) = 0.1655

B. Computations for Sediment/Soil Ingestion Rate (estimated as percentage of dry weight food intake following USEPA 1993)

Food Source*	Ingestion Rate (IR = TIRxP/1000) (kg wet/day)	Percent Moisture*	IR (kg/d-dry)
Fish	0.3204	75.0	0.080
Crayfish	0.0034	74.0	0.001
Herptiles	0.0101	75.5	0.002
Birds	0.0017	68.0	0.001
Mammals	0.0017	68.0	0.001

Total dry weight food ingestion rate (kg/d) = 0.085
Estimated % soil in diet = 2% (no similar spp in USEPA 1993) = 2
SIR = soil ingestion rate (kg dry/d) = 0.0071

C. Computations for Water Ingestion Rate

WIR (L/d) = water ingestion rate = 0.059 BW^0.67 (kg) (USEPA 1993, equation 3-15) =0.10

D. Contaminant Exposure Computations

Exposure Source	Contaminant Exposure *(mg/kg/d)*
Fish (FE)	FE = fish concentration (mg/kg) x FIR (kg/day) / BW (kg)
Crayfish (CE)	CE = crayfish concentration (mg/kg) x CIR (kg/day)/ BW (kg)
Herptiles (HE)	HE = fish concentration (mg/kg) x HIR (kg.day) / BW (kg)[1]
Birds (BE)	BE = sediment concentration (mg/kg) x TF (soil to tissue) x BIR (kg.day) / BW (kg)[2]
Mammals (ME)	ME = sediment concentration (mg/kg) x TF (soil to tissue) x MIR (kg.day) / BW (kg)[2]
Sediment/soil (SE)	SE = sediment concentration (mg/kg) x SIR (kg/day) / BW (kg)[3]
Water (WE)	WE = water concentration (mg/kg) x WIR (kg/day) / BW (kg)[4]
Total Exposure (TE)	TE = FE + IE + HE + SE + WE

1. Herptile concentration assumed same as fish concentrations because frogs, snakes, salamanders, etc. potentially consumed by raccoons resemble fish in being ectothermic and feeding (usually) in the aquatic food chain. Actual herptile concentrations were unavailable.
2. Concentrations in birds and mammals (primarily rodents) were computed from sediment levels (either average or maximum) using a tissue to soil concentration ratio computed from the data in Paller and Wike (1996) or from default TF values given in ERD-AG---3
3. For MeHG computations, sediment MeHg concentrations are assumed to be 5% of the total Hg concentration (USEPA 1997, Vol. III, Table 3-10).
4. For MeHg computations, water MeHg concentrations are assumed to be 7.6% of the total Hg concentration (SRS Mercury report: Bowers et al. 2003)

APPENDIX D

Principal Threat Source Material Evaluation

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D.1 INTRODUCTION

The concept of principal threat waste and low-level threat waste as developed by the U.S. Environmental Protection Agency (USEPA) in the National Contingency Plan (40 Code of Federal Regulations 300.430[a][1][iii]) is to be applied on a site-specific basis when characterizing source material. Source materials are those materials that include or contain hazardous substances, pollutants, or contaminants that act as a reservoir for migration to surface water, or air, or that act as a source for direct exposure (USEPA 1991).

The determination of whether the source materials present at a waste unit would be classified as principal threat source material (PTSM) is based principally on the USEPA guidance document (USEPA 1991). In this guidance, the USEPA defines principal threat wastes as "those source materials considered to be highly toxic or mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur." They include liquids and other highly mobile materials (e.g., materials that released from surface soil due to volatilization, leaching, or surface runoff) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat." However, the guidance does state that treatment alternatives for source materials should generally be evaluated where the combined toxicity and mobility pose a potential risk of 1E-03 or greater. According to USEPA, the PTSM concept expectation was to "help streamline and focus the remedy selection process, not as a mandatory waste classification requirement."

The USEPA, South Carolina Department of Health and Environmental Control, and U.S. Department of Energy evaluated the USEPA guidance with respect to toxicity and contaminant migration analysis performed at Savannah River Site (SRS). In practice, SRS risk assessment and contaminant migration evaluations identify constituents of concern (COCs) associated with source material or impacted media and determine the associated risk (i.e., adverse health impacts as measured by the hazard index [HI] and numerical estimate of risk) or potential impact to environmental media. If threshold risk levels are exceeded, problems are identified and an evaluation of remedial alternatives is conducted in the Feasibility Study (FS). Since the risk assessment does not evaluate human receptor exposure to subsurface soils, further revaluation is

needed to account for potentially highly toxic source material or contaminated soils at depth that would results in unacceptable risk should exposure occur. Therefore, a quantitative determination of whether contamination exists above PTSM levels (i.e., 1E-03) at the Lower Three Runs (LTR) Integrator Operable Unit (IOU) in all soil depths was performed.

D.1.1 Background

The LTR IOU consists of natural and man-made water bodies, including ponds and streams, and man-made canals that transmitted and temporarily stored reactor cooling water obtained from the Savannah River after circulating through the P Reactor and R Reactor. This water was ultimately discharged into the lower arm of the LTR IOU tail section, ultimately discharging back into the Savannah River. The water bodies are segregated into exposure areas (EAs) for investigation, evaluation, and potential remediation purposes based on the primary source of contamination (i.e., R Reactor or P Reactor). The media evaluated for the EAs in terms of the PTSM evaluation include sediment/soil, both beneath water as well as immediately adjacent floodplain soils.

Figure D-1 shows the locations of the EAs within the upper subunit of the LTR IOU. Below is a summary of each EA.

- EA 1 includes Pond A and the R Reactor Area Discharge Canal. Pond A is approximately (~) 2.6 hectares (ha [6.4 acres {ac}]) and received water from the R-Area Discharge Canal and subsequently discharged to Pond B. Initially, the Discharge Canal effluent flowed into Joyce Branch prior to the construction of the canal to Pond B. The canal from R Reactor to Pond A is ~645-meters (m [2,116.1-feet {ft}]) long. The canal from the R-Discharge Canal to Joyce Branch is ~233-m (764.4-ft) long. Water levels in Pond A and the R Reactor Area Discharge Canal fluctuate from year to year based on precipitation amounts.

- EA 2 includes the canal from Pond A to Pond B which is ~2,837-m (9,307.7-ft) long. It received water from Pond A, which flowed to and discharged into Pond B. The water level within the canal fluctuates based on precipitation and discharge from Pond A.

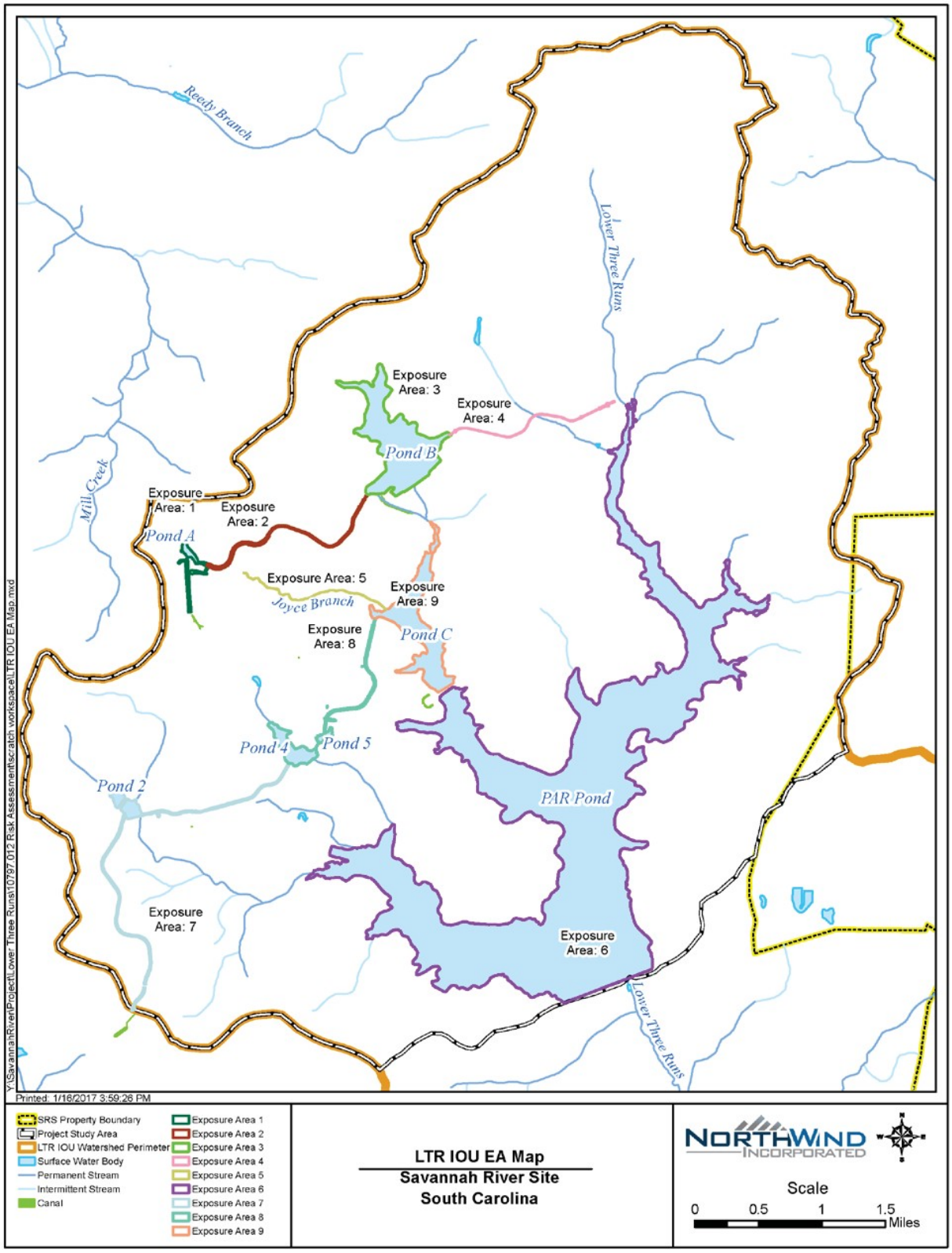


Figure D-1. LTR IOU Exposure Areas

- EA 3 includes Pond B and the overflow canal that was constructed to connect Pond B to Pond C as an emergency water release channel. The canal from Pond B to Pond C is ~547-m (1,794.6-ft) long. Pond B is ~82.1 ha (202.8 ac). Pond B generally maintains its water level from year to year.

- EA 4 includes the canal from Pond B to the North Arm of PAR Pond and is ~2,305-m (7,562.3-ft) long. It received water from Pond B, which flowed to and discharged into the North Arm of PAR Pond. The water level within the canal fluctuates based on precipitation amounts and water movement from Pond B.

- EA 5 includes the natural stream (i.e., Joyce Branch) that flows into Pond C, which was initially used to transmit reactor water from R Reactor directly to Pond C prior to the construction of the canal system to Pond B. Joyce Branch is also known as the Old R-Area Discharge Canal. The water level within the natural stream fluctuates based on groundwater inputs and precipitation amounts.

- EA 6 includes PAR Pond from below the Pond C dam on the Hot Arm of PAR Pond (downgradient side of Pond C) to the PAR Pond dam on the downgradient end of PAR Pond, as well as the north and west arms of PAR Pond. PAR Pond is ~1,068.3 ha (2,640 ac) and received water from R Area and P Area via Pond B and Pond C, respectively. Pond C and PAR Pond are separated by an earthen barrier that allows flow between the two bodies of water. The water level in PAR pond naturally fluctuates and has consistently maintained a level well above 59.4-m (195-ft) mean sea level (msl) since the drawdown in 1991. Full pool is 60.9-m (200-ft) msl.

- EA 7 includes the P Effluent Canal, Pond 2, and the canal from Pond 2 (which includes Pond 3) to Pond 4. Pond 2 is ~7.9 ha (19.6 ac) and received water from the P Effluent Canal. Water from Pond 2 flowed through the canal system and discharged into Pond 4. The canal from P-Area is ~3,582-m (11,751.9-ft) long. The canal from Pond 2 to Ponds 4 is ~2,081-m (6,827.4-t) long. Water levels in the canals and Pond 2 fluctuate from year to year based on precipitation amounts.

- EA 8 includes Ponds 4 and 5 and the canal to Pond C. Pond 4 is ~14.3 ha (35.3 ac) and received water from P-Area, through Pond 2 and subsequently discharged to Pond 4 and Pond 5. Pond 5 is ~4.0 ha (9.9 ac) and received water from Pond 4 and subsequently discharged to Pond C via a 1,887-m (6,190.9-ft) long canal. Water levels in the canals and Ponds 4 and 5 fluctuate from year to year based on precipitation amounts.

- EA 9 includes Pond C. Pond C is ~53.5 ha (132.4 ac) and received water from the R-Area via Joyce Branch and the P Area via the Pond 5 discharge canal. Pond C and PAR Pond are separated by an earthen dam barrier with a hydraulic connection that allows flow between the two bodies of water from Pond C to PAR Pond. Pond C maintains its water level from year to year.

D.1.2 Data

For the IOU program, previous characterization efforts have focused primarily on determining the nature of contamination and identifying areas where IOU Phase II early actions were required. Several characterization efforts were performed for the LTR Remedial Investigation/Baseline Risk Assessment (RI/BRA) from the initial RI Work Plan through the data evaluation/culling process that resulted in the final dataset supporting this document. The *Remedial Investigation Work Plan for the Lower Three Runs Integrator Operable Unit* (WSRC 2002) compiled exiting data that were available for the LTR IOU (including sediment, sediment/soil, surface water, and fish) from various sampling and monitoring efforts conducted by various investigators that established the LTR IOU database (Phase I). A detailed discussion of these efforts is presented in Section 3.2 and a brief summary of the previous studies performed and summarized in the RI Work Plan is described below:

- Surface Sediments in Pre-Cooler Ponds 2, 4, and 5 were collected in March 2000 (WSRC-TR-2000-00164, Savannah River Technology Center) to determine levels of radioactive lead and mercury in sediments that could be exposed if the pre-cooler dams were eliminated or allowed to fail. Results indicated evidence of radioisotope (namely cobalt-60 and cesium [Cs]-137), lead, and mercury contamination exceeding background levels.

- Sediment cores from shallow and deep-water locations in PAR Pond, Pond C, and L Lake were collected in July 1995 (WSRC-TR-96-0238, Savannah River Technology Center) to develop a defensible characterization of contaminants found in sediments in these water bodies. Results indicated mercury and radioisotope contamination exceeding concentrations from the reference sites.

- Sediments where collected in August 1995 (Phase I) and April 1996 (Phase 2) at four sites in Pond 2, eight sites in or near Pond 5, and one site along the canal between Pond 2 and Pond 5 (WSRC-TR-96-0175, Savannah River Technology Center) to identify the maximum levels of contamination that could be exposed by fluctuating water levels in ponds as a result of shutting down the river water distribution system. Results indicated that radioisotope activity levels were comparable to activities measured during other studies of the PAR Pond cooling system.

- Sediment and small mammal samples were collected from exposed sediments of PAR Pond in 1995 before the reservoir was refilled following a 4-year drawdown (WSRC-TR-96-0292, Savannah River Technology Center). Samples were analyzed for radionuclides and metals to determine if contaminant levels in the PAR Pond sediments were high enough to cause deleterious ecological effects. Results indicated that mercury was slightly elevated and Cs-137 was present at levels well in excess of levels at control sites. Also, levels of Cs-137 detected in small mammals were elevated, while no evidence of mercury bioaccumulation was seen.

Upon completion of the Work Plan, the LTR IOU entered Phase II of the IOU program (investigation process). Phase II was the ongoing monitoring and assessment of the IOU (with periodic reporting) prior to the onset of Phase III final action determinations. A summary of the monitoring presented in periodic reports is presented below.

- Areas targeted for additional sampling included the unnamed tributary south of R-Area in the Ponds 4/5 subunit and the unnamed tributary northeast of P-Area of the Pond 2 subunit. Sediment/soil samples were collected in Ponds 4/5 subunit for definitive level data (i.e., full suite of analytes, including target compound list, target analyte list, gross alpha, nonvolatile beta, and gamma spectroscopy. Additionally, samples collected in the Pond 2 subunit were

analyzed for metals and gamma emitters (primarily Cs-137) along the reach of the tributary for definitive level data.

- A third round of LTR IOU sampling was performed that consisted of follow-on speciation for alpha spectroscopy and nonvolatile beta-emitting radionuclides in sediment/soil samples south of R Area.

Following analysis of data collected from these sampling efforts, additional sampling was defined in *Sampling and Analysis Plan for the Lower Three Runs Stream, Floodplain, and Headwaters [SAP]* (SRNS 2009). This SAP included characterization of all subunits (upper, middle, and lower) of the LTR IOU that were targeted for further characterization based on gaps in definitive characterization data from the previous investigations.

Past characterization efforts of the LTR IOU have indicated that Cs-137 is the major contaminant in the former reactor cooling water system. In 2009/2010 and again in 2016 (which was specific to PAR Pond), extensive sampling of the LTR IOU was performed to augment prior data collected in the IOU to ensure sufficient information is available for evaluating risks to human health and ecological receptors. This sampling was performed as outlined in an approved SAP (SRNS 2010) and included sampling within three types of systems: canals; pre-cooler ponds/PAR Pond; and stream/channel/floodplain. Within each system, the sample design involved an even spacing of transects to collect an unbiased population of data. Data consisted of field gamma readings along transects that were supplemented with the collection of sediment, sediment/soil, and surface water samples for laboratory analyses. The sampling effort included collection of sediment/soil from the 0- to 1.2-m (0-to 4-ft) depths interval from each of nine LTR EAs as well as several background locations for all media. The identification and definition of problems warranting action and associated extent of contamination is based on the final data set that includes both high and medium level pedigree historic data as well as data collected from the 2009/2010 characterization effort. Historical data sets were assigned a high, medium, or low pedigree rating based on availability of published reports, level of quality assurance/quality control documentation, etc. A summary of the number of analytical data supporting the Phase III evaluation is shown below.

Media	# LTR IOU Analytical Records		
	Ponds and Canal System 2009/2010 Data	Medium/High Pedigree Historical Data	2009/2010 Background Data
Sediment	5,539		564
Sediment/Soil	26,750	53,822	1,040
Surface Water	15,455	33,124	855
Fish	504	4,945	268

IOU – Integrator Operable Unit LTR = Lower Three Rivers

Data summaries for sediment/soil from the 0- to 1.2-m (0-to 4-ft)-depth (all depths) interval for each EA from the data sources discussed above that were used in this screening are presented in Appendix A. For discussion of the nature and extent of contamination, see Chapter 3 of the RI.

D.1.3 Receptor

The onsite worker receptor scenario involves a worker who is performing maintenance, collecting samples, or conducting field research within the immediate areas of the EAs. The exposure assumptions for the onsite worker are 20 years, 150 days/year, and 8 hours per day. All other parameters are the same as the standard USEPA Industrial Worker scenario. These site-specific assumptions are based on input provided by the Savannah River Ecology Laboratory and are consistent with a wetlands researcher. This receptor is routinely evaluated in the IOU program. Given the current and expected future land use of the LTR IOU, the onsite worker is the most likely receptor exposure scenario for the LTR IOU.

D.1.4 Sources of Risk-Based Threshold Values

The USEPA Regional Screening Levels (RSLs) website (USEPA 2016) is the source of chemical constituent risk-based threshold values used in this evaluation. The website was accessed on October 14, 2016. The threshold limits for the site-specific onsite worker scenario were obtained using the website calculator function with the site-specific exposure parameters presented in Section D.1.3 to derive site-specific RSLs. The RSLs for this scenario are provided in Attachment D-1.

The USEPA Superfund Radionuclide Preliminary Remediation Goals (PRGs) for Superfund website (USEPA 2014) is the source of the radionuclide threshold values used in this evaluation.

The website was accessed on October 23, 2016. The threshold limits for the onsite worker were obtained by using the website calculator function with the same site-specific exposure parameters discussed above to derive site-specific PRGs. The PRGs for this scenario are provided in Attachment D-2.

D.2 PTSM EVALUATION PROCESS

To determine whether contaminated source material/soils/sediments should be preliminarily considered PTSM, a simple quantitative assessment evaluating the toxicity of the source is used in which the results are compared to a threshold for determining PTSM.

In determining whether the source should be considered PTSM, the evaluation considers the cumulative effects of both the potential risk from carcinogenic constituents and the adverse effects from noncarcinogens to an onsite worker receptor. The source material (i.e., sediment/soil) is preliminarily considered to be PTSM if the cumulative risk exceeds at least one of the following threshold screening criteria:

- Carcinogens – greater than 1E-03 onsite worker risk
- Noncarcinogens – onsite worker HI greater than 10

In the preliminary screen, the unit maximum concentration for every detected constituent for the sediment/soil media from the all depth interval (i.e., 0- to 1.2-m [0- to 4-ft]) at each LTR IOU EA is determined and used as the exposure point concentration (EPC). Appendix A presents the maximum detected constituent concentrations and activity concentrations for each EA used in the PTSM screen.

For carcinogens, the individual risk associated with each constituent is calculated by multiplying the ration of the EPC over the RSL or PRG by 1E-06. Each of these risks is summed to calculate the cumulative carcinogenic risk associated with the source. For noncarcinogens, a hazard quotient (HQ) associated with each constituent is calculated by dividing the EPC by the RSL. These HQs are summed to derive the cumulative HI. If neither threshold criteria for PTSM are exceeded based on the maximum detected concentrations and activity concentrations, then PTSM is not present

and it is not necessary to evaluate further. If either of the threshold criteria are exceeded, then further evaluation is provided in a refinement step (i.e., uncertainty analysis).

A refinement/uncertainty analysis is conducted to further evaluate the constituents and source(s) that exceed the PTSM screening criteria. This analysis is intended to assist in making a final determination as to the presence of PTSM at a specific unit. Uncertainties where it may not be appropriate to identify the source as PTSM include 1) if the source defined as PTSM appears skewed (i.e., biased high) based on a single sample result, 2) if the source term may be impacted (i.e., reduced) by the natural radioactive decay of a radionuclide with a relatively short half-life relative to the date of collection, 3) if a published toxicity value is undergoing additional evaluation, or 4) if the HI exceeds 10 based on the cumulative effects of noncarcinogens that effect different target organs.

D.2.1 Sediment/Soil Media

The primary media of concern for the PTSM evaluation for LTR IOU consists of sediment/soil. This medium represents the most likely reservoir for contaminants that originated from the R Reactor Area and P Reactor Area. The screening evaluation performed for each EA for PTSM is summarized below.

D.2.1.1 Screening Evaluation

For the screening evaluation for PTSM, maximum concentrations for nonradiological constituents and activity concentrations for radionuclides in sediment/soil (all depths) were used to calculate HQs for noncarcinogens and numerical risk for carcinogens. The following equations are used to calculate HQs and risks for the PTSM evaluation:

$$\textit{noncarcinogen hazard quotient} = \frac{[\textit{Maximum Concentration}]}{[\textit{RSL}]}$$

$$\textit{carcinogen risk estimate} = \frac{[\textit{Maximum Concentration}]}{[\textit{RSL or PRG}]} \times 1E\text{-}06$$

The PTSM screening evaluation by EA are presented in Tables D-1 through D-9.

D.2.1.2 Refinement/Uncertainty Evaluation

The 95% upper confident level (UCL) on the mean, instead of the maximum detected concentration, is used for the subsequent comparison to PTSM thresholds. A review of the data in the subsurface interval for each EA indicates that there is no appreciable contamination in the deeper soil intervals. Therefore, the 95% UCL from the 0- to 0.3-m (0- to 1-ft) interval was used as the EPC in an effort to not bias the evaluation low in the refinement/uncertainty evaluation. Appendix A contains the 95% UCL on the mean values for each EA. The refined calculation also considers radioactive decay for Cs-137, which has a half-life of 30.2 years. All Cs-137 data was decay corrected to January 1, 2017.

D.2.2 Results/Refinement of Constituents of Concern

Results of the PTSM screening and refinement/uncertainty evaluation are presented below by EA.

D.2.2.1 Exposure Area 1

The chart below summarizes the results of the PTSM screening for EA 1, including both the original dataset and the decay-corrected dataset for Cs-137. Concentrations used in the screening, the EPC (i.e., maximum activity concentration [max] and 95% UCL), the resultant risks, and the number of sample locations in which the activity concentration exceeds the PTSM threshold value of 180 pCi/g are presented for both datasets.

Original Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
686	3.8E-03	148[1]	8.2E-04	5/61

Decay-corrected Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
526[1]	2.9E-03	115[1]	6.4E-04	5/45[1]

1 – Data from the 0- to 1-ft-depth interval

Results of the PTSM screening for EA 1 (see Table D-1) indicate that the HI is 0.05 and the cumulative risk is 3.96E-03. The only constituent that exceeds the PTSM threshold level is Cs-137(+D) (3.8E-03), which contributes ~96% to the cumulative risk based on the maximum detected activity concentration of 686 pCi/g. However, recalculating the risk associated with Cs-137(+D) using the less conservative 95% UCL on the mean (148 pCi/g from the 0- to 0.3-m

[0- to 1-ft]) sample interval), the resultant Cs-137(+D) risk is 8.2E-04. Further, with a half-life of 30.2 years for Cs-137 and the time frame from which the data were collected in EA 1, the decay corrected 95% UCL for Cs-137(+D) would be expected to be lower (115 pCi/g) as would be the associated risk to the onsite worker (6.4E-04). Also, there are only 5 samples out of 61 in which the activity concentrations exceed the PTSM threshold level, all from the same sample location. Assuming this sample location represents a hotspot, the PTSM threshold level using a 2-square meter (m^2) area correction factor increases the PRG for Cs-137(+D) by a factor of ~4 (PTSM threshold = 810 pCi/g). Thus, the maximum detected value and the decay corrected maximum detected value, 686 pCi/g and 526 pCi/g, respectively, would be below the area corrected PTSM threshold level.

Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM refined COCs (RCOCs) identified for EA 1. However, it is recognized that one location (R-1) has five separate samples that are above the PTSM threshold for the onsite worker in both the original and decay corrected datasets. This result, including the decay-corrected risk, will be taken into consideration in the remedy selection process documented in the feasibility study (FS) phase of the project.

D.2.2.2 Exposure Area 2

The chart below summarizes the results of the PTSM screening for EA 2, including both the original dataset and the decay corrected dataset for Cs-137, including the parameters discussed in Section D.2.2.1.

Original Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
180	1.0E-03	48.8[1]	2.7E-04	0/66

Decay Corrected Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
155[1]	8.6E-04[1]	41.9[1]	2.3E-04[1]	0/44[1]

[1]Data from 0- to 1-ft depth interval.

Results of the PTSM screening for EA 2 (see Table D-2) indicate that the HI is 0.16 and the cumulative risk is 1.1E-03. The Cs-137(+D) risk is 1.0E-03 (equivalent to the PTSM threshold limit), which contributes ~91% to the cumulative risk based on the maximum detected activity

concentration of 180 pCi/g. However, recalculating the risk using the less conservative 95% UCL on the mean (48.8 pCi/g from the 0- to 0.3-m (0- to 1-ft) sample interval), and the Cs-137(+D) risk is 2.7E-04. Further, with a half-life of 30.2 years of Cs-137 and the time frame from which the data were collected in EA 2, the decay-corrected maximum detected activity concentration would be expected to be lower (155 pCi/g) as would be the associated risk to the onsite worker (8.6E-04), which is below the PTSM threshold level; the decay corrected 95% UCL (41.9 pCi/g) results in a risk is 2.3E-04.

Based on the initial PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 2. However, it is recognized that there is one location in EA 2 (RDC-007-001) where the measured activity of Cs-137 (in 2010) equaled the PTSM threshold for the onsite worker. This result, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

D.2.2.3 Exposure Area 3

The chart below summarizes the results of the PTSM screening for EA 3, including both the original dataset and the decay-corrected dataset for Cs-137, including the parameters discussed in Section D.2.2.1.

Original Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
457	2.5E-03	98.4[1]	5.5E-04	2/44

Decay Corrected Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
276[1]	1.5E-03	59.16[1]	3.3E-04[1]	2/44[1]

[1]Data from 0- to 1-ft depth interval.

Results of the initial PTSM screening for EA 3 (see Table D-3) indicate that the HI is 0.16 and the cumulative risk is 2.7E-03. The only constituent that exceeds the PTSM threshold level is Cs-137(+D) (2.5E-03), which contributes ~93% to the cumulative risk based on the maximum detected activity concentration of 457 pCi/g. However, recalculating the risk using the less conservative 95% UCL on the mean (98.4 pCi/g from the 0- to 0.3-m (0- to 1-ft) sample interval), the Cs-137(+D) risk is 5.5E-04. With a half-life of 30.2 years and the time frame from which the data were collected in EA 3, the decay-corrected maximum detected activity concentration would be expected to be lower (276 pCi/g), as would be the associated risk to the onsite worker

(1.5E-03); the decay corrected 95% UCL (59.2 pCi/g) results in a risk of 3.3E-04. There are two samples where the measured concentrations exceeded the PTSM threshold level. Continued radioactive decay of Cs-137(+D) would result in a continuous drop in the calculated risk with time. Assuming the sample location represents a hotspot, the PTSM threshold level using a 2-m^2 area correction factor increases the PRG for Cs-137(+D) by a factor of ~4. Thus, the maximum detected value and the decay corrected maximum detected value, 457 pCi/g and 276 pCi/g, respectively, would be below the area corrected PTSM threshold level.

Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 3. However, it is recognized that there are two specific locations in EA 3 (SCB-29 and SCB-34) where measured activities of Cs-137 (circa 1994) exceeded the PTSM threshold for the onsite worker. These results, including the decay corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

D.2.2.4 Exposure Area 4

Results of the PTSM screening for EA 4 (see Table D-4) indicate that the HI is 0.05 and the cumulative risk is 3.5E-04. Because no constituents exceed the PTSM threshold levels, there are no PTSM RCOCs identified for EA 4.

D.2.2.5 Exposure Area 5

The chart below summarizes the results of the PTSM screening for EA 5 including both the original dataset and the decay corrected dataset for Cs-137, including the parameters discussed in Section D.2.2.1.

Original Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
457	2.5E-03	98.4[1]	5.5E-04	2/44

Decay Corrected Dataset

Max *pCi/g*	Max Risk	95% UCL *pCi/g*	Risk	# > PTSM
276[1]	1.5E-03	59.16[1]	3.3E-04[1]	2/44[1]

[1]Data from 0- to 1-ft depth interval.

Results of the PTSM screening for EA 5 (see Table D-5) indicate that the HI is 0.13 and the cumulative risk is 2.5E-03. The only constituent that exceeds the PTSM threshold level is Cs-137(+D) (2.3E-03), which contributes 91 percent to the cumulative risk based on the maximum

detected activity concentration of 405 pCi/g. With a half-life of 30.2 years and the time frame from which the data were collected in EA 5, decay would result in a lower activity concentration. Using the decay corrected 95% UCL (168.3 pCi/g from the 0- to 0.3-m (0- to 1-ft) sample interval), the associated risk associated with Cs-137(+D) (9.4E-04) is below the PTSM threshold level. There are 4 samples out of 23 in the original dataset and 4 samples out of 17 in the decay-corrected dataset in which the activity concentrations exceed the PTSM threshold level. There are four samples (two each) at two specific locations with measured levels above the PTSM threshold for Cs-137.

Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 5. However, it is recognized that there are four samples total (two each) at two specific locations (LTR-02 and LTR-04) with measured activities (from 2003-2004) above the PTSM threshold for Cs-137 for the onsite worker. These results, including the decay-corrected risk, will be taken into consideration in the remedy selection process documented in the FS phase of the project.

D.2.2.6 Exposure Area 6

Results of the PTSM screening for EA 6 (see Table D-6) indicate that the HI is 0.49 and the cumulative risk is 7.8E-04. Because no constituents exceed the PTSM threshold levels, there are no PTSM RCOCs identified for EA 6.

D.2.2.7 Exposure Area 7

Results of the PTSM screening for EA 7 (see Table D-7) indicate that the HI is 0.4 and the cumulative risk is 1.8E-03. However, no individual constituents exceed the PTSM threshold level, although the cumulative risk does exceed the threshold level. The cumulative risk is due to summing the individual constituent risks for Cs-137(+D), potassium (K)-40, radium (Ra)- 226(+D), and thorium (Th)-232(+D), which are 8.3E-04, 1.2E-04, 2.8E-04, and 5.19E-04, respectively. Detected activity concentrations of K-40, Ra-226(+D), and Th-232(+D) are likely naturally occurring because these constituents are typically present in the environment. Below is a summary of the uncertainties associated with these constituents.

- K-40 is a naturally-occurring radionuclide that can be found wherever potassium is found. Potassium is a constituent of natural clay minerals in sediment and soil.

- The EPC for Ra-226(+D) is based on the detected concentration of bismuth (Bi)-214, which is a daughter product assuming secular equilibrium (SE). While SE is a valid assumption for rocks and vadose zone soils, this assumption should not be applied to natural waters or to sediments in contact with natural waters. The sediments in EA 7 with elevated Bi-214 (up to 12.4 pCi/g) and Ra-226 (up to 5.99 pCi/g) are in contact with percolating groundwater, which may be enriched with naturally-occurring radium and its daughter radon. Bi-214 can have very high natural concentrations in groundwater, and can impart those concentrations to sediment that is exposed to such groundwater. Because Bi-214, and its parents radon and radium, were not used at SRS, and because elevated levels of naturally occurring Bi-214 and Ra-226 are well known in SRS groundwater, the detections of Bi-214 and Ra-226 are accepted as real and are regarded as natural.

- Th-232(+D) is assumed to be present at the activity concentration of Ra-224, a daughter of Th-232. However, SE should not be assumed for sediment in contact with natural waters. Ra-224 is a short-lived daughter of the thorium decay chain. Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in P- and R-Area waste units because the activity concentration in EA 7 sediment/soils is 3.5 pCi/g, which is typical of natural thorium. The probable origin for Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater and Ra-228, although not often analyzed for, is known to be elevated in some SRS monitoring wells. Sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides. The concentrations of Th-232(+D) are regarded as having a natural origin because thorium concentrations in sediment are indicative of natural origin, thorium is not a COC in P and R Areas, and Ra-224 and Bi-212 were not used in SRS processes.

Discounting the contributions of the naturally occurring constituents K-40, Ra-226(+D), and Th-232(+D), the resultant risk due solely to Cs-137(+D) (risk = 8.3E-04) is below the PTSM threshold level. Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are no PTSM RCOCs identified for EA 7.

D.2.2.8 Exposure Area 8

Results of the PTSM screening for EA 8 (see Table D-8) indicate that the HI is 0.39 and the cumulative risk is 1.4E-03. No individual constituents exceed the PTSM threshold level, although the cumulative risk does exceed the threshold value. The cumulative risk is due to summing the individual risk estimates for Cs-137(+D), Ra-226(+D), and thorium-232(+D), which are 6.98E-04, 1.87E-04, and 4.70E-04, respectively. Detected activity concentrations of Ra-226(+D) and Th-232(+D) are likely naturally occurring because these constituents are typically present in the environment as discussed above. The uncertainties associated with these constituents are summarized below.

- Ra-226(+D) is assumed to be present at the activity concentration of lead-214 (Pb-214), a daughter of Ra-226. SE is a valid assumption for rocks and vadose zone soils, but should not be applied to natural waters, or to sediment in contact with natural waters. The sediments in EA 8 with elevated Pb-214 (up to 8.15 pCi/g) and Ra-226 (up to 1.75 pCi/g) are in contact with percolating groundwater, which may be enriched with naturally occurring radium and its daughter radon. Lead-214, being a product of both radium and radon, can have high natural concentrations in groundwater, and can impart those concentrations to sediment that is exposed to such groundwater. Because Pb-214, and its parents radon and radium, were not used at SRS, and because elevated levels of naturally-occurring Pb-214 and Ra-226 are well known in SRS groundwater, the detections of Pb-214 and Ra-226 are accepted as real, and are regarded as natural.

- Th-232(+D) is assumed to be present at the activity concentration of Ra-224, a daughter of Th-232. However, SE should not be assumed for sediment in contact with natural waters. Ra-224 is a short-lived daughter of the thorium decay chain. Thorium did have a very limited role in SRS reactor processes, but Th-232 is not a COC in P- and R-Area waste units, as the activity concentration in EA 8 sediment/soils is 2.19 pCi/g, which is typical of natural thorium. The probable origin for Ra-224 is dissolved Ra-228 in groundwater. Radium is soluble in groundwater, and Ra-228, although not often analyzed for, is known to be elevated in some SRS monitoring wells. Sediment exposed to groundwater flux can adsorb radium and its daughters, and accumulate elevated concentrations of natural radionuclides. Since thorium

concentrations in sediment are indicative of natural origin, and since thorium is not a COC in P and R Areas, and since Ra-224 and Bi-212 were not used in SRS processes, the concentrations of Th-232(+D) are regarded as having a natural origin.

However, discounting the contributions of the naturally-occurring constituents, radium-226(+D) and thorium-232(+D), the resultant risk due solely to Cs-137(+D) (risk =7.0E-04) is below the PTSM threshold level. Based on the PTSM screening and the subsequent refinement/uncertainty evaluation, there are not PTSM RCOCs identified for EA 8.

D.2.2.9 Exposure Area 9

Results of the PTSM screening for EA 9 (see Table D-9) indicate that the HI is 0.31 and the cumulative risk is 7.5E-04. Because no constituents exceed the PTSM threshold levels, there are no PTSM RCOCs identified for EA 9.

D.2.3 Summary/Conclusions of the PTSM Evaluation

No PTSM RCOCs are identified for any EA within the LTR IOU. However, EAs 1, 3, and 5 had specific locations where Cs-137 levels were above the PTSM threshold. These locations with higher Cs-137 activity concentrations (i.e., hotspots) will be re-evaluated in the FS phase of the project to ensure that a full range of alternatives is considered in the remedy selection process. The revised conceptual site model (CSM) is presented in Chapter 3.

D.2.4 Additional Uncertainty

In December 2016, the USEPA PRG website announced a revision to the approach for calculating PRGs. The primary change was that the plus daughters (+D) option had been removed from the selection list and SE PRGs are not the preferred (default) option. Later in December 2016, USEPA acknowledged that an unexpected error had occurred in the SE PRG calculations. In January 2017, another update was announced due to new risk and dose coefficients for a handful of radionuclide constituents.

The PRG website currently indicates that the default tables do not reflect changes and updates are pending. The calculator function appears to function, but the new approach for calculation SE

PRGs is a work in progress that still needs to be verified by USEPA prior to implementation for the LTR IOU.

Using the calculator function, the revised Cs-137 SE PRG is 0.144 pCi/g for the onsite worker. This activity corresponds to a 1E-06 risk; 144 pCi/g corresponds to a 1E-03 risk and would be the new PTSM threshold (pending USEPA verification). The new PTSM threshold for Cs-137 will be re-evaluated in the FS phase of the project upon finalization of the SE PRG methodology.

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D.3 REFERENCES

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Table D-1. Preliminary PTSM Screening Evaluation for Exposure Area 1

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	9.02E+03	1.87E+06	4.82E-03	---	---
Antimony	5.56E-01	7.79E+02	7.14E-04	---	---
Arsenic	2.34E+00	7.99E+02	2.93E-03	6.24E+00	3.75E-07
Barium	5.09E+01	3.61E+05	1.41E-04		
Beryllium	3.72E-01	3.82E+03	9.74E-05	1.45E+04	2.57E-11
Cadmium	6.16E-02	1.64E+03	3.76E-05	1.93E+04	3.19E-12
Calcium	4.46E+02	EN[5]	---	---	---
Chromium[6]	1.50E+01	5.81E+03	2.58E-03	1.32E+01	1.14E-06
Cobalt	1.99E+00	5.78E+02	3.44E-03	3.86E+03	5.16E-10
Copper	6.69E+00	7.79E+04	8.59E-05	---	---
Cyanide	2.23E-01	2.46E+02	9.07E-04	---	---
Iron	1.33E+04	1.36E+06	9.78E-03	---	---
Lead	8.54E+00	8.00E+02	1.07E-02	---	---
Magnesium	4.67E+02	EN[5]	---	---	---
Manganese	1.77E+02	4.27E+04	4.15E-03	---	---
Mercury[7]	3.58E-02	7.60E+01	4.71E-04	---	---
Nickel	2.92E+00	3.73E+04	7.83E-05	1.34E+05	2.18E-11
Potassium	2.18E+02	EN[5]	---	---	---
Selenium	1.89E+00	9.73E+03	1.94E-04	---	---
Sodium	2.19E+01	EN[5]	---	---	---
Vanadium	6.14E+01	9.72E+03	6.32E-03	---	---
Zinc	2.68E+01	5.84E+05	4.59E-05	---	---
Organics (mg/kg)					
Acetone	4.00E-01	1.12E+06	3.57E-07	---	---
Bis[2-ethylhexyl]phthalate	3.57E+00	2.74E+04	1.30E-04	3.42E+02	1.04E-08
Ethylbenzene	6.47E-04	3.41E+04	1.90E-08	5.30E+01	1.22E-11
Isopropylbenzene	2.59E-03	1.66E+04	1.56E-07	---	---
Methyl acetate	3.91E-03	1.95E+06	2.01E-09	---	---
Methyl ethyl ketone	2.42E-02	3.22E+05	7.52E-08	---	---
Toluene	1.24E-02	7.81E+04	1.59E-07	---	---
Pesticides/PCBs (mg/kg)					
DDD	6.32E-04	---	---	1.99E+01	3.18E-11
DDE	3.80E-03	---	---	1.93E+01	1.97E-10
DDT	2.50E-03	8.64E+02	2.89E-06	1.78E+01	1.40E-10
Methoxychlor	2.92E-03	6.84E+03	4.27E-07	---	---
PCB-1260	3.50E-03	---	---	2.06E+00	1.70E-09
Radionuclides (pCi/g)					
Americium-241	1.84E+00	---	---	9.69E+00	1.90E-07
Americium-243(+D)	2.77E-01	---	---	5.39E-01	5.14E-07
Californium-244	1.74E-01	---	---	1.93E+09	9.02E-17
Carbon-14	2.69E+00	---	---	2.31E+03	1.16E-09

Table D-1. Preliminary PTSM Screening Evaluation for Exposure Area 1
(Continued/End)

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Radionuclides (pCi/g) cont'd					
Cesium-137(+D)	6.86E+02	---	---	1.80E-01	3.81E-03
Cobalt-60	6.48E-01	---	---	8.32E-02	7.79E-06
Curium-244	4.46E-02	---	---	6.34E+01	7.03E-10
Curium-245 and Curium-246	2.69E-01	---	---	1.28E+00	2.10E-07
Plutonium-238	4.86E-01	---	---	2.88E+01	1.69E-08
Plutonium-239(+D)	2.16E+00	---	---	2.54E+01	8.50E-08
Plutonium-239 and Plutonium-240	1.18E+00	---	---	2.54E+01	4.65E-08
Potassium-40	4.15E+00	---	---	4.56E-01	9.10E-06
Radium-226(+D)[8]	3.71E+00	---	---	4.36E-02	8.51E-05
Lead-214	3.71E+00	---	---	---	---
Bismuth-214	3.41E+00	---	---	---	---
Strontium-89 and Strontium-90(+D)	1.54E+00	---	---	1.77E+01	8.68E-08
Thorium-230	1.60E+00	---	---	3.70E+01	4.32E-08
Thorium-232(+D)[9]	3.70E+00	---	---	8.85E-02	4.18E-05
Radium-228	1.48E+00	---	---	---	---
Actinium-228	2.50E+00	---	---	---	---
Thorium-228	3.70E+00	---	---	---	---
Lead-212	2.16E+00	---	---	---	---
Bismuth-212	1.31E+00	---	---	---	---
Thallium-208	7.30E-01	---	---	---	---
Uranium-233 and Uranium-234	1.64E+00	---	---	5.30E+01	3.09E-08
Uranium-234	2.78E+00	---	---	5.80E+01	4.79E-08
Uranium-235(+D)	1.37E-01	---	---	6.27E-01	2.19E-07
Uranium-238(+D)	2.73E+00	---	---	2.91E+00	9.38E-07
		Hazard Index PTSM?[10]	**0.05 NO**	**Cumulative Risk PTSM?[11]**	**3.96E-03 YES**

1. EPC - maximum detected concentration from all sediment/soil depth intervals (see Table A.1.1.1.2).
2. -Nonradiological RSLs are site-specific onsite worker soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed on October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-2. Preliminary PTSM Screening Evaluation for Exposure Area 2

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	2.18E+04	1.87E+06	1.17E-02	--	---
Antimony	4.39E-01	7.79E+02	5.64E-04	---	---
Arsenic	1.18E+01	7.99E+02	1.48E-02	6.24E+00	1.89E-06
Barium	2.11E+01	3.61E+05	5.84E-05	---	---
Beryllium	3.15E-01	3.82E+03	8.25E-05	1.45E+04	2.17E-11
Cadmium	6.13E-02	1.64E+03	3.74E-05	1.93E+04	3.18E-12
Calcium	5.18E+02	EN[5]	---	---	---
Chromium6	3.20E+01	5.81E+03	5.51E-03		2.42E-06
Cobalt	1.59E+00	5.78E+02	2.75E-03	3.86E+03	4.12E-10
Copper	1.31E+01	7.79E+04	1.68E-04	---	---
Iron	2.58E+01	1.36E+06	3.60E-02	---	---
Lead	3.00E+02	8.00E+02	3.23E-02	---	---
Magnesium	5.99E+01	EN[5]	---	---	---
Manganese	3.52E-02	4.27E+04	1.40E-03	---	---
Mercury[7]	3.91E+00	7.60E+01	4.63E-04	---	---
Nickel	1.98E+02	3.73E+04	1.05E-04	1.34E+05	2.92E-11
Potassium	2.06+00	EN[5]	---	---	---
Selenium	8.45E-01	9.73E+03	2.12E-04	---	---
Thallium	8.45E-01	1.95E+01	4.33E-02	---	---
Vanadium	1.12E+02	9.72E+03	1.15E-02	---	---
Zinc	1.96E+01	5.84E+05	3.36E-05	---	---
Organics (mg/kg)					
Acetone	4.60E-02	1.12E+06	4.11E-08	---	---
Benzaldehyde	4.70E-01	1.95E+05	2.41E-06	1.70E+03	2.76E-10
Bis[2-chloroethyl] ether	8.00E-01	---	---	2.15E+00	3.72E-07
Bis[2-ethylhexyl]phthalate	4.40E-02	2.74E+04	1.61E-06	3.42E+02	1.29E-10
Toluene	1.90E-01	7.81E+04	2.43E-06	---	---
Radionuclides (pCi/g)					
Americium-241	0E-02	---	---	9.69E+00	8.98E-09
Americium-243(+D)	1.26E-01	---	---	5.39E-01	2.34E-07
Carbon-14	7.00E-01	---	---	2.31E+03	3.03E-10
Cesium-137(+D)	1.80E+02	---	---	1.80E-01	1.00E-03
Curium-243 and Curium-244	5.70E-02	---	---	1.07E+00	5.33E-08
Curium-245 and Curium-246	7.60E-02	---	---	1.28E+00	5.94E-08
Neptunium-237(+D)	2.30E-02	---	---	4.24E-01	5.42E-08
Plutonium-238	4.40E-02	---	---	2.88E+01	1.53E-09
Plutonium-239 and Plutonium-240	1.19E-01	---	---	2.54E+01	4.69E-09
Potassium-40	4.60E+00	---	---	4.56E-01	1.01E-05
Radium-226(+D)[8]	2.33E+00	---	---	4.36E-02	5.34E-05
Lead-214	2.33E+00	---	---	---	---
Bismuth-214	1.71E+00	---	---	---	---
Strontium-90(+D)	4.60E-01	---	---	1.77E+01	2.60E-08
Thorium-230	1.02E+00	---	---	3.70E+01	2.76E-08
Thorium-232(+D)[9]	2.84E+00	---	---	8.85E-02	3.21E-05
Actinium-228	2.84E+00	---	---	---	---

Table D-2. Preliminary PTSM Screening Evaluation for Exposure Area 2
(Continued/End)

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
***Radionuclides (pCi/g)* cont'd**					
Radium-228	2.27E+00	---	---	---	---
Thorium-2 28	1.59E+00	---	---	---	---
Lead-212	2.59E+00	---	---	---	---
Bismuth-212	2.70E+00	---	---	---	---
Thallium-208	1.02E+00	---	---	---	---
Uranium-233 and Uranium-234	1.17E+00	---	---	5.30E+01	2.21E-08
Uranium-235(+D)	5.70E-02	---	---	6.27E-01	9.09E-08
Uranium-238(+D)	1.35E+00	---	---	2.91E+00	4.64E-07
		Hazard Index PTSM?[10]	**0.16 NO**	**Cumulative Risk PTSM?[11]**	**1.10E-03 YES**

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.2.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents
11. 11 Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-3. Preliminary PTSM Screening Evaluation for Exposure Area 3

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	3.17E+04	1.87E+06	1.70E-02	---	
Arsenic	5.30E+00	7.99E+02	6.63E-03	6.24E+00	8.49E-07
Barium	6.47E+01	3.61E+05	1.79E-04	---	---
Beryllium	7.96E-01	3.82E+03	2.08E-04	1.45E+04	5.49E-11
Cadmium	6.05E-0	1.64E+03	3.69E-04	1.93E+04	3.13E-11
Calcium	4.86E+0	EN[5]	---	---	---
Chromium[6]	6.14E+01	5.81E+03	1.06E-02	1.32E+01	4.65E-06
Cobalt	5.63E+00	5.78E+02	9.74E-03	3.86E+03	1.46E-09
Copper	2.09E+01	7.79E+04	2.69E-04	---	
Iron	3.26E+04	1.36E+06	2.40E-02	---	
Lead	2.33E+01	8.00E+02	2.91E-02	---	
Magnesium	7.44E+02	EN[5]	---	---	
Manganese	1.76E+02	4.27E+04	4.12E-03	---	
Mercury[7]	7.31E-02	7.60E+01	9.26E-04	---	
Nickel	1.19E+01	3.73E+04	3.19E-04	1.34E+05	8.88E-11
Potassium	5.52E+02	EN[5]	---	---	
Selenium	1.23E+00	9.73E+03	1.26E-04	---	
Sodium	5.85E+01	EN[5]	---	---	
Thallium	9.44E-01	1.95E+01	4.84E-02	---	
Vanadium	5.78E+01	9.72E+03	5.95E-03	---	
Zinc	5.66E+01	5.84E+05	9.69E-05	---	
Organics (mg/kg)					
Acetone	4.07E-01	1.12E+06	3.63E-07	---	---
Carbon disulfide	1.11E-02	5.79E+03	1.92E-06	---	---
Methyl ethyl ketone	6.04E-02	3.22E+05	1.88E-07	---	---
Toluene	2.93E-03	7.81E+04	3.75E-08	---	---
Pesticides/PCBs (mg/kg)					
DDD	7.80E-04	---	---	1.99E+01	3.92E-11
DDE	3.28E-03	---	---	1.93E+01	1.70E-10
Radionuclides (pCi/g					
Americium-243(+D)	2.54E-01	---	---	5.39E-01	4.71E-07
Cesium-137(+D)	4.57E+02	---	---	1.80E-01	2.54E-03
Potassium-40	3.04E+00	---	---	4.56E-01	6.67E-06
Radium-226(+D)[8]	2.48E+00	---	---	4.36E-02	5.69E-05
Lead-214	2.48E+00	---	---	---	---
Bismuth-214	2.02E+00	---	---	---	---
Thorium-230	1.35E+00	---	---	3.70E+01	3.65E-08
Thorium-232(+D) [9]	3.89E+00	---	---	8.85E-02	4.40E-05
Actinium-228	3.89E+00	---	---	---	---
Thorium-228	3.30E+00	---	---	---	---
Lead-212	3.88E+00	---	---	---	---
Thallium-208	1.15E+00	---	---	---	---
Uranium-233 and Uranium-234	1.88E+00	---	---	5.30E+01	3.55E-08
Uranium-235(+D)	3.38E-01	---	---	6.27E-01	5.39E-07
Uranium-238(+D)	1.68E+00	---	---	2.91E+00	5.77E-07
		Hazard Index	**0.16**	**Cumulative Risk**	**2.65E-03**
		PTSM?[10]	**NO**	**PTSM?[11]**	**YES**

Table D-3. Preliminary PTSM Screening Evaluation for Exposure Area 3
(Continued/End)

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.3.1.2).
2. Nonradiological RSLs are Site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-4. Preliminary PTSM Screening Evaluation for Exposure Area 4

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	1.05E+04	1.87E+06	5.61E-03	---	---
Arsenic	2.80E+00	7.99E+02	3.50E-03	6.24E+00	4.49E-07
Barium	4.65E+01	3.61E+05	1.29E-04	---	---
Beryllium	1.76E-01	3.82E+03	4.61E-05	1.45E+04	1.21E-11
Cadmium	1.33E-02	1.64E+03	8.11E-06	1.93E+04	6.89E-13
Calcium	1.88E+02	EN[5]	---	---	---
Chromium[6]	1.71E+01	5.81E+03	2.94E-03	1.32E+01	1.30E-06
Cobalt	1.05E+00	5.78E+02	1.82E-03	3.86E+03	2.72E-10
Copper	4.19E+00	7.79E+04	5.38E-05	---	---
Iron	1.58E+04	1.36E+06	1.16E-02	---	---
Lead	8.84E+00	8.00E+02	1.11E-02	---	---
Magnesium	1.84E+02	EN[5]	---	---	
Manganese	2.03E+02	4.27E+04	4.75E-03	---	---
Mercury[7]	3.17E-02	7.60E+01	4.17E-04	---	---
Nickel	2.99E+00	3.73E+04	8.02E-05	1.34E+05	2.23E-11
Potassium	1.18E+02	EN[5]	---	---	---
Selenium	1.06E+00	9.73E+03	1.09E-04	---	---
Vanadium	5.11E+01	9.72E+03	5.26E-03	---	---
Zinc	5.46E+00	5.84E+05	9.35E-06	---	---
Organics (mg/kg)					
Acetone	2.30E-02	1.12E+06	2.05E-08	---	---
Bis[2-ethylhexyl]phthalate	5.20E-02	2.74E+04	1.90E-06	3.42E+02	1.52E-10
Carbon disulfide	2.4E-03	5.79E+03	4.15E-07	---	---
Chrysene	4.20E-02	---	---	6.02E+02	6.98E-11
Chloroform	1.10E-03	1.71E+03	6.43E-07	2.88E+00	3.82E-10
Pesticides/PCBs (mg/kg)					
DDT	4.90E-03	8.64E+02	5.67E-06	1.78E+01	2.75E-10
Radionuclides (pCi/g					
Americium-241	3.20E-02	---	---	9.69E+00	3.30E-09
Americium-243(+D)	6.70E-02	---	---	5.39E-01	1.24E-07
Carbon-14	6.30E-01	---	---	2.31E+03	2.73E-10
Cesium-137(+D)	5.00E+01	---	---	1.80E-01	2.78E-04
Curium-243 and Curium-244	4.00E-02	---	---	1.07E+00	3.74E-08
Plutonium-238	1.08E-01	---	---	2.88E+01	3.75E-09
Plutonium-239 and Plutonium- 240	2.60E-02	---	---	2.54E+01	1.02E-09
Potassium-40	2.83E+00	---	---	4.56E-01	6.21E-06
Radium-226(+D)[8]	1.80E+00	---	---	4.36E-02	4.13E-05
Lead-214	1.80E+00	---	---	---	---
Bismuth-214	1.61E+00	---	---	---	---
Thorium-230	1.11E+00	---	---	3.70E+01	3.00E-08
Thorium-232(+D)[9]	1.98E+00	---	---	8.85E-02	2.24E-05
Radium-228	1.48E+00	---	---	---	---
Actinium-228	1.93E+00	---	---	---	---
Thorium-228	1.68E+00	---	---	---	---
Lead-212	1.66E+00	---	---	---	---
Bismuth-212	1.98E+00	---	---	---	---
Thallium-208	7.30E-01	---	---	---	---
Uranium-233 and Uranium-234	8.80E-01	---	---	5.30E+01	1.66E-08
Uranium-235(+D)	4.90E-02	---	---	6.27E-01	7.81E-08
Uranium-238(+D)	9.50E-01	---	---	2.91E+00	3.26E-07
		Hazard Index	**0.05**	**Cumulative Risk**	**3.50E-04**
		PTSM?[10]	**NO**	**PTSM?[11]**	**NO**

Table D-4. Preliminary PTSM Screening Evaluation for Exposure Area 4 *(Continued/End)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.4.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-5. Preliminary PTSM Screening Evaluation for Exposure Area 5

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	2.13E+04	1.87E+06	1.14E-02	---	---
Antimony	5.98E-01	7.79E+02	7.68E-04	---	---
Arsenic	2.90E+00	7.99E+02	3.63E-03	6.24E+00	4.65E-07
Barium	1.02E+02	3.61E+05	2.83E-04	---	---
Beryllium	9.61E-01	3.82E+03	2.52E-04	1.45E+04	6.63E-11
Cadmium	2.23E-01	1.64E+03	1.36E-04	---	1.16E-11
Calcium	4.30E+04	EN[5]	---	1.93E+04	---
Chromium6	5.62E+01	5.81E+03	9.67E-03	---	4.26E-06
Cobalt	9.90E+00	5.78E+02	1.71E-02	1.32E+01	2.56E-09
Copper	2.83E+01	7.79E+04	3.63E-04	3.86E+03	---
Cyanide	1.28E+00	2.46E+02	5.20E-03	---	---
Iron	2.46E+04	1.36E+06	1.81E-02	---	---
Lead	2.56E+01	8.00E+02	3.20E-02	---	---
Magnesium	1.27E+03	EN[5]	---	---	---
Manganese	9.52E+02	4.27E+04	2.23E-02	---	---
Mercury[7]	2.29E-01	7.60E+01	3.01E-03	---	---
Nickel	8.03E+00	3.73E+04	2.15E-04	1.34E+05	5.99E-11
Potassium	5.01E+02	EN[5]	---	---	---
Selenium	5.96E-01	9.73E+03	6.13E-05	---	---
Sodium	3.76E+01	EN[5]	---	---	---
Vanadium	4.51E+01	9.72E+03	4.64E-03	---	---
Zinc	5.34E+01	5.84E+05	9.14E-05	---	---
Organics (mg/kg)					
Acetone	5.40E-01	1.12E+06	4.82E-07	---	---
Carbon disulfide	1.77E-03	5.79E+03	3.06E-07	---	---
Methyl ethyl	3.31E-02	3.22E+05	1.03E-07	---	---
ketone Toluene	6.57E-03	7.81E+04	8.41E-08	---	---
Pesticides/PCBs (mg/kg)					
DDE	4.41E-03	---	---	1.93E+01	2.28E-10
DDT	1.14E-02	8.65E+02	1.32E-05	1.78E+01	6.40E-10
PCB-1260	5.30E-03	---	---	2.06E+00	2.57E-09
Radionuclides (pCi/g					
Americium-241	3.20E-01	---	---	9.69E+00	3.30E-08
Americium-243(+D)	3.41E-01	---	---	5.39E-01	6.33E-07
Cesium-137(+D)	4.05E+02	---	---	1.80E-01	2.25E-03
Cobalt-60	1.83E+00	---	---	8.32E-02	2.20E-05
Potassium-40	5.49E+00	---	---	4.56E-01	1.20E-05
Radium-226(+D)[8]	4.39E+00	---	---	4.36E-02	1.01E-04
Lead-214	4.39E+00	---	---	---	---
Bismuth-214	3.66E+00	---	---	---	---
Thorium-230	3.38E+00	---	---	3.70E+01	9.14E-08
Thorium-232(+D)[9]	6.42E+00	---	---	8.85E-02	7.25E-05
Radium-228	6.42E+00	---	---	---	---
Actinium-228	6.42E+00	---	---	---	---
Thorium-228	5.83E+00	---	---	---	---
Lead-212	6.28E+00	---	---	---	---
Thallium-208	1.95E+00	---	---	---	---
Uranium-233 and Uranium-234	3.29E+00	---	---	5.30E+01	6.21E-08
Uranium-235(+D)	2.41E-01	---	---	6.27E-01	3.84E-07
Uranium-238(+D)	2.84E+00	---	---	2.91E+00	9.76E-07
		Hazard Index	**0.13**	**Cumulative Risk**	**2.46E-03**
		PTSM?[10]	**NO**	**PTSM?[11]**	**NO**

Table D-5. Preliminary PTSM Screening Evaluation for Exposure Area 5 *(Continued/End)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.5.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accesses October 23, 2016
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-6. Preliminary PTSM Screening Evaluation for Exposure Area 6

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	1.82E+04	1.87E+06	9.73E-03	---	---
Antimony	1.10E+01	7.79E+02	1.41E-02	---	---
Arsenic	7.67E+00	7.99E+02	9.60E-03	6.24E+00	1.23E-06
Barium	1.47E+02	3.61E+05	4.07E-04	---	---
Beryllium	1.33E+00	3.82E+03	3.48E-04	1.45E+04	9.17E-11
Cadmium	5.90E-01	1.64E+03	3.60E-04	1.93E+04	3.06E-11
Calcium	1.46E+03	EN[5]	---	---	---
Chromium6	2.54E+01	5.81E+03	4.73E-03	1.32E+01	1.92E-06
Cobalt	7.75E+00	5.78E+02	1.34E-02	3.86E+03	2.01E-09
Copper	7.03E+00	7.79E+04	9.02E-05	---	---
Cyanide	3.40E+00	2.46E+02	1.38E-02	---	---
Iron	2.78E+04	1.36E+06	2.04E-02	---	---
Lead	1.79E+01	8.00E+02	2.24E-02	---	---
Magnesium	3.03E+02	EN[5]	---	---	---
Manganese	2.66E+02	4.27E+04	6.23E-03	---	---
Mercury[7]	9.58E-01	7.60E+01	1.51E-02	---	---
Nickel	9.15E+00	3.73E+04	2.45E-04	1.34E+05	6.83E-11
Potassium	2.26E+02	EN[5]	---	---	---
Selenium	7.64E+00	9.73E+03	7.85E-04	---	---
Silver	9.03E-01	3E+03	9.28E-05		
Sodium	3.07E+01	EN[5]	---	---	---
Thallium	6.89E+00	1.95E+01	3.53E-01	---	---
Vanadium	5.71E+01	9.72E+03	5.87E-03	---	---
Zinc	3.18E+01	5.84E+05	5.45E-05	---	---
Organics (mg/kg)					
2-Chlorophenol	5.92E-02	9.73E+03	6.08E-06	---	---
Acetone	9.33E-02	1.12E+06	8.33E-08	---	---
Benzoic acid	2.47E-01	5.47E+06	4.52E-08	---	---
Bis[2-ethylhexyl]phthalate	3.05E-02	2.74E+04	1.11E-06	3.42E+02	8.92E-11
Butylbenzylphthalate	3.64E-02	2.74E+05	1.33E-07	2.52E+03	1.44E-11
Carbon disulfide	1.92E-02	5.79E+03	3.32E-06	---	---
Cinnamyl Cinnamate	2.60E-01	---	---	---	---
Dibutylphthalate	2.84E-02	1.37E+05	2.07E-07	---	---
Diethylphthalate	2.07E-02	1.09E+06	1.90E-08	---	---
Fluoranthene	3.38E-02	5.02E+04	6.73E-07	---	---
Methyl cyclopentane	3.00E-03	---	---	---	---
Phenol	4.88E-03	4.10E+05	1.19E-08	---	---
Phenols	3.15E-01	4.10E+05	7.68E-07	---	---
Methyl ethyl ketone	2.75E-03	3.22E+05	8.54E-09	---	---
Methyl isobutyl ketone	8.41E-04	2.31E+05	3.64E-09	---	---
Styrene	1.38E-04	5.81E+04	2.38E-09	---	---
Toluene	3.05E-03	7.81E+04	3.91E-08	---	---
Xylenes	4.55E-04	4.14E+03	1.10E-07	---	---
Radionuclides (pCi/g)					
Barium-133	2.70E-01	---	---	4.56E-01	5.92E-07
Cesium-134	1.30E-01	---	---	3.46E-01	3.76E-07
Cesium-137(+D)	1.24E+02	---	---	1.80E-01	6.89E-04
Cobalt-58	3.23E-02	---	---	5.82E+00	5.55E-09
Cobalt-60	1.13E+00	---	---	8.32E-02	1.36E-05
Europium-152	4.70E-01	---	---	1.08E+01	4.35E-06
Europium-155	3.30E-01	---	---	9.01E+00	3.66E-08

Table D-6. Preliminary PTSM Screening Evaluation for Exposure Area 6
(Continued/End)

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
***Radionuclides (pCi/g)* cont'd**					
Manganese-54	4.92E-02	---	---	1.52E+00	3.24E-08
Neptunium-239	3.10E+00	---	---	1.37E+03	2.26E-09
Plutonium-238	6.90E-01	---	---	2.88E+01	2.40E-08
Plutonium-239(+D)	4.60E-01	---	---	2.54E+01	1.81E-08
Plutonium-239 and Plutonium-240	1.10E-01	---	---	2.54E+01	4.33E-09
Potassium-40	4.38E+00	---	---	4.56E-01	9.61E-06
Promethium-146	1.25E-02	---	---	3.04E-01	4.11E-08
Radium-226(+D)[8]	1.46E+00	---	---	4.36E-02	3.35E-05
Lead-214	1.46E+00	---	---	---	---
Ruthenium-106(+D)	2.30E-01	---	---	5.08E+00	4.53E-08
Strontium-89/-90(+D)	1.45E+01	---	---	1.77E+01	8.19E-07
Strontium-90(+D)	1.52E+00	---	---	1.77E+01	8.59E-08
Thorium-230	5.42E-01	---	---	3.70E+01	1.46E-08
Thorium-232(+D)[9]	2.04E+00	---	---	8.85E-02	2.71E-05
Radium-228	1.89E+00	---	---	---	---
Actinium-228	2.35E+00	---	---	---	---
Thorium-228	1.12E+00	---	---	---	---
Lead-212	2.40E+00	---	---	---	---
Thorium-234(+D)	5.59E+00	---	---	7.03E+02	7.95E-09
Tin-113	7.00E-02	---	---	6.98E+02	1.00E-10
Uranium-233 and Uranium-234	7.44E-01	---	---	5.30E+01	1.40E-08
Uranium-235(+D)	1.08E-01	---	---	6.27E-01	1.72E-07
Uranium-238(+D)	5.89E-01	---	---	2.91E+00	2.02E-07
Zinc-65	1.60E-01	---	---	2.71E+00	5.90E-08
Zirconium-95	7.01E-02	---	---	8.58E+00	8.17E-09
		Hazard Index	**0.49**	**Cumulative Risk**	**7.83E-04**
		PTSM?[10]	**NO**	**PTSM?[11]**	**NO**

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.6.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-7. Preliminary PTSM Screening Evaluation for Exposure Area 7

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	3.28E+04	1.87E+06	1.75E-02	---	---
Antimony	6.90E-01	7.79E+02	8.86E-04	---	---
Arsenic	1.49E+01	7.99E+02	1.86E-02	6.24E+00	2.39E-06
Barium	1.14E+02	3.61E+05	3.16E-04	---	---
Beryllium	4.72E+00	3.82E+03	1.24E-03	1.45E+04	3.26E-10
Cadmium	3.78E-01	1.64E+0	2.30E-04	1.93E+04	1.96E-11
Calcium	8.29E+02	EN[5]	---	---	---
Chromium6	7.07E+01	5.81E+03	1.22E-02	1.32E+01	5.36E-06
Cobalt	1.83E+01	5.78E+02	3.17E-02	3.86E+03	4.74E-09
Copper	2.47E+01	7.79E+04	3.17E-04	---	---
Cyanide	1.15E+00	2.46E+02	4.67E-03	---	---
Iron	3.64E+04	1.36E+06	2.68E-02	---	---
Lead	5.80E+01	8.00E+02	7.25E-02	---	---
Magnesium	8.13E+02	EN[5]	---	---	---
Manganese	9.93E+02	4.27E+04	2.33E-02	---	---
Mercury[7]	1.15E+00	7.60E+01	1.51E-02	---	---
Nickel	9.83E+00	3E+04	2.64E-04	1.34E+05	7.34E-11
Potassium	4.29E+02	EN[5]	---	---	---
Selenium	3.63E+00	9.73E+03	3.73E-04	---	---
Silver	3.25E-01	9.73E+03	---	---	---
Sodium	5.36E+01	EN[5]	---	---	---
Thallium	3.19E+00	1.95E+01	1.64E-01	---	---
Vanadium	6.52E+01	9.72E+03	6.71E-03	---	---
Zinc	4.45E+01	5.84E+05	7.62E-05	---	---
Organics (mg/kg)					
Acetone	3.80E-01	1.12E+06	3.39E-07	---	---
Bis[2-ethylhexyl]phthalate	5.90E-02	2.74E+04	2.15E-06	3.42E+02	1.73E-10
Carbon disulfide	2.82E-03	5.79E+03	4.87E-07	---	---
Chloroform	4.84E-04	1.71E+03	2.83E-07	2.88E+00	1.68E-10
Methyl acetate	2.17E-02	1.95E+06	1.11E-08	---	---
Methyl ethyl ketone	3.40E-02	3.22E+05	1.06E-07	---	---
Toluene	1.43E-02	7.81E+04	1.83E-07	---	---
Xylenes	5.17E-04	4.14E+03	1.25E-07	---	---
Pesticides/PCBs (mg/kg)					
DDD	1.07E-03	---	---	1.99E+01	5.38E-11
DDE	4.10E-03	---	---	1.93E+01	2.12E-10
DDT	8.19E-03	8.64E+02	9.48E-06	1.78E+01	4.60E-10
PCB-1254	2.04E-02	2.44E+01	8.36E-04	2.02E+00	1.01E-08
PCB-1260	9.40E-03	---	---	2.06E+00	4.56E-09
Radionuclides (pCi/g)					
Americium-241	8.80E-01	---	---	9.69E+00	9.08E-08
Americium-243(+D)	4.70E-02	---	---	5.39E-01	8.72E-08
Carbon-14	6.30E-01	---	---	2.31E+03	2.73E-10
Cesium-137(+D)	1.49E+02	---	---	1.80E-01	8.28E-04
Cobalt-60	1.55E+01	---	---	8.32E-02	1.87E-04
Curium-243 and Curium-244	9.80E-02	---	---	1.07E+00	9.16E-08
Plutonium-238	9.40E-02	---	---	2.88E+01	3.26E-09
Potassium-40	5.29E+01	---	---	4.56E-01	1.16E-04
Radium-226(+D)8	5.99E+00	---	---	4.36E-02	1.37E-04
Lead-210	1.90E+00	---	---	---	---
Lead-214	1.22E+01	---	---	---	---

Table D-7. Preliminary PTSM Screening Evaluation for Exposure Area 7 *(Continued/End)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
***Radionuclides (pCi/g* cont'd**					
Bismuth-214	1.24E+01	---	---	---	---
Thorium-230	1.59E+00	---	---	3.70E+01	4.30E-08
Thorium-231	9.60E-01	---	---	6.95E+04	1.38E-11
Thorium-232(+D)[9]	4.59E+01	---	---	8.85E-02	5.19E-04
Radium-224	4.59E+01	---	---	---	---
Radium-228	2.61E+00	---	---	---	---
Actinium-228	7.61E+00	---	---	---	---
Thorium-228	5.11E+00	---	---	---	---
Lead-212	7.16E+00	---	---	---	---
Bismuth-212	8.80E+00	---	---	---	---
Thallium-208	3.21E+00	---	---	---	---
Thorium-234(+D)	5.70E+00	---	---	7.03E+02	8.10E-09
Uranium-233 and Uranium- 234	1.33E+00	---	---	5.30E+01	2.51E-08
Uranium-235(+D)	3.60E-01	---	---	6.27E-01	5.74E-07
Uranium-238(+D)	1.80E+00	---	---	2.91E+00	6.19E-07
		Hazard Index	**0.40**	**Cumulative Risk**	**1.80E-03**
		PTSM?[10]	**NO**	**PTSM?[11]**	**NO**

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.7.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 1026.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for methyl mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk 1E-03 for carcinogenic constituents.

Table D-8. Preliminary PTSM Screening Evaluation for Exposure Area 8

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	3.69E+04	1.87E+06	1.97E-02	---	---
Antimony	1.29E+00	7.79E+02	1.66E-03	---	---
Arsenic	7.85E+00	7.99E+02	9.82E-03	6.24E+00	1.26E-06
Barium	1.18E+02	3.61E+05	3.27E-04	---	---
Beryllium	1.70E+00	3.82E+03	4.45E-04	1.45E+04	1.17E-10
Cadmium	5.49E-01	1.64E+03	3.35E-04	1.93E+04	2.84E-11
Calcium	5.65E+02	EN[5]	---	---	---
Chromium[6]	1.45E+02	5.81E+03	2.50E-02	1.32E+01	1.10E-05
Cobalt	1.33E+01	5.78E+02	2.30E-02	3.86E+03	3.45E-09
Copper	3.68E+01	7.79E+04	4.72E-04	---	---
Cyanide	2.60E+00	2.46E+02	1.06E-02	---	---
Iron	3.72E+04	1.36E+06	2.74E-02	---	---
Lead	9.81E+01	8.00E+02	1.23E-01	---	---
Magnesium	1.67E+03	EN[5]	---	---	---
Manganese	2.63E+02	4.27E+04	6.16E-03	---	---
Mercury[7]	1.27E+00	7.60E+01	1.66E-03	---	---
Nickel	1.71E+01	3.73E+04	4.58E-04	1.34E+05	1.28E-10
Potassium	9.16E+02	EN[5]	---	---	---
Selenium	2.87E+00	9.73E+03	2.95E-04	---	---
Silver	4.39E-01	9.73E+03	4.51E-05	---	---
Sodium	6.14E+01	EN[5]	---	---	---
Thallium	2.21E+00	1.95E+01	1.13E-01	---	---
Vanadium	7.34E+01	9.72E+03	7.55E-03	---	---
Zinc	1.21E+02	5.84E+05	2.07E-04	---	---
Organics (mg/kg)					
Acetone	1.05E+00	1.12E+06	9.38E-07	---	---
Bis[2-ethylhexyl]phthalate	2.20E-01	2.74E+04	8.03E-06	3.42E+02	6.43E-10
Carbon disulfide	8.77E-03	5.79E+03	1.51E-06	---	---
Methyl ethyl ketone	6.31E-02	3.22E+05	1.96E-07	---	---
Toluene	7.64E-03	7.81E+04	9.78E-08	---	---
Pesticides/PCBs (mg/kg)					
DDD	3.70E-01	---	---	1.99E+01	1.86E-08
DDE	5.11E-01	---	---	1.93E+01	2.65E-08
DDT	2.74E-01	8.64E+02	3.17E-04	1.78E+01	1.54E-08
PCB-1242	6.38E-02	---	---	1.98E+00	3.22e-08
PCB-1254	1.01E-01	2.44E+01	4.14E-03	2.02E+00	5.00E-08
Radionuclides (pCi/g)					
Americium-241	3.38E-01	---	---	9.69E+00	3.49E-08
Cesium-137(+D)	1.26E+02	---	---	1.80E-01	6.98E-04
Cobalt-60	5.86E-01	---	---	8.32E-02	7.04E-06
Plutonium-238	3.50E-02	---	---	2.88E+01	1.22E-09
Potassium-40	2.27E+01	---	---	4.56E-01	4.99E-05
Radium-226(+D)[8]	8.15E+00	---	---	4.36E-02	1.87E-04
Lead-214	8.15E+00	---	---	---	---
Bismuth-214	8.10E+00	---	---	---	---
Thorium-230	1.37E+00	---	---	3.70E+01	3.70E-08
Thorium-232(+D)[9]	4.16E+01	---	---	8.85E-02	4.70E-04
Radium-224	4.16E+01	---	---	---	---
Radium-228	3.07E+00	---	---	---	---
Actinium-228	7.51E+00	---	---	---	---
Thorium-228	2.32E+00	---	---		

Table D-8. Preliminary PTSM Screening Evaluation for Exposure Area 8 *(Continued/End)*

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Lead-212	6.59E+00	---	---		
Bismuth-212	7.53E+00	---	---		
Thallium-208	3.05E+00	---	---	---	---
Uranium-233 and Uranium-234	1.90E+00	---	---	5.30E+01	3.58E-08
Uranium-238(+D)	1.42E+00	---	---	2.91E+00	4.88E-07
		Hazard Index	**0.40**	**Cumulative Risk**	**1.80E-03**
		PTSM?[10]	**NO**	**PTSM?[11]**	**NO**

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.8.1.2).
2. Nonradiological RSLs are site-specific onsite worker soil scenario values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-224, Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Table D-9. Preliminary PTSM Screening Evaluation for Exposure Area 9

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Inorganics (mg/kg)					
Aluminum	1.80E+04	1.87E+06	9.63E-03	---	---
Arsenic	2.85E+00	7.99E+02	3.57E-03	6.24E+00	4.57E-07
Barium	8.61E+01	3.61E+05	2.39E-04	---	---
Beryllium	7.72E-01	3.82E+03	2.02E-04	1.45E+04	5.32E-11
Cadmium	5.05E-02	1.64E+03	3.08E-05	1.93E+04	
Calcium	8.17E+02	EN[5]	---	---	
Chromium[6]	3.27E+01	5.81E+03	5.63E-03	1.32E+01	
Cobalt	5.50E+00	5.78E+02	9.52E-03	3.86E+03	1.42E-09
Copper	1.41E+01	7.79E+04	1.81E-04	---	---
Cyanide	1.42E-01	2.46E+02	5.77E-04	---	---
Iron	1.76E+04	1.36E+06	1.29E-02	---	---
Lead	1.81E+01	8.00E+02	2.26E-02		
Magnesium	3.76E+02	EN[5]	---		
Manganese	1.81E+02	4.27E+04	4.24E-03		
Mercury[7]	7.66E-02	7.60E+01	1.01E-03		
Nickel	6.29E+00	3.73E+04	1.69E-04	1.34E+05	4.69E-11
Potassium	3.20E+02	EN[5]	---	---	---
Selenium	3.37E+00	9.73E+03	3.46E-04	---	---
Sodium	2.72E+01	EN[5]	---	---	---
Thallium	4.59E+00	1.95E+01	2.35E-01	---	---
Vanadium	4.23E+01	9.72E+03	4.35E-03	---	---
Zinc	3.11E+01	5.84E+05	5.33E-05	---	---
Organics (mg/kg)					
2-Hexanone	2.87E-04	2.24E+03	1.28E-07	---	---
Acetone	3.32E-01	1.12E+06	2.96E-07	---	---
Benzene	1.06E-03	7.05E+02	1.50E-06	1.06E+01	1.00E-10
Benzo[a]pyrene	5.29E-03	---	---	6.02E-01	8.79E-09
Benzo[b]fluoranthene	5.45E-03	---	---	6.02E+00	9.05E-10
Benzo[g,h,i]perylene	4.24E-03	---	---	---	---
Benzoic acid	3.08E-01	5.47E+06	5.63E-08	---	---
Bis[2-ethylhexyl]phthalate	2.67E-01	2.74E+04	9.74E-06	3.42E+02	7.81E-10
Camphene	2.50E-03	---	---	---	---
Carbon disulfide	1.76E-02	5.79E+03	3.04E-06	---	---
Chloroform	8.96E-04	1.71E+03	5.24E-07	2.88E+00	3.11E-10
Chloromethane	1.60E-03	7.72E+02	2.07E-06	---	---
Chrysene	4.38E-03	---	---	6.02E+02	7.28E-12
Dibutylphthalate	2.77E-02	1.37E+05	2.02E-07	---	---
Diethylphthalate	6.01E-03	1.09E+06	5.51E-09	---	---
Docosane	5.40E-01	---	---	---	---
Fluoranthene	7.13E-03	5.02E+04	1.42E-07	---	---
Methyl ethyl ketone	2.55E-02	3.22E+05	7.92E-08	---	---
Methyl isobutyl ketone	5.57E-04	2.31E+05	2.41E-09	---	---
Phenol	4.21E-03	4.10E+05	1.03E-08	---	---
Phenols	2.15E-01	4.10E+05	5.24E-07	---	---
Pyrene	6.67E-03	3.77E+04	1.77E-07	---	---
Styrene	1.49E-04	5.81E+04	2.56E-09	---	---
Toluene	3.90E-03	7.81E+04	4.99E-08	---	---
Xylenes	4.58E-04	4.14E+03	1.11E-07	---	---
Pesticides/PCBs (mg/kg)					
DDE	8.48E-04	---	---	1.93E+01	4.39E-11
PCB-1254	1.90E-03	2.44E+01	7.79E-05	2.02E+00	9.41E-10

Table D-9. Preliminary PTSM Screening Evaluation for Exposure Area 9
(Continued/End)

Constituent	Exposure Point Concentration[1]	Noncarcinogenic Hazard Estimate		Carcinogenic Risk Estimate	
		Onsite Worker		Onsite Worker	
		RSL[2]	Hazard Quotient (HQ) Estimate[3]	RSL/PRG[2]	Risk Estimate[4]
Radionuclides (pCi/g)					
Cesium-137(+D)	1.17E+02	---	---	1.80E-01	6.47E-04
Cobalt-60	4.48E-01	---	---	8.32E-02	5.38E-06
Manganese-54	4.76E-02	---	---	1.52E+00	3.13E-08
Plutonium-238	1.76E-01	---	---	2.88E+01	6.11E-09
Plutonium-239/240	1.71E-01	---	---	2.54E+01	6.73E-09
Potassium-40	3.22E+00	---	---	4.56E-01	7.06E-06
Radium-226(+D)[8]	2.06E+00	---	---	4.36E-02	4.72E-05
Lead-214	1.94E+00	---	---	---	---
Bismuth-214	2.06E+00	---	---	---	---
Strontium-89/-90(+D)	1.30E+00	---	---	1.77E+01	7.34E-08
Strontium-90(+D)	2.28E+00	---	---	1.77E+01	1.29E-07
Thorium-230	1.56E+00	---	---	3.70E+01	4.22E-08
Thorium-232(+D)[9]	3.56E+00	---	---	8.85E-02	4.02E-05
Actinium-228	3.45E+00	---	---	---	---
Thorium-228	3.56E+00	---	---	---	---
Radium-228	1.17E+00	---	---	---	---
Lead-212	3.22E+00	---	---	---	---
Thallium-208	1.04E+00	---	---	---	---
Thorium-234(+D)	3.83E+00	---	---	7.03E+02	5.45E-09
Uranium-233 and Uranium- 234	2.29E+00	---	---	5.30E+01	4.32E-08
Uranium-238(+D)	2.82E+00	---	---	2.91E+00	9.69E-07
		Hazard Index	**0.31**	**Cumulative Risk**	**7.51E-04**
		PTSM?10	**NO**	**PTSM?11**	**NO**

1. EPC - maximum detected concentration from all sediment and sediment/soil depth intervals (see Table A.1.9.1.2).
2. Nonradiological RSLs are site-specific onsite worker scenario soil values from the *USEPA Regional Screening Levels (RSLs)* calculator (see Attachment D-1). Radiological PRGs are site-specific onsite worker scenario soil values from the *USEPA Radiological Preliminary Remediation Goals (PRGs) for Superfund* calculator (see Attachment D-2). Websites accessed October 23, 2016.
3. Hazard Estimate - exposure point concentration / RSL concentration.
4. Risk Estimate - (exposure point concentration / PRG or RSL concentration) × 1E-06.
5. EN - essential nutrient, RSL is not available.
6. RSL for hexavalent chromium used.
7. RSL for elemental mercury used.
8. Pb-214 and Bi-214 are daughter products of Ra-226 and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from B-214, Pb-214 and Ra-226 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Ra-226(+D) PRG.
9. Ra-228, Ac-228, Th-228, Pb-212, B-212, and Tl-208 are daughter products of Th-232, and can be used to estimate its activity since these constituents are in secular equilibrium. The highest detected activity from the Ra-228, Ac-228, Th-228, Pb-212, B-212, Tl-208, and Th-232 measurements was used in this assessment. The daughter products are not screened separately since they are considered in the Th-232(+D) PRG.
10. Waste unit potentially has PTSM if HI □ 10 for noncarcinogenic constituents.
11. Waste unit potentially has PTSM if cumulative risk ◆ 1E-03 for carcinogenic constituents.

Attachment D-1

USEPA Regional Screening Levels Website:
Site-Specific RSLs for Onsite Worker Scenario (website accessed October 14, 2016)

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Site-specific
Onsite Worker Equation Inputs for Sediment/Soil

Variable	Value
TR (target cancer risk) unitless	0.000001
THQ (target hazard quotient) unitless	1
AT**ow** (averaging time - outdoor worker)	365
EF**ow** (exposure frequency - outdoor worker) day/yr	150
ED**ow** (exposure duration - outdoor worker) yr	20
ET**ow** (exposure time - outdoor worker) hr	8
LT (lifetime) yr	70
BW**ow** (body weight - outdoor worker)	80
IR**ow** (soil ingestion rate - outdoor worker) mg/day	100
SA**ow** (surface area - outdoor worker) cm^2/day	3,527
AF**ow** (skin adherence factor - outdoor worker) mg/cm^2	0.12

Site-specific
Onsite Worker Risk-Based Screening Levels for Sediment/Soil

Chemical	Ingestion SF *(mg/kg-day)*$^{-1}$	Inhalation Unit Risk *(µg/m^3)*$^{-1}$	Chronic RfD *(mg/kg-day)*	Chronic RfC *(mg/m^3)*	Ingestion SL TR=1.0E-6 *(mg/kg)*	Dermal SL TR=1.0E-6 *(mg/kg)*	Inhalation SL TR=1.0E-6 *(mg/kg)*	Carcinogenic SL TR=1.0E-6 *(mg/kg)*	Ingestion SL THQ=1 *(mg/kg)*	Dermal SL THQ=1 *(mg/kg)*	Inhalation SL THQ=1 *(mg/kg)*	Noncarcinogenic SL THI=1 *(mg/kg)*	Screening Level *(mg/kg)*
Acetone	-	-	9.00E-01	3.09E+01	-	-	-	-	1.75E+06	-	3.08E+06	1.12E+06	1.12E+06 sat
Aluminum	-	-	1.00E+00	5.00E-03	-	-	-	-	1.95E+06	-	4.96E+07	1.87E+06	1.87E+06 max
Antimony (metallic)	-	-	4.00E-04	-	-	-	-	-	7.79E+02	-	-	7.79E+02	7.79E+02 nc
Aroclor 1242	2.00E+00	5.71E-04	-	-	3.41E+00	5.75E+00	2.64E+01	1.98E+00	-	-	-	-	1.98E+00 ca
Aroclor 1254	2.00E+00	5.71E-04	2.00E-05	-	3.41E+00	5.75E+00	3.77E+01	2.02E+00	3.89E+01	6.57E+01	-	2.44E+01	2.02E+00 ca*
Aroclor 1260	2.00E+00	5.71E-04	-	-	3.41E+00	5.75E+00	5.89E+01	2.06E+00	-	-	-	-	2.06E+00 ca
Arsenic, Inorganic	1.50E+00	4.30E-03	3.00E-04	1.50E-05	7.57E+00	3.58E+01	8.08E+03	6.24E+00	9.73E+02	4.60E+03	1.49E+05	7.99E+02	6.24E+00 ca
Barium	-	-	2.00E-01	5.00E-04	-	-	-	-	3.89E+05	-	4.96E+06	3.61E+05	3.61E+05 max
Benzaldehyde	4.00E-03	-	1.00E-01	-	1.70E+03	-	-	1.70E+03	1.95E+05	-	-	1.95E+05	1.70E+03 sat
Benzene	5.50E-02	7.80E-06	4.00E-03	3.00E-02	1.24E+02	-	1.16E+01	1.06E+01	7.79E+03	-	7.75E+02	7.05E+02	1.06E+01 ca*
Benzo[a]pyrene	7.30E+00	1.10E-03	-	-	9.33E-01	1.70E+00	3.16E+04	6.02E-01	-	-	-	-	6.02E-01 ca
Benzo[b]fluoranthene	7.30E-01	1.10E-04	-	-	9.33E+00	1.70E+01	3.16E+05	6.02E+00	-	-	-	-	6.02E+00 ca
Benzo[g,h,i]perylene	-	-	-	-	-	-	-	-	-	-	-	-	
Benzoic Acid	-	-	4.00E+00	-	-	-	-	-	7.79E+06	1.84E+07	-	5.47E+06	5.47E+06 max
Beryllium and compounds	-	2.40E-03	2.00E-03	2.00E-05	-	-	1.45E+04	1.45E+04	3.89E+03	-	1.98E+05	3.82E+03	3.82E+03 nc
Bis(2-chloroethyl)ether	1.10E+00	3.30E-04	-	-	6.19E+00	-	3.29E+00	2.15E+00	-	-	-	-	2.15E+00 ca
Bis(2-ethylhexyl)phthalate	1.40E-02	2.40E-06	2.00E-02	-	4.87E+02	1.15E+03	1.45E+07	3.42E+02	3.89E+04	9.20E+04	-	2.74E+04	3.42E+02 ca*
Butyl Benzyl Phthalate	1.90E-03	-	2.00E-01	-	3.59E+03	8.47E+03	-	2.52E+03	3.89E+05	9.20E+05	-	2.74E+05	2.52E+03 ca
Cadmium (Diet)	-	1.80E-03	1.00E-03	1.00E-05	-	-	1.93E+04	1.93E+04	1.95E+03	1.15E+04	9.92E+04	1.64E+03	1.64E+03 nc
Carbon Disulfide	-	-	1.00E-01	7.00E-01	-	-	-	-	1.95E+05	-	5.97E+03	5.79E+03	5.79E+03 sat
Chloroform	3.10E-02	2.30E-05	1.00E-02	9.77E-02	2.20E+02	-	2.92E+00	2.88E+00	1.95E+04	-	1.87E+03	1.71E+03	2.88E+00 ca
Chloromethane	-	-	-	9.00E-02	-	-	-	-	-	-	7.72E+02	7.72E+02	7.72E+02 nc

Site-specific
Onsite Worker Risk-Based Screening Levels for Sediment/Soil (cont.)

Chemical	Ingestion SF *(mg/kg-day)*-1	Inhalation Unit Risk *(µg/m3)*-1	Chronic RfD *(mg/kg-day)*	Chronic RfC *(mg/m3)*	Ingestion SL TR=1.0E-6 *(mg/kg)*	Dermal SL TR=1.0E-6 *(mg/kg)*	Inhalation SL TR=1.0E-6 *(mg/kg)*	Carcinogenic SL TR=1.0E-6 *(mg/kg)*	Ingestion SL THQ=1 *(mg/kg)*	Dermal SL THQ=1 *(mg/kg)*	Inhalation SL THQ=1 *(mg/kg)*	Noncarcinogenic SL THI=1 *(mg/kg)*	Screening Level *(mg/kg)*
Chlorophenol, 2-	-	-	5.00E-03	-	-	-	-	-	9.73E+03	-	-	9.73E+03	9.73E+03 nc
Chromium(III)	-	-	1.50E+00	-	-	-	-	-	2.92E+06	-	-	2.92E+06	2.92E+06 max
Chromium(VI)	5.00E-01	8.40E-02	3.00E-03	1.00E-04	1.36E+01	-	4.13E+02	1.32E+01	5.84E+03	-	9.92E+05	5.81E+03	1.32E+01 ca
Chrysene	7.30E-03	1.10E-05	-	-	9.33E+02	1.70E+03	3.16E+06	6.02E+02	-	-	-	-	6.02E+02 ca
Cobalt	-	9.00E-03	3.00E-04	6.00E-06	-	-	3.86E+03	3.86E+03	5.84E+02	-	5.95E+04	5.78E+02	5.78E+02 nc
Copper	-	-	4.00E-02	-	-	-	-	-	7.79E+04	-	-	7.79E+04	7.79E+04 nc
Cumen (isopropylbenzene)	-	-	1.00E-01	4.00E-01	-	-	-	-	1.95E+05	-	1.81E+04	1.66E+04	1.66E+04 nc
Cyanide	-	-	6.0E-04	8.0E-04	-	-	-	-	1.17E+03	-	3.11E+02	2.46E+02	2.46E+02 nc
DDD	2.40E-01	6.90E-05	-	-	2.84E+01	6.71E+01	5.03E+05	1.99E+01	-	-	-	-	1.99E+01 ca
DDE, p,p'-	3.40E-01	9.70E-05	-	-	2.00E+01	-	5.54E+02	1.93E+01	-	-	-	-	1.93E+01 ca
DDT	3.40E-01	9.70E-05	5.00E-04	-	2.00E+01	1.58E+02	3.58E+05	1.78E+01	9.73E+02	7.67E+03	-	8.64E+02	1.78E+01 ca*
DDT/DDE/DDD (total)	-	-	-	-	-	-	-	-	-	-	-	-	
Dibutylphthalate	-	-	1.00E-01	-	-	-	-	-	1.95E+05	4.60E+05	-	1.37E+05	1.37E+05 max
Diethylphthalate	-	-	8.00E-01	-	-	-	-		1.56E+06	3.68E+06	-	1.09E+06	1.09E+06 nc
Ethylbenzene	1.10E-02	2.50E-06	1.00E-01	1.00E+00	6.19E+02	-	5.79E+01	5.30E+01	1.95E+05	-	4.14E+04	3.41E+04	5.30E+01 ca
Fluoranthene	-	-	4.00E-02	-	-	-	-	-	7.79E+04	1.42E+05	-	5.02E+04	5.02E+04 nc
Hexanone, 2-	-	-	5.00E-03	3.00E-02	-	-	-	-	9.73E+03	-	2.91E+03	2.24E+03	2.24E+03 nc
Iron	-	-	7.00E-01	-	-	-	-	-	1.36E+06	-	-	1.36E+06	1.36E+06 max
Lead and Compounds	-	-	-	-	-	-	-	-	-	-	-	8.00E+02	8.00E+02 nc
Manganese	-	-	2.40E_02	5.00E-05	-	-	-	-	4.67E+04	-	4.96E+05	4.27E+04	4.27E+04 nc
Mercuric Chloride	-	-	3.00E-04	3.00E-04	-	-	-	-	5.84E+02	-	2.98E+06	5.84E+02	5.84E+02 nc
Mercury (elemental)	-	-	-	3.00E-04	-	-	-	-	-	-	7.60E+01	7.60E+01	7.60E+01 sat
Methoxychlor	-	-	5.00E-03	-	-	-	-	-	9.73E+03	2.30E+04	-	6.84E+03	6.84E+03 nc
Methyl Acetate	-	-	1.00E+00	-	-	-	-	-	1.95E+06	-	-	1.95E+06	1.95E+06 sat
Methyl Ethyl Ketone	-	-	6.00E-01	5.00E+00	-	-	-	-	1.17E+06	-	4.45E+05	3.22E+05	3.22E+05 sat
Methyl Isobutyl Ketone	-	-	-	3.00E+00	-	-	-	-	-	-	2.31E+05	2.31E+05	2.31E+05 sat
Methyl Mercury	-	-	1.00E-04	-	-	-	-	-	1.95E+02	-	-	1.95E+02	1.95E+02 nc
Methylnaphthalene, 2-	-	-	4.00E-03	-	-	-	-	-	7.79E+03	1.42E+04	-	5.02E+03	5.02E+03 nc
Nickel Soluble Salts	-	2.60E-04	2.00E-02	9.00E-05	-	-	1.34E+05	1.34E+05	3.89E+04	-	8.93E+05	3.73E+04	3.73E+04 nc
Nitrate + Nitrite (as N)	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrite	-	-	1.00E-01	-	-	-	-	-	1.95E+05	-	-	1.95E+05	1.95E+05 max
Phenanthrene	-	-	-	-	-	-	-	-	-	-	-	-	
Phenol	-	-	3.00E-01	2.00E-01	-	-	-	-	5.84E+05	1.38E+06	1.98E+09	4.10E+05	4.10E+05 max
Pyrene	-	-	3.00E-02	-	-	-	-	-	5.84E+04	1.06E+05	-	3.77E+04	3.77E+04 nc
Selenium	-	-	5.00E-03	2.00E-02	-	-	-	-	9.73E+03	-	1.98E+08	9.73E+03	9.73E+03 nc
Silver	-	-	5.00E-03	-	-	-	-	-	9.73E+03	-	-	9.73E+03	9.73E+03 nc
Styrene	-	-	2.00E-01	1.00E+00	-	-	-	-	3.89E+05	-	6.83E+04	5.81E+04	5.81E+04 sat
Thallium (Soluble Salts)	-	-	1.00E-05	-	-	-	-	-	1.95E+01	-	-	1.95E+01	1.95E+01 nc
Toluene	-	-	8.00E-02	5.00E+00	-	-	-	-	1.56E+05	-	1.57E+05	7.81E+04	7.81E+04 sat
Vanadium and Compounds	-	-	5.04E-03	1.00E-04	-	-	-	-	9.81E+03	-	9.92E+05	9.72E+03	9.72E+03 nc
Xylenes	-	-	2.00E-01	1.00E-01	-	-	-	-	3.89E+05	-	4.19E+03	4.14E+03	4.14E+03 sat
Zinc and Compounds	-	-	3.00E-01	-	-	-	-	-	5.84E+05	-	-	5.84E+05	5.84E+05 max

SF = slope factor
RfD = reference dose
RfC = reference concentration

SL = screening level
TR = target risk
THQ = target hazard quotient

THI = target hazard index
ca = cancer
ca* = cancer – where nc <100X ca SL

max = SL exceeds ceiling limit
nc = noncancer
sat = SL exceeds csat

Attachment D-2

USEPA Radionuclide Preliminary Remediation Goals for Superfund Website:
Site-Specific PRGs for Onsite Worker Scenario
(website accessed October 23, 2016)

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Site-specific Onsite Worker Equation Inputs for Sediment/Soil

Variable	Value	Variable	Value
Slab size for ACF (area correction factor) m**2**	1000,029	A**s** (acres)	0.5
Cover layer thickness for GSF (gamma shielding factor) cm	0	A**s** (acres)	0.5
TR (target cancer risk) unitless	0.000001	Q/C**wp** (g/m^2-s per kg/m**3**)	93.77
t**ow** (time - outdoor worker) yr	20	PEF (particulate emission factor) m^3/kg	1.359E+09
EF**ow** (exposure frequency - outdoor worker) day/yr	150	A (PEF Dispersion Constant)	16.2302
ED**ow** (exposure duration - outdoor worker) yr	20	B (PEF Dispersion Constant)	18.7762
IRS**ow** (soil intake rate - outdoor worker) mg/day	100	C (PEF Dispersion Constant)	216.108
IRA**ow** (inhalation rate - outdoor worker) m**3**/day	60	V (fraction of vegetative cover) unitless	0.5
ET**ow** (exposure time - outdoor worker) hr/day	8	U**m** (mean annual wind speed) m/s	4.69
City (Climate Zone)	0	U**t** (equivalent threshold value)	11.32
A**s** (acres)	0.5	F(x) (function dependent on U**m**/U**t**) unitless	0.194

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Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Ac-228	4.92E-11	4.04E-06	8.58E-13	7.67E+07	9.09E+09	1.78E+03	1.78E+03
Am-241	3.77E-08	2.77E-08	9.10E-11	3.72E+01	6.11E+02	1.34E+01	9.69E+00
Am-243	3.70E-08	9.78E-08	9.03E-11	3.69E+01	6.13E+02	3.74E+00	3.37E+00
Am-243+D	3.70E-08	6.67E-07	9.25E-11	3.61E+01	6.13E+02	5.48E-01	5.39E-01
Ba-133	3.29E-11	1.44E-06	4.40E-12	1.36E+03	1.24E+06	4.56E-01	4.56E-01
Bi-212	8.44E-11	4.96E-07	4.44E-13	9.04E+08	3.23E+10	8.86E+04	8.86E+04
Bi-212+D	8.44E-11	4.96E-07	4.44E-13	9.04E+08	3.23E+10	8.86E+04	8.86E+04
Bi-214	3.10E-11	7.34E-06	1.47E-13	8.30E+09	2.67E+11	1.82E+04	1.82E+04
Bi-214+D	3.10E-11	7.34E-06	1.47E-13	8.30E+09	2.67E+11	1.82E+04	1.82E+04
C-14	1.69E-11	7.86E-12	1.38E-12	2.42E+03	1.34E+06	5.17E+04	2.31E+03
Cf-244	3.23E-11	6.06E-11	9.03E-14	1.39E+10	2.64E+11	2.26E+09	1.93E+09
Cm-243	3.70E-08	4.20E-07	7.88E-11	53.2E+01	7.74E+02	1.09E+00	1.07E+00
Cm-244	3.56E-08	1.40E-10	6.88E-11	6.94E+01	9.11E+02	3.73E+03	6.34E+01
Cm-245	3.81E-08	2.74E-07	9.18E-11	3.63E+01	5.95E+02	1.33E+00	1.28E+00
Cm-246	3.81E-08	1.80E-08	9.10E-11	3.67E+01	5.96E+02	2.03E+01	1.28E+01
Cm-247	3.49E-08	1.31E-06	8.58E-11	3.89E+01	6.49E+02	2.79E-01	2.77E-01
Cm-247+D	3.49E-08	1.37E-06	8.62E-11	3.87E+01	6.49E+02	2.66E-01	2.64E-01

Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil *(Continued/)*

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Co-58	7.92E-12	4.48E-06	1.56E-12	1.53E+05	2.04E+08	5.82E+00	5.82E+00
Co-60	1.01E-10	1.24E-05	7.33E-12	1.29E+03	6.34E+05	8.32E-02	8.32E-02
Cs-134	6.99E-11	7.10E-06	4.48E-11	5.01E+02	2.18E+06	3.46E-01	3.46E-01
Cs-137	1.12E-10	5.52E-10	3.18E-11	1.31E+02	2.52E+05	8.25E+02	1.13E+02
Cs-137+D	1.12E-10	2.53E-06	3.18E-11	1.31E+02	2.52E+05	1.80E-01	1.80E-01
Eu-152	1.91E-10	5.41E-06	2.87E-12	1.86E+03	1.90E+05	1.08E-01	1.08E-01
Eu-155	1.92E-11	1.25E-07	8.29E-13	1.24E+04	3.64E+06	9.01E+00	9.01E+00
I-129	1.64E-10	6.18E-09	1.17E-10	2.85E+01	1.38E+05	5.91E+01	1.92E+01
K-40	2.22E-10	7.99E-07	1.51E-11	2.21E+02	1.02E+05	4.57E-01	4.56E-01
Mn-54	1.21E-11	3.89E-06	1.48E-12	3.65E+04	3.03E+07	1.52E+00	1.52E+00
Np-237	2.87E-08	5.17E-08	4.70E-11	7.09E+01	7.89E+02	7.06E+00	6.37E+00
Np-237+D	2.87E-08	8.55E-07	4.96E-11	6.72E+01	7.89E+02	4.27E-01	4.24E-01
Np-239	4.48E-12	5.69E-07	2.19E-12	3.26E+06	1.08E+10	1.37E+03	1.37E+03
Pb-210	1.59E-08	1.48E-09	5.99E-10	7.48E+00	1.92E+03	3.32E+02	7.29E+00
Pb-212	6.40E-10	4.96E-07	1.31E-11	2.91E+06	4.04E+08	8.40E+03	8.38E+03
Pb-214	4.00E-11	9.94E-07	2.21E-13	4.10E+09	1.54E+11	9.99E+04	9.99E+04
Pm-146	1.02E-10	3.27E-06	1.97E-12	4.61E+03	6.05E+05	3.04E-01	3.04E-01
Pu-238	5.22E-08	6.91E-11	1.17E-10	3.08E+01	4.69E+02	5.71E+03	2.88E+01
Pu-239	5.55E-08	2.09E-10	1.21E-10	2.76E+01	4.08E+02	1.75E+03	2.54E+01
Pu-239+D	5.55E-08	2.09E-10	1.21E-10	2.76E+01	4.08E+02	1.75E+03	2.54E+01
Pu-240	5.55E-08	7.12E-11	1.21E-10	2.76E+01	4.09E+02	5.13E+03	2.57E+01
Ra-224	1.13E-08	3.91E-08	8.47E-11	5.44E+04	2.77E+06	1.29E+04	1.04E+04
Ra-224+D	1.13E-08	4.19E-08	8.47E-11	5.44E+04	2.77E+06	1.20E+04	9.82E+03
Ra-226	2.82E-08	2.50E-08	2.95E-10	1.13E+01	8.07E+02	1.47E+01	6.35E+00
Ra-226+D	2.82E-08	8.37E-06	2.95E-10	1.13E+01	8.07E+02	4.38E-02	4.36E-02
Ru-106	2.24E-10	0.00E+00	1.84E-11	2.45E+03	1.37E+06	-	2.45E+03
Ru-106+D	2.24E-10	9.71E-07	1.84E-11	2.45E+03	1.37E+06	5.09E+00	5.08E+00
Sn-113	1.47E-11	2.28E-08	1.89E-12	7.76E+04	6.78E+07	7.04E+02	6.98E+02
Sr-89	3.03E-11	7.24E-09	6.51E-12	5.13E+04	7.49E+07	5.05E+03	4.60E+03
Sr-90	4.26E-10	4.83E-10	5.14E-11	8.17E+01	6.70E+04	1.06E+03	7.58E+01
Sr-90+D	4.33E-10	1.95E-08	5.88E-11	7.14E+01	6.59E+04	2.36E+01	1.77E+01
Th-228	1.32E-07	5.64E-09	6.40E-11	3.78E+02	1.25E+03	4.70E+02	1.79E+02
Th-230	3.41E-08	8.45E-10	7.73E-11	4.31E+01	6.64E+02	4.32E+02	3.70E+01

Site-specific Onsite Worker Preliminary Remediation Goals for Sediment/Soil *(Continued/End)*

Isotope	Inhalation Slope Factor *(risk/pCi)*	External Exposure Slope Factor *(risk/yr per pCi/g)*	Adult Soil Ingestion Slope Factor *(risk/pCi)*	Ingestion PRG *(pCi/g)*	Inhalation PRG *(pCi/g)*	External Exposure PRG *(pCi/g)*	Total PRG *(pCi/g)*
Th-230	3.41E-08	8.45E-10	7.73E-11	4.31E+01	6.64E+02	4.32E+02	3.70E+01
Th-231	1.50E-12	2.49E-08	9.07E-13	1.75E+07	7.19E+10	6.98E+04	6.95E+04
Th-232	4.33E-08	3.58E-10	8.47E-11	3.94E+01	5.23E+02	1.02E+03	3.53E+01
Th-232+D	8.70E-08	4.04E-06	7.55E-10	4.42E+00	2.60E+02	9.03E-02	8.85E-02
Th-234	3.08E-11	1.77E-08	9.51E-12	7.36E+04	1.54E+08	4.33E+03	4.09E+03
Th-234+D	3.08E-11	1.08E-07	9.51E-12	7.36E+04	1.54E+08	7.10E+02	7.03E+02
Tl-208	0.00E+00	1.75E-05	0.00E+00	-	-	4.96E+04	4.96E+04
U-233	2.83E-08	7.11E-10	5.22E-11	6.39E+01	8.01E+02	5.13E+02	5.30E+01
U-234	2.78E-08	2.53E-10	5.11E-11	6.52E+01	8.15E+02	1.44E+03	5.80E+01
U-235	2.50E-08	5.51E-07	4.92E-11	6.78E+01	9.06E+02	6.62E-01	6.56E-01
U-235+D	2.50E-08	5.76E-07	5.00E-11	6.67E+01	9.06E+02	6.34E-01	6.27E-01
U-238	2.36E-08	1.24E-10	4.66E-11	7.15E+01	9.60E+02	2.94E+03	6.51E+01
U-238+D	2.37E-08	1.19E-07	5.62E-11	5.93E+01	9.56E+02	3.07E+00	2.91E+00
Zn-65	7.55E-12	2.80E-06	8.92E-12	7.77E+03	6.24E+07	2.71E+00	2.71E+00
Zr-95	2.12E-11	3.36E-06	2.18E-12	1.21E+05	8.44E+07	8.58E+00	8.58E+00

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PRG = preliminary remediation goal

+D = includes contribution from short-lived decay products (i.e., decay chain daughters)

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APPENDIX E

Remedial Goal Option Calculations

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E.1 INTRODUCTION

The remedial goal option (RGO) calculations for the Lower Three Runs (LTR) Integrator Operable Unit (IOU) are provided in this appendix.

E.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS RGOs

As presented in the Remedial Investigation (RI), there are no applicable, relevant, or appropriate requirement (ARAR) refined constituents of concern (RCOCs) identified for any media (e.g., surface water) within the LTR IOU. Therefore, no ARAR RGOs are presented.

E.3 HUMAN HEALTH RISK-BASED RGOs

The human health risk assessment (HHRA) is presented in Appendix B of this document. Human health (HH) RCOCs, cesium-137(+D) (Cs-137[+D]) and cobalt-60 (Co-60), were identified in sediment/soil media for the resident, industrial worker and onsite worker scenarios. Risk-based RGOs are based on the preliminary remediation goals (PRGs) presented in Appendix B and are calculated for each of these scenarios at various target risk levels (1E-06, 1E-05, and 1E-04). The HH RGOs for sediment/soil media are provided in Table E-1.

Table E-1. Human Health Risk-Based RGOs for Sediment/Soil Media

HH RCOC	Exposure Medium	Units	Resident			Industrial Worker			Onsite Worker		
			1E-06	1E-05	1E-04	1E-06	1E-05	1E-04	1E-06	1E-05	1E-04
Cs-137(+D)	Sediment/soil	pCi/g	0.0606	0.606	6.06	0.0910	0.910	9.1	0.18	1.8	18
Co-60	Sediment/soil	pCi/g	0.0329	0.329	3.29	0.048	0.48	4.8	0.0832	0.832	8.32
NA = not applicable											

The HHRA also identified Cs-137 and mercury as RCOCs in fish tissue consumed by a recreational fisherman receptor. Risk-based RGOs for Cs-137(+D) are calculated at the same target risk levels (1E-06, 1E-05, and 1E-04) using the PRGs presented in Appendix B. The RGOs for mercury, a noncarcinogen, are calculated at the hazard quotient (HQ) = 0.1, HQ = 1, and HQ = 3 levels using the regional screening levels (RSLs) presented in Appendix B. The HH RGOs for fish tissue are provided in Table E-2.

No HH RCOCs were identified for surface water media.

Table E-2. Human Health Risk-Based RGOs for Fish Tissue

HH RCOC	Exposure Medium	Units	Recreational Fisherman					
			1E-06	1E-05	1E-04	HQ = 0.1	HQ = 1	HQ = 3
Cs-137(+D)	Fish tissue	pCi/g	0.0544	0.544	5.4	NA	NA	NA
Mercury	Fish tissue	mg/kg	NA	NA	NA	0.0154	0.154	0.462
NA = not applicable								

E.4 ECOLOGICAL RISK-BASED RGOs

The ecological risk assessment (ERA) is presented in Appendix C of this document. No ecological RCOCs were identified for the LTR IOU; therefore, RGOs are not developed in this appendix.

E.5 PTSM RGOs

The principal threat source material (PTSM) evaluation is presented in Appendix D of this document. No PTSM RCOCs were identified for the LTR IOU; therefore, RGOs are not developed in this appendix.

APPENDIX F

Natural Resource Injury Evaluation Checklist

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NATURAL RESOURCE INJURY EVALUATION CHECKLIST

This checklist is provided to assist project teams in determining the potential for natural resource injuries in the conduct and planning of remedial activities. For the most part, the questions only require a simple 'yes/no' or 'to be determined' response. Some require a short answer or explanation. However, it is in the best interest of the project team to be as complete as possible and add any relevant information.

Five main areas are being evaluated, as follows:

- Are there potential natural resource injuries and what do they consist of?
- What are the potential impacts from implementing the remedial alternatives?
- Are there potential residual injuries that will not be addressed by the alternative?
- Would implementation of the alternative cause additional injuries?
- What potential irreversible and irretrievable resources may be identified?

The checklist should be re-visited and revised as Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities continue and additional information becomes available.

1. Has a release of a hazardous substance occurred?

Yes. Integrator Operable Unit (IOU)-related constituents were identified in sediment/soil and surface water media.

2a. Have natural resources for which Federal or State agencies (or Indian Tribes) may assert trusteeship under CERCLA been or are likely to have been adversely affected by the release?

Yes. Natural resources are defined by Section 101(16) of CERCLA, as "land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources." The National Contingency Plan (NCP) Section 300.600(b) indicates that natural resources may include not only the environmental organisms and abiotic resources, but the "supporting

ecosystems associated with the biotic resources" as well. Resources are categorized into five groups: 1) Surface water resources, 2) groundwater resources, 3) air resources, 4) geologic resources, and 5) biological resources. Resources can also be classified as direct use (i.e., drinking water, hunting, etc.) or nonuse (i.e., aesthetic value or existence). Nonuse services do not require physical or visual contact between people and the resource. Nonuse resources include resources that provide well-being for people (or other flora/fauna) because they exist (e.g., nesting sites, threatened and endangered species, natural areas, etc.).

2b. List the potentially affected resources (e.g. ground water, waterfowl, etc.).

Potentially affected resources include geologic resources (soil/sediment), and contaminants in fish tissue (cesium-137 and mercury) have been identified. Waterfowl surveys have also indicated elevated levels of cesium-137.

3. Is the amount of hazardous substance released sufficient to potentially cause a natural resource injury?

Yes, based on human health assessment of cesium-137 and cobalt-60 in sediment/soil and cesium-137 and mercury in fish.

4. Will the remedial alternatives being considered, or action already taken, sufficiently address the injuries to natural resources (including residual injuries)?

Remedial alternatives will be identified and evaluated in the Feasibility Study (FS). Each alternative is evaluated as to whether it would be protective of human health and the environment.

5. Will the remedial alternatives being considered produce additional impacts to natural resources during remediation?

If yes, the potential impacts associated with each alternative need to be identified and discussed in the appropriate documentation including the feasibility study, statement of basis/proposed plan, record of decision or permit modification.

Remedial alternatives will be identified and evaluated in the FS. Each alternative is evaluated as to whether it would be protective of human health and the environment.

The potential costs for addressing resource injuries should be taken into consideration when selecting a remedial alternative. The liability (damage) associated with resource injuries could drive the cost of the intended best or lowest cost alternative.

6. Identify any irreversible and/or irretrievable resource losses in the appropriate documentation.

No irreversible and/or irretrievable resource losses are known to exist.

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