

**2024 CERCLA Five-Year Review for the Upper East Fork
Poplar Creek and Chestnut Ridge Administrative Watersheds and
the Lower East Fork Poplar Creek and Oak Ridge Associated
Universities South Campus Facility Operable Units on the
U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee**



This document has been reviewed and confirmed to be
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Date: 06/26/2024

UCOR eDC/RO ID: 43844

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DOE/OR/01-2962&D1

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Date Issued—July 2024

Prepared for the
U.S. Department of Energy
Office of Environmental Management

United Cleanup Oak Ridge LLC
under contract 89303322DEM000067

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ACRONYMS

AEA	Atomic Energy Act of 1954
AM	Action Memorandum
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
BCBG	Bear Creek Burial Grounds
BCV	Bear Creek Valley
bgs	below ground surface
BMP	best management practice
BSWTS	Big Spring Water Treatment System
BV	Bethel Valley
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ChR	Chestnut Ridge
CMP	Comprehensive Monitoring Plan
CMTS	Central Mercury Treatment System
COC	contaminant of concern
COLEX	column-exchange
CPU	central processing unit
CR	Clinch River
CROET	Community Reuse Organization of East Tennessee
CSF	cancer slope factor
D&D	decontamination and decommissioning
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DOE	U.S. Department of Energy
ECU	excavation confirmation unit
EEMTS	East End Mercury Treatment System
EEVOC	East End Volatile Organic Compound
EFK	East Fork kilometer
EFPC	East Fork Poplar Creek
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
EPP	excavation/penetration permit
ERA	ecological risk assessment
ESD	Explanation of Significant Differences
ETTP	East Tennessee Technology Park
EU	exposure unit
EUWG	End Use Working Group
FCAP	Filled Coal Ash Pond
FFA	Federal Facility Agreement
FI	fraction ingested
FIT	Facility Instruction and Training
FR	Federal Register
FS	feasibility study
FY	fiscal year
FYR	Five-Year Review
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient

ILCR	incremental lifetime cancer risk
IP	integration point
KHQ	Kerr Hollow Quarry
LEFPC	Lower East Fork Poplar Creek
LiDAR	light detection and ranging
LTM	long-term monitoring
LUC	land use control
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
LUM	Land Use Manager
LWBR	Lower Watts Bar Reservoir
MCK	McCoy Branch kilometer
MCL	maximum contaminant level
MCL-DC	maximum contaminant level-derived concentration
MNA	monitored natural attenuation
MTF	Mercury Treatment Facility
MV	Melton Valley
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSC	non-significant change
O&M	operation and maintenance
ORAU	Oak Ridge Associated Universities
OREIS	Oak Ridge Environmental Information System
OREM	Office of Environmental Management
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSY	Old Salvage Yard
OU	operable unit
PC	Poplar Creek
PCB	polychlorinated biphenyl
PCCR	Phased Construction Completion Report
PCE	tetrachloroethene
PCR	Post-Construction Report
PCU	perimeter confirmation unit
POC	point of compliance
PRG	preliminary remediation goal
PTS	passive treatment system
PVC	polyvinyl chloride
Q	quarter
RA	remedial action
RAO	remedial action objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act of 1976
RER	Remediation Effectiveness Report
RI	remedial investigation
RL	remediation level

RmA	removal action
RmAR	Removal Action Report
ROD	Record of Decision
RSL	regional screening level
S&M	surveillance and maintenance
SCF	South Campus Facility
SEMS	Superfund Enterprise Management System
SSAB	Site Specific Advisory Board
SWMU	solid waste management unit
TBC	to be considered
TC	time-critical
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TSS	total suspended solids
UCOR	United Cleanup Oak Ridge LLC
UEFPC	Upper East Fork Poplar Creek
UNC	United Nuclear Corporation
UST	underground storage tank
UU/UE	unlimited use/unrestricted exposure
VARP	Vulnerability Assessment and Resilience Plan
VC	vinyl chloride
VI	vapor intrusion
VISL	screening level
VOC	volatile organic compound
WEMA	West End Mercury Area
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex
YWQP	Y-12 Water Quality Program

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Oak Ridge Reservation		
EPA ID: TN1890090003		
Region: 4	State: TN	City/County: Oak Ridge/Anderson, Roane Cos.
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? No	
REVIEW STATUS		
Lead agency: Other Federal Agency If "Other Federal Agency" was selected above, enter Agency name: U.S. Department of Energy (DOE)		
Author name (Federal or State Project Manager): Sam Scheffler, DOE Project Manager		
Author affiliation: DOE		
Review period: 06/05/2023 – 08/20/2024		
Date of site inspection: 10/17/2023 – 10/18/2023		
Type of review: Statutory		
Review number: Sixth FYR for EPA SEMS OUs 01, 10, 26, 27, 38, 42, and 50		
Triggering action date: 03/19/2022		
Due date (five years after triggering action date): 03/19/2027		

FIVE-YEAR REVIEW SUMMARY FORM (cont.)

The table below is for the purpose of the summary form and associated data entry and does not replace the two tables required in Sections VIII and IX by the FYR guidance. Instead, data entry in this section should match information in Sections VII and IX of the FYR report.

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
REMEDIAL ACTIONS: OU-01 (UNC Disposal Site RA), OU-10 (LEFPC Floodplain Soils and Groundwater RA), OU-26 (FCAP/Upper McCoy Branch RA), OU-27 (ORAU SCF), OU-28 (UEFPC Phase I Interim RAs), OU-38 (KHQ RA), OU-42 (Union Valley Interim RA), and OU-50 (UEFPC Phase II Interim RA for Contaminated Soils and Scrapyard) REMOVAL ACTIONS: OU-42 (EEVOC Plume RmA)

Issues and Recommendations Identified in the Five-Year Review:				
OU(s): 28 (UEFPC Phase I Interim RA) [UEFPC WATERSHED]	Issue Category: Monitoring (Issue/Recommendation UEF-1)			
	Issue: Mercury concentrations at Station 17 are above the 200-ppt performance goal. Mercury concentrations in fish in UEFPC have yet to respond to commensurate reductions of mercury from historical response actions.			
	Recommendation: Remedial measures have not been completed under the UEFPC Phase I Interim ROD. Implementation of actions under the UEFPC Phase I Interim ROD is not complete, and construction of the Outfall 200 MTF per the Mercury Mitigation Strategy is ongoing.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
Yes	Yes	Federal Facility DOE	EPA/TDEC	09/30/2025, Outfall 200 MTF PCCR

Protectiveness Statement(s)

Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.

<i>OU:</i> <u>01 (UNC Disposal Site</u> <u>RA)</u> [Y-12, CR OU 3 (UNC LF)]	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date</i> <i>(if applicable):</i> Not applicable
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Protectiveness Statement:

The remedy implemented at the UNC Disposal Site (containment) is protective of human health and the environment. Protectiveness is achieved through a multilayer cap. Remedy components are in place to ensure the integrity of the multilayer caps is being maintained and to remain effective and protective. Although not specified in the UNC ROD, access controls (signs, fencing, and security patrols) and EPP controls are in place. The UNC Disposal Site is located entirely within a DOE-controlled boundary designated pursuant to Section 229 of the AEA. Within this boundary, public access is restricted and security patrols are maintained.

Additional actions (i.e., groundwater) will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

<i>OU:</i> <u>10 (LEFPC Floodplain</u> <u>Soils and Groundwater</u> <u>RA)</u> [LEFPC OU Y-12]	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date</i> <i>(if applicable):</i> Not applicable
---	---	---

Protectiveness Statement:

The remedy implemented at LEFPC (removal) is protective of human health and the environment. Protectiveness is achieved by removing floodplain soil. LUCs are in place to prevent human exposure to floodplain soils in the NOAA area (former Dean Stallings Ford automobile dealership) with mercury contamination > 400 ppm. Controls, including surveys to determine any changes in land use patterns along LEFPC, monitoring to detect residential use of shallow groundwater, and surveys to verify land use in the area of the automobile dealership parking lot, are in place.

Additional actions (i.e., LEFPC creek bank and creek bed sediment, surface water, and aquatic biota) will be addressed in the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037).

<i>OU:</i> <u>26 (FCAP/Upper McCoy Branch RA)</u> [CR OU 2 FCAP, MCCOYBR, ROG Y-12]	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> 09/30/2019
<i>Protectiveness Statement:</i> The remedy implemented at FCAP (containment) is protective of human health and the environment. Protectiveness is achieved through dam reengineering and a PTS. LUCs are in place to prevent human exposure. Access controls including signs, fencing, and gates are in place. A property record notice containing land use restrictions is in place at the Anderson County Court House, Register of Deeds office. Additional actions, as necessary, will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).		

<i>OU:</i> <u>27 (ORAU SCF)</u> [ORAU - SOUTH CAMPUS FAC]	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> Not applicable
<i>Protectiveness Statement:</i> The remedy implemented at SCF (LUCs) is protective of human health and the environment. Protectiveness is achieved with LUCs to prevent human exposure until MNA parameters (all COCs below MCLs) are achieved. A property record notice containing groundwater use restrictions is in place at the Anderson County Court House, Register of Deeds office.		

<i>OU:</i> <u>28 (UEFPC</u> <u>– Phase I Interim RA)</u> [UEFPC WATERSHED]	<i>Protectiveness Determination:</i> Will be protective	<i>Addendum Due Date</i> <i>(if applicable):</i> Not applicable
<i>Protectiveness Statement:</i> The UEFPC Phase I Interim ROD remedy (removal, treatment, and LUCs) will be protective for ecological receptors with the reduction in mercury concentrations passing Station 17 (i.e., exiting OU-28) through ongoing and future actions, including the new MTF identified in the UEFPC Phase I Interim ROD Amendment and the Mercury Mitigation Strategy. The remedy is protective of human health; LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the Anderson and Roane Counties Court House, Register of Deeds office. Additionally, land transfer deeds within this area contain land use and groundwater use restrictions and are in place at the Anderson County Court House, Register of Deeds office. Remedy components are in place to ensure integrity of the treatment systems is being maintained and to remain effective and protective. Additional actions under the UEFPC Phase I Interim ROD and the Mercury Mitigation Strategy will ensure protectiveness (FFA Appendix J date RAR 2047). Additional future actions include the Final UEPFC ROD (groundwater, soil, sediment, ecological, and LUCs; FFA Appendix J date 2034; RAR 2035) and the EFPC Surface Water ROD (surface water, creek bank and bed sediments, ecological, and LUCs; FFA Appendix J date 2035; RAR 2037).		
<i>OU:</i> <u>38 (KHQ RA)</u> [KERR HOLLOW QUARRY]	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date</i> <i>(if applicable):</i> Not applicable
<i>Protectiveness Statement:</i> The remedy implemented at KHQ (removal) is protective of human health and the environment. Protectiveness is achieved through debris removal. LUCs are in place to prevent human exposure. Access controls (signs, fencing, and security patrols) and EPP controls are in place. A property record notice containing land use restrictions is in place at the Anderson County Court House, Register of Deeds office. Additional actions, as necessary, will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).		

OU: <u>42</u> – <u>Union Valley Interim</u> <u>RA</u>; – <u>Y-12 EEVOC Plume</u> <u>RmA</u> [UNION VALLEY]	Protectiveness Determination: Protective	Addendum Due Date (if applicable): Not applicable
Protectiveness Statement: Union Valley: The remedy implemented at Union Valley (LUCs) is protective of human health and the environment. Protectiveness is achieved through administrative controls. LUCs are in place to prevent human exposure. License agreements with non-federal property owners in Union Valley are in place notifying them of the potential contamination and requiring them to notify DOE of any changes in use of groundwater or surface water in certain areas. Additional actions for Union Valley groundwater, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035). EEVOC: The RmA implemented for the EEVOC plume is protective of human health and the environment. This RmA consists of an operating water treatment system to remove VOCs. Treated water is discharged downstream from the EEVOC Plume treatment system into EFPC at the POC. There have been no performance goal exceedances since monitoring at the POC began in FY 2011. Remedy components are in place to ensure integrity of the treatment system is maintained to remain effective and protective. UEFPC LUCs are in place to prevent human exposure. Additional actions, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).		
OU: <u>50 (UEFPC Phase II</u> <u>Interim RA for</u> <u>Contaminated Soils and</u> <u>Scrapyard)</u> [UEFPC WATERSHED]	Protectiveness Determination: Will be protective	Addendum Due Date (if applicable): Not applicable
Protectiveness Statement: The remedy implemented at UEFPC under the UEFPC Phase II Interim ROD (removal and LUCs) will be protective of human health and the environment upon completion. Protectiveness will be achieved by identifying and removing contaminated media. In the interim, LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the Anderson and Roane Counties Court Houses, Register of Deeds office. Additional actions (i.e., groundwater, soil, sediment, ecological, LUCs) will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).		

Additional Findings in the 2024 FYR

There were no additional findings identified in the 2024 FYR.

AEA = Atomic Energy Act of 1954
COC = contaminant of concern
ChR = Chestnut Ridge

CR = Clinch River
DOE = U.S. Department of Energy
EFPC = East Fork Poplar Creek
EEVOC = East End Volatile Organic Compound
EPA = U.S. Environmental Protection Agency
EPP = excavation/penetration permit
FCAP = Filled Coal Ash Pond
FFA = Federal Facility Agreement
FY = fiscal year
FYR = Five-Year Review
KHQ = Kerr Hollow Quarry
LEFPC = Lower East Fork Poplar Creek
LUC = land use control
MCL = maximum contaminant level
MNA = monitored natural attenuation
MTF = Mercury Treatment Facility
NOAA = National Oceanic and Atmospheric Administration
NPL = National Priorities List
ORAU = Oak Ridge Associated Universities
OU = operable unit
PCCR = Phased Construction Completion Report
POC = point of compliance
ppt = parts per trillion
ppm = parts per million
PTS = passive treatment system
RA = remedial action
RAR = Remedial Action Report
RmA = removal action
ROD = Record of Decision
SCF = South Campus Facility
SEMS = Superfund Enterprise Management System
TDEC = Tennessee Department of Environment and Conservation
UEFPC = Upper East Fork Poplar Creek
UNC = United Nuclear Corporation
VOC = volatile organic compound
Y-12 = Y-12 National Security Complex

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EXECUTIVE SUMMARY

This document presents the 2024 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Five-Year Review (FYR) for the Upper East Fork Poplar Creek and Chestnut Ridge administrative watersheds and Lower East Fork Poplar Creek and Oak Ridge Associated Universities South Campus Facility single-action Records of Decision (RODs) on the Oak Ridge site. The Oak Ridge Reservation (ORR) was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List in 1989 to identify the area within East Tennessee where operations conducted by the federal government took place during World War II and the Cold War era and remediation would be required. In subsequent years, over 75 CERCLA remedial actions and removal actions (RmAs) have been identified; many are complete, while others are ongoing or yet to be started. In 2001, the signatory parties to the ORR *Federal Facility Agreement for the Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/OR-1014; Federal Facility Agreement [FFA])—the U.S. Department of Energy (DOE), EPA, and the Tennessee Department of Environment and Conservation—agreed to consolidate the FYRs of actions requiring an FYR into a Reservation-wide review in lieu of many individual FYRs (DOE/OR/01-1941&D2/R1). Previous Reservation-wide FYRs were performed in 2001 (*2001 Remediation Effectiveness Report/CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* [DOE/OR/01-1941&D2/R1]), 2006 (*2006 Remediation Effectiveness Report/Second Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* [DOE/OR/01-2289&D3]), 2011 (*2011 Third Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* [DOE/OR/01-2516&D2]), and 2016 (*2016 Fourth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* [DOE/OR/01-2718&D2]). This 2024 FYR represents the second part of the sixth CERCLA FYR of the Oak Ridge site. DOE is the lead agency for this review.

The goal of the FYR is to track DOE's efforts at achieving protection of human health and the environment through implementing CERCLA actions on the ORR and offsite locations. The FYR evaluates these efforts, identifies potential issues related to the current status of the actions, and recommends follow-up actions to achieve protectiveness. The methods, findings, and conclusions of the FYR are documented in this report.

This FYR is designed to meet the requirements of the *Comprehensive Five-Year Review Guidance* (EPA 2001; Comprehensive FYR Guidance). The first step in performing the review was to identify which of the actions required a full review. Based on EPA's guidance and consultation with the Oak Ridge FFA parties, nine actions were identified for a full review in this 2024 FYR. The key factor in determining the need for a review was whether a CERCLA ROD left contamination in place above unrestricted land use cleanup criteria. In addition, some CERCLA RmAs required a review.

The nine individual reviews were performed following EPA's Comprehensive FYR Guidance (EPA 2001), which lays out a process that includes stakeholder involvement, site visits, background information, and a series of questions that must be addressed by the technical review. The three primary questions are:

- A. Is the remedy functioning as intended by the decision documents?
- B. Are the assumptions used at the time of remedy selection valid?
- C. Has any other information come to light that could call into question the protectiveness of the remedy?

The outcome of each review is a list of issues, recommendations, and follow-up actions, and a statement of protectiveness. The FYR Summary Table, preceding this Executive Summary, summarizes issues and recommendations identified for one action and the protectiveness statements and follow-on actions coming out of each of the nine actions. No additional findings or recommendations for the actions reviewed in this document were identified.

REFERENCES

- DOE/OR-1014. *Federal Facility Agreement for the Oak Ridge Reservation*, 1992, U.S. Department of Energy, U.S. Environmental Protection Agency Region 4, and Tennessee Department of Environment and Conservation, Washington, D.C. URL: <https://ucor.com/regulatory-agreements-for-the-oak-ridge-reservation/>. Last accessed February 2024.
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- DOE/OR/01-2289&D3. *2006 Remediation Effectiveness Report/Second Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, 2007, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
- DOE/OR/01-2516&D2. *2011 Third Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, 2012, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
- DOE/OR/01-2718&D2. *2016 Fourth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee*, 2018, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
- EPA 2001. *Comprehensive Five-Year Review Guidance*, EPA 540/R/01/007, Office of Solid Waste and Emergency Response 9355.7-03B-P, U.S. Environmental Protection Agency, Washington, D.C.

1. 2024 OAK RIDGE SITE FIVE-YEAR REVIEW

1.1 INTRODUCTION

In Oak Ridge, the U.S. Department of Energy (DOE) and its predecessor agency have had a mission of uranium enrichment, weapons production, and energy research since the 1940s, which has resulted in a legacy of hundreds of contaminated areas on the Oak Ridge Reservation (ORR) (Figure 1.1). These contaminated areas on the ORR associated with the federal mission were placed on the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) National Priorities List (NPL) in 1989. The Oak Ridge NPL site (Oak Ridge site) comprises approximately 12,281 acres of the approximately 32,465-acre DOE-owned ORR, with the remainder of the ORR determined to be clean and not part of the contaminated areas that compromise the Oak Ridge site.

This document presents the 2024 CERCLA Five-Year Review (FYR) for the Upper East Fork Poplar Creek (UEFPC) watershed (including Union Valley), the Chestnut Ridge (ChR) administrative watershed, and single-action Records of Decision (RODs) for the Oak Ridge Associated Universities (ORAU) South Campus Facility (SCF) and Lower East Fork Poplar Creek (LEFPC). This 2024 FYR represents the second Oak Ridge site FYR completed under the “Agreement of Revised Protocol for Future Submittals of the Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Review of the U.S. Department of Energy (DOE) Oak Ridge Site,” submitted by DOE to the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation (TDEC) on November 30, 2021 (DOE 2021). EPA responded on the same date, acknowledging the revised protocol as presented in Table 1.1 (EPA 2021).

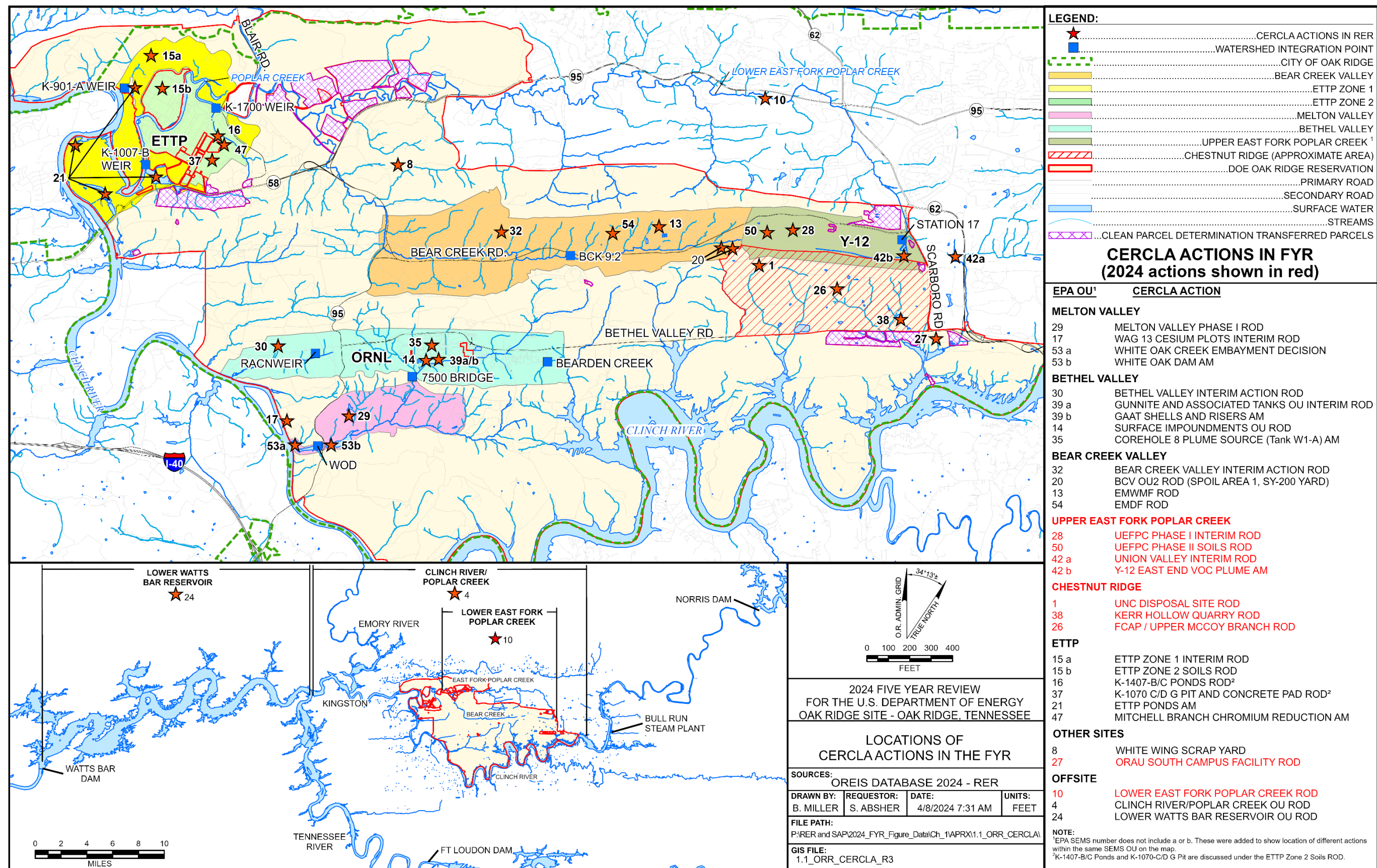
Historically, the FYR has been completed as a comprehensive document for the Oak Ridge site every 5 years from 2001 through the *2021 Fifth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2895&D2; 2021 FYR). During preparation of the 2021 FYR, DOE, EPA, and TDEC agreed that, due to the size and complexity of the Oak Ridge site FYR document, it had become cumbersome to prepare and thoroughly review in a timely manner. A new protocol was agreed upon that entails a FYR for a sub-area of the ORR (single watershed or group of watersheds) every year starting in 2023. The trigger date for this FYR is March 19, 2022, which is based upon the EPA March 19, 2022, due date for the 2021 FYR. The revised protocol abides by the statutory date for all CERCLA FYRs of the ORR sites to be conducted and the final DOE protectiveness determinations to be submitted at least 30 days prior to March 19, 2027.

The goal of the FYR is to track DOE’s efforts at achieving protection of human health and the environment through implementing current and future CERCLA actions on the Oak Ridge site and off-site locations (Figure 1.2). The FYR evaluates these efforts, determines protectiveness, identifies issues, and recommends follow-up actions to ensure protectiveness. The *Comprehensive Five-Year Review Guidance* (EPA 2001) Recommended Template and FYR Office of Solid Waste and Emergency Response guidances were reviewed and, to the extent practicable, followed for this 2024 FYR.

1.1.1 Oak Ridge Site Chronology and Background

Since the ORR was placed on the NPL in 1989, over 75 CERCLA remedial actions (RAs) and removal actions (RmAs) have been identified; many are complete, while others are ongoing or yet to be started. The *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014; Federal Facility Agreement [FFA]), signed by DOE, EPA, and TDEC in 1991, and implemented on January 1, 1992, describes how remediation under CERCLA will be performed.

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Table 1.1. Schedule for ORR sub-area FYRs

ORR sub-area	D1 submittal date^a
LWBR, CR/PC, and ETPP	August 20, 2023
UEFPC, ChR, ORAU SCF, and LEFPC	August 20, 2024
BCV (including EMWMF and EMDF) and WWSY	August 20, 2025
MV/BV	August 20, 2026
LWBR and CR/PC	August 20, 2027
ETTP	August 20, 2028
UEFPC, LEFPC, ChR, and SCF	August 20, 2029
BCV (including EMWMF and EMDF) and WWSY	August 20, 2030
MV/BV	August 20, 2031

^aThe U.S. Environmental Protection Agency (EPA) deadline for submittal of protectiveness determinations to the Superfund Enterprise Management System database is March 19, following the D1 submittal of the MV/BV FYR in each series (e.g., March 19, 2027, for the current series). U.S. Department of Energy protectiveness determinations for all FYRs within a series must be finalized and submitted to EPA 30 to 45 days *prior* to this date.

BCV = Bear Creek Valley

BV = Bethel Valley

ChR = Chestnut Ridge

CR = Clinch River

EMDF = Environmental Management Disposal Facility

EMWMF = Environmental Management Waste Management Facility

ETTP = East Tennessee Technology Park

FYR = Five-Year Review

LEFPC = Lower East Fork Poplar Creek

LWBR = Lower Watts Bar Reservoir

MV = Melton Valley

ORAU = Oak Ridge Associated Universities

ORR = Oak Ridge Reservation

PC = Poplar Creek

SCF = South Campus Facility

UEFPC = Upper East Fork Poplar Creek

WWSY = White Wing Scrap Yard

MV	ROD for Interim Actions (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete</u> • Solid Waste Storage Areas • Soil and Sediment • Buildings	<u>Incomplete</u> • None	Final MV ROD (FY 2036)	Groundwater, surface water, creek bed sediment, soil, ecological; WOL (surface water, sediment, soil, ecological); LUCs
			MV Reactors and Facilities ROD (FY 2037)	Buildings, LUCs
BV	ROD for Interim Actions (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete</u> • Solid Waste Storage Area	<u>Incomplete</u> • Soil and Sediment • Buildings	BV Groundwater ROD (FY 2037)	Groundwater, soil, ecological, LUCs (surface water, creek bed, and sediments in BV are included in the Final MV ROD)
BCV	Phase I Interim ROD / EMWMF (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete</u> • BYBY • Oil Landfarm Soil	<u>Incomplete</u> • S-3 Site Pathway 3 • EMWMF • EMDF	Final BCV ROD (FY 2039)	Groundwater, soil, surface water, sediment, ecological, S-3 Site, LUCs
			BCV Burial Grounds ROD (FY 2034)	Burial Grounds, LUCs
UEFPC/ChR	UEFPC Phase I/Phase II Interim ROD (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete (UEFPC)</u> • Phase I Mercury Sources (WEMA) • Phase II Scrapyard debris and soil • Union Valley Interim ROD <u>Complete Final RODs (ChR)</u> • UNC ROD • KHQ ROD • FCAP ROD	<u>Incomplete</u> • Outfall 200 MTF • Sediment removal (Lake Realty, UEFPC) • UEFPC Phase I and Phase II Soil	Final UEFPC ROD (FY 2034)	UEFPC groundwater (including Union Valley), soil, sediment, ecological, LUCs
			EFPC SW ROD (FY 2035)	UEFPC and LEFPC surface water, creek bank and bed sediments, ecological, LUCs
			Chestnut Ridge ROD (FY 2038)	Soil, Ecological, LUCs
ETTP	Zone 1 Interim ROD / Zone 2 Final ROD (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete</u> • Zone 1 Interim Soils ROD	<u>Incomplete</u> • Zone 2 Soils ROD • Slabs	Zone 1 Final Soils ROD (FY 2023) [†]	Soil, LUCs
			K-31/K-33 Area GW ROD (FY 2023) [†]	Groundwater, LUCs
			Main Plant GW Interim ROD (FY 2023) [†]	Groundwater, LUCs
			Zone 1 Groundwater Plumes ROD (FY 2026)	Groundwater, LUCs
			Remaining Media ROD (FY 2026)	Ecological, surface water, sediment, LUCs
			Main Plant GW Final ROD (FY 2032)	Groundwater, LUCs
Offsite, Others	LWBR, CR/PC and LEFPC Final RODs, Others (LUCs in place)		Future RODs	Media Included in Future ROD
	<u>Complete</u> • LWBR Surface Water, Sediment, Ecological • CR/PC Sediment, Ecological • LEFPC Floodplain soil, groundwater, floodplain ecological • WWSY Interim ROD Surface soil • ORAU SCF ROD		CR/PC SW ROD (FY 2043)	Surface water, LUCs
			EFPC SW ROD (FY 2035)	UEFPC and LEFPC surface water, creek bank and bed sediments, ecological, LUCs
			WWSY Final ROD (FY 2034)	Soil, buried waste, LUCs

RED font indicates CERCLA actions included in this 2024 FYR.

[†] RODs have been submitted but are pending approval.

Figure 1.2. Status of CERCLA response actions on the ORR.

In the mid-1990s, the FFA parties (DOE, EPA, and TDEC) recognized that (1) making numerous, individual remedial decisions on the ORR was an inefficient use of limited resources; (2) remediation of comingled radioactive elements and research-developed compound releases generally would not result in unlimited use and unrestricted exposure (UU/UE); and (3) inconsistent remedial decisions would result without an overall strategy tied to the anticipated end use of the area being addressed. Therefore, DOE, EPA, and TDEC agreed to make remedial decisions at a watershed-scale using consensus end uses developed by the citizen stakeholders for the watersheds to develop protective, risk-based remediation levels (RLs). DOE commissioned the End Use Working Group (EUWG) Stewardship Committee to recommend end uses, and they published the *Oak Ridge Reservation Stakeholder Report on Stewardship* (DOE 1998a; ORR Stakeholder Report) that made such recommendations. Groundwater remediation has not been included in the watershed ROD decisions to date, but groundwater remediation has been included in other decisions and is currently underway or being considered for future decisions.

The watersheds were used as a basis for decision-making because the primary pathway for off-site contaminant transport is via surface water. The Clinch River (CR) bounds the ORR on three sides, and there are active creeks that flow down the valleys to the CR (Figure 1.1). These surface water systems are fed by runoff from rainfall and by the groundwater that continually discharges to the surface streams. As much as 90% of the water entering the ground flows rapidly through highly porous, shallow soil, which is present at most of the contaminated sites, before discharging to nearby surface water. Consequently, the primary pathway for contaminant migration is through shallow groundwater to surface water, which then has the potential to flow offsite. Because of abundant rainfall (a 30-year moving average of 56.3 in./year), contaminant transport by shallow subsurface flow to surface waters, and the presence of contaminated sites in defined watersheds, a watershed strategy became the basis for remedial decision-making. Watershed remedial decision-making is an integrated, holistic approach to restore and protect ecosystems and to protect human health by focusing on hydrologically defined drainage basins. Watershed remedial decision-making is applied to environmental restoration of the ORR by grouping contaminated sites into the following five watersheds (Figure 1.1):

- Melton Valley (MV)
- Bethel Valley (BV)
- Bear Creek Valley (BCV)
- UEFPC
- East Tennessee Technology Park (ETTP)

Additionally, decisions have been made and/or actions taken offsite (LEFPC, CR/Poplar Creek [PC], Union Valley, and Lower Watts Bar Reservoir [LWBR]) and onsite, within the ChR area, and at the White Wing Scrap Yard and ORAU SCF (Figure 1.1).

The watershed RODs contain performance objectives to be met and a series of RAs designed to achieve them. Completed CERCLA actions in the watershed are gauged against their action-respective goals through performance monitoring. However, when CERCLA actions have yet to be fully implemented within a watershed, baseline conditions are monitored, against which the effectiveness of the actions can be evaluated in the future. Contaminants released from the sites accumulate in floodplain soils and sediments. Contaminants not retained, or those remobilized, are released to the surface waters and potentially offsite to the CR. Therefore, the surface water acts as an integrator of contaminant flux, and integration points (IPs) are identified in each watershed at which contaminant releases can be measured, assessed, tracked, and prioritized. Surface water contaminant IPs are points at which all upstream contaminant releases converge to exit the watershed (or subwatershed in the case of ETTP). Once the baseline monitoring and characterization are completed and the cleanup objectives are defined, the

contribution of each RA toward achieving the objectives can be estimated and assessed at the watershed IP. Through surface water monitoring, both the specific performance of each action and the cumulative progress toward achieving the cleanup objectives can be assessed.

In advance of watershed decisions to be made with the associated series of RAs, single-project actions were performed primarily to mitigate immediate risks and to reduce further migration of contaminants offsite. Watershed Interim or Final RODs have now been signed for sources and soil. This allowed decisions to be made and remediation performed on sources and soil, while the more complex decisions (i.e., groundwater, surface water, sediment, ecological protection, and final land use controls [LUCs]) were deferred until the source terms are remediated and there is a better understanding of the contaminant pathways. The D2 versions of the *Record of Decision for Groundwater in the K-31/K-33 Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2950&D1; K-31/K-33 Area Groundwater ROD) and *Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2949&D1; Main Plant Area Groundwater Interim ROD) have been prepared and are in the approval process. A schematic of the current status of the watershed RODs on the ORR is shown on Figure 1.2. RODs included in this 2024 FYR are shown in red.

The CERCLA remedy evaluation process begins with the expectation that treatment will be used to address principal threat wastes and that groundwater will be returned to its beneficial use. Because most of the remediation decisions for ORR sites do not allow for UU/UE, performance monitoring, LUCs, and/or engineered remedies are required at these sites. While UU/UE is commonly referred to as residential use, it is more accurately described as a condition that allows a property to be put to any use without the need for limitations or restrictions to prevent the occurrence of unacceptable human exposure or environmental impacts as a result of the presence of residual contamination. LUCs allow the realization of economically profitable and socially beneficial use or reuse of property while simultaneously ensuring protection of human health and the environment.

LUCs are any restriction or control arising from the need to protect human health and the environment that limits use of and/or exposure to any portion of that property, including water resources. LUCs encompass institutional controls (EPA 2000) (e.g., property record restrictions, property record notices, zoning notices, excavation/penetration permit [EPP] programs, easements, covenants, well drilling prohibitions, land use restrictions, permits, advisories, and other legal restrictions) and access restrictions achieved by engineered barriers (e.g., fencing) or by human means (e.g., security guards).

Engineered remedies (e.g., engineered soil covers and water treatment systems) have an ongoing requirement for operations and maintenance (O&M) and performance objectives. Verification that the O&M is being performed to meet the performance objectives is necessary.

The framework for remediation has been considered linear, progressing from identification of a potentially contaminated site through completion of remediation. However, because residual contamination on the ORR will remain for long periods of time, a framework (NRC 2002) recognizing the iterative process of remediation (Figure 1.3) is needed.

Evaluation of environmental monitoring and verification of LUCs and engineered remedies are included in the annual Remediation Effectiveness Report (RER) and used in the CERCLA FYR to assess performance of completed CERCLA actions in which residual contamination is left in place that does not allow for UU/UE. The Water Resources Restoration Program (WRRP) was established by DOE in 1996 to implement a consistent approach to long-term environmental monitoring and verification of the completed CERCLA response actions across the ORR. The WRRP provides a central administrative and reporting function that integrates and coordinates the numerous activities associated with this monitoring and verification, including preparing watershed-specific Remedial Action Report (RAR) Comprehensive Monitoring Plans (CMPs) and a single *Quality Assurance Project Plan for the Water Resources Restoration Program, U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (UCOR-4049).

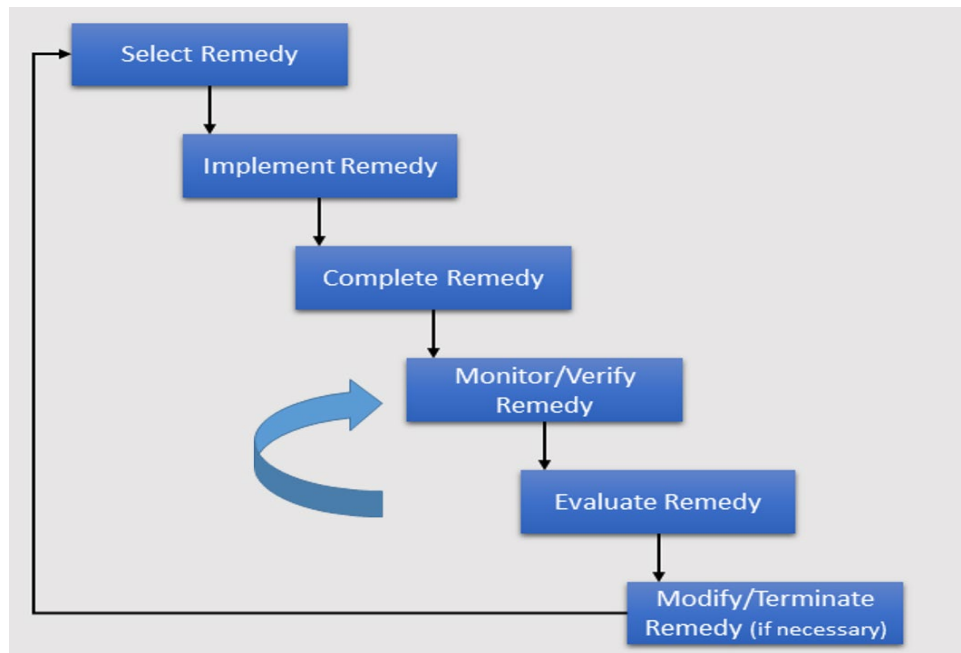


Figure 1.3. Framework for remediation.

In 2001, the signatory parties to the ORR FFA—DOE, EPA, and TDEC—agreed to consolidate the review of actions requiring an FYR into a Reservation-wide review in lieu of many individual FYRs. Five previous Reservation-wide FYRs were performed beginning in 2001 and culminating with the 2021 FYR. The *2023 CERCLA Five Year Review for the East Tennessee Technology Park Administrative Watershed and the Clinch River/Poplar Creek and Lower Watts Bar Reservoir Operable Units on the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2947&D1; 2023 FYR) was the first of four parts of the sixth FYR of the Oak Ridge site. This 2024 FYR represents the second part of the sixth FYR of the Oak Ridge site, with subsequent parts to be completed in 2025 and 2026 (Table 1.1). DOE is the lead agency for this review.

The FYR consists of a technical assessment of each CERCLA action to answer three primary questions for each action undergoing an FYR:

- A. Is the remedy functioning as intended by the decision documents?
- B. Are the assumptions used at the time of remedy selection still valid?
- C. Has any other information come to light that could call into question the protectiveness of the remedy?

Statutory-driven FYRs are performed pursuant to CERCLA Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) when both of the following conditions are true:

- Upon RA completion, hazardous substances, pollutants, or contaminants will remain onsite above levels that allow for UU/UE.
- The ROD for the site was signed on, or after, October 17, 1986 (the effective date of the Superfund Amendments and Reauthorization Act of 1986), and the RA was selected under CERCLA Section 121.

Some of the actions taken on the ORR to address environmental contamination were not comprehensive RAs identified in RODs; rather, they were completed under DOE-led Action Memoranda (AM) RmAs. In general, RmAs are not reviewed every 5 years. However, EPA has discretionary power to review RmAs. The East End Volatile Organic Plume (EEVOC) AM is a RmA reviewed in this 2024 FYR.

Table 1.2 lists actions and associated decision documents associated with the Oak Ridge site. Actions reviewed in this 2024 FYR are shown in red. The 2024 FYR actions were determined through a series of meetings and discussions with the Project Teams (representatives from DOE, EPA, TDEC, and contractors) during November and December 2022 and finalized during the site visits in October 2023. The 2024 FYR actions are also shown in red in the legend on Figure 1.1. The following criteria were used to develop the list of actions to be covered in this 2024 FYR:

- The action resulted in hazardous substances, pollutants, or contaminants remaining in place above levels that allow for UU/UE after implementing the remediation.
- A new RA was initiated within 2 years from the previous review (i.e., between October 2020 and October 2023).
- An RmA has an active operating system (e.g., a pump and treat system) in place to control contaminant migration or that actively involves containing/treating an environmental medium.
- The regulators requested the review as a matter of policy (e.g., a review of the Environmental Management Waste Management Facility [EMWMF], which is an active landfill located in BCV).

No decontamination and decommissioning (D&D) actions are included in this 2024 FYR because the slab and soil underneath the buildings on the ORR are deferred to other decision documents.

1.1.2 Physical Characteristics

The ORR (Figure 1.1) consists of three major DOE facilities and their associated CERCLA administrative watersheds and areas downstream of these facilities that are CERCLA operable units (OUs):

- The Oak Ridge National Laboratory (ORNL) and associated waste disposal areas that fall within the MV and BV watersheds.
- The Y-12 National Security Complex (Y-12) and associated waste disposal areas that fall within the UEFPC and BCV watersheds and are adjacent to the ChR hydrogeologic regime (including ORAU SCF).
- The former Oak Ridge Gaseous Diffusion Plant (K-25 Site), now referred to as ETP, which is made up of several small watersheds but treated as a single administrative watershed.
- Areas that are outside the DOE Oak Ridge site boundary but lie downgradient of the facilities (Figure 1.1) and, thus, have received contamination from the facilities over the years. These primary areas are as follows:
 - LEFPC, which runs from Y-12 through the city of Oak Ridge and eventually into PC near ETP.
 - The CR/PC and LWBR surface water system, which is downgradient of all facilities and is the ultimate receiving water body for all contaminants leaving the Oak Ridge site.
 - Union Valley, the location east of Y-12 and the location of a groundwater plume that has exited the Reservation.

Table 1.2. Oak Ridge site CERCLA FYR decisions

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision ^a (Appendix E/J estimated start date)
MV				
MV Interim Source Actions	ROD (DOE/OR/01-1826&D3): 09/21/00; ROD Amendment (DOE/OR/01-2170&D1): 09/07/04; ESD: 03/12/04, 09/07/04, 09/13/05, 12/27/06; LUCIP: 05/24/06	RAR: 09/05/07 RAR Addendum: 08/22/14	Yes/Yes	Additional actions (i.e., groundwater, the environment) will be addressed in the final MV ROD (FFA Appendix J date 2036; RAR 2037)
WOCE	Decision (no DOE document number): 11/09/90	No formal CERCLA closure document; letter submitted to State governor's office: 09/30/92	No/Yes	Additional actions (i.e., WOCE surface water/sediments) will be addressed under the final MV ROD (FFA Appendix J date 2036; RAR 2037)
WAG 13 Cesium Plots	Interim ROD (DOE/OR/01-1059&D4): 10/06/92	RAR PCR (DOE/OR/01-1218&D2): 08/25/94	No/Yes	Additional actions, as necessary, will be addressed under the Non-Watershed ROD (FFA Appendix J date 2045; RAR 2047)
WOD	TC AM (DOE/OR/01-2460&D1): 07/23/10	RmAR (DOE/OR/01-2509&D1): 11/08/11	No/Yes	Additional actions will be addressed under the final MV ROD (FFA Appendix J date 2036; RAR 2037)
BV				
BV Interim Actions	ROD (DOE/OR/01-1862&D4): 05/02/02; NSC: 06/25/04, 12/03/04, 09/10/09, 10/26/09, 11/16/13, 03/21/16; 11/05/20; ESD (DOE/OR/01-2446&D2): 11/03/10	Subprojects completed with full review: PCCR for Mercury Sumps: 08/27/10, PCCR for Corehole 8 Extraction Systems: 04/23/12, PCCR for BV Burial Grounds: 05/11/12, PCCR for Northwest Quadrant Slabs and Soils: 11/05/12	Yes/Yes ^b	Additional actions (i.e., groundwater, ecological receptors) will be addressed in the final BV ROD (FFA Appendix J date 2037; RAR 2038) Surface water and sediment will be addressed in the final MV ROD (FFA Appendix J date 2036; RAR 2037)
	GAAT OU Interim ROD (DOE/OR/02-1591&D3): 09/02/97 (liquid and sludge removal)	RAR (DOE/OR-01-1955&D1): 10/02/01		
	GAAT OU AM (DOE/OR/01-1957&D2): 07/13/01 (stabilizing shells and risers by filling with grout)	RmAR (DOE/OR/01-2010&D1): 08/21/02		
SIOU RA	ROD (DOE/OR/02-1630&D2): 09/25/97	RAR for Impoundments A and B (DOE/OR/01-2086&D2): 05/17/04, RAR for Impoundments C and D (DOE/OR/01-1784&D2): 04/19/99	No/Yes	Additional actions will be addressed under the final BV ROD (FFA Appendix J date 2037; RAR 2038)

Table 1.2. Oak Ridge site CERCLA FYR decisions (cont.)

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision^a (Appendix E/J estimated start date)
Corehole 8 Plume Source (Tank W-1A) RmA	AM (DOE/OR/01-1749&D1): 09/17/98	RmAR (DOE/OR/01-1969&D3): 08/30/12	No/Yes	Additional actions (i.e., groundwater, ecological receptors) will be addressed under the final BV ROD (FFA Appendix J date 2037; RAR 2038)
BCV				
BCV Phase I ROD	ROD (DOE/OR/01-1750&D4): 06/16/00, NSC: 07/10/17	Actions complete: PCCR BYBY: 01/12/04, RAR Oil Landfarm Soil Containment Pad: 07/01/01, PCCR DARA: 12/20/19	Yes/Yes	A non-TC RmA will be implemented to address uranium flux contributions to Bear Creek near NT-8 (AM: 05/02/24, RmA Work Plan: 09/30/24). Additional actions under the BCV Phase I ROD S-3 Ponds Pathways 1, 2, and 3 project will address AWQC exceedances and degradation of biotic communities in Bear Creek (FFA Appendix J date RAR 2032) Additionally, implementing the final BCV ROD (FFA Appendix J date 2039; RAR 2042) and BCBG ROD (FFA Appendix J date 2034; RAR 2042) will also address AWQC exceedances, degradation of biotic communities, and excess uranium flux contributions to Bear Creek
BCV OU 2 RA (Spoil Area 1, SY-200 Yard)	ROD (DOE/OR/02-1435&D2): 01/23/97	NFA, action complete; LUCs and S&M ongoing	No/Yes	Additional actions, as necessary, will be addressed under a final ROD for BCV (FFA Appendix J date 2039; RAR 2042)
EMWMF	ROD (DOE/OR/01-1791&D3): 11/02/99; ESD: 05/11/01, 01/11/05, 06/29/10	Annual CARARs (PCCRs beginning in FY 2013)	Yes/Yes ^c	NA
EMDF	ROD (DOE/OR/01-2794&D2/R2): 09/30/22	Early site preparation began in FY 2023	NA	NA

Table 1.2. Oak Ridge site CERCLA FYR decisions (cont.)

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision ^a (Appendix E/J estimated start date)
UEFPC				
Phase I Interim Source Control Actions	ROD (DOE/OR/01-1951&D3): 05/02/02; NSC: 10/05/06 (erratum 06/09/08), 05/17/07, 09/30/09, 03/14/14; ESD (DOE/OR/02-1539&D2): 08/29/12; ROD Amendment (DOE/OR/01-2697&D2): 05/24/16	Subprojects completed with full review: PCCR for BSWTS: 07/01/05, PCCR for WEMA storm sewer remediation: 08/31/12; Building 81-10 area Work Plan; under construction: Outfall 200 MTF (actions not yet implemented: UEFPC and Lake Reality sediment/soil removal; removal of five tanks)	Yes/Yes	Additional actions under the Phase I ROD and the Mercury Mitigation Strategy will ensure protectiveness (FFA Appendix J date RAR 2047). Additional future actions include the Final UEFPC ROD (FFA Appendix J date 2034; RAR 2035) and the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037)
Phase II Interim RA for Contaminated Soils and Scrapyard	ROD (DOE/OR/01-2229&D3): 04/21/06; NSC: 09/03/19, with partial withdrawal: 02/05/20	Subprojects completed with full review: PCCR for Y-12 Salvage Yard: 10/11/11, PCCR for Soils: 11/01/12. EU 5 completed with NFA per Attachments C.3 and C.4 to the UEFPC RA Work Plan: 09/17/22. Actions not yet implemented: remaining UEFPC soil remediation	No/Yes	Additional actions (i.e., groundwater) will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035)
Union Valley	Interim ROD (DOE/OR/02- 1545&D2): 07/10/97	This action was completed prior to uniform adherence to the RAR process; hence, no RAR exists for this decision	No/Yes	Additional actions, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035)
Y-12 EEVOC Plume RmA	AM (DOE/OR/01-1819&D2): 06/25/99, NSC: 03/06/13	RmAR (DOE/OR/01-2297&D1): 06/07/06 Erratum to establish monitoring POC: 03/05/13	Yes/No	Additional actions, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035)
CR				
UNC Disposal Site	ROD (no DOE document number): 06/28/91	PCR (DOE/OR/01-1128&D1): 09/06/94	Yes/Yes	Additional actions will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041)
KHQ	NFA ROD (DOE/OR/02- 1398&D2): 09/29/95	RA completed under approved RCRA Closure Plan	Yes/Yes	Monitoring and LUC requirements for KHQ to be managed under an RAR CMP

Table 1.2. Oak Ridge site CERCLA FYR decisions (cont.)

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision^a (Appendix E/J estimated start date)
FCAP	ROD (DOE/OR/02-1410&D3): 02/21/96	RAR (DOE/OR/01-1596&D1): 06/03/97	Yes/Yes	Additional actions, as necessary, will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041)
ETTP				
Zone 1 Interim Actions (soil)	ROD (DOE/OR/01-1997&D2): 11/08/02; ESD (DOE/OR/01- 2781&D2): 08/28/18; ROD Amendment (DOE/OR/01- 2796&D3): 03/26/20; ROD Amendment (DOE/OR/01- 2817&D3): 06/23/20	All Zone 1 Interim actions completed; final documents (PCCR/PCCR Addenda) approved	No/Yes	NFA is recommended for Zone 1 soil in the Zone 1 Final Soils ROD submitted in April 2022 (FFA Appendix E date; RAR 09/30/24). The Zone 1 Final Soils ROD defers the decision for the K-720 Fly Ash Pile to the Zone 1 Groundwater Plumes ROD (FFA Appendix E date 09/30/26; RAR Appendix J date 2028) in addition to actions for Zone 1 groundwater. Additional actions for surface water, sediment, and the environment will be addressed in the ETTP Remaining Ecology/Surface Water/Sediment Final ROD (FFA Appendix E date 09/30/26; RAR Appendix J date 2028)
Zone 2 Soil, Buried Waste, and Subsurface Structure Interim Actions	ROD (DOE/OR/01-2161&D2): 04/19/05; NSC (DOE/OR/01- 2161&D2/R1): 10/11/17; NSC (DOE/OR/01-2161&D2); submitted by DOE on 08/30/23	Actions ongoing; PCCR submittal and approval ongoing	Yes/Yes	Additional actions for selected Zone 2 groundwater plumes ^d will be addressed in the ETTP Main Plant Area Groundwater IROD (08/04/23; Appendix J date RAR 2034), the ETTP Main Plant Area Final Groundwater ROD (FFA Appendix J date 2032; RAR 2037), and the K-31/K-33 Area Groundwater ROD (07/30/23; Appendix E date RAR 2026). Additional actions for surface water, sediment, and remaining ecology will be addressed in the ETTP Remaining Ecology/Surface Water/Sediment Final ROD (FFA Appendix E date 09/30/2026; RAR Appendix J date 2028)

Table 1.2. Oak Ridge site CERCLA FYR decisions (cont.)

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision ^a (Appendix E/J estimated start date)
K-1407-B/C Ponds (<i>now included under the ETPP Zone 2 Soils ROD</i>)	ROD (DOE/OR/02-1125&D3): 09/30/93	RAR (DOE/OR/01-1371&D1) approved: 08/16/95, Erratum approved: 05/26/15	Yes/Yes	Additional actions are addressed under the Zone 2 Soils ROD (DOE/OR/01-2161&D2); FFA Appendix E date RAR 03/18/26
K-1070-C/D G-Pit and Concrete Pad (<i>now included under the ETPP Zone 2 Soils ROD</i>)	ROD (DOE/OR/02-1486&D4): 01/23/98	RAR (DOE/OR/01-1964&D2) approved: 10/15/03, Erratum approved: 03/13/15	No/Yes	Additional actions are addressed under the Zone 2 Soils ROD (DOE/OR/01-2161&D2); FFA Appendix E date RAR 03/18/26
ETTP Ponds RmA	AM (DOE/OR/01-2314&D2): 03/12/07	RmAR (DOE/OR/01-2456&D1/R1) approved: 03/10/11 (supersedes DOE/OR/01-1767&D2)	Yes/Yes	ETTP Ponds will be evaluated in additional actions for surface water, sediment, and the environment and will be addressed under the ETPP Remaining Ecology/Surface Water/Sediment Final ROD (FFA Appendix E date 09/30/2026; RAR Appendix J date 2028)
MB Chromium Reduction RmA	AM (DOE/OR/01-2448&D1): 04/13/10	RmAR (DOE/OR/01-2384&D1) approved: 04/04/13, RmAR Addenda (DOE/OR/01-2598&D2/A1/R1) approved: 10/06/16, 08/07/17	Yes/Yes	Additional actions, as necessary, will be addressed under the ETPP Remaining Ecology/Surface Water/Sediment Final ROD (FFA Appendix E date 09/30/2026; RAR Appendix J date 2028)
Other				
WWSY (WAG 11) Surface Debris	Interim ROD (DOE/OR-1055&D4): 10/06/92	PCR (DOE/OR/01-1263&D2): 09/14/94	No/Yes	Additional actions, as necessary, will be addressed under a future WWSY ROD (FFA Appendix J date 2034; RAR 2041)
ORAU SCF	ROD (DOE/OR/02-1383&D3): 12/28/95	RAR (DOE/OR/02-1474&D2): 08/20/96	Yes/Yes	NA

Table 1.2. Oak Ridge site CERCLA FYR decisions (cont.)

CERCLA action	Decision document, date signed	Action/Document status	Monitoring/ LUCs required?	Future follow-up action for residuals not covered by decision ^a (Appendix E/J estimated start date)
Offsite				
LEFPC	ROD (DOE/OR/02-1370&D2): 08/17/95, ESD (DOE/OR/02- 1443&D2): 11/15/96	RAR (DOE/OR/01-1680&D5): 08/15/00	Yes/Yes	Additional actions (i.e., LEFPC streambed, stream banks, aquatic biota) will be addressed in the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037)
LWBR	ROD (DOE/OR/02-1373&D3): 09/29/95, NSC for ecological protection clarification (DOE/OR/01-2602): 11/04/14	RA Work Plan (DOE/OR/02- 1376&D3): 05/25/96, RAR CMP: 08/13/20	Yes/Yes	NA
CR/PC	ROD (DOE/OR/02-1547&D3): 09/23/97	RAR: 06/14/99, RAR CMP (DOE/OR/01-1820&D3): 08/13/20	Yes/Yes	Additional actions (i.e., surface water) will be addressed under the CR/PC Surface Water ROD (FFA Appendix J date 2043; RAR 2044)

Red text indicates CERCLA actions included in this 2024 FYR.

^aMedia currently proposed for further action under the watershed RODs are shown on Figure 1.2.

^bThere were no LUCs specified in the decision documents for GAAT, but LUCs for tanks are included in the LUC table in the BV Interim ROD (DOE/OR/01-1862&D4).

^cThe CERCLA action status of the EMWMF is evaluated in the annual PCCR and is not included in the Remediation Effectiveness Report.

^dThe ETTP Zone 2 Main Plant Area Groundwater IROD includes the following six plumes: K-27/K-1232, K-1401, K-1239, K-1035, K-25/K-1024, and K-1407-B Pond; the remaining Zone 2 groundwater plumes will be addressed in the ETTP Main Plant Area Final Groundwater ROD.

AM = Action Memorandum
 AWQC = ambient water quality criteria
 BCBG = Bear Creek Burial Ground
 BCV = Bear Creek Valley
 BSWTS = Big Spring Water Treatment System
 BV = Bethel Valley
 BYBY = Boneyard/Burnyard
 CARAR = Capacity Assurance Remedial Action Report
 CERCLA = Comprehensive Environmental Response,
 Compensation, and Liability Act of 1980
 ChR = Chestnut Ridge
 CMP = Comprehensive Monitoring Plan
 CR = Clinch River
 DARA = disposal area remedial action
 DOE = U.S. Department of Energy
 EEVOC = East End Volatile Organic Compound
 EFPC = East Fork Poplar Creek
 EMDF = Environmental Management Disposal Facility
 EMWMF = Environmental Management Waste Management Facility
 ESD = Explanation of Significant Differences
 ETTP = East Tennessee Technology Park
 EU = exposure unit

FCAP = Filled Coal Ash Pond
 FFA = Federal Facility Agreement
 FY = fiscal year
 FYR = Five-Year Review
 GAAT = Gunitite and Associated Tanks
 IROD = Interim Record of Decision
 KHQ = Kerr Hollow Quarry
 LEFPC = Lower East Fork Poplar Creek
 LUC = land use control
 LUCIP = Land Use Control Implementation Plan
 LWBR = Lower Watts Bar Reservoir
 MB = Mitchell Branch
 MTF = Mercury Treatment Facility
 MV = Melton Valley
 NA = not applicable
 NFA = no further action
 NSC = non-significant change
 NT = North Tributary
 ORAU = Oak Ridge Associated Universities
 OU = operable unit
 PC = Poplar Creek
 PCCR = Phased Construction Completion Report

PCR = Post-Construction Report
 POC = point of compliance
 RA = remedial action
 RAR = Remedial Action Report
 RCRA = Resource Conservation and
 Recovery Act of 1976
 RmA = removal action
 RmAR = Removal Action Report
 ROD = Record of Decision
 S&M = surveillance and maintenance
 SCF = South Campus Facility
 SIOU = Surface Impoundments Operable Unit
 TC = time-critical
 UEFPC = Upper East Fork Poplar Creek
 UNC = United Nuclear Corporation
 WAG = waste area grouping
 WEMA = West End Mercury Area
 WOCE = White Oak Creek Embayment
 WOD = White Oak Dam
 WWSY = White Wing Scrap Yard
 Y-12 = Y-12 National Security Complex

The specific background, site chronology, physical characteristics, and contaminant sources within UEFPC, ChR, ORAU SCF, and LEFPC are discussed in Chapters 2 through 5 of this report.

The nearest population center is the City of Oak Ridge (U.S. Census population estimate 31,824 in 2021), and the nearest boundary to this population center is the portion of the ORR boundary separating the DOE property from residential and commercial areas of Oak Ridge. The largest nearby city is Knoxville, Tennessee, with a population around 193,000. The population in the Knoxville Metropolitan area is approximately 893,000.

Ecological habitats on the ORR support a wide variety of rare, threatened, and endangered plants and animals. According to the *Oak Ridge Reservation Annual Site Environmental Report* for 2022 (DOE-SC-OSO/RM-2023-01; 2022 Annual Site Environmental Report), 16 plant species occurring on the ORR are listed by the state as rare (endangered, threatened, or special concern). An additional four plant species are under review for federal listing and are informally considered special concern. Ten additional rare plant species occur in the area but their presence is unconfirmed. Twenty-one species of federally or state-listed (endangered, threatened, or in need of management) vertebrate species have been confirmed on parts of the ORR. The hellbender (state endangered), northern pinesnake (state threatened), golden-winged warbler (state threatened), Henslow's sparrow (state threatened), gray bat (federal endangered), little brown bat (state threatened and under review for federal listing), Indiana bat (federal endangered), northern long-eared bat (federal endangered), and tricolored bat (state threatened and proposed for federal listing) are listed as endangered or threatened in Tennessee (TWRA 2021, FWS 2024). The only federally listed animal species known to occur on the ORR in recent years are bat species (gray, Indiana, and northern long-eared). Suitable roosting and foraging habitat for the three federally listed bat species occurs across the ORR. Surveys conducted in 2022 indicate the use of several caves on the ORR by gray bats and other bat species (2022 Annual Site Environmental Report).

1.1.3 Land Use and Water Resources

1.1.3.1 End use

Projected end uses for areas within the DOE ORR were developed during numerous public meetings, documented, and endorsed by the EUWG. This federal and public group then initiated the ORR stewardship planning process in the late-1990s timeframe. This process produced the ORR Stakeholder Report. This report included recommendations based on the broad end-use categories for the contaminated lands of the ORR. These identified uses have guided CERCLA decisions to date.

Current watershed ROD land uses have remained consistent with the EUWG end use recommendations (*Final Report of the Oak Ridge Reservation End Use Working Group*; DOE 1998b) as much as possible. Land uses specified in the watershed RODs can be broadly categorized as unrestricted, unrestricted industrial, recreational (unrestricted and controlled), controlled industrial, and waste management. Table 1.3 shows the current land uses for the ORR.

1.1.3.1.1 End use designations

Unrestricted use: No restrictions on surface or subsurface land use. The remediated floodplain soil areas along LEFPC are designated unrestricted use.

Unrestricted industrial use: Controls excavations or penetrations below 10 ft and prevents uses of the land more intrusive than industrial use above 10 ft. The eastern-most portion of Y-12, including Lake Reality and the ORAU SCF, is designated unrestricted industrial use.

Table 1.3. Current land use planning for the ORR

Land area within the ORR	Land use category ^{a,b}				
	Unrestricted ^c	Unrestricted industrial ^d	Recreational ^e	Controlled industrial ^f	Waste management ^g
MV	NA	NA	Surface water and floodplain of WOC, WOL, and WOCE	In areas of MV watershed not deemed recreational or waste management	MV remediation areas
BV	All areas of BV watershed not deemed unrestricted industrial, recreational, or controlled industrial	Developed areas east and west of the Main Plant Area	SWSA 3 and Contractor's Landfill area ^h	Main Plant Area	NA
UEFPC	NA	Eastern end of Y-12 in vicinity of New Hope Pond	NA	Western and central areas of Y-12	ChR
BCV ^h	Zone 1 (western area)	NA	Zone 2 (buffer zone)	Zone 3 (eastern area); includes EMWMF ⁱ	NA
ETTP	NA	Zone 1 Zone 2 (except for waste management areas)	Unrestricted Zone 1 ^d Controlled K-770 Asbestos Area ^e Contractor's Spoil Area ^e K-720 Fly Ash Pile ^e Duct Bank Corridor ^f	K-770 Asbestos Area ^e Duct Bank Corridor ^f	NA

^aSource: Watershed Records of Decision (RODs) and amendments.

^bGroundwater use is restricted on the entire ORR.

^cNo restrictions on surface or subsurface land use.

^dControl excavations below 10 ft.

^eRestrict access and activity to passive surface use (0 ft).

^fControl excavations below 2 ft.

^gPrevent unauthorized access to restricted area, and prevent unauthorized contact, removal, or excavation of waste material left in place.

^hThis is a buried waste disposal area, and unauthorized contact, removal, or excavation of waste material is prohibited.

ⁱBased on the Environmental Management Disposal Facility ROD, the end use for Zone 1 and Zone 2 will be revised to restricted recreational and controlled industrial, respectively, which will be codified in an upcoming modification to the BCV Phase I ROD.

BCV = Bear Creek Valley

BV = Bethel Valley

ChR = Chestnut Ridge

EMWMF = Environmental Management Waste Management Facility

ETTP = East Tennessee Technology Park

MV = Melton Valley

NA = not applicable (land use not specified in this watershed)

ORR = Oak Ridge Reservation

SWSA = solid waste storage area

UEFPC = Upper East Fork Poplar Creek

WOC = White Oak Creek

WOCE = White Oak Creek Embayment

WOL = White Oak Lake

Y-12 = Y-12 National Security Complex

Recreational use: Varies slightly among the RODs, but generally restricts recreational activity to passive surface use; prevents unauthorized contact, removal, or excavation of waste material; prevents unauthorized destruction or modification of engineered RAs; and precludes use of the area for additional future waste disposals of alternate uses inconsistent with the management of currently disposed waste. There are no areas in UEFPC, ChR, ORAU SCF, or LEFPC that are designated recreational land use. Current land use in LEFPC includes Municipal Recreation (parks, golf), but it is not a ROD designated use.

Controlled industrial use: Prevents excavations below either 0 ft, 2 ft, or a depth considered protective to the industrial worker. The western and central areas of Y-12 are designated for controlled industrial use.

Waste management use: Prevents unauthorized access to restricted areas and prevents unauthorized contact, removal, or excavation of waste material left in place. The ChR administrative watershed is designated for waste management use.

1.1.3.2 Water resources

Waters that flow in surface streams on the ORR eventually reach LWBR and the Tennessee River via the CR. The CR is part of the Tennessee Valley Authority-managed river system that bounds the ORR on the eastern, southern, and western boundaries. Surface water at each of the major facilities of the ORR drains into a tributary or series of tributaries, streams, or creeks within different watersheds. Flow in these streams originates as runoff from rainfall, groundwater that continually discharges to the surface streams via springs and seeps, and DOE facility water discharges in some areas. Each of these watersheds eventually drains into the CR. The largest of the drainage basins is that of PC, which receives drainage from the northwestern sector of the ORR. In Y-12, there is a watershed divide between the BCV and UEFPC watersheds. In the UEFPC watershed, UEFPC surface water flows in an easterly direction to Lake Reality, where it turns and flows in a northerly direction until it exits the UEFPC watershed at Station 17. Station 17 is the administrative boundary between UEFPC and LEFPC, which are collectively known as East Fork Poplar Creek (EFPC). From Station 17, LEFPC flows into the City of Oak Ridge and eventually EFPC discharges into PC.

Groundwater on the ORR lies within three primary geologic groups underlying the plant sites and burial areas: the Knox, the Conasauga, and the Chickamauga Groups. ChR is primarily underlain by Knox Group dolomites, while the Y-12 Plant and UEFPC are underlain by bedrock of the Maynardville Limestone. Groundwater occurs both in the unsaturated zone as transient, shallow subsurface stormflow that quickly discharges to surface water, and in the deeper saturated zone that maintains a relatively stable water table. Fractures, karst conduits, and the man-made aspects (pipelines, tank farms, and basement sumps) have resulted in some known preferential flowpaths at each of the plant sites.

1.2 RESPONSE ACTION SUMMARY

1.2.1 Basis for Taking Action

Contamination on the Oak Ridge site is related to the many federal missions that have taken place during and since the Manhattan Project. Two contaminants—specifically mercury and cesium—were called out as the primary reason for the NPL listing in 1989.

Mercury releases originated at Y-12 from the column-exchange (COLEX) process developed to separate and enrich lithium. The COLEX process was first tested in Building 9201-2 (Alpha-2). Active operations took place in additional buildings from 1953–1963. These buildings are located in an area that is now referred to in many CERCLA documents as the West End Mercury Area (WEMA). During operations, large quantities of mercury released through leaky pipes and valves and spilled onto floors and into floor drains. The Mercury Task Force, formed in 1983, found some documented, larger spills estimated to have contributed as much as 425,000 lb to the environment. Total mercury quantities lost from inventory are estimated to be as high as 2 to 2.43 million lb, as per the *Oak Ridge Health Studies Phase I Report, Volume 2, Part A – Dose Reconstruction Feasibility Study* (DOE/OR/21981-T3-Vol. 2-PtA).

Since the time of operations, mercury has been observed in sumps, storm sewers, basements, subsurface soils, and creek and impoundment sediments and is suspected to be located within the structure of the buildings inside walls, ceilings, floors, and insulation. Mercury migrates from WEMA via the storm sewer system and subsurface flow to EFPC, and eventually flows to PC.

Cesium-137 is a man-made byproduct of nuclear fission. From the early 1940s–1960s, ORNL produced sizable quantities of Cs-137 from test and production reactors at the site. ORNL discharged a fraction of its cesium-contaminated liquid waste through holding ponds and eventually into White Oak Creek where it flowed and adsorbed to creek, lake, and riverbed sediments in the White Oak Lake Impoundment (both within the ORR) and on to the CR and the Lower Watts Bar Lake system (off the ORR).

Solvents were used in machining and cleaning operations. In some cases, chlorinated solvents spilled and leaked into the subsurface, reaching the underlying bedrock groundwater. These chlorinated volatile organic compounds (VOCs) are found in the form of dissolved-phase groundwater plumes, and where sufficient material was released, as dense, nonaqueous-phase liquids (DNAPLs). Known or suspected DNAPL sources in the groundwater exist at the following locations:

- The Y-12 site, specifically the EEVOC Plume and within BCV (where organics from the S-3 Site and from the Bear Creek Burial Grounds [BCBG] are comingled with uranium and nitrate in the groundwater).
- Several locations across ETTP, with the highest masses located in the Mitchell Branch area.
- The east end of BV.

Only the organic plume at the east end of Y-12 (EEVOC) is known to have migrated offsite. In addition to these organic plumes, there is a major radionuclide plume—mainly Sr-90—in BV, and the large-mass uranium/nitrate plume in BCV.

Burial grounds at ORNL, Y-12, and ETTP were developed over the years to serve as disposal facilities for wastes generated by operations at the three plant sites, and as the U.S. Atomic Energy Commission’s Southern Regional Burial Grounds for wastes from over 50 federal facilities. These burial grounds contain a wide range of radionuclides, metals, and organic contaminants. At Y-12, large burial grounds were developed west of the Plant site in BCV. These burial grounds contain large quantities of depleted uranium.

On the ORR, excess buildings have been dispositioned under the CERCLA non-time-critical (TC) RmA process. Much of this D&D work to date has occurred in the ETTP area; however, three TC D&D actions have been completed and one D&D project is ongoing in UEFPC (refer to Table 2.1).

1.2.2 Response Actions

Table 1.2 lists the ongoing or completed CERCLA response actions that meet the requirements for evaluation (actions evaluated in this 2024 FYR are shown in red). In general, the response to date has followed this pattern:

- **1990s:** Actions were implemented to address major off-site contaminant issues identified in the NPL listing (e.g., mercury in EFPC and cesium in the CR/Watts Bar Reservoir system). Additional, smaller response actions were implemented to address known ongoing releases within each of the plant sites.
- **Early 2000s:** Watershed-scale RODs were signed to address primary sources of contamination within the plant sites (e.g., waste burial grounds in MV).
- **2004–2008:** Emphasis shifted to MV burial ground closure, ETTP contaminant sources, and building D&D activities.
- **2008–2012:** ETTP sources and building D&D activities continued. Additional actions throughout Y-12 and ORNL benefited from American Recovery and Reinvestment Act of 2009 funding.
- **2012–present:** ETTP building D&D activities have been accelerated and are nearing completion.

Chapters 2 through 5 of this report detail the CERCLA response actions included in this 2024 FYR.

1.2.3 Status of Implementation

CERCLA RODs for the major primary contaminant sources (e.g., soil and waste burial grounds) are in place. The majority of RODs that will address secondary sources, including groundwater plumes, surface water and sediment, and ecological populations, have not been developed. However, the *Record of Decision for Lower East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/02-1370&D2; LEFPC ROD) addresses ecological receptors in floodplain soils. Ecological receptors will be addressed in future RODs. Refer to Figure 1.2 for a schematic of the current status of the watershed RODs on the ORR.

1.2.4 Land Use Control Requirements

Because most of the remediation decisions on the ORR do not allow for UU/UE, LUCs are required. LUCs are broadly defined in the *Land Use Control Assurance Plan for the Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/OR/01-1824&D0; LUC Assurance Plan [LUCAP]) and are to be maintained until the concentrations of contamination in the soil and/or groundwater are at such levels to allow for UU/UE. The LUCAP requires LUC Implementation Plans (LUCIPs) be developed to specify the specific controls and mechanisms needed to achieve identified LUC objectives.

LUCs implemented on the ORR include the following:

- **Property record restrictions (upon transfer):** A property record restriction restricts the use of property and/or prohibits the use of groundwater by imposing limitations. DOE shall record property record restrictions in accordance with state law at the Roane County or Anderson County Register of Deeds office. Each transfer or fee title from the United States federal government will include a CERCLA Section 120(h) covenant that will describe residual contamination on the property and environmental use restrictions expressly prohibiting activities inconsistent with the LUC objectives to the degree practicable to ensure clear delineation of the restriction.
- **Property record notices:** A property record notice notifies the public about the existence and location of a regulated hazardous substance, the location of land that is not appropriate for UU/UE, and limitations on the use. DOE acquired the land now within the ORR through various methods, including condemnation through use of eminent domain; purchase; and transfer from other federal, state, and local government agencies. The acquisitions by eminent domain and purchase have been filed for record at the pertinent county offices of record.

There are two types of property record notices that will need to be filed by DOE. The first type, a general notice, is filed when regulated hazardous substances (e.g., radionuclides, hazardous chemicals, and asbestos) are left in place in an area at levels that may pose an unreasonable threat to public health, safety, or the environment. The second type, a more specific notice for individual areas, is filed after completing remediation of the specific unit (e.g., landfill) when hazardous wastes or asbestos-containing materials are left in place in the unit.

- **EPP program:** The EPP program notifies the worker/developer (i.e., permit requestor) on the extent of contamination and prohibits or limits excavation/penetration activity to ensure the excavation/penetration activity is conducted safely. An existing internal EPP program currently administered by DOE contractors requires workers/developers to obtain authorization before beginning subsurface excavation/penetration activities.

- **Access controls:** An access control (e.g., fence, gate, portal, sign, and surveillance patrol) controls and restricts access to workers and the public to prevent unauthorized uses. Access controls in and around the ORR that restrict/limit access to workers and/or the public to contaminated units/areas will be evaluated by the remediation projects and, if necessary, selected in the corresponding design or construction completion report. DOE will erect and maintain signs across the ORR at appropriate locations to achieve LUC objectives. The patrols will be implemented, as needed, upon completion of RAs. DOE and/or its agent will maintain responsibility for the access controls until concentrations of hazardous substances are at levels to allow for UU/UE. In the event of property transfer, DOE will document access controls in the transfer documents and deed and will verify they are maintained.

Other LUCs are specified for certain decisions, including DOE-provided license agreements and notifications, title searches, and surveys (e.g., Union Valley).

1.2.4.1 LUC verification and reporting

Records documenting LUC activities are maintained in Land Use Manager (LUM), a web-based tool used to document LUCs are in place. The annual RER evaluates the status and effectiveness of the LUCs and how any deficiencies or inconsistent uses identified in LUM have been addressed. The annual evaluation addresses whether the use restriction and controls referenced above were communicated in the deed(s), whether the owners and state and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed to such restrictions and controls. LUC certifications since the last full FYR of the ORR (2021 FYR) are included in Appendix A of the *2022 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee, Data and Evaluations* (DOE/OR/01-2916&D2; 2022 RER) and the *2023 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee, Data and Evaluations* (DOE/OR/01-2938&D2; 2023 RER) and will be included in the D2 version of the *2024 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee, Data and Evaluations* (DOE/OR/01-2960&D1; 2024 RER). The verification process is outlined below for the LUCs identified in Section 1.2.4:

- **Property record restrictions (upon transfer):** Verified every 5 years by WRRP personnel that the transferred parcels still contain restrictions filed at the Anderson and/or Roane County courthouse as applicable, and that new transfers contain restrictions in the quitclaim deeds flowed down from the CERCLA ROD. Verified either in person at the applicable county courthouse(s) or online, if available. A table with verification documentation is attached to the inspection form in LUM.
- **Property record notices:** Verified every 5 years by WRRP personnel either in person at the Anderson and/or Roane County courthouse or online, if available. Documentation with either a photo or screen capture is attached to the inspection form in LUM.
- **EPP program:** Verified annually via email from the EPP Program Manager documenting the permit program was functioning according to procedures. Additionally, WRRP personnel identify any permit requests in the vicinity of remedies. Email documentation is attached to the inspection form in LUM.
- **Access controls:** Verified annually via site tour with WRRP personnel, facility managers, and DOE. Documentation, including photos, is attached to the inspection form in LUM.

Finalized LUM records will be made available upon formal written or email request to DOE.

1.2.5 Engineered Remedies

Engineered remedies are remedies that have ongoing O&M requirements and include soil covers, caps, and water treatment systems. O&M is an important component of a CERCLA response action, ensuring the remedy continues to perform as intended, is maintained, and remains protective of human health and the environment. DOE and/or its agent will maintain responsibility for the engineered remedy until the concentrations of hazardous substances are at levels to allow for UU/UE. In the event of property transfer, DOE will document transferred engineered remedies in the transfer documents and/or deed and will verify they are maintained.

1.2.5.1 Engineered remedy verification and reporting

Engineered remedies are tracked in LUM to ensure they remain operational. Ongoing O&M activities are reported in the RER. DOE verifies operation of the engineered remedies in the RER and identifies any necessary maintenance that was performed during the year. Engineered remedy effectiveness and protectiveness are evaluated in this 2024 FYR.

1.3 PROGRESS SINCE LAST FIVE-YEAR REVIEW

1.3.1 Closure of 2021 Five-Year Review Issues

The 2021 FYR identified one issue for the actions included in this 2024 FYR associated with the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3; UEFPC Phase I Interim ROD) that concerned mercury concentrations at Station 17 above the performance standard. Chapter 2 of this 2024 FYR discusses resolution of this issue. No issues or additional findings were identified for any other actions in this 2024 FYR.

1.4 ORGANIZATION OF 2024 FIVE-YEAR REVIEW

The Oak Ridge NPL site (contaminated portions of the ORR) and adjacent media impacted by federal operations at the site have been further divided into administrative watershed actions or, in some cases, further divided into single-source RAs. The scale of this review is so complex that it could result in a document so large it would be difficult for stakeholders to review simply from a time standpoint. To address the need to keep the report as readable and succinct as possible, while simultaneously attempting to adhere to FYR requirements for each decision under review, two key principles were followed:

- Information pertaining to the Reservation as a whole and to the process used to perform this 2024 FYR of UEFPC, ChR, ORAU SCF, and LEFPC is presented in Chapter 1. Detailed reviews of the individual RODs and AM selected to be reviewed in this 2024 FYR are presented in Chapters 2 through 5. The outline of this 2024 FYR is as follows:
 - Chapter 1, 2024 Oak Ridge Site FYR (introduction and 2024 FYR process)
 - Chapter 2, Y-12 – UEFPC Watershed
 - Chapter 3, Y-12 – ChR
 - Chapter 4, ORAU SCF
 - Chapter 5, Offsite: LEFPC

- Appendix A, 2024 FYR Site Visits
- Appendix B, Applicable or Relevant and Appropriate Requirement (ARAR) and Human Health Risk Updates
- Appendix C, Property Transfers for UEFPC Watershed
- Appendix D, Certification of LUC Implementation for Fiscal Year (FY) 2023
- Appendix E, FY 2022 UNC Engineering Evaluation Report

The FYR is designed to meet the requirements of EPA 2001, Appendix F (Sample FYR Report), as well as to align with EPA's *Recommended Five-Year Review Template* (EPA 2016).

Summary-level detail is presented for each individual ROD or AM being addressed. Background information and the most recent monitoring details (from samples collected since the last FYR) are summarized herein. Details have been published in previous CERCLA reports, including the annual RERs and RODs for CERCLA actions on the Oak Ridge site.

1.5 2024 FIVE-YEAR REVIEW

This 2024 FYR is the sixth FYR of CERCLA actions located in UEFPC and ChR and for single actions for LEFPC and ORAU SCF (refer to Figure 1.1). The ORR FFA parties and the FYR Planning Team participated in planning meetings for UEFPC, ChR, ORAU SCF, and LEFPC conducted in November and December 2022 to scope this CERCLA FYR and to agree on specific FYR sampling. Per the FFA, DOE is the lead agency for this 2024 FYR. DOE's lead is Mr. Roger Petrie. The EPA FFA Project Manager is Ms. Samantha Urquhart-Foster. Mr. Randy Young represents TDEC.

Per statutory requirements and agreement with the FYR Planning Team, this 2024 FYR addresses RA RODs that left waste in place above levels that allow for UU/UE. Based on this criterion, the following RODs are evaluated in this 2024 FYR:

- UEFPC watershed:
 - UEFPC Phase I Interim ROD, which includes the following amendment:
 - *Amendment to the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee Water Treatment at Outfall 200* (DOE/OR/01-2697&D2; UEFPC Phase 1 Interim ROD Amendment)
 - *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/01-2229&D3; UEFPC Phase II Interim ROD)
 - *Record of Decision for an Interim Action for Union Valley, Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/02-1545&D2; Union Valley Interim ROD)

In addition, the following removal action in UEFPC was reviewed:

- *Action Memorandum for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee* (DOE/OR/01-1819&D2; EEVOC Plume AM)
- ChR administrative watershed:
 - *Record of Decision, United Nuclear Corporation Disposal Site Declaration, Y-12 Plant, Oak Ridge, Tennessee* (DOE 1991; United Nuclear Corporation [UNC] ROD)

- *Record of Decision for Kerr Hollow Quarry at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/02-1398&D2; Kerr Hollow Quarry [KHQ] ROD)
- *Record of Decision for Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond and Vicinity), Oak Ridge, Tennessee* (DOE/OR/02-1410&D3; Filled Coal Ash Pond [FCAP] ROD)
- Other sites – ORAU SCF:
 - *Record of Decision for Oak Ridge Associated Universities, South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1383&D3; ORAU SCF ROD)
- Offsite – LEFPC:
 - LEFPC ROD

Additional key documents used for decision-specific reviews are identified in subsequent chapters of this 2024 FYR.

Detailed site chronology and background for each of the actions included in this 2024 FYR are included in subsequent chapters. Appendix A of the *2016 Fourth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2718&D2; 2016 FYR) documents the remainder of the more than 75 CERCLA RAs and RmAs that do not require a review at this time.

The overall FYR process was similar for all CERCLA actions reviewed in this 2024 FYR. Once the planning meeting participants and the FFA parties agreed on the scope of the FYR, the general evaluation process included tasks from the following list. (Note not all of the tasks listed below were included for every action in this 2024 FYR but varied per the specific requirements of each action [e.g., not all actions stipulated water level measurements].) The “FYR Process” section under each CERCLA action reviewed for this 2024 FYR and presented in subsequent chapters includes the specific tasks completed to determine protectiveness of that specific action. Tasks performed as part of the review included:

- Reviewing decision and post-decision documents.
- Confirming RA implementation.
- Reviewing water level measurement data in wells or piezometers.
- Reviewing groundwater, surface water, sediment, stormwater, influent/effluent, and/or biota monitoring data from the past 3 years since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs.
- Reviewing site documentation on remedy performance, including downtimes and enhancements (e.g., engineering evaluations and costs of implementation) for treatment or operating systems.
- Conducting interviews with the facility manager, O&M personnel, or others familiar with the project, and conducting site visits with the above-listed personnel; project team; and representatives from EPA, TDEC, and the community. The results are documented on the Site Interview/Site Visit forms provided in Appendix A of this 2024 FYR, with the purpose of assessing protectiveness of the remedy and functionality of LUCs and/or engineered remedy integrity.
- Reviewing and determining if there have been changes to ARARs or human health risk criteria (Appendix B of this 2024 FYR).
- Reviewing UEFPD transferred properties to determine if additional DOE parcels have been transferred during the past 3 years since the 2021 FYR (Appendix C of this 2024 FYR).
- Reviewing LUC verifications from the past 3 years since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs, and including the FY 2023 signed verification page in Appendix D of this 2024 FYR.

1.5.1 Community Notification and Involvement and Site Interviews

1.5.1.1 Community notification

DOE solicited community involvement on this 2024 FYR through the following routes:

- Members of the ORR Site-Specific Advisory Board (SSAB), a federally appointed citizens' panel that provides independent advice and recommendations to DOE's Office of Environmental Management (OREM) Program in Oak Ridge, participated in the Site Visits for UEFPC and LEFPC (October 17, 2023) and ChR and ORAU SCF (October 18, 2023).
- DOE published notice of the impending FYR (Figure 1.4) in the following media outlets:
 - Monday, December 4, 2023: *The Oak Ridger*.
 - Wednesday, December 6, 2023: *Roane County News*.

There is a vast Public Administrative Record for each of the decisions included in this 2024 FYR. These records are available to stakeholders from the DOE Information Center:

Building 1916-T1
1 Science.gov Way
Oak Ridge, TN 37831
865-241-4780
1-800-382-6938, Option 6
doeic@science.doe.gov
<http://doeic.science.energy.gov/>

1.5.1.2 Site interviews and site visits

EPA's Recommended FYR Template (EPA 2016) defers to EPA's Comprehensive FYR Guidance (EPA 2001) for executing FYR site interviews and site visits. Site interviews were conducted on August 21 and 23, 2023, followed by site visits on October 17 and 18, 2023. To allow maximum participation from stakeholders (including the FFA parties, facility managers, SSAB members, and the FYR Project Teams), site interviews were reviewed immediately prior to the site visits using the Microsoft Teams online conference system to allow additional participants from the regulatory agencies to participate. Table 1.4 summarizes the schedule of interviews and site visits conducted in preparation of this 2024 FYR. Listed in the table are the key contacts for each review, including the facility manager responsible for each site. Site Interview/Site Visit forms documenting results of the interviews and site visits are located in Appendix A of this 2024 FYR.

1.5.1.2.1 Site interviews

Section 3.5.2 and Appendix C of EPA's Comprehensive FYR Guidance (EPA 2001) contain recommendations for conducting FYR interviews. Participants in the site interviews included representatives from DOE and the FYR Project Team, consisting of contractors from United Cleanup Oak Ridge LLC (UCOR). Contractor specialties included facility managers (responsible for everything on their site's footprint), engineers, inspectors, and specialty scientists. The site interviews focused on background information (previous and current concerns about the site, influences that affected remedy decision, and further clarification on decisions made during remedy selection), changes in present and prospective land uses and restrictions, implementation progress and remedy effectiveness, and any O&M issues. All site interviews were conducted using a combination of in-person and the online conferencing system Microsoft Teams to allow a greater number of participants. Results of the site interviews are documented in Section A (Site Interview) and Section B (Documentation) of the FYR Site Inspection Checklists, contained in Appendix A of this 2024 FYR.

Oak Ridge Environmental Management Program

2024 Five-Year Review for the Department of Energy Oak Ridge Site



The U.S. Department of Energy's (DOE's) Oak Ridge Office of Environmental Management is preparing a five-year review (FYR) for a portion of the Oak Ridge National Prioritized Listed (NPL) Site in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

Starting in 2023, a FYR will be completed each year for a sub-area of the Oak Ridge NPL site. These FYRs ensure the completed and ongoing remedial actions continue to protect human health and the environment or are expected to be protective when all actions are complete.

The Draft Final version of the 2024 FYR (*2024 CERCLA Five-Year Review for Upper East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds and the Lower East Fork Poplar Creek and Oak Ridge Associated Universities South Campus Facility Operable Units on the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee*) will be available for review beginning August 21, 2024 at the DOE Information Center, Office of Scientific and Technical Information, 12 Science Way, Oak Ridge, Tennessee 37830. The Center is open Monday through Friday, 8 a.m. to 5 p.m. The telephone number is (865) 241-4780, and the website address is www.energy.gov/orem/services/community-engagement/doe-information-center.

For additional information, contact:

Roger Petrie

Federal Facility Agreement Manager

U.S. Department of Energy Office of Environmental
Management

Federal Building 200 Administration Road

Oak Ridge, TN 37830

Roger.Petrie@orem.doe.gov

Figure 1.4. Public notice of 2024 FYR.

Table 1.4. Summary of 2024 FYR site interviews and visits

Watershed	CERCLA action	Facility Manager^a interview, date	Site visit date	Site visit participants
UEFPC	UEFPC Phase I Interim ROD, UEFPC Phase II Interim ROD, Union Valley Interim ROD, EEVOC Plume AM	Seth Cook, Andy Hudson, and Aaron Clements (CNS); Dick Ketelle, Sid Garland, and Brianna Humphrey (RSI); and Terry Mathews (ORNL ESD) – 08/21/23	10/17/23	EPA, TDEC, DOE, UEFPC S&M (CNS), SSAB, and FYR Project Team
ChR	UNC ROD, KHQ ROD, FCAP ROD	Paul Waldschlager, Betsy Brucken, Eddie Arnold, and Dick Ketelle (RSI) – 08/23/23	10/18/23	EPA, TDEC, DOE, ChR S&M, SSAB, and FYR Project Team
Other	ORAU SCF	Dick Ketelle and Sid Garland (RSI) – 08/23/23	10/18/23	EPA, TDEC, DOE, SSAB, and FYR Project Team
Offsite	LEFPC	Sam Scheffler (DOE), Diana Turner and Lynn Sims (RSI), and Terry Mathews (ORNL ESD) – 08/23/23	10/17/23	EPA, TDEC, DOE, SSAB, and FYR Project Team

^aIncludes support personnel (e.g., engineers).

AM = Action Memorandum

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

ChR = Chestnut Ridge

CNS = Consolidated Nuclear Security, LLC

DOE = U.S. Department of Energy

EEVOC = East End Volatile Organic Compound

EPA = U.S. Environmental Protection Agency

ESD = Environmental Sciences Division

FCAP = Filled Coal Ash Pond

FYR = Five-Year Review

KHQ = Kerr Hollow Quarry

LEFPC = Lower East Fork Poplar Creek

ORAU = Oak Ridge Associated Universities

ORNL = Oak Ridge National Laboratory

ROD = Record of Decision

RSI = RSI Entech LLC

S&M = surveillance and maintenance

SCF = South Campus Facility

SSAB = Site-specific Advisory Board

TDEC = Tennessee Department of Environment and Conservation

UEFPC = Upper East Fork Poplar Creek

UNC = United Nuclear Corporation

1.5.1.2.2 Site visits

Section 3.5.3 and Appendix D of EPA’s Comprehensive FYR Guidance (EPA 2001) contain recommendations for site visits. A site visit provides the FFA parties opportunity to evaluate the site and visually confirm overall effectiveness of the remedy, as well as to review LUCs and engineered remedy components of the remedy. The 2024 site visits were conducted via an in-person tour to various facilities and sites across the UEFPC watershed, ChR administrative watershed, ORAU SCF, and LEFPC. Participants in the site visits included representatives from DOE, regulatory agencies (EPA and TDEC), members of the SSAB, and the FYR Project Team consisting of UCOR and various subcontractors. As stated in Section 1.5.1.2, site interviews were reviewed immediately prior to the site visits using the Microsoft Teams online conference system to allow additional participation from regulatory agencies. A summary of the 2024 site visits, including updated photographs, is provided in Section C of the FYR Site Interview/Site Visit forms (Appendix A).

1.5.2 Data Review

This 2024 FYR focuses on long-term monitoring (LTM) data that were designed and collected specifically to measure effectiveness of past actions in the UEFPC watershed and ChR administrative watershed and the ORAU SCF and LEFPC RODs. Most of these data were collected as part of the Oak Ridge site WRRP, which manages collection of LTM data under RAR CMPs. The Y-12 Water Quality Program (YWQP) performs monitoring required for the UEFPC watershed, ChR administrative watershed, ORAU SCF, and the off-site CERCLA LEFPC ROD covered in this 2024 review.

WRRP shares and obtains data with the plant environmental compliance programs, primarily the National Pollutant Discharge Elimination System (NPDES) and Biological Monitoring and Abatement Program data collection programs. The vast amounts of environmental characterization data from the ORR are archived and available on the Oak Ridge Environmental Information System (OREIS).

Some CERCLA decision documents require additional FYR sampling, with samples collected in the year prior to the FYR. Most recently, DOE conducted additional sampling in FY 2023 for inclusion in the 2024 FYR. Other FYR biota (select fish and invertebrates) and/or surface water analytes were analyzed in FY 2023 and are reported in this 2024 FYR.

In late 2009, at the FFA Managers' meeting, an agreement was reached that watershed-specific monitoring plans would be prepared that would include the necessary baseline or trend monitoring, as well as the required monitoring specified in existing decision or post-decision documents (e.g., RODs, AM, RARs, and RmA Reports [RmARs]). The technical approach for baseline or trend monitoring is related to the respective hydrologic characteristics of the individual watershed. For example, baseline monitoring may include a surface water IP, where all upstream contaminant releases converge. Although not all upgradient remedies may have been implemented and the performance criteria not yet defined, baseline monitoring provides data necessary for trending purposes.

In mid-2013, all watershed-specific monitoring plans were made primary CERCLA documents by tying them to the RAR for the watershed-wide decisions and calling them RAR CMPs. This gave regulators both the responsibility and authority for review and approval of the RAR CMPs. The RAR CMPs included performance monitoring required by CERCLA decision and post-decision documents, as well as any agreed-on baseline monitoring in the watershed. Since that time, many of the RAR CMPs (including the *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* [DOE/OR/01-2466&D5; EFPC and ChR RAR CMP]) were updated to include not only monitoring requirements, but also LUC and engineered remedy requirements and a watershed-wide LUCIP. In 2020, regulators approved a streamlined errata process to allow expedient updates to the RAR CMPs in response to rapidly changing conditions (particularly at ETTP). The EFPC and ChR RAR CMP was approved by TDEC in January 2023 and by EPA in February 2023. The D5 version provides a more integrated and dynamic RAR CMP, specifying monitoring requirements, LUCs, and engineered remedies (caps, soil covers, and treatment systems requiring systems operations and/or surveillance and maintenance [S&M] activities). The EFPC and ChR RAR CMP includes the 2024 FYR actions in UEFPC and ChR as well as the ORAU SCF and LEFPC.

A comprehensive data review was completed as part of the yearly RER and this 2024 FYR to verify required monitoring was completed as stipulated in the RAR CMPs. A comprehensive check is made every year to validate RER monitoring data information is contained in OREIS.

In each chapter of this 2024 FYR, a section identifying specific performance monitoring goals and objectives for the CERCLA action is presented prior to evaluating performance monitoring results. Additional screening criteria (e.g., ambient water quality criteria [AWQC] and Safe Drinking Water Act of 1974 maximum contaminant levels [MCLs]) are used in some of the results evaluations for comparative purposes but are not performance objectives or goals unless explicitly stated in the report.

Throughout this document, unless specifically noted as federal AWQC, the acronym AWQC is referencing Tennessee water quality criteria in TDEC Chapter 0400-40-03 (formerly Chapter 1200-04-03). Tennessee has surface water use classifications listed in TDEC Chapter 0400-40-04 (formerly Chapter 1200-04-04) and assigns one or more of those uses to each surface water body in the state. Numeric and narrative AWQC are listed in Chapter 0400-40-03-.03 for each of these designated uses. For the designated uses set for streams on the ORR, only fish and aquatic life, recreational use, and domestic water supply (e.g., the CR)

have specific numeric AWQC provided for particular compounds. Unless stated otherwise, the most stringent of the applicable AWQC for the assigned designated uses for ORR surface waters were used in this 2024 FYR for comparison to the surface water data. Although ARARs are generally frozen at the time of ROD signature, EPA's Comprehensive FYR Guidance (EPA 2001) requests the reviewer to evaluate changes in chemical-, location-, and action-specific ARARs since the time of the decision.

1.5.3 Land Use Control Verification and Engineered Remedy Integrity

EPA defines LUCs as both “institutional and engineering controls.” Because most of the remediation decisions for the ORR will not allow for UU/UE, the remedies selected will generally include LUCs. LUCs are to prevent the receptor from encountering the residual hazard (removes the exposure pathway). DOE will be using the term *engineered remedies* for identifying those treatment systems or designed RAs that must be maintained to ensure effectiveness of the completed remedy. The LUCs and engineered remedies will both be necessary to remain both protective and effective for an extended, or possibly indefinite, period of time until residual hazards are reduced sufficiently to permit UU/UE.

LUCs, defined for this document, are legal and other administrative measures intended to prevent the public from coming into contact with contamination left in place. LUCs include controls such as property record restrictions, property record notices, EPP programs, and access controls. LUCs will be implemented by DOE to both prevent exposure to contamination and to facilitate the area in achieving its anticipated land use.

Engineered remedies, as defined in this document, will be used to identify those completed remedies/systems that will require DOE to fund, maintain, and/or operate to remain effective as long as necessary. Examples of engineered remedies include specific CERCLA waste facilities, designed caps, soil covers, and water treatment systems. While the terminology used by DOE is not identical to the EPA policy for LUCs, the intent and result are the same—“to maintain the level of protectiveness that one or more remedial/corrective actions were designed to achieve.” Because verification requirements of engineered remedies and LUCs, as defined above, are vastly different, this unique and more-specific definition used for the ORR should be more suitable to long-term protectiveness of the remedies.

Additionally, in September 2011, EPA released guidance in the *Recommended Evaluation of Institutional Controls: Supplement to the Comprehensive Five-Year Review Guidance* (EPA 2011) to support FYRs under CERCLA where LUCs (EPA-termed institutional controls) are included as components of site remedies. The EPA guidance recommends these controls be mentioned specifically in the overall protectiveness statement when long-term protectiveness hinges on compliance with them.

As part of this 2024 FYR, DOE analyzed LUCs and engineered remedies during key FYR activities, including document reviews, site interviews, and site inspections. The document review process is described below, and the site interviews/site inspection process is described in Section 1.5.1.2.

1.5.3.1 LUC and engineered remedy document reviews

Various CERCLA decision documents are used to make remediation decisions on the ORR. Typically, either a ROD for an RA or an AM for an RmA defines the selected remedy. Some decisions include associated changes (e.g., non-significant changes [NSCs], explanations of significant differences [ESDs], or ROD amendments). These response decision documents contain the statutory decision for the response actions and may also specify LUC/engineered remedy requirements. However, because most decision documents generally lack specifics on these requirements, additional LUC/engineered remedy details typically are found in remedy completion documents.

Following additional guidance provided in EPA 2011, DOE reviewed remedy decision documents, LUC instruments, and other documents with LUC/engineered remedy information as follows:

- **Remedy decision documents** were examined to determine whether:
 - The remedy leaves waste onsite, which will limit site and/or resource use such that UU/UE is not achieved.
 - The remedy meets the RA objective (RAO) in the decision document(s) for the intended end use.
 - The decision document adequately specifies the RAOs to be achieved and the role of the LUC/engineered remedy component of the RA.
 - If LUCs/engineered remedies were not selected as part of the original remedy, do current conditions indicate additional controls are necessary to ensure protectiveness?
- **LUC instruments and other documents with LUC/engineered remedy information** were examined to determine:
 - **Status of LUC implementation:** Property record notices and property record restrictions are still in place and effective; permit or enforcement tool (e.g., EPP program and groundwater use restrictions) requirements are in place.
 - **Reporting of LUC/engineered remedy obligations:** Annual oversight and reporting of enforcement, and certification requirements to ensure compliance with controls; verification that O&M is being performed to meet performance objectives.
 - **Long-term effectiveness and enforceability of LUCs/engineered remedies:** Responsible parties for LUC/engineered remedy implementation have followed through with their obligations, which include implementing, maintaining, and enforcing LUCs/engineered remedy requirements.

1.5.3.2 LUM

Use of an electronic tracking database, LUM, was started in 2013. Specifically, LUM enables the DOE OREM (implemented through WRRP) to implement, track, maintain, and document LUCs and engineered remedies. The system incorporates information primarily using checklists from various DOE contractors and subcontractors on the ORR. LUM generates automatic email reminders and notifications of inspections, documents and tracks deficiencies, is integrated with the Geographic Information System, promotes standardization into the process, and is comprehensive (requirements for LUCs and engineered remedies are entered into LUM as they are required by the decision documents and/or the response action completion report). LUM is a records system; the system is backed up daily and it has an assigned retention schedule. WRRP routinely reviews the status of the checklists in LUM to monitor effectiveness and summarize compliance with LUC/engineered remedy requirements and other long-term stewardship requirements annually in the RER.

Many of the affected area inspections to assess the condition of engineered remedies, as well as physical LUCs (i.e., access controls, signs, security patrols), are performed by the DOE S&M programs in accordance with site-specific S&M plans.

Documentation verifying implementation of administrative LUCs (i.e., property record restrictions, property record notices, EPP programs) is obtained from many sources, including the Anderson and/or Roane County Register of Deeds offices for property record restrictions and property record notices, and project engineers for the EPP program. Copies of this documentation are obtained by WRRP and maintained with the project files.

The DOE OREM Manager annually verifies, in the RER, that LUCIPs are being implemented on the Oak Ridge site. The approved LUCs for MV; BV; BCV; ETTP; and as of 2023, EFPC and ChR, currently require an annual certification. The FY 2023 certification will be added following approval certification in the 2024 RER.

1.5.4 Cost Inputs

The FYR also captures the cost of operating systems, S&M, and LTM that are required to maintain effectiveness and protectiveness. Estimates of post-action cost are part of the initial decision-making, but the FYR can provide actual costs related to leaving waste in place. For UEFPC, ChR, ORAU SCF, and LEFPC, post-action CERCLA activities are managed under the following programs:

- WRRP, which covers the CERCLA monitoring program, tracking LUC implementation, and oversight of the specific field sampling projects—YWQP.
- Post-CERCLA S&M activities costs are reported for the UEFPC and ChR watersheds, but S&M activities are minor or non-existent at ORAU SCF and LEFPC.

These programs do not capture costs by individual RODs and AMs; therefore, it is not possible to separate and report the cost of monitoring requirements of different actions within a single plant site. As such, the approach to reporting costs in this 2024 FYR is to present program-level costs for S&M and LTM and system-specific costs for any ongoing collection and treatment units, including the UEFPC Phase I Interim ROD Big Spring Water Treatment System (BSWTS) and EEVOC Plume pump and treat system in the UEFPC watershed. Table 1.5 summarizes how costs are presented in this 2024 FYR.

Table 1.5. Cost breakdown for 2024 FYR

Cost item	UEFPC	ChR	ORAU SCF	LEFPC
System operations	BSWTS, EEVOC Plume system	NA	NA	NA
S&M; LUC implementation	Y-12 S&M	Y-12 S&M	NA	NA
WRRP – program and reporting	WRRP	WRRP	WRRP	WRRP
LTM (field sampling) and LUC tracking	Y-12 LTM (YWQP)	Y-12 LTM (YWQP)	Y-12 LTM (YWQP)	Y-12 LTM (YWQP)
BSWTS = Big Spring Water Treatment System ChR = Chestnut Ridge EEVOC = East End Volatile Organic Compound FYR = Five-Year Review LEFPC = Lower East Fork Poplar Creek LTM = long-term monitoring LUC = land use control NA = not applicable because no costs incurred or inconsequential cost item			ORAU = Oak Ridge Associated Universities S&M = surveillance and maintenance SCF = South Campus Facility UEFPC = Upper East Fork Poplar Creek WRRP = Water Resources Restoration Program Y-12 = Y-12 National Security Complex YWQP = Y-12 National Security Complex Water Quality Program	

Program-level costs for the items shown in Table 1.5 are provided in Table 1.6. These costs are direct project costs and do not include overhead and general and administrative costs. Costs associated with the BSWTS collection and treatment unit are presented in Section 2.1.4.5; costs associated with EEVOC Plume treatment system are presented in Section 2.4.4.5.

Table 1.6. Annual program-level costs of S&M and LTM activities for UEFPC and off-site CERCLA decisions

Location/Program-level cost item	Estimated annual cost ^a	
	2021 FYR	2024 FYR
Y-12 S&M	\$251,250	\$562,844
Y-12 – LTM (WRRP and YWQP)	\$4,531,202	\$5,306,092

^aDirect project costs. Overhead and general administrative costs are excluded.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

FYR = Five-Year Review

LTM = long-term monitoring

S&M = surveillance and maintenance

UEFPC = Upper East Fork Poplar Creek

WRRP = Water Resources Restoration Program

Y-12 = Y-12 National Security Complex

YWQP = Y-12 National Security Complex Water Quality Program

1.6 TECHNICAL ASSESSMENT

As stated in Section 1.1, the goal of the FYR is to evaluate whether completed CERCLA actions on the ORR site continue to be protective. Careful analysis of environmental monitoring data (soil, groundwater, sediment, surface water, and/or biological monitoring data), verification of LUCs, engineered remedy integrity, and information gathered during the FYR site interviews and site visits was used to answer three primary questions:

- A. Is the remedy functioning as intended by the decision documents?
- B. Are the assumptions used at the time of remedy selection still valid?
- C. Has any other information come to light that could call into question the protectiveness of the remedy?

A FYR summary table was prepared for each CERCLA action included in this 2024 FYR. This table lists the three primary questions, stated above, each with a subset of detailed questions. The FYR summary table template is shown in Table 1.7.

Table 1.7. FYR summary table template

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?		
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?		
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?		
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?		
Are operating procedures, as implemented, maintaining the effectiveness of response actions?		

Table 1.7. FYR summary table template (cont.)

Question	Response	Note
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?		
Have there been any changes in land use or expected land use on or near the site?		
Have new human health or ecological exposure pathways or receptors been identified?		
Have new contaminants or contaminant sources been identified?		
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?		
Have there been any changes in the physical site conditions?		
Have there been any changes in the toxicity factors for COCs?		
Were there significant changes in the standardized risk assessment methodologies?		
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?		
Is the site located in an area subject to natural disasters?		
ARAR = applicable or relevant and appropriate requirement COC = contaminant of concern FYR = Five-Year Review	LUC = land use control ROD = Record of Decision TBC = to be considered	

1.6.1 Applicable or Relevant and Appropriate Requirements

In the preamble to the final NCP, EPA stated its policy that it will not reopen remedy selection decisions contained in RODs (i.e., ARARs are normally frozen at the time of ROD signature) unless a “new or modified requirement calls into question the protectiveness of the selected remedy” (55 Federal Register [FR] 8757; EPA 1990). The preamble goes on to state “a policy of freezing ARARs at the time of ROD signing will not sacrifice protection of human health and the environment because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently if there is reason to believe that the remedy is no longer protective of human health and the environment” (EPA 1990). The preamble also notes a remedy would not necessarily need to be modified solely to attain a newly promulgated or modified requirement, but that such requirements “contribute to [the] evaluation of the protectiveness” (EPA 1990). Therefore, although ARARs generally are frozen at the time of ROD signature, EPA’s Comprehensive FYR Guidance requests the reviewer evaluate changes in chemical-, location-, and action-specific ARARs since the time of the decision.

Any newly promulgated action- and location-specific regulations published in the FR are reviewed continuously to determine if they could affect protectiveness of the remedies on the Oak Ridge site. Changes to chemical-specific ARARs are summarized within each of the individual “CERCLA Action” sections in this 2024 FYR. Additional details are provided in Appendix B. A change in an ARAR may not necessarily result in a change in the resulting risk and, therefore, may not impact protectiveness.

1.6.2 Human Health Risk

1.6.2.1 Risk methods for FYR

EPA's Comprehensive FYR Guidance (EPA 2001) states responsible parties "should investigate the effect of significant changes in the risk parameters that were used to support the remedy selection, such as reference doses, cancer potency factors, and exposure pathways of concern." Since the signing of the RODs on the Oak Ridge site, there have been changes in risk assessment methods and toxicity factors that necessitate a review of the potential impacts to the decisions, as detailed in Appendix B.

The cumulative impact of risk method and toxicity factor changes on any given CERCLA decision is most applicable to actions that have risk-based RLs defined that are part of the RAOs codified in a ROD. Many of the RAs on the Oak Ridge site do not have defined RLs; rather, they have some other basis, such as source removal, action-based levels, or ARAR-based levels.

In addition to evaluating the potential impact of risk assessment changes on the RLs, this 2024 FYR (and previous FYRs—2001, 2006, 2011, 2016, and 2021) provides a simple update of media concentrations at key locations compared to risk-based RLs. This comparison provides an update as to the level of protectiveness (e.g., industrial, recreational) that has been achieved at each of these locations. Many of the RODs at the Oak Ridge site are interim in nature. The most up-to-date toxicity factors will be used in final watershed RODs, which will supersede interim action RODs where applicable, and will encompass the most current human health risk assessment (HHRA) protocols.

1.6.3 Ecological Risk

Although several of the characterization efforts on the Oak Ridge site have included some level of ecological risk evaluation, only three decisions have directly addressed protection of ecological receptors—the off-site decisions for LEFPC floodplain soils, CR/PC, and LWBR. Final decisions on remaining ecological risk concerns will be addressed in the final watershed RODs. In the three cases where ecological risks are covered by the ROD, the remedy selected was continued monitoring, primarily to ensure contaminant bioaccumulation is not increasing.

DOE assessed ecological risk for LEFPC in the *East Fork Poplar Creek-Sewer Line Beltway Remedial Investigation* (DOE/OR/02-1119&D2; EFPC Remedial Investigation [RI]) while EPA was developing the current guidance for conducting ecological risk assessments (ERAs). The guidance for the eight-step process that eventually emerged is described in the *Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (EPA 1997).

While the ERA for LEFPC did not use the eight-step terminology, it is consistent with this process, and it is unlikely risk-management decisions would have been different had current guidance been available before the ERA was conducted. Additional analysis of the LEFPC decision is provided in Chapter 5.

1.7 ISSUES/RECOMMENDATIONS

Issues and recommendations are identified when conditions are noted in the FYR that affect either current and/or future protectiveness. Any issues identified in this process will be tracked in EPA's Superfund Enterprise Management System (SEMS) database (<https://www.epa.gov/enviro/sems-overview>). For reference, the EPA SEMS OU designation for each action reviewed in this 2024 FYR is listed at the beginning of each action.

1.7.1 Other Findings

This section is provided for items that are included in the FYR report but are not tracked as formal issues and recommendations affecting current and/or future protectiveness. These include recommendations identified during the FYR that may improve performance of the remedy, reduce costs, improve O&M management, accelerate site close out, conserve energy, and promote sustainability (EPA 2016).

1.8 PROTECTIVENESS STATEMENT

A protectiveness statement is prepared for each action evaluated in the FYR. Guidance on wording for the protectiveness statement is provided in EPA's memorandum titled *Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews* (EPA 2012). For any actions with a deferred protectiveness determination, a planned addendum completion date will be provided with the protectiveness statement.

1.9 NEXT FIVE-YEAR REVIEW

FYRs subsequent to this 2024 FYR will be prepared and submitted as shown in Table 1.1.

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2. Y-12 NATIONAL SECURITY COMPLEX – UPPER EAST FORK POPLAR CREEK WATERSHED

Most of the UEFPC watershed is located within the DOE ORR boundary established under the Atomic Energy Act of 1954 (AEA) (Figure 2.1). CERCLA remediation work began in UEFPC in 1991. Since that time, there have been seven RmAs, two single-action RODs, two single-action interim RODs, and two phased watershed-scale RODs. Based on CERCLA requirements for performing FYRs and agreements with the regulators, the following actions are included in this review (Table 2.1):

- UEFPC Phase I Interim ROD (DOE/OR/01-1951&D3)
- UEFPC Phase II Interim ROD (DOE/OR/01-2229&D3)
- Union Valley Interim ROD (DOE/OR/02-1545&D2)
- EEVOC Plume AM (DOE/OR/01-1819&D2)

Additional UEFPC actions not included in this 2024 FYR are also listed in Table 2.1, with additional details available in Appendix A of the 2016 FYR. These actions are not included in this 2024 FYR because either the action resulted in no further action (NFA), there are no CERCLA monitoring or LUC requirements, or they are D&D projects involving building demolition.

2.1 PHASE I INTERIM SOURCE CONTROL ACTIONS

ROD:	DOE/OR/01-1951&D3: 05/02/02
NSC:	Mercury monitoring 10/05/06, Erratum 06/09/08
NSC:	9201-5 Sump water 05/17/07
NSC:	Sump water 10/29/09
ESD:	DOE/OR/01-2539&D2: 08/29/12
NSC:	UEFPC monitoring in RAR CMP 03/14/14
NSC:	Alpha-2 basement sump 05/18/23
ROD Amendment:	DOE/OR/01-2697&D2: 05/24/16
PCCR for BSWTS:	DOE/OR/01-2218&D1: 07/01/05
PCCR for WEMA:	DOE/OR/01-2526&D2: 08/31/12

Decision document: *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*

EPA SEMS OU: 28 – OU28 UEFPC Watershed

2.1.1 Introduction

Contaminants have been left in place in UEFPC at levels that do not allow for UU/UE. The purpose of this review is to determine whether the remedies in place associated with the UEFPC Phase I Interim ROD (along with the UEFPC Phase 1 Interim ROD Amendment [DOE/OR/01-2697&D2] and the *Explanation of Significant Differences for the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* [DOE/OR/01-2539&D2; UEFPC Phase I Interim ROD ESD]) and the five NSCs issued are protective of human health and the environment.

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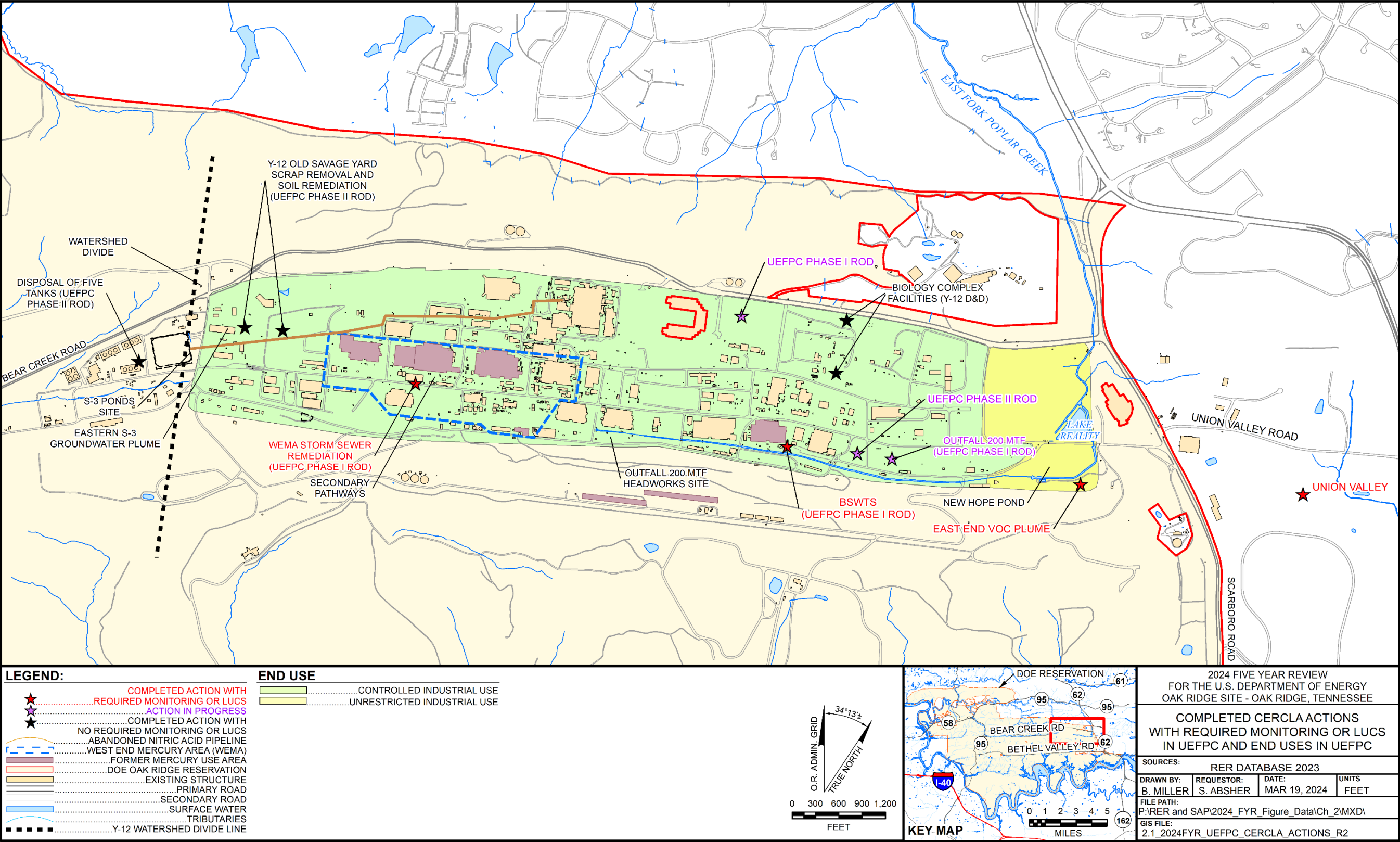


Figure 2.1. Completed CERCLA actions with required monitoring or LUCs in UEFPC and end uses within UEFPC and Union Valley.

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Table 2.1. CERCLA actions in UEFPC watershed

CERCLA action	Decision document, date signed	Completion document
FYR action		
<i>Watershed-scale action</i>		
Phase I Interim Source Control Actions	Interim ROD (DOE/OR/01-1951&D3): 05/02/02 NSC: 10/05/06, mercury monitoring NSC: 05/17/07, 9201-5 sump water Erratum to the 10/05/06 NSC: 06/09/08, sampling at Outfall 163 NSC: 10/29/09; sump water ESD (DOE/OR/01-2539&D2): 08/29/12, updates to selected remedy NSC: submitted 03/14/14; UEFPC monitoring to be managed in EFPC and ChR RAR CMP ROD Amendment: 05/24/16, Outfall 200 MTF NSC: 05/18/23, Building 9201-2 (Alpha-2) basement sump	Watershed-scale requirements provided in ROD LUC requirements for New Hope Pond to be managed in EFPC and ChR RAR CMP Monitoring requirements for Eastern S-3 Groundwater Plume to be managed in EFPC and ChR RAR CMP PCCR for BSWTS for Building 9201-2 (DOE/OR/01-2218&D1) approved: 07/01/05 PCCR WEMA storm sewer remediation (DOE/OR/01-2526&D2) approved: 08/31/12
Phase II Interim RA for Contaminated Soils and Scrapyard	Interim ROD (DOE/OR/01-2229&D3): 04/21/06 NSC: approved 09/03/19; addition of EUs and revision of boundary line between EUs. Partial withdrawal of NSC to add EUs 15, 16, and 17 submitted: 02/05/20	Watershed-scale requirements provided in ROD PCCR for Y-12 Salvage Yard – scrap removal (DOE/OR/01-2481&D1) approved: 10/11/11 PCCR for Y-12 Salvage Yard Soil (DOE/OR/01-2564&D1) approved: 11/01/12; (DOE/OR/01/-2481&D1/A1) addendum for removal and disposal of five tanks approved: 02/11/14 RAWP (DOE/OR/01-2423&D2) Attachment C.4 (<i>Phase 2 Technical Memorandum for Exposure Unit 5 at Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee</i>) - NFA: approved 9/17/22
<i>Single-project action</i>		
Y-12 EEVOC Plume	AM (DOE/OR/01-1819&D2): 06/25/99 NSC: 03/06/13	RmAR (DOE/OR/01-2297&D1) approved: 06/07/06 • Erratum to establish monitoring POC submitted: 03/05/13 (no approval required)
Union Valley	Interim ROD (DOE/OR/02-1545&D2): 07/10/97	-- ^a
CERCLA action not reviewed		
<i>Single-project action</i>		
Mercury Tanks (Tanks 2100-U, 2101-U, and 2104-U)	Interim ROD (DOE/OR/02-1164): 09/26/91	RAR (DOE/OR/01-1169&D1) approved: 03/02/94
Plating Shop Container Areas	ROD (DOE/OR-1049&D3): 09/30/92	NFA
Abandoned Nitric Acid Pipeline (UEFPC OU 2)	ROD (DOE/OR/02-1265&D2): 09/12/94	NFA

Table 2.1. CERCLA actions in UEFPC watershed (cont.)

CERCLA action	Decision document, date signed	Completion document
Building 9201-4 Exterior Process Piping	AM (DOE/OR/02-1571&D2): 04/22/97	RmAR (DOE/OR/02-1650&D1) approved: 09/30/99
Lead Source Removal of Former YS-860, Firing Range RmA	AM (DOE/OR/02-1622&D1): 03/10/98	RmAR (DOE/OR/01-1774&D2) approved: 02/24/99
9822 Sediment Basin and Building 81-10 Sump RmA	AM (DOE/OR/01-1716&D2): 06/19/98	RmAR (DOE/OR/01-1763&D2) approved: 02/24/99
Removal of Mercury from Storm Sewer System	TC AM (DOE/OR/01-2574&D1): 07/19/12	RmAR for Mercury Reduction Project (DOE/OR/01-2595&D1) approved: 02/11/14 RmAR for Mercury Reduction Project revision to document objectives have been met and to terminate action (DOE/OR/01-2595&D1/R1) approved: 08/28/17
Removal of Debris and Soil from the Haul Road Ravine Disposal Area	TC AM (DOE/OR/01-2662&D1): 10/06/14	RmAR (DOE/OR/01-2668&D1) approved: 12/03/15
<i>Demolition project</i>		
Removal of Legacy Materials from Buildings 9201-5 and 9204-4	TC AM (DOE/OR/01-2404&D1): 05/04/09 Addendum (DOE/OR/01-2404&D1/A1): 10/03/11	RmAR (DOE/OR/01-2519&D2) approved: 02/27/12
Demolition of Buildings 9735 and 9206 filter house	TC AM (DOE/OR/01-2405&D1): 05/04/09	RmAR (DOE/OR/01-2502&D1) approved: 02/15/12
Demolition of Buildings 9211, 9220, 9224, and 9769 (Biology Complex)	TC AM (DOE/OR/01-2406&D1): 05/04/09	RmAR (DOE/OR/01-2508&D2) approved: 02/13/12
Y-12 Facilities Deactivation/Demolition	AM (DOE/OR/01-2462&D2): 09/29/10 • NSC added Buildings 9401-4, 9401-4A, 9720-92, and 9404-17: 05/14/19 • NSC added Buildings 9990-3 and 9401-3A: 10/04/19 • NSC added Buildings 9803, 9811-3, and 9616-8: 10/28/20 • NSC added Building 9404-18: 06/14/21 • Addendum added ARARs for discharge of treated water and added treatment of wastewater at ORNL wastewater treatment plants: 03/28/23	Project Completion Report (Beta-3 Legacy Material) (DOE/OR/01-2570&D1) approved: 11/05/12 RmAR Just In Case Yard (DOE/OR/01-2532&D1) approved: 11/05/12 PCCR for Secondary Pathways Project (DOE/OR/01-2596&D1) approved: 02/11/14 PCCR for Building 9206 Duct and Fan Removal (DOE/OR/01-2613&D1) approved: 07/21/14 PCCR for Building 9808 Demolition (DOE/OR/01-2696/D1) approved: 09/27/16 (completion letter) PCCR for Alpha 5 Dust Collector (DOE/OR/01-2842&D1) approval pending notification of waste disposal PCCR for Biology Buildings 9743-2 and 9770-2 (DOE/OR/01-2790&D1) approved: 11/29/18

Table 2.1. CERCLA actions in UEFPC watershed (cont.)

CERCLA action	Decision document, date signed	Completion document
		PCCR for COLEX West Side demolition (DOE/OR/01-2816&D1) approved: 08/21/19
		PCCR for Buildings 9401-4, 9401-4A, and 9720-92 (DOE/OR/01-2860&D1) approved: 09/08/21
		PCCR for Building 9720-22 (DOE/OR/01-2861&D1) approved: 09/08/21
		PCCR for Demolition of the Biology Complex (DOE/OR/01-2926&D2) approved: 11/27/22
		PCCR for Building 9404-18 (DOE/OR/01-2929&D1): submitted 06/06/23
		PCCR for Building 9213 (DOE/OR/01-2945&D2): approved 08/28/23

^aThis action was completed prior to uniform adherence to the RAR process; hence, no RAR exists for this decision.

-- = Not applicable, not available, or insufficient data to calculate the statistic.

AM = Action Memorandum

ARAR = applicable or relevant and appropriate requirement

BSWTS = Big Spring Water Treatment System

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

ChR = Chestnut Ridge

CMP = Comprehensive Monitoring Plan

COLEX = column exchange

EEVOC = East End Volatile Organic Compound

EFPC = East Fork Poplar Creek

ESD = Explanation of Significant Differences

EU = exposure unit

FYR = Five-Year Review

LUC = land use control

MTF = Mercury Treatment Facility

NFA = no further action

NSC = non-significant change

ORNL = Oak Ridge National Laboratory

OU = operable unit

PCCR = Phased Construction Completion Report

POC = point of compliance

RA = remedial action

RAR = Remedial Action Report

RAWP = Remedial Action Work Plan

RmA = removal action

RmAR = Removal Action Report

ROD = Record of Decision

TC = time-critical

UEFPC = Upper East Fork Poplar Creek

WEMA = West End Mercury Area

Y-12 = Y-12 National Security Complex

2.1.1.1 Site chronology and background

Mercury fate and transport at Y-12 has been investigated through numerous studies. A comprehensive overview of historical investigations is contained in the *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1641&D2; UEFPC RI). Between 239,000 and 470,000 lb of mercury was lost during lithium-separation activities; however, it is currently unknown how much residual mercury remains in soil beneath basements and in storm sewers at Y-12. The presence of residual mercury has been documented in soils, storm sewers, and in UEFPC sediments and bank soils. Current data indicate the flux from these various sources is highly variable and dependent on a number of factors, such as rainfall and mobilization of particulate-bound mercury in sediment as a result of bank and channel erosion.

Table 2.2 presents a chronology of events associated with the UEFPC Phase I Interim ROD.

Table 2.2. Chronology of events associated with UEFPC Phase I Interim ROD

Event	Date
239,000 lb to 470,000 lb of mercury were lost from lithium isotope separation processes at Y-12 into EFPC	1953–1983
Primary mercury loss from operations ceased	1963
Portions of the Y-12 sewer were relined, which further reduced releases	1986–1987
The ORR was placed on the NPL as a CERCLA site	1989
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
The UEFPC RI (DOE/OR/01-1641&D2) was approved	1998
The FS for UEFPC (DOE/OR/01-1747&D2) was approved	1999
The public comment period and Proposed Plan (DOE/OR/01-1839&D3) were developed	2000–2001
The FS Addendum (DOE/OR/01-1747&D3/A3) was approved	2001
The UEFPC Phase I Interim ROD (DOE/OR/01-1951&D3) was signed by the FFA parties	May 2002
Approval of BSWTS design was received	October 2003
Construction of BSWTS began	March 2004
BSWTS began operations (testing phase, March–August 2005)	March 2005
PCCR for BSWTS (DOE/OR/01-2218&D1)	July 2005
UEFPC was included in the third 2006 FYR for the ORR (DOE/OR/01-2289&D3)	FY 2006
NSC: mercury monitoring	October 2006
NSC: 9201-5 sump water	May 2007
Erratum of October 2006 NSC: sampling at Outfall 163	June 2008
Initiation of WEMA action (storm sewers)	FY 2009
NSC: Sump water	September 2009
Storm Drain Engineering Study Report (DOE/OR/01-2429&D2)	December 2009
RAWP for remediation of WEMA storm sewers was approved (DOE/OR/01-2447&D2)	August 2010
Reinstatement of flow-proportional composite sampling at Outfalls 150, 160, 163, and 169A	FY 2010
UEFPC Soils 81-10 Area Characterization Report (DOE/OR/01-2485&D2) was completed and indicated mercury contamination was not impacting UEFPC	2011
WEMA storm drain fieldwork	February–September 2011
UEFPC was included in the third 2011 FYR for the ORR (DOE/OR/01-2516&D2)	2011

Table 2.2. Chronology of events associated with UEFPC Phase I Interim ROD (cont.)

Event	Date
WEMA storm drain PCCR (DOE/OR/01-2526&D2)	August 2012
ESD: Updates to the selected remedy (DOE/OR/01-2539&D2)	August 2012
Mercury Mitigation Strategy (DOE/OR/01-2605&D2)	January 2014
NSC: UEFPC monitoring to be managed in EFPC and ChR RAR CMP (DOE/OR/01-2466&D5)	March 2014
Focused FS for supplemental mercury abatement actions under the ROD for Phase I Source Control actions was approved (DOE/OR/01-2660&D3)	2015
Proposed Plan for Water Treatment at Outfall 200 under the ROD for Phase I Source Control Actions was approved (DOE/OR/01-2661&D2)	2015
UEFPC Phase I Interim ROD Amendment (for Outfall 200 MTF) was approved (DOE/OR/01-2697&D2)	May 2016
UEFPC was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D2)	2016
RDR/RAWP (DOE/OR/01-2735&D2) for water treatment at Outfall 200 in the UEFPC Characterization Area was submitted	FY 2017
Contract awarded to build the Outfall 200 MTF	November 2018
Outfall 200 MTF early site preparation (constructed necessary utilities, installed secant pile walls near EFPC, and demolished and relocated existing structures)	FYs 2018–2019
Excavation/construction began at Outfall 200 MTF and headworks sites; small treatment system installed to remove mercury from water collected in headworks site	FY 2020
Addendum to the RDR/RAWP (DOE/OR/01-2735&D2/A1/R1) to address approaches for ARAR compliance for the Outfall 200 MTF intake and outfall structures and to mitigate the permanent loss of net resource value of the length of UEFPC between Outfall 200 and BSWTS was approved by EPA and TDEC in FY 2021. DOE continued working to identify future mitigation options for discussion with EPA and TDEC	November 2020
UEFPC was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021
Construction continued at Outfall 200 MTF headworks site and downstream treatment system site	FYs 2022–2023
NSC: 9201-2 (Alpha-2) basement sump	FY 2023

ARAR = applicable or relevant and appropriate requirement
 BSWTS = Big Spring Water Treatment System
 CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
 ChR = Chestnut Ridge
 CMP = Comprehensive Monitoring Plan
 DOE = U.S. Department of Energy
 EFPC = East Fork Poplar Creek
 EPA = U.S. Environmental Protection Agency
 ESD = Explanation of Significant Differences
 FFA = Federal Facility Agreement
 FS = feasibility study
 FY = fiscal year
 FYR = Five-Year Review
 MTF = Mercury Treatment Facility

NPL = National Priorities List
 NSC = non-significant change
 ORR = Oak Ridge Reservation
 PCCR = Phased Construction Completion Report
 RAR = Remedial Action Report
 RAWP = Remedial Action Work Plan
 RDR = Remedial Design Report
 RI = remedial investigation
 ROD = Record of Decision
 TDEC = Tennessee Department of Environment and Conservation
 UEFPC = Upper East Fork Poplar Creek
 WEMA = West End Mercury Area
 Y-12 = Y-12 National Security Complex

Reductions in mercury mass in UEFPC to date have been achieved largely by ceasing operations that use mercury and implementing remedial measures under the former Reduction of Mercury in Plant Effluents Program in the mid- to late 1990s (UEFPC RI). Prior to the UEFPC Phase I Interim ROD, three additional previous actions affecting mercury flux were conducted under the Reduction of Mercury in Plant Effluents Program:

- **1996:** A flow management program was initiated to release approximately 3 million gal of water per day from the CR to the UEFPC channel just below Outfall 200 to improve stream conditions for aquatic biota. This was terminated in 2014, resulting in a reduction of the base-flow at Station 17 by a factor of approximately two-thirds. The impact of this change on the dynamics of mercury flux in UEFPC is being evaluated through ongoing monitoring. Several fish toxicity incidents have occurred since 2014.
- **January 2000:** A CERCLA treatability study and bank stabilization project to minimize bank erosion and lower flux for a portion of UEFPC, which was titled *Treatability Study Report for the Upper East Fork Poplar Creek Bank Stabilization at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1890&D1), was completed. This study provided the basis for ongoing biological monitoring in UEFPC.
- **1998:** The Lake Reality bypass project, which rerouted UEFPC flow around Lake Reality and reduced the flux of methylmercury in water (a form more susceptible to biouptake) downstream of Lake Reality by approximately 90%, was completed.

Key documents reviewed for this 2024 FYR include:

- UEFPC Phase I Interim ROD.
- UEFPC Phase I Interim ROD Amendment.
- EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).
- *Phased Construction Completion Report for the Big Spring Water Treatment System at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2218&D1).
- 2021 FYR (DOE/OR/01-2895&D2).
- 2022 RER (DOE/OR/01-2916&D2).
- 2023 RER (DOE/OR/01-2938&D2).
- 2024 RER (DOE/OR/01-2960&D1); specifically Chapter 5, “UEFPC Watershed.”

2.1.1.2 Physical characterization

The UEFPC watershed encompasses a drainage area of about 1170 acres in the eastern portion of the ORR and extends from the west end, at the surface water divide between eastward-flowing EFPC and westward-flowing Bear Creek, eastward to Scarboro Road (Figure 2.1). The UEFPC administrative watershed contains the principal portions of the Y-12 facility. In addition, groundwater contamination in Union Valley is administratively included within the UEFPC watershed because it is contiguous with contamination beneath Y-12. The crest of Pine Ridge forms the northern hydrologic boundary of the watershed, and the crest of ChR is the southern hydrologic boundary.

2.1.1.3 Land and resource use

The UEFPC watershed is dominated by the heavily industrialized portions of Y-12, which occupy about 800 acres of the watershed. With the addition of the Highly Enriched Uranium Materials Facility and the Uranium Processing Facility (under construction), this area will remain under federal government

(DOE/National Nuclear Security Administration [NNSA]) control for the foreseeable future. The identified land use goals included in the UEFPC Phase I Interim ROD were updated and modified by the UEFPC Phase II Interim ROD and include, as shown on Figure 2.1, the following:

- The central and western Y-12 areas will be remediated to meet a controlled industrial land use. Industrial use in the upper 2 ft of the area will be unrestricted. Use of the subsurface below the depth of 2 ft will be authorized by DOE NNSA for federal use, or if transferred, by the FFA parties.
- The eastern side of the Y-12 area will be remediated to meet an unrestricted industrial land use for the upper 10 ft of the area.

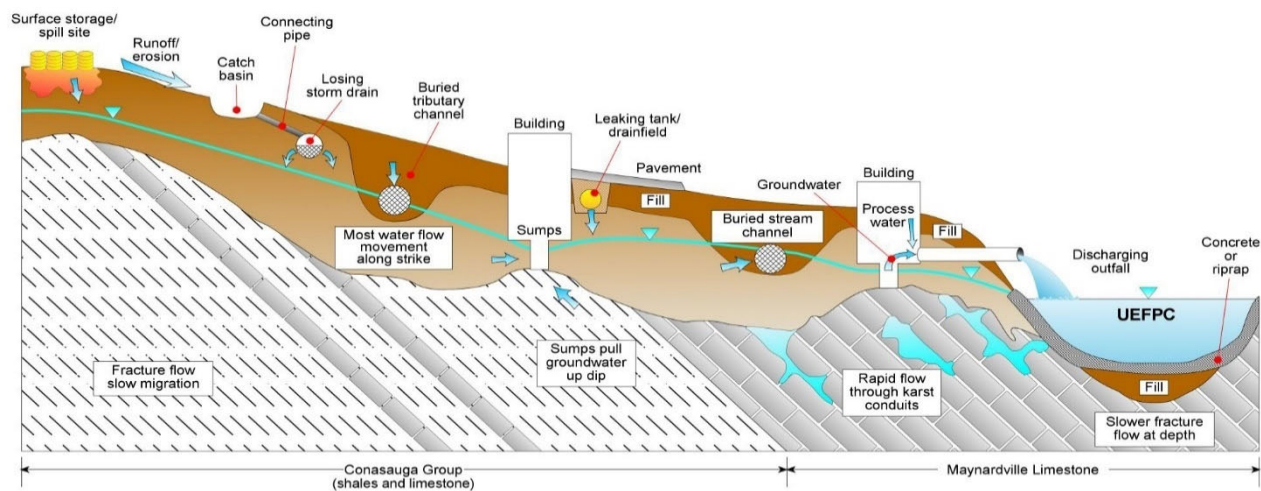
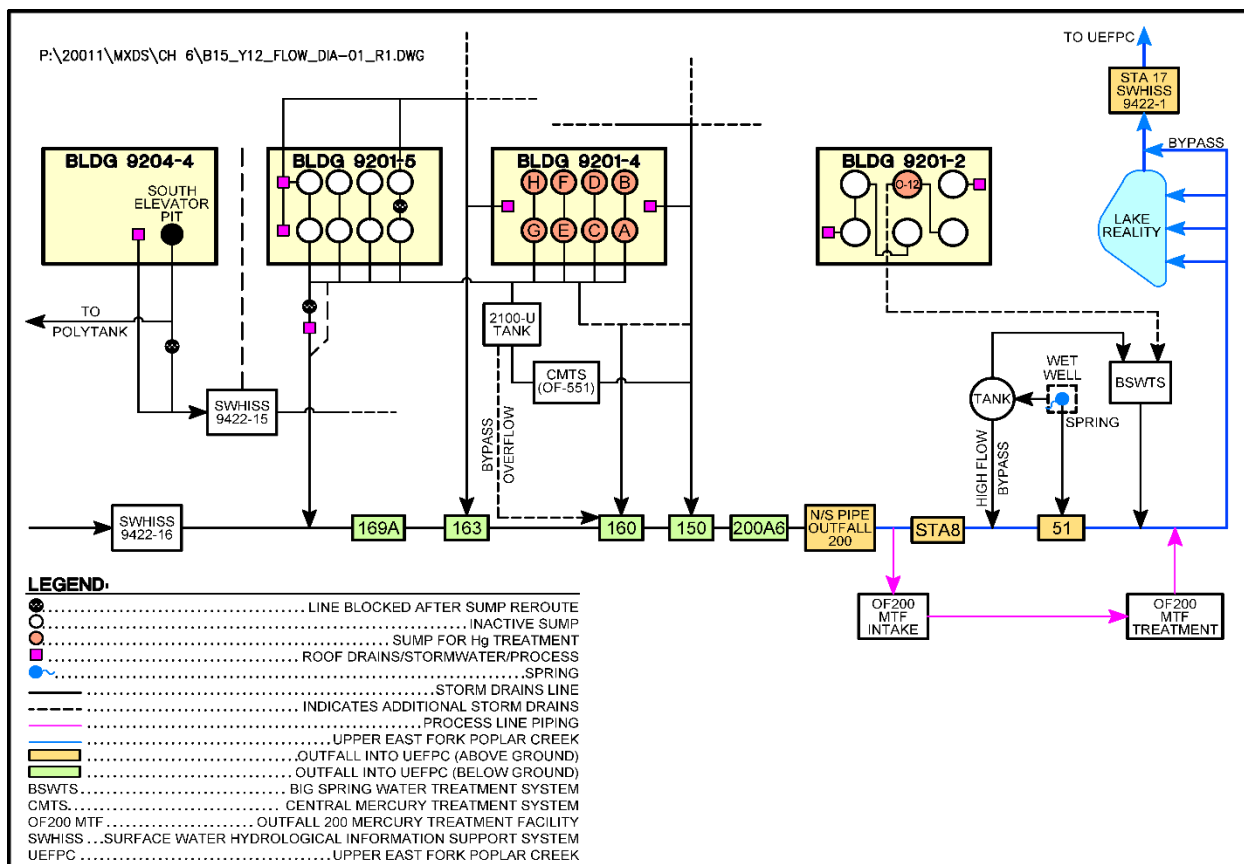
EFPC originates at the North/South Pipes (Outfall 200) within Y-12 and exits DOE property at Station 17. The state of Tennessee has posted EFPC as “deemed-not-suitable-for-recreation-activities” due to the presence of contaminants.

2.1.2 Response Action Summary

2.1.2.1 Basis for taking action

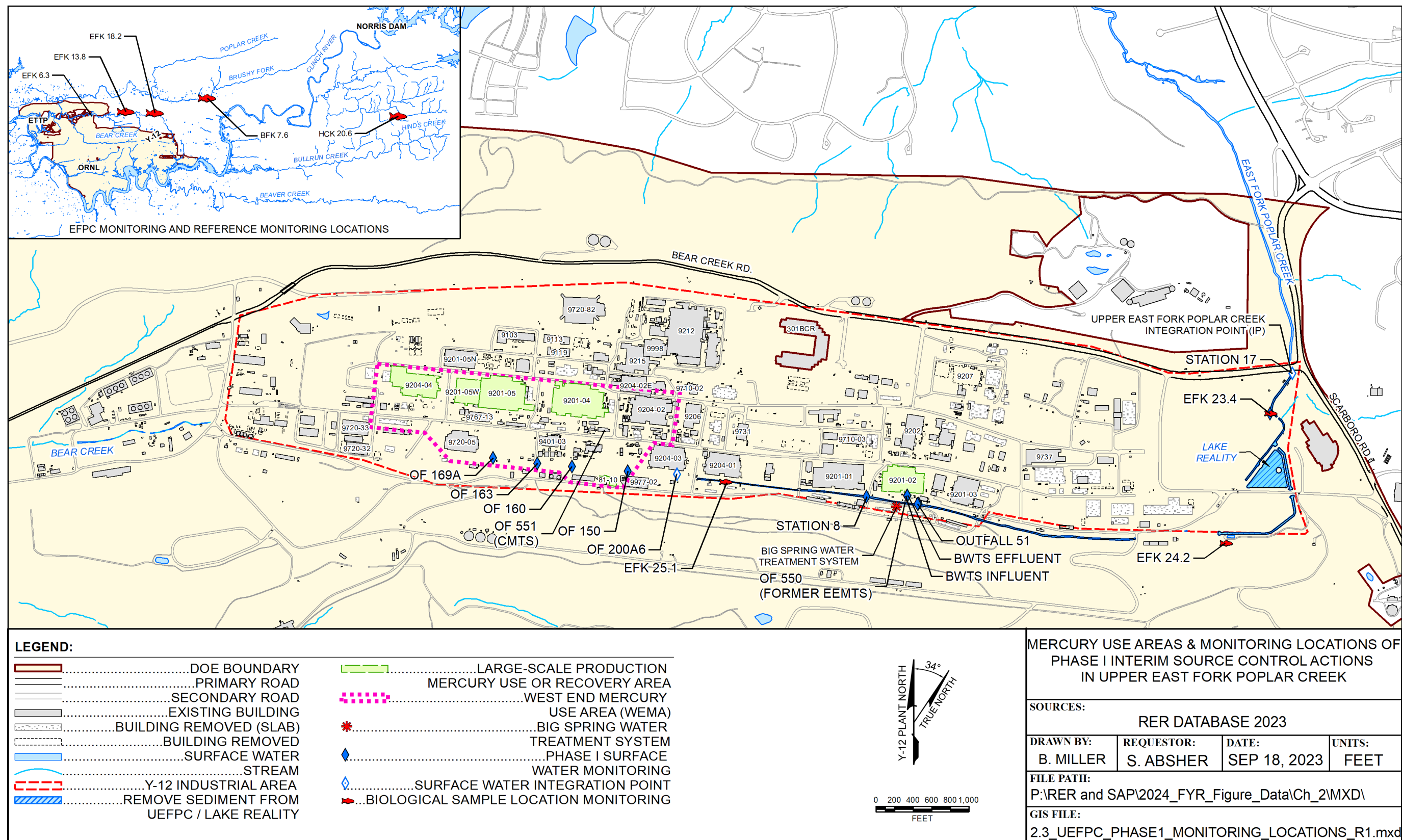
Mercury contamination is widespread at the Y-12 site and has been identified in soil, sediment, surface water, groundwater, buildings, drains, and sumps. Contamination is introduced into groundwater through multiple paths, including spills, pipeline leaks, and dissolution from contaminated soils and sediments (Figure 2.2). Mercury enters UEFPC surface water from direct erosion of contaminated soil, migration of dissolved mercury through storm drains and outfalls, and through shallow groundwater. In addition to widespread mercury contamination throughout the UEFPC watershed, several areas have been identified as significant sources of mercury releases. These areas include WEMA (under and around Buildings 9201-4, 9201-5, and 9204-4), the Building 81-10 area, the Building 9201-2 area (Outfall 51), Lake Reality, and the UEFPC streambed (Figure 2.2). The UEFPC streambed and Lake Reality contain sediments with elevated concentrations of mercury and other contaminants, which are subject to remobilization and/or downstream transport.

Peak mercury discharges at Station 17 occurred in 1958. Mercury concentrations in UEFPC have generally been decreasing, supported by the response actions taken to date, but they remain above the interim goal and regulatory criteria (i.e., AWQC). Mercury continues to be released into UEFPC from point (discrete) and nonpoint (diffuse) sources within the Y-12 site. Historically, the primary point sources of mercury to UEFPC at Y-12 have included mercury-contaminated water discharge from the basement sumps of former mercury-use buildings (i.e., Buildings 9201-2, 9202, 9201-4, 9201-5, and 9204-4), mercury-contaminated pipes (internal and external to buildings) and storm drains that ultimately discharge through Outfall 200, and the mercury-contaminated natural spring flow surfacing near the historic mercury-use area and discharging via Outfall 51. The point source at Outfall 51 is now treated by BSWTS, and discharge from the WEMA building basement sumps (with the exception of Building 9201-5) is treated at the Central Mercury Treatment System (CMTS). Treatment of the discharge from the WEMA storm sewer system at Outfall 200 is the subject of the UEFPC Phase I Interim ROD Amendment. UEFPC Phase I Interim ROD mercury use areas and monitoring locations are shown on Figure 2.3. UEFPC flows directly from Y-12 into the City of Oak Ridge. The storm sewer network servicing the former mercury-processing buildings in WEMA has become contaminated from mercury in soil and groundwater. This contaminated storm drain network discharges through a series of outfalls into UEFPC surface water. Current and historical contaminant releases from the UEFPC watershed exit the ORR via surface water (UEFPC at Station 17) and groundwater (east into Union Valley). A recreational user under an exposure scenario of fish consumption only was identified as the primary receptor for the response actions.



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Figure 2.2. Storm drains, sumps, and major outfalls in UEFPC (top) as they relate to UEFPC groundwater flow conceptual model (bottom).



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The principal contaminants detected in surface water include mercury (inorganic and methylmercury) and uranium. Principal contaminants detected in UEFPC sediment and biota are mercury, uranium, and polychlorinated biphenyls (PCBs). Station 17 at the ORR boundary is the UEFPC watershed IP for evaluating surface water quality changes as RAs progress (Figure 2.1). Flux values for mercury and other contaminants at Station 17 represent total contaminant mass exiting the watershed via the surface water exit pathway. LTM at various frequencies, primarily for mercury, uranium, and radiological constituents, has occurred at this station under a number of historical compliance programs. Other compounds (e.g., PCBs, VOCs, semivolatile organic compounds, and metals) have been monitored over various time intervals and frequencies.

2.1.2.2 Response actions

The UEFPC Phase I Interim ROD addressed mercury-contaminated soils, sediments, and groundwater, which contribute to contamination of surface water within the UEFPC characterization area. The remedy included a combination of source control and receptor media (e.g., sediment) remedies designed to reduce mercury loading within UEFPC. The overall effectiveness of the various actions specified under the UEFPC Phase I Interim ROD is evaluated through a watershed-level remedial performance standard—0.2 µg/L (200 ppt or 200 ng/L)—for total aqueous mercury in surface water at the watershed IP (Station 17; Figures 2.1 and 2.3). Other key components of the UEFPC Phase I Interim ROD also have performance standards and goals based on expected outcomes of individual components of the remedy. Progress toward attaining these goals is measured through monitoring mercury at selected interior outfalls, UEFPC mainstream locations, and biological sampling, as presented in Section 2.1.4.2.

The RAO for the selected remedy included mercury source control actions to restore surface water to human health, recreational, risk-based values at Station 17 under an exposure scenario of fish consumption only. The UEFPC Phase I Interim ROD ESD documented removal of the hydraulic isolation component of the remedy (soil capping), as planned D&D actions within WEMA eliminated the need for the action. Additionally, the UEFPC Phase I Interim ROD Amendment added construction and operation of a new water treatment facility to achieve further reductions in mercury releases from Y-12 and in the concentrations of mercury in UEFPC surface water. This additional response action would supplement the RAs already included in the selected remedy of the UEFPC Phase I Interim ROD and UEFPC Phase I Interim ROD ESD to support attaining the Phase I RAO (to restore surface water to human health, recreational, risk-based values at Station 17) and to make substantial progress toward attaining the long-term water quality goal of meeting the AWQC in-stream standard for mercury in UEFPC surface water (51 ng/L). Principal components of the decision, as specified in the UEFPC Phase I Interim ROD, the UEFPC Phase I Interim ROD ESD, and the UEFPC Phase I Interim ROD Amendment, are listed below:

- Remove contaminated sediments in storm sewers, UEFPC, and Lake Reality.
- Treat discharge from Outfall 51 (including Big Spring and Building 9201-2 basement dewatering sumps) at the BSWTS.
- Temporarily treat water using existing facilities (i.e., East End Mercury Treatment System [EEMTS] and CMTS; the EEMTS was decommissioned upon rerouting contaminated water to the BSWTS).
- Construct and operate the Mercury Treatment Facility (MTF) to treat water from Outfall 200.
- Implement LUCs to prevent consumption of fish from UEFPC and to monitor/control access by workers and the public.
- Monitor surface water (Station 17).

2.1.2.3 Status of implementation

UEFPC watershed remediation is being conducted in stages using a phased approach. Phase I addresses remediation of mercury-contaminated sediment, storm drain discharges, and groundwater discharges that contribute contamination to surface water. The BSWTS component of the remedy was implemented beginning in 2005. It was constructed to treat discharge from Outfall 51 (including the Big Spring) and to treat water from the Building 9201-2 sumps. Mercury-contaminated water was rerouted from the Building 9201-2 sumps and the EEMTS to BSWTS during December 2005. The EEMTS was decommissioned upon rerouting of contaminated water to the BSWTS. As addressed in the NSC approved on May 18, 2023, the absence of water in the Building 9201-2 basement (upon demolition activities to fill the basement with flowable fill) will negate the need for the remaining sump to continue operations and the sump will be shut down when the demolition activities commence. Flowable fill is required in the basement to provide structural support during the building demolition activities. Currently, underlying groundwater and adjacent surface water are being monitored to establish baseline conditions and will continue to evaluate the impact of sump shutdown during demolition. BSWTS will continue to treat water from Outfall 51/Big Spring.

Removing contaminated sediment and relining storm sewers in WEMA was initiated in FY 2009 and was completed in 2012. This component of the remedy limited mercury migration by removing source mass and hydraulically isolating the pipes to minimize migration pathways into and out of storm sewers. The initial phase of work included video camera surveys of more than 20,000 linear ft of storm sewer to determine the condition of the sewer lines. The *Engineering Study Report for the West End Mercury Area (WEMA) Storm Sewer Remediation Project at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2429&D2; Storm Drain Engineering Study), which documented results of the video camera surveys, was approved on December 1, 2009. Results of the Storm Drain Engineering Study were used to prepare the *Remedial Design Report/Remedial Action Work Plan for the West End Mercury Area (WEMA) Storm Sewer Remediation Project at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2447&D2) for remediating the storm sewers and received regulatory approval on August 26, 2010. As agreed with the Project Team, flow-proportional composite sampling of the four WEMA outfalls (150, 160, 163, and 169) was reinstated in early FY 2010.

Continued monitoring of effluent from CMTS (Outfall 551), which treats building sump discharges from Building 9201-4 in WEMA, to evaluate effectiveness of WEMA actions (e.g., hydraulic controls and storm sewer relining/replacement) is specified in the UEFPC Phase I Interim ROD.

In 2014, the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2605-&D2; Mercury Mitigation Strategy) was approved. This document provides a strategic plan to prepare for future demolition/remediation projects at Y-12. Additional documents under the UEFPC Phase I Interim ROD were completed in 2015, including the *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for the Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-2660&D3) and the *Proposed Plan for Water Treatment at Outfall 200 under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-2661&D2), to evaluate treatment of mercury-contaminated water at Outfall 200. The UEFPC Phase I Interim ROD Amendment was approved on May 24, 2016. This amendment modified the UEFPC Phase I Interim ROD to include the Outfall 200 MTF as initially proposed in the Mercury Mitigation Strategy. Additionally, five NSCs and the UEFPC Phase I Interim ROD ESD were approved, as referenced above under the UEFPC Phase I Interim ROD (see Table 2.1).

The purpose of the Outfall 200 MTF is to reduce the mercury concentration in water exiting the Y-12 site at Station 17, as documented in the UEFPC Phase I Interim ROD Amendment. Operation of the Outfall 200 MTF is expected to mitigate potential releases of mercury exiting Y-12 during demolition of WEMA

process facilities that used significant quantities of mercury in lithium processing. The resulting mercury removal would be expected to contribute substantially towards reducing the mercury concentration in UEFPC surface water at Station 17 to meet the interim goal of 200 ng/L established in the UEFPC Phase I Interim ROD and the long-term goal of attaining the AWQC in-stream standard of 51 ng/L for total mercury. In FY 2020, a small, temporary, portable treatment system was installed and operated to treat mercury and solids in extracted excavation water from the MTF headworks site. This was enhanced in FY 2021 to ensure compliance with substantive requirements of stormwater runoff Construction General Permit No. TNR10-0000. Also in FY 2021, an *Addendum to the Remedial Design Report/Remedial Action Work Plan for Water Treatment at Outfall 200 in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-2735&D2/A1/R1) to address approaches for ARAR compliance for the Outfall 200 MTF intake and outfall structures and to mitigate the permanent loss of net resource value of the length of UEFPC between Outfall 200 and BSWTS Outfall 51 was approved by EPA and TDEC. The small, temporary water treatment system to remove solids from excavation pit water ceased operation in July of FY 2023, and the system was shut down and removed soon after. Stormwater management activities for the site continue. The system design is the same as that specified in the UEFPC Phase I Interim ROD Amendment.

Although construction of the headworks site and treatment facility site are still ongoing and the system is not yet operational, a site interview focusing on construction activities was conducted in December 2023 (Appendix A). Construction has complied with all other ARARs related to the construction stage of the project (i.e., floodplain requirements, fugitive dust from construction activities, Tennessee Aquatic Resource Alteration Permit requirements for construction of intake and outfall structures).

The contaminated sediments of Lake Reality will be excavated under the UEFPC Phase I Interim ROD, although the schedule for implementing this RA has been revised under the UEFPC Phase I Interim ROD ESD to follow demolition of the WEMA former mercury use buildings and remediation of underlying soils. The current FFA Appendix E milestone and Appendix J out-year target dates for these activities are as follows: WEMA Building Rm A Work Plan: 09/30/25; WEMA Building D&D Phased Construction Completion Reports (PCCRs): Beta 1 – 2028, Beta 4 – 2033, Alpha 5 – 2036, and Alpha 4 – 2040; and the WEMA Building D&D Phase 1 RmAR: 2043.

Land use restrictions are required as part of the UEFPC Phase I Interim ROD and have been achieved through LUCs that limit the use of those areas of the property and water resources that are contaminated. Table 2.3 lists the status of the UEFPC Phase I Interim ROD subprojects and associated tasks for the remedy. Figure 2.3 illustrates the locations of the principal components of the remedy, including monitoring locations.

Table 2.3. Organization of Phase I interim source control actions within UEFPC watershed

Project	Project task	Major RA	Status
WEMA remediation	Storm sewers	Flush contaminated sediments from storm sewers	Complete
		Reline or replace storm sewers as needed	Complete
Building 9201-2 water treatment system (BSWTS)	Outfall 51	Remove mercury from groundwater discharge from Outfall 51 to 0.2 µg/L (200 ppt) or less	Complete, monitoring ongoing
	Dewatering sumps	Remove mercury from groundwater collected in dewatering sumps in Building 9201-2 to 0.2 µg/L (200 ppt) or less	Ongoing
Sediment/soil removal	UEFPC and Lake Reality	Remove contaminated sediments and bank soils from UEFPC and Lake Reality to reduce mercury levels	FFA Appendix J milestone: RAR 09/30/2047

Table 2.3. Organization of Phase I interim source control actions within UEFPC watershed (cont.)

Project	Project task	Major RA	Status
Monitoring	UEFPC outfalls	Monitor surface water to evaluate reductions in contaminant concentrations and flux	Ongoing
Outfall 200 MTF (added in the UEFPC Phase I Interim ROD Amendment, DOE/OR/01-2697&D2)	Outfall 200	Treat discharges to the WEMA storm sewer system at Outfall 200 to support the Phase 1 ROD RAO (to restore surface water to human health recreational risk-based values at Station 17) and ultimately the AWQC instream standard	Construction ongoing, FFA Appendix E milestone: PCCR 09/30/2025

AWQC = ambient water quality criteria
BSWTS = Big Spring Water Treatment System
FFA = Federal Facility Agreement
MTF = Mercury Treatment Facility
PCCR = Phased Construction Completion Report
ppt = parts per trillion

RA = remedial action
RAO = remedial action objective
RAR = Remedial Action Report
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek
WEMA = West End Mercury Area

2.1.2.4 LUC requirements

LUCs for the UEFPC Phase I Interim ROD are included in the EFPC and ChR RAR CMP, which was approved in February 2023 and serves as the LUCIP for the EFPC administrative watershed (Table 2.4). In addition, Appendix C includes a table listing the Y-12 property parcels transferred by DOE to third parties. The EFPC and ChR RAR CMP stated, “In the event of property transfer, DOE will ensure that DOE’s property disposal agent incorporates the LUC objectives and LUCs into restrictive covenant languages in the deeds transferring the property. The deed will contain appropriate provisions to ensure the restrictions continue to run with the land and are enforceable by DOE.” Table 2.5 lists the LUCs required for UEFPC transferred property.

The FYR evaluation of LUCs for the UEFPC Phase I Interim ROD is discussed in Section 2.1.4.4.1.

2.1.2.5 Engineered remedies

There are three currently operating treatment systems in the UEFPC watershed: BSWTS, CMTS, and EEVOC Plume. Engineered remedy requirements for UEFPC are listed in Table 2.6. Verification of remedy integrity is summarized in Section 2.1.4.4.2 (BSWTS and CMTS) and Section 2.4.4.4.2 (EEVOC Plume treatment system).

2.1.3 Progress Since Last Five-Year Review

The 2021 FYR (DOE/OR/01-2895&D2) of the UEFPC Phase I Interim ROD concluded:

The UEFPC Phase I Interim ROD remedy (removal, treatment, and LUCs) is not currently protective for ecological receptors because elevated mercury concentrations passing Station 17 (i.e., exiting OU 28) routinely exceed the RAO resulting in unacceptably high mercury bioaccumulation in the LEFPC food chain and current exposure to ecological receptors. However, the remedy is protective of human health; LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the County Court House, Register of Deeds office. Additionally, land transfer deeds within this area contain land use and groundwater use restrictions and are in place at the County Court House, Register of Deeds office. Remedy components are in place to ensure integrity of the treatment systems is being maintained and to remain effective and protective.*

Table 2.4. LUC requirements for EFPC administrative watershed

Type of control	Purpose of control	Duration	Implementation and frequency	Affected area^a
Property record restrictions: A. Land use	Restrict use of certain property by imposing limitations	Until concentrations of hazardous substances are at such levels to allow for UU/UE	Drafted and implemented by DOE upon transfer of affected areas; recorded by DOE in accordance with state law at County Register of Deeds office (verified every 5 years)	All WMAs and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • Controlled industrial is unrestricted to 2 ft, below 2 ft authorized by DOE NNSA for federal use or by FFA parties if transferred (western and central UEFPC watershed, includes UEFPC Phase I and Phase II Interim RODs, BSWTS, WEMA Mercury Use area, Eastern S-3 Groundwater Plume^b, and Secondary Pathways^c) • Unrestricted industrial to 10 ft (eastern UEFPC watershed, includes New Hope Pond and EEVOC Plume) • Unrestricted (LEFPC)
B. Groundwater	Prohibit use of groundwater	Groundwater use prohibitions are in place until the final decision is made on groundwater	Drafted and implemented by DOE upon transfer of affected areas; recorded by DOE in accordance with state law at County Register of Deeds office (verified every 5 years)	B. LEFPC
Property record notices	Inform the public about the existence and location of contaminated areas and media and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater	Notice recorded by DOE in accordance with state law at County Register of Deeds office and copied to appropriate zoning office (verified every 5 years) A. Tennessee Code Annotated notice of land use restrictions under signing of the ROD B. Unit-specific affected area notice recorded in Roane County Register of Deeds office and zoning office upon completion of an RA that leaves hazardous substances in place	All WMAs and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: A. All UEFPC (land use and groundwater) B. LEFPC

Table 2.4. LUC requirements for EFPC administrative watershed (cont.)

Type of control	Purpose of control	Duration	Implementation and frequency	Affected area ^a
EPP program	Provide notice to worker/developers (i.e., permit requestor) on extent of contamination and prohibit or limit excavation/penetration activity	Until concentrations of hazardous substances are at such levels to allow for UU/UE; unauthorized groundwater use prohibitions are in place until the final decision is made on groundwater	Implemented by DOE and its contractors; initiated by permit request (verified annually)	Remediation systems, all WMAs, and areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • All UEFPC and LEFPC for groundwater • UEFPC watershed below 2 ft
Access controls (e.g., fences, gates, portals, signs, and surveillance patrols)	Provide notice or warning to prevent unauthorized access	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater	Controls maintained by DOE (verified annually)	Remediation systems, all WMAs, and areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • UEFPC and LEFPC surface water • Former RCRA PCP sites
Other (license agreements and notifications, title searches, surveys inquiring about new groundwater wells or surface water use, and notification of Tennessee-licensed well drillers of license agreements and terms)	Protect human health from the contaminated plume originating beneath Y-12 and detected in groundwater below privately owned land in Union Valley	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater	WRRP shall report search results to the DOE Program Office annually	Union Valley

Table 2.4. LUC requirements for EFPC administrative watershed (cont.)

^aThe specific locations to which LUCs apply are documented in post-ROD documents. Per the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3), the above LUCs apply to WEMA mercury-contaminated areas and UEFPC surface water (signs and surveillance patrols). The *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/01-2229&D3) requires restrictions across the entire watershed.

^bEastern S-3 Groundwater Plume and New Hope Pond are former RCRA PCP sites and are discussed in the annual Remediation Effectiveness Reports.

^cSecondary Pathways is a decontamination and decommissioning project and is discussed in the annual Remediation Effectiveness Reports.

BSWTS = Big Spring Water Treatment System

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

DOE = U.S. Department of Energy

EEVOC = East End Volatile Organic Compound

EFPC = East Fork Poplar Creek

EPP = excavation/penetration permit

FFA = Federal Facility Agreement

LEFPC = Lower East Fork Poplar Creek

LUC = land use control

NNSA = National Nuclear Security Administration

PCP = post-closure permit

RA = remedial action

RCRA = Resource Conservation and Recovery Act of 1976

ROD = Record of Decision

UEFPC = Upper East Fork Poplar Creek

UU/UE = unrestricted use/unlimited exposure

WEMA = West End Mercury Area

WMA = waste management area

Y-12 = Y-12 National Security Complex

Table 2.5. LUC summary for UEFPC transferred property

Impacted parcel	ROD LUC restriction/objective ^a	Instrument in place	Instrument language	Meets intent of ROD?	Compliance with ROD objective?
Parcels of land for private-sector buildings adjacent to Y-12 (located on both sides of and within the bounds of Bear Creek Road, Scarboro Road, First Street, and Second Street) ^b	Property record restrictions: • Prohibit uses of groundwater	Deeds, Anderson County, Tennessee Register of Deeds office ^c	The Grantee covenants and agrees that it shall not construct or permit to be constructed any well, and shall not extract, utilize, consume or permit to be extracted, any water from the aquifer below the surface of the ground within the boundary of the Property for the purpose of human consumption, or other use, unless such groundwater has been tested and found to meet applicable standards for human consumption, or such other use, and such Grantee or occupant shall first have obtained prior written approval of the Grantor and the applicable regulatory authorities (FFA)	Yes	Yes
	Property record restrictions: • Limits use of property	Deeds, Anderson County, Tennessee Register of Deeds office ^c	The Grantee covenants and agrees that the property shall not be used for any residential housing, any elementary or secondary school, any childcare facility or children's playground, any recreational use, or developed in any manner inconsistent with the land use assumptions of industrial use contained in CERCLA RODs for the UEFPC characterization area	Yes	Yes
	EPP program to provide notice to worker/developer (i.e., permit requestor) on extent of contamination and prohibit or limit EPP activity	Deeds, Anderson County, Tennessee Register of Deeds office ^c	Grantee covenants and agrees that it will not at any time cause or allow any excavation, use, or disturbance of any portion of the Property located more than 22.5 ft bgs within Site A or located more than 18.5 ft bgs within Site B without prior written approval of the Grantor, EPA, and TDEC. Grantee covenants and agrees that any excavation on adjacent property is prohibited without prior written approval from the Grantor. Grantee covenants and agrees that any facilities constructed on the Property will not have basements	Yes	Yes

Table 2.5. LUC summary for UEFPC transferred property (cont.)

Impacted parcel(s)	ROD LUC restriction/objective ^a	Instrument in place	Instrument language	Meets intent of ROD?	Compliance with ROD objective?
	Access controls: • Signs to provide notice or warning to prevent unauthorized access/use • Monitor access by workers/public	Deeds, Anderson County, Tennessee Register of Deeds office ^c	The Grantor covenants and agrees that Grantor shall: (1) post signs providing notice or warning to prevent unauthorized access to the property being transferred, and (2) patrol the transferred property to control and monitor access by workers, badged visitors, and unbadged public visitors. The Grantee covenants and agrees that it shall not hinder, obstruct, or otherwise interfere with Grantor's compliance with this Condition 15J (1) and (2)	Yes	Yes

^aReference: *Record of Decision for Phase I Interim Source Control Actions in Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3) and *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek* (DOE/OR/01-2229&D3).

^bParcels are identified in the deed as Site A property between Bear Creek Road and First Street and Site B property between Scarboro Road, Second Street, and Bear Creek Road. Construction easement drawings identify Site A as the current Jack Case Center and Site B as the current New Hope Center.

^cReference: *Deed for Parcel of Land for Private-Sector Buildings Adjacent to the Existing Y-12 National Security Complex* (Book 1411, pages 1386–1401); *Construction Easement for Property Located on Both Sides of and Within the Bounds of Bear Creek Road, Scarboro Road, First Street, and Second Street* (Book 1411, pages 1402–1418).

bgs = below ground surface

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

EPA = U.S. Environmental Protection Agency

EPP = excavation/penetration permit

FFA = Federal Facilities Agreement

LUC = land use control

ROD = Record of Decision

TDEC = Tennessee Department of Environment and Conservation

UEFPC = Upper East Fork Poplar Creek

Y-12 = Y-12 National Security Complex

Table 2.6. Engineered remedy requirements for UEFPC watershed

Affected area/type of remedy	Purpose	Implementation	Verification frequency
BSWTS – treatment system	A treatment system to treat discharge from Outfall 51 (including the large-volume spring) and water from the Building 9201-2 sumps	O&M by DOE	Verify purpose and O&M annually
CMTS – treatment system ^a	Ongoing treatment of WEMA effluents pending demonstration of remedy effectiveness (hydraulic controls and capping)	O&M by DOE	Verify purpose and O&M annually
EEVOC Plume – treatment system	Pump and treat using well GW-845 installed within the plume	O&M by DOE	Verify purpose and O&M annually

^aCMTS is under the auspices of the National Pollutant Discharge Elimination System permit.

BSWTS = Big Spring Water Treatment System

CMTS = Central Mercury Treatment System

DOE = U.S. Department of Energy

EEVOC = East End Volatile Organic Compound

O&M = operations and maintenance

UEFPC = Upper East Fork Poplar Creek

WEMA = West End Mercury Area

Additional actions under the UEFPC Phase I Interim ROD and the Mercury Mitigation Strategy will ensure protectiveness (FFA Appendix J date RAR 2047). Additional future actions include the Final EFPC ROD (FFA Appendix J date 2034; RAR 2035) and the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037).

** – UEFPC Phase I ROD (DOE/OR/01-1951&D3), Basis for Action Statement 2, p. 2 51 – “Levels of mercury in fish are potentially presenting an unacceptable risk to fish and fish-eating birds.*

There was one UEFPC issue identified during the 2021 FYR; see Table 2.7. This issue was closed in the 2024 RER.

2.1.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 2.1.1.1.
- Reviewed effectiveness, performance monitoring, exit pathway monitoring, and ecological monitoring data evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M inspections and maintenance information.
 - Changes in land use and verifying LUCs.
 - Surface water monitoring data.
 - Biological monitoring data (baseline).
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data, LUCs, and engineered remedy requirements, as specified in the associated decision documents.

2.1.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this 2024 FYR.

2.1.4.2 Data review

Current monitoring for the UEFPC Phase I Interim ROD is included in the EFPC and ChR RAR CMP; see Section 1.5.2.

Table 2.7. Issues and recommendations identified in 2021 FYR of UEFPC Phase I Interim ROD

DOE FYR issue# (SEMS OU#)	Issue from previous reviews	Recommendation/follow-up action	Party responsible; oversight agency	Milestone date	Action taken and outcome	Status
UEF-1 (OU 28)	UEFPC Phase I Interim ROD: Mercury concentrations at Station 17 are above the 200-ppt performance goal. Mercury concentrations in fish in UEFPC have yet to respond to commensurate reductions of mercury from historical response actions	Remedial measures have not been completed under the UEFPC Phase I Interim ROD. Implementation of actions under the UEFPC Phase I Interim ROD is ongoing, and construction of the Outfall 200 MTF per the Mercury Mitigation Strategy is ongoing	DOE; EPA/TDEC	FFA milestone for Outfall 200 MTF construction start: 09/30/18	In FY 2023, installation of an intake structure in UEFPC in the MTF headworks area and an outfall structure located downstream in UEFPC at the Outfall 200 MTF continued. At the MTF headworks site, secant wall and anchoring system are complete, and rebar installation is in process for the Storm Flow Pump Station and Grit Pump Buildings. At the Outfall 200 MTF, structural steel was fabricated offsite and erected for the treatment building. Roof deck panels were installed on the treatment building. Construction continues on the treatment filter building. Fabrication of the 500,000-gal equalization tank was completed with hydrotesting remaining to be performed. Underground and subgrade utilities and piping continue to be installed at both the MTF headworks site and Outfall 200 MTF	Closed in 2024 RER

DOE = U.S. Department of Energy

EPA = U.S. Environmental Protection Agency

FFA = Federal Facility Agreement

FY = fiscal year

FYR = Five-Year Review

MTF = Mercury Treatment Facility

OU = operable unit

ppt = parts per trillion

RER = Remediation Effectiveness Report

ROD = Record of Decision

SEMS = Superfund Enterprise Management System

TDEC = Tennessee Department of Environment and Conservation

UEF = Upper East Fork Poplar Creek issue

UEFPC = Upper East Fork Poplar Creek

The UEFPC Phase I Interim ROD included a 200-ppt (0.2-µg/L) performance goal for mercury in surface water at the UEFPC IP (Station 17) based on an adult recreator consuming fish, as well as performance goals and expected outcomes for components of the actions. The AWQC for mercury of 0.051 µg/L was waived under an interim action waiver. Objectives of the remedy are summarized in Table 2.8. The UEFPC Phase I Interim ROD contained performance criteria only for surface water at the watershed-scale; however, the selected interim source control remedy addressed several media, including groundwater, sediment, and soil. The goals of the UEFPC Phase I Interim ROD were specific to only mercury because it is the primary contaminant of concern (COC) with significant risk in surface water to warrant action.

Table 2.8. Performance measures for Phase I interim source control actions in UEFPC watershed

Site	UEFPC Phase I Interim ROD goal	Performance standard	Monitoring location	Schedule and parameter ^a
Station 17	Reduce mercury levels to a level protective of a recreational receptor based on fish consumption	0.2-µg/L (200-ppt) total mercury. (Performance standards not defined in ROD for uranium and zinc monitoring; performance determined from trend evaluation)	Station 17	Continuous, flow-paced monitoring for mercury and uranium (weekly collection frequency); weekly grab samples for zinc
Building 9201-2 water treatment system (BSWTS)	Reduce mercury levels to a level protective of a recreational receptor based on fish consumption	200-ppt mercury	BSWTS effluent discharge point	Quarterly grab samples for VOCs and semiannual monitoring for mercury and uranium
CMTS	Ongoing treatment of WEMA effluents pending demonstration of remedy effectiveness (hydraulic controls and capping) ^b	200-ppt mercury	Outfall 551	Continuous, flow-paced monitoring for mercury (minimum weekly collection frequency); continue current system performance monitoring as required by O&M specifications
WEMA	Protect recreational surface water users	Reduce mercury flux in WEMA outfalls by approximately 50%. Reduction will be monitored in outfalls and is anticipated within 1 year of remediation ^c	Outfalls 150, 160, 163, and 169A	Continuous, flow-paced monitoring for mercury (minimum weekly collection frequency) prior to remediation
UEFPC and Lake Reality	Protect recreational surface water users	Reduce Station 8 area ungauged mercury flux by 70% and ungauged mercury flux between Station 8 and Station 17 by up to 100%. Reduction will be monitored at Station 8 and Station 17 and is anticipated within 1 year of remediation	Station 8 and Station 17	Grab samples at Station 8 weekly. Weekly monitoring at Station 17 for mercury

^aReference: *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2466&D4). Performance standards and associated monitoring for the Outfall 200 Mercury Treatment Facility (*Amendment to the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee Water Treatment at Outfall 200* [DOE/OR/01-2697&D2]) will be included once the Mercury Treatment Facility is completed.

^bHydraulic controls and capping were eliminated per the *Explanation of Significant Differences for the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-2539&D2).

^cBaseline monitoring reinstated in Fiscal Year 2010.

BSWTS = Big Spring Water Treatment System
CMTS = Central Mercury Treatment System
O&M = operations and maintenance
ppt = parts per trillion

ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek
VOC = volatile organic compound
WEMA = West End Mercury Area

Surface water quality metrics used to evaluate progress toward attaining ROD goals are summarized in Table 2.8, and monitoring locations are shown in Figure 2.3. Surface water monitoring at Station 17, including analysis for uranium and zinc, is conducted to gauge cumulative effects of the various actions as they are completed. In addition, biological monitoring is performed to assess reductions of mercury in fish tissue at East Fork kilometer (EFK) 23.4, slightly upstream of the UEFPC IP (Station 17).

To achieve the watershed-wide, mercury-reduction objectives, key individual components of the Phase I remedy have action-specific performance standards. The 200-ppt performance standard applies to discharges from BSWTS that treats shallow, contaminated groundwater from the Building 9201-2 basement dewatering sumps and spring discharges from the Outfall 51 spring (Big Spring); these are two sources of dissolved, readily bioavailable mercury to UEFPC. Prior to BSWTS construction, Outfall 51 contributed an estimated 25% to the overall flux at Station 17. Building sump discharges from Building 9201-2 were previously treated at the EEMTS prior to discharge to UEFPC; these discharges are now routed to BSWTS. Additionally, current treatment of building sump discharges from the WEMA CMTS must continue to achieve applicable NPDES permit discharge limits and system performance criteria in accordance with O&M specifications. CMTS has current NPDES discharge limits for mercury of 2000 ppt (monthly average) and 4000 ppt (daily maximum); this older system was not designed to remove mercury to the UEFPC Phase I Interim ROD goal of 200 ppt.

The goals, performance standards, and monitoring locations shown in Table 2.8 were established by the UEFPC Phase I Interim ROD; however, specifics, including the schedule and parameters, are in the EFPC and ChR RAR CMP. To achieve watershed-wide, mercury-reduction objectives, individual components of the Phase I remedy have action-specific performance standards that assist in reaching the UEFPC Phase I Interim ROD-determined goal.

Only performance goals of the actions that have been completed or are ongoing are discussed in this section. The anticipated future land uses for Y-12, as identified in the UEFPC Phase I Interim ROD, are controlled industrial in the eastern and central portions of the plant and unrestricted industrial within the eastern portion of the plant (Figure 2.1).

2.1.4.2.1 Watershed-scale update – Station 17 (IP)

Watershed-scale surface water monitoring in UEFPC is conducted at Station 17, the IP where the stream leaves the Y-12 site and DOE property. The UEFPC watershed remediation goals focus on reducing mercury in surface water in and downstream of Y-12. Per the UEFPC RI, uranium and zinc are also identified as COCs in UEFPC surface water, but the UEFPC Phase I Interim ROD did not establish performance goals for these constituents.

Annual fluxes and average concentrations of uranium and mercury at Station 17 are provided in Table 2.9. Locations of mercury source areas are shown on Figure 2.3. Only in 2007 did the average mercury concentration at Station 17 achieve the interim goal of 200 ng/L. Mercury flux increased during FYs 2011–2013 due to the WEMA storm drain cleanout project and then began to decline toward the pre-storm drain cleanout levels in FY 2014. The effects of the West COLEX demolition project are apparent in the increased mercury concentrations measured in FY 2018, and decreases through FYs 2021–2023 did not attain the UEFPC Phase I Interim ROD goal of 200-ng/L total mercury.

COCs in the UEFPC watershed also include zinc and uranium. Uranium contamination in UEFPC originates from groundwater seepage and stormwater transport of surface contamination in Y-12. Groundwater contamination in WEMA is a source of uranium flux at Outfall 200A6. Other significant sources of uranium located in the eastern end of Y-12 that may enter UEFPC are the former Oil Skimmer Basin located adjacent to the original UEFPC channel in the eastern end of the plant area, an unknown

Table 2.9. Annual uranium and mercury fluxes^a and average concentrations at Station 17

Date^b	Mercury flux (kg)^c	Average mercury (ng/L)^{c,d,e}	Uranium flux (kg)^c	Average uranium (µg/L)^{c,e}	Annual rainfall (in.)^f
2000	12.0	746	143	12	52.0
2001	9.4	638	85	7	46.0
2002	7.3	536	172	14	52.7
2003	8.8	597	148	11	73.7
2004	8.2	524	119	10	56.4
2005	14.6	742	157	12	59.0
2006	4.0	328	89	8	46.4
2007	4.0	198	86	7	36.3
2008	2.7	221	98	9	46.0
2009	3.9	273	177	14	62.5
2010	7.0	476	198	16	55.8
2011	24	1660	173	13	60.4
2012	21.5	1780	161	14	61.8
2013	20	1710	181	15	63.7
2014	14.4	1490	120	12	48.8
2015	8.1	1030	178	25	55.9
2016	5.3	743	141	21	50.2
2017	8.3	856	147	21	57.9
2018	12.4	1860	134	21	58.9
2019	9.2	1120	233	28	70.0
2020	8.7	979	186	23	75.9
2021	9.6	1265	129	22	58.8
2022	8.5	1112	140	20	56.4
2023	6.7	954	145	24	50.4

^aFlux goals for uranium and mercury at Station 17 were not included in the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3; Upper East Fork Poplar Creek [UEFPC] Phase I Interim Record of Decision [ROD]).

^bThe Y-12 Environmental Compliance Program conducted monitoring through Fiscal Year (FY) 2010; the Water Resources Restoration Program conducted monitoring from FY 2011 to present.

^cReported average is for 7-day, continuous flow-paced samples.

^d**Bold** values exceed the UEFPC Phase I Interim ROD mercury concentration goal of 200 parts per trillion (200 ng/L) for Station 17.

^eReported mercury and uranium results are from composite samples collected and analyzed by the Environmental Management Program.

^fAverage annual rainfall = 54 in.

source adjacent to wells GW-605/606, and the Uranium Oxide Vault/Building 9418-3. As shown in Table 2.9, average uranium annual concentrations measured at Station 17 within the FYs 2021–2023 FYR period were between 20 and 24 µg/L, which are all less than the 30-µg/L uranium MCL screening concentration. The annual uranium flux is generally proportional to annual rainfall, with higher uranium fluxes occurring during years of higher rainfall, as shown on Table 2.9.

Zinc was analyzed in weekly grab samples collected at Station 17 during the FYs 2021–2023 FYR period for comparison to AWQC (120 µg/L). The average zinc concentration at Station 17 is about 25 µg/L, which is less than the AWQC screening concentration. During the FYs 2021–2023 monitoring period, three

samples contained zinc at concentrations greater than the 120- $\mu\text{g/L}$ criterion. All three elevated results occurred during autumn of 2022, with values of 320 $\mu\text{g/L}$ on September 21, 2022; 130 $\mu\text{g/L}$ on October 5, 2022; and 170 $\mu\text{g/L}$ on December 7, 2022. The cause of the elevated results is unknown.

2.1.4.2.2 BSWTS

At the time of the UEFPC Phase I Interim ROD, the main source of flow at Outfall 51 was Big Spring, located near the southeast corner of Building 9201-2. Mercury contamination within shallow groundwater beneath and adjacent to Building 9201-2 discharges at this spring. The spring discharge was captured within a brick enclosure (spring box) during Building 9201-2 construction in 1943 and directed to UEFPC via a drainpipe at Outfall 51. During BSWTS construction, Big Spring flow was intercepted and routed to the new treatment system in the latter part of FY 2005 during test and startup operations. As a result, the flow at Outfall 51 decreased significantly and now consists of only minor contributions from area groundwater peripheral to the spring collection box. BSWTS has been fully operational since September 26, 2005. Since July 2008, BSWTS effluent has been sampled continuously, and weekly composite samples are analyzed for total mercury.

Figure 2.4 compares mercury concentrations at Outfall 51 and the BSWTS effluent. During FYs 2021–2023, the average mercury BSWTS influent concentration was 3056 ng/L, 2092 ng/L, and 1679 ng/L, respectively, and treated water volumes were approximately 140 million gal, 29 million gal, and 34 million gal, respectively. Over those FYs, flow to the Big Spring wet well was reduced by treatment interruptions due to grouting at the Outfall 200 MTF headworks excavation and dewatering activities that captured and diverted some of the groundwater from the karst flow system that feeds the BSWTS wet well.

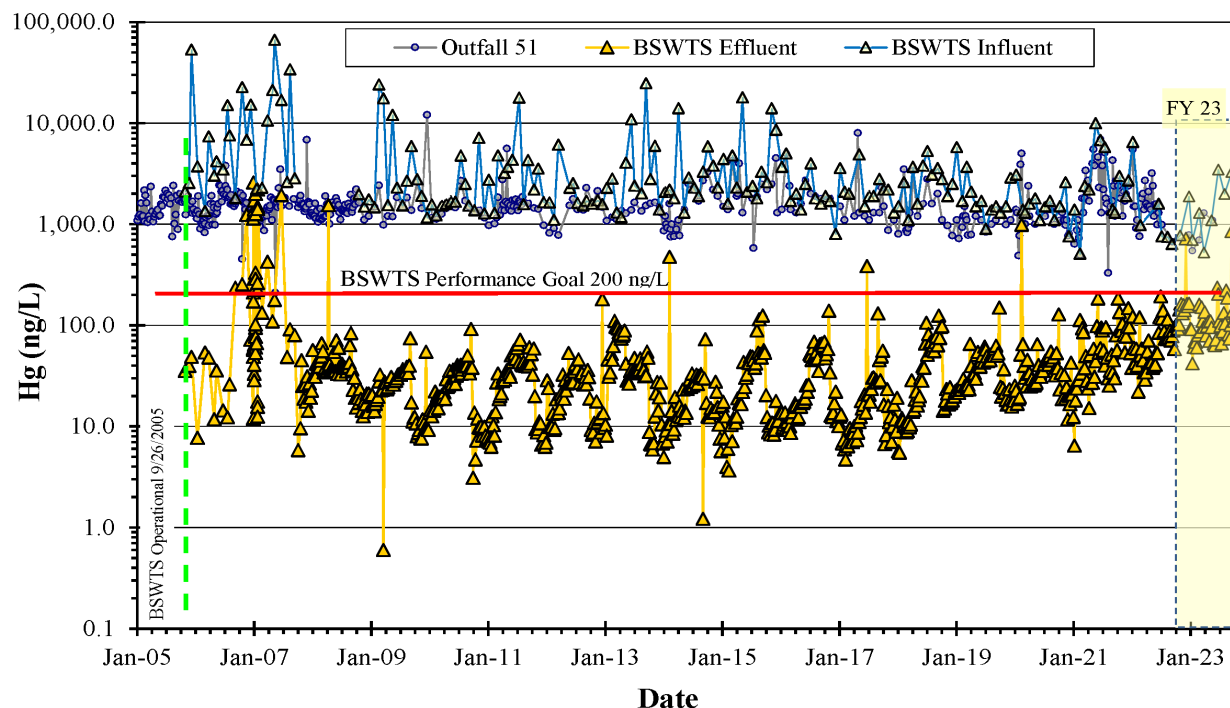


Figure 2.4. Mercury concentration at Outfall 51 and BSWTS.

The average mercury concentration in BSWTS effluent during FY 2021 was 45 ng/L, for FY 2022 was 77 ng/L, and during FY 2023 was 140 ng/L, all of which are well below the 200-ng/L goal specified in the UEFPC Phase I Interim ROD. BSWTS treatment of mercury-contaminated groundwater from the

Building 9201-2 (Alpha-2) basement was continuous during FYs 2022–2023. During the FYR evaluation period, the BSWTS mercury treatment system met its effluent goal in 96.7% of the 154 weekly composite samples. During the FYR evaluation period, only five BSWTS effluent weekly composite samples exceeded the 200-ng/L goal for mercury. The goal was exceeded on November 30, 2022 (727 ng/L); June 14, 2023 (239 ng/L); June 21, 2023 (206 ng/L); August 9, 2023 (223 ng/L); and September 13, 2023 (855 ng/L). The total mercury flux discharged in the treated BSWTS effluent for FYs 2021–2023 is listed in Table 2.10. Granular activated carbon treatment media in BSWTS are typically changed annually during autumn. The effluent mercury concentration decreases following media change out and gradually increases through the operating year prior to the subsequent change out.

Table 2.10. Mercury discharges from sample locations at BSWTS, FYs 2021–2023

FY	BSWTS effluent (g)	BSWTS bypass (g)	Outfall 51 (g)
2021	6.8	49	615
2022	10.2	49	508
2023	16.8	0	~17

BSWTS = Big Spring Water Treatment System

FY = fiscal year

Because BSWTS was designed to operate at a maximum capacity of 300 gpm, there are times during prolonged rainy periods when the system receives more inflow volume than can be treated, and the excess volume is bypass flow. Although such conditions may occur in any season, the majority of bypass flows occur during the winter and spring months when groundwater recharge amounts are greatest. In FY 2014, DOE installed sampling equipment to measure bypass flow volumes and to sample for mercury to estimate the amount of mercury that bypasses treatment. The mercury mass discharged to UEFPC via equalization tank overflow averages approximately 1% or less of the UEFPC watershed mercury discharges. Annual mercury discharge fluxes from the system overflow into UEFPC are included in Table 2.9. As shown, no system overflow occurred during FY 2023 as a result of the reduced inflow to the BSWTS wet well attributed to the excavation dewatering groundwater pumping at the Outfall 200 MTF headworks site.

Table 2.10 includes the annual estimated mercury discharge fluxes from Outfall 51 directly to UEFPC. The significant reduction of mercury discharge from Outfall 51 during FY 2023 is a result of greatly diminished outfall flow volumes attributed to Outfall 200 MTF excavation dewatering and lower-than-average annual rainfall during FY 2023. The BSWTS effluent and BSWTS overflow mercury masses are based on data from autosampler composite samples, while the Outfall 51 estimated mercury discharge mass is based on grab sample mercury concentrations and instantaneous flow measurement at the outfall.

2.1.4.2.3 CMTS

Continued monitoring of effluent from CMTS, which treats building sump discharges from WEMA, is specified in the UEFPC Phase I Interim ROD pending demonstration of the effectiveness of actions.

The UEFPC Phase I Interim ROD specified CMTS “meet NPDES requirement of 200 ng/L mercury at Station 17,” which represents the ROD intent that treatment system effluent be controlled as one component of the multiple actions required to attain the water quality goal at Station 17. Additionally, there are NPDES permit limits of 2000-ng/L monthly average and 4000-ng/L daily maximum mercury concentrations. Because of a 2005 accidental introduction of methanol from a leaking Alpha 5 cooling (brine) system that interfered with mercury treatment, an NSC to the UEFPC Phase I Interim ROD was approved in May 2007 so that CMTS no longer receives water from sump pumps located in the Building 9201-5 basement. CMTS continues treating Building 9201-4 sump water (a much larger source of mercury).

Effluent samples were collected from composites at CMTS (Outfall 551) and analyzed for mercury. CMTS effluent monitoring for 3 years, FYs 2021–2023, is summarized in Table 2.11 and shows that, during the past 3 years, CMTS effluent has met the NPDES goal (2000-ng/L monthly average and 4000-ng/L daily maximum mercury). The facility mercury discharge is estimated based on applying each composite mercury concentration to the summed effluent flow since the preceding sample data.

Table 2.11. CMTS effluent mercury data summary, FYs 2021–2023

FY	Total annual flow (L)	Maximum mercury concentration (ng/L)	Estimated mercury discharge (g)
2021	5,346,010	795	0.56
2022	5,790,043	910	1.63
2023	5,257,911	906	0.64

CMTS = Central Mercury Treatment System

FY = fiscal year

2.1.4.2.4 WEMA mercury discharges

Extensive mercury contamination exists in WEMA as a result of historic process leaks and spills. Some mercury remains in soil as elemental mercury metal. Movement of elemental mercury in soil can occur as a result of pore pressure changes related to groundwater level fluctuations and rainfall percolation processes. As mercury moves downward and laterally, it can seep into the subsurface storm drains through cracks and open joints. Once in the storm drains, mercury accumulates in low points moved by the current of stormwater.

Throughout the past 3 years, flow-paced continuous-sampling devices were operational at Outfalls 150, 160, 163, and 169A. These outfalls carry the principal WEMA drainages into the main storm drainpipes that discharge at Outfall 200 and make up the headwater baseflow of UEFPC (see Figure 2.3). Outfall 200A6 serves as an IP for contamination leaving WEMA and entering the UEFPC stream where the storm drain daylights at Outfall 200 (Figure 2.3). Continuous flow-paced monitoring at Outfall 200A6 has been implemented since the beginning of FY 2007.

Table 2.12 presents FY annual summaries of the mean, median, and maximum measured mercury concentrations in the 7-day composite mercury samples collected at WEMA monitoring stations. At monitoring station Outfall 200A6, two samples are analyzed from each weekly sample. One aliquot is for unfiltered, total mercury analysis, while the second aliquot is filtered through 0.45-micron filter media prior to shipment to remove suspended solids from the sample. The second aliquot is considered to represent the dissolved mercury concentration.

Table 2.13 presents the FY annual summaries of WEMA monitoring station mercury flux. For Outfall 200A6, both the total mercury flux and the dissolved mercury flux are reported. During FY 2021, Outfall 150 experienced elevated mercury flux associated with site preparation activities for the East COLEX demolition.

Direct mercury recovery from storm drains

During FY 2021, approximately 1.1 to 1.47 kg of metallic mercury was recovered from UEFPC storm drains. The recovered mercury is placed in storage for future disposition. During FYs 2022–2023, several visits were made to the storm drain 150 basin where visible mercury accumulates; however, on every visit to the location, there was insufficient mercury to allow recovery. No elemental mercury was recovered during FY 2022 or FY 2023.

Table 2.12. Summary of mercury concentration data (ng/L) for WEMA monitoring stations, FYs 2021–2023

FY	Outfall 200A6 ^a			Outfall 150			Outfall 160			Outfall 163			Outfall 169A		
	Mean	Median	Maximum	Mean	Median	Maximum	Mean	Median	Maximum	Mean	Median	Maximum	Mean	Median	Maximum
2021	631/393	566/613	1310/76	7044	355	167,000	1774	1495	5720	786	742	2000	517	500	740
2022	661/439	567/361	3130/2840	513	314	5410	2013	1515	8570	747	72	1520	485	466	893
2023	632/454	600/441	959/755	1072	288	30,700	2356	1975	7370	1170	1120	2200	624	584	1190

^aFor Outfall 200A6 only, total mercury concentration/dissolved mercury concentration.

FY = fiscal year

WEMA = West End Mercury Area

Table 2.13. WEMA monitoring station mercury fluxes, FYs 2021–2023

FY	WEMA mercury flux (g)				
	Outfall 200A6 ^a	Outfall 150	Outfall 160	Outfall 163	Outfall 169A
2021	1307/807	4208	50	64	602
2022	1594/992	421	78	89	758
2023	1333/929	780	50	135	787

^aFor Outfall 200A6 only, annual total mercury flux/annual dissolved mercury flux.

FY = fiscal year

WEMA = West End Mercury Area

2.1.4.2.5 UEFPC instream monitoring

In addition to monitoring conducted in WEMA, 7-day composite samples are also collected in UEFPC at Station 8 and at the watershed exit point IP at Station 17. Mercury in the storm drains in WEMA is predominantly dissolved, in part because of the presence of chlorinated water in the storm drains. The principal source of chlorinated water in the storm drains is the discharge of once-through cooling water from some building processes. Water that exits the storm drain at Outfall 200 is dechlorinated at the point of discharge prior to flowing downstream in the UEFPC channel. As the dissolved mercury moves downstream, there is a strong tendency for the mercury to adsorb to sediment and other surfaces, including periphyton, in the stream channel. Consequently, mercury transport in the stream includes movement of mercury attached to sediment that is carried downstream. Storm discharges accentuate the particle-associated mercury transport by scouring the stream channel surfaces.

Table 2.14 summarizes data for total suspended solids (TSS), annual average total mercury concentration, annual average dissolved mercury, and annual average percent dissolved mercury at Outfall 200A6, Station 8, and Station 17. As at Outfall 200A6, unfiltered and filtered aliquots of each 7-day composite collected at Station 8 and Station 17 are analyzed to track total and dissolved percentages of mercury. The data summary indicates there is a tendency for TSS to increase in the downstream flow direction after entering the stream and for the percentage of dissolved mercury to decrease in the downstream direction.

Table 2.14. Summary of suspended sediment, total mercury, and dissolved mercury in UEFPC, FYs 2021–2023

FY	Location	TSS number of detections/number of samples	Average detected TSS (mg/L) ^a	Average TSS result (mg/L) ^b	Maximum TSS (mg/L)	Average total mercury (ng/L)	Average dissolved mercury (ng/L)	Percent dissolved mercury (%)
2021	Outfall 200A6	21/52	24.7	12.7	75	631	393	62
	Station 8	42/52	20.6	17.7	63	1017	113	11
	Station 17	50/52	46.0	44.6	250	1265	71	6
2022	Outfall 200A6	34/52	17.2	23.7	140	661	439	67
	Station 8	50/52	26.9	29.0	85	955	94	10
	Station 17	50/52	67.0	69.5	300	1112	72	6
2023	Outfall 200A6	44/52	7.5	6.5	95	632	454	72
	Station 8	52/52	34	34	150	1351	109	8
	Station 17	50/50	53	53	290	954	58	6

^aAverage of all detected TSS results that were greater than the detection limit.

^bAverage of all TSS results, including non-detected results assumed to be equal to the detection limit concentration (4 mg/L).

FY = fiscal year

TSS = total suspended solids

UEFPC = Upper East Fork Poplar Creek

Table 2.15 summarizes annual total and dissolved mercury fluxes measured at Outfall 200A6, instream monitoring location Station 8, and watershed exit IP Station 17. During FYs 2021–2023, Outfall 200A6 (representing combined inputs from WEMA and other upstream areas) contributed approximately 17% (14% to 20%) of the total mercury flux at Station 17. The remainder of the total mercury flux measured at Station 17 is attributed to unquantified storm drain inputs to UEFPC and transport of particle-associated mercury that is predominantly derived from the stream reach between Outfall 200A6 and Station 8. During

Table 2.15. Annual total and dissolved mercury fluxes at Outfall 200A6, Station 8, and Station 17, FYs 2021–2023

FY	Mercury flux (g)		
	Outfall 200A6 ^a	Station 8	Station 17
2021	1307/807	3615/393	9615/426
2022	1594/992	3754/417	8529/453
2023	1333/929	5102/442	6714/331

^aAnnual total mercury flux/annual dissolved mercury flux.

FY = fiscal year

FYs 2021–2023, the dissolved mercury flux measured at Outfall 200A6 averaged 2.3 times (1.9 times to 2.8 times) the dissolved mercury flux measured at Station 17. The reason for the reduction in dissolved mercury flux between Outfall 200 and Station 17 is the elimination of chlorine where water emerges from the storm drain at Outfall 200. Free chlorine in water holds mercury in solution as mercuric chloride, which prevents dissolved mercury from adsorbing to solids. Removing the free chlorine breaks the chlorine bonds, which allows the dissolved mercury (II) to adsorb to sediment and solid material surfaces in the stream channel in the downstream flow regime.

2.1.4.2.6 Biological monitoring

Ecological risks to aquatic biota and plants in surface water and spring discharges were evaluated in the UEFPC RI. The UEFPC Phase I Interim ROD did not quantitatively evaluate or include ecology; however, the UEFPC Phase I interim ROD states, *Biological monitoring (fish tissue) will be performed annually until the final ROD is signed to assess reductions of mercury in fish*. The ecological health of EFPC has been monitored since 1985. Fish and benthic macroinvertebrate communities are monitored to evaluate watershed trends, and data are reported in the annual RER. Ecological risk issues related to the integrated UEFPC and LEFPC systems will be addressed under the EFPC Surface Water ROD.

Fish mercury concentrations in UEFPC have been compared to aqueous mercury concentrations over time to assess fish responses to various Y-12 actions that can affect mercury. Using Y-12 NPDES compliance data, aqueous mercury concentrations at Station 17 have fluctuated significantly in response to actions at Y-12 (Figure 2.5). The watershed-level remedial performance standard at Station 17 is 0.2 µg/L (200 ppt or 200 ng/L). In July and August 2018, construction and demolition activities occurring at the west end of Y-12 led to elevated aqueous mercury concentrations in UEFPC, with concentrations in grab samples taken at Station 17 >1 µg/L during this time period. The pulse of mercury into the stream was associated with elevated mercury discharges to a storm drain at the West COLEX site that resulted in failed NPDES toxicity tests at Outfall 200 and a fish kill in UEFPC (Mathews et al. 2019). A toxicity identification/reduction evaluation study plan was initiated in August 2018 to identify and remove the cause of the observed toxicity in Outfall 200 effluent. In this study, mercury was identified as the toxicant leading to the failed toxicity tests and fish kill in the creek. Actions were taken to prevent mercury-contaminated water from entering the creek during the summer of 2018. Follow-on toxicity testing showed no further toxicity at Outfall 200 from 2019–2023. While aqueous concentrations have dropped since the spike in 2018, they have remained elevated (averaging 0.5 µg/L to 0.98 µg/L in 2019–2023) with respect to the previous 5 years when aqueous mercury concentrations averaged between 0.2 µg/L and 0.45 µg/L. Despite elevated aqueous concentrations,

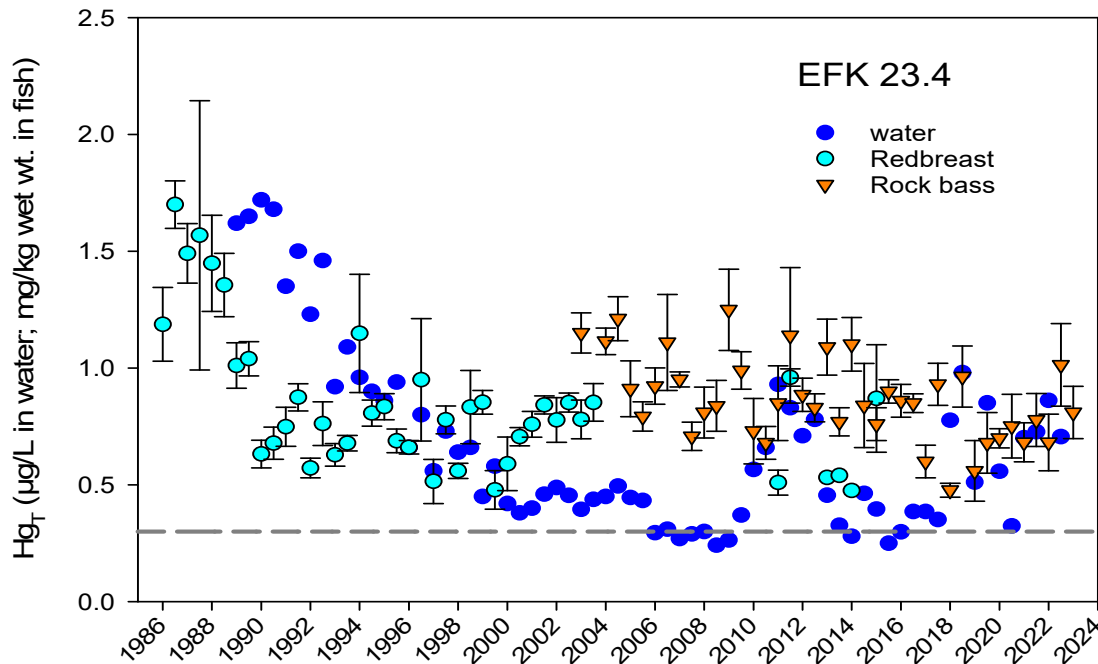


Figure 2.5. Mean mercury concentration in redbreast sunfish and rock bass at EFK 23.4 and trailing 6-month mean mercury concentration in water, 1986–2023.

fillet mercury concentrations at the EFK 23.4 sampling site were lower than they had been in previous years but remained above EPA’s criterion for mercury in fish fillet (0.3 µg/g). Over the past 4 years, fish concentrations have been slowly increasing at EFK 23.4, but they remain below concentrations seen prior to the mercury releases in 2018 (Figure 2.5). Expected responsiveness of fish to reduced mercury levels in surface water has not been observed (i.e., mercury concentrations in fish tissue have not declined at a rate similar to the mercury concentrations in surface water at Station 17), indicating a more-complex relationship than previously thought.

2.1.4.3 Site inspections

As part of this FY 2024 FYR, the site managers were interviewed on August 21, 2023, and a site visit was conducted on September 17, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and watershed monitoring information required by the UEFPC Phase I Interim ROD. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

2.1.4.4 LUC verification and certification and engineered remedy verification

All UEFPC LUCs and engineered remedies specified in Tables 2.4, 2.5, and 2.6 were verified for this 2024 FYR. The certification of LUC implementation for FY 2023 for UEFPC is included in Appendix D. Results are summarized in Table 2.16, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of Table 2.1.6 identifies the specific table listing the requirements and the section providing details of the verifications.

Table 2.16. Verification of LUCs and engineered remedy integrity in UEFPC

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirement/status review
LUC	UEFPC property record restriction	Implemented for transferred properties	See Tables 2.4 and 2.5 and text below
LUC	UEFPC property record notices	Implemented for completed actions	See Table 2.4 and text below
LUC	UEFPC EPP program	Implemented for completed actions	See Tables 2.4 and 2.5 and text below
LUC	UEFPC access controls	Implemented for completed actions	See Tables 2.4 and 2.5 and text below
Engineered remedy	BSWTS	Implemented	See Table 2.6 and text below
Engineered remedy	CMTS	Implemented	See Table 2.6 and text below
Engineered remedy	EEVOC Plume treatment system	Implemented	See Table 2.6 and Section 2.4.2.2
LUC	Union Valley Interim ROD	Implemented	See Table 2.4 and Section 2.3.4.4

BSWTS = Big Spring Water Treatment System
CMTS = Central Mercury Treatment System
EEVOC = East End Volatile Organic Compound
EPP = excavation/penetration permit

LUC = land use control
ROD = Record of Decision
UEFPC = Upper East Fork Poplar Creek

2.1.4.4.1 LUCs

LUCs are per the UEFPC Phase I Interim ROD and apply to WEMA mercury-contaminated areas and UEFPC surface water (signs and surveillance patrols). The UEFPC Phase II Interim ROD requires restrictions across the entire watershed. The EFPC and ChR RAR CMP was approved in February 2023 and serves as the LUCIP for the EFPC administrative watershed. Per the EFPC and ChR RAR CMP, all LUC requirements have been met and are verified annually in the RER. All LUCs are tracked and archived in the LUM application. The LUCs for UEFPC were certified in FY 2023 following approval of the EFPC and ChR RAR CMP LUCIP in February 2023 (Appendix D). Results over the last 3 years of the verification are as follows:

- Property record restrictions (deeds):** Property record restrictions have been recorded by DOE at the Anderson County Register of Deeds office for facilities/parcels in UEFPC that have been transferred for private-sector use/development (as of September 30, 2023). The EFPC and ChR RAR CMP requirements (Table 2.5) require verification every 5 years. It was verified in FY 2023 that the LUC requirements are included in the Covenant Deferral Requests and quitclaim deeds for transferred property in UEFPC. The properties remain industrial use and are subject to the state law requiring owners to contact Tennessee 811 before they dig. If work is being performed on the transferred property, causing disturbance to more than 22.5 ft below ground surface (bgs) within Site A (Jack Case Center) or located more than 18.5 ft bgs within Site B (New Hope Center), then authorization is needed from DOE, EPA, and TDEC prior to digging (see Figure C.1 in Appendix C for parcel transfers at Y-12).

- **Property record notices:** Notice of land use restrictions must be filed in accordance with Tennessee statute Tennessee Code Annotated 68-212-225 when an RA includes land use restrictions. Land use restrictions, per the statute, may apply to activities on, over, or under the land, including groundwater and property use. DOE filed the initial UEFPC Property Record Notice with the Anderson County Register of Deeds office on January 25, 2017. It is titled, “Notice of Land Use Restrictions for the Upper East Fork Poplar Creek Watershed Area,” and was filed as an Environmental Notation in Book 1653, pages 666–669. The notice requires restrictions that apply specifically to the UEFPC watershed and prevent residential use of the property and both access to and use of groundwater and surface water located in, on, or under the property, unless permitted by DOE for monitoring, research, or operational activities.

Additionally, DOE filed the same UEFPC Property Record Notice with the Roane County Register of Deeds office on February 17, 2017, because the UEFPC watershed falls within both Anderson and Roane Counties. It was filed as an Environmental Notation in Book 1601, pages 105–108. It was verified in FY 2023 that the DOE Property Record Notice remains properly recorded at both the Anderson and Roane Counties Register of Deeds offices.

- **EPP program:** An existing EPP program currently administered by DOE contractors requires workers/developers to obtain authorization before beginning subsurface excavation/penetration activities. DOE and/or its agents will maintain responsibility for the EPP program for contamination handling, locations for ongoing federal government activities at the site, and for land transfer until concentrations of hazardous substances are at levels to allow for UU/UE. From FYs 2021–2023, for properties that are not transferred, the EPP program was verified to be functioning according to established internal procedures and plans.
- **Access controls:** DOE and/or its agent will maintain responsibility for the access controls until the concentrations of hazardous substances are at levels to allow for UU/UE. In the event of property transfer, DOE will document access controls in the transfer documents and deed and will verify they are maintained. All major access points to UEFPC remain guarded or locked at all times, and interior gates are selectively locked. Specifically, access is restricted by security portals at the east and west ends of Bear Creek Road. Access controls are in place at UEFPC and meet the intent of the LUC objectives. From FYs 2021–2023, signs were maintained to control access and surveillance patrols were conducted by security personnel at Y-12. While TDEC’s fish consumption advisories are for EFPC (from the mouth to New Hope Pond), they do not cover the waters on Y-12 property. Y-12’s strict security and patrols prevent any fishing activities. DOE verified the access controls documented for transferred properties were maintained in accordance with deed language, which states DOE shall post signs providing notice or warning to prevent unauthorized access to the property being transferred; and patrol the transferred property to control and monitor access by workers, badged visitors, and unbadged public visitors.

2.1.4.4.2 Engineered remedies

Engineered remedy requirements for UEFPC are included in the EFPC and ChR RAR CMP beginning in February 2023. Engineered remedies include inspections and O&M for BSWTS and CMTS. Over the last 3 years, O&M was conducted in accordance with Y-12 system operator subcontractor procedures (see Table 2.17). Specific operations procedures/plans associated with BSTWS and CMTS are implemented to maintain effectiveness of those engineered remedies. All inspections were conducted as tracked and archived in LUM. Status of systems performance from FYs 2021–2023 is included in Section 2.1.4.2.

Table 2.17. 2024 FYR summary for UEFPC Phase I Interim ROD

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	BSWTS – Yes Station 17 – No	UEFPC remedy implementation is incomplete. BSWTS has been operational for 18 years and met its effluent goal in 96.4% of the 896 total weekly composite samples. During the FYs 2021–2023 evaluation period, BSWTS met its effluent goal in 96.7% of the 154 weekly composite samples. The average mercury concentration at Station 17 has decreased from 1860 ng/L in 2018 to 954 ng/L in 2023, and the annual mercury flux at Station 17 continued to decrease in FYs 2021–2023 following the spike of 12.4 kg in FY 2018 associated with the West COLEX demolition project to 6.7 kg in FY 2023. Performance standards at the IP (Station 17) have not been met (Section 2.1.4.2.1)
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	NA	Remedy implementation is incomplete. The BSWTS component action is completed and performing as specified in the UEFPC Phase I Interim ROD. Occasional expected bypass conditions occur during periods of higher-than-average rainfall, which affects effectiveness of this component of the UEFPC Phase I Interim ROD; however, potential bypass conditions were a known component of the remedy. Evaluation of bypass conditions in FYs 2021–2023 is included in Section 2.1.4.2.2. Concentrations of mercury in the WEMA storm sewers have decreased significantly since the FY 2018 demolition work at the West COLEX Facility. Outfall 200 MTF and other components of the remedy that will decrease mercury concentrations in UEFPC are ongoing or pending
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	LUCs are being implemented and maintained per the EFPC and ChR RAR CMP, approved in February 2023. LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	Yes	The Former Reduction of Mercury in Plant Effluents Program and single-project CERCLA actions (storm sewer relining, treatment facilities, Building 81-10 sump removal, etc.) took place prior to the UEFPC Phase I Interim ROD. These single actions addressed several major sources of mercury flux to UEFPC
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	Yes	Operations at BSWTS and CMTS are being implemented and maintained per the EnergySolutions Operation Manuals (Sections 2.1.4.1.2): • Y50-41-WT-12.01, Revision 6, Central Mercury Treatment System Startup and Support Operation • Y50-41-WT-14.02, Revision 3, Big Spring Water Treatment System Startup, Operation, and Shutdown • Y12-WTO-99-D-008, Revision 3, Liquid Waste Management Services Preventative Maintenance, Calibration, and Inspection Program

Table 2.17. 2024 FYR summary for UEFPC Phase I Interim ROD (cont.)

Question	Response	Note
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	No	The recreational AWQC for mercury is unchanged (0.051 µg/L), although it was waived in the UEFPC Phase I Interim ROD under an interim action waiver, and an interim risk-based goal of 200 ppt as measured at Station 17 is currently used. There have been no other substantive changes to the ARARs/TBC criteria cited in the UEFPC Phase I Interim ROD
Have there been any changes in land use or expected land use on or near the site?	Yes	Y-12 remains government-controlled, industrial land use. Several parcels of land adjacent to Y-12 were transferred for private-sector buildings (Section 2.1.2.4, Table 2.5). LUCs were appropriately transferred with the land
Have new human health or ecological exposure pathways or receptors been identified?	No	No new human health or ecological exposure pathways or receptors have been identified. Transferred properties deeds have restrictions for groundwater, soils, and surface water to ensure protectiveness
Have new contaminants or contaminant sources been identified?	No	No new contaminants have been identified since the UEFPC Phase I Interim ROD was approved
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	No	Used carbon and filters from BSWTS are sampled for WAC compliance and sent to the Y-12 Landfill under special permit
Have there been any changes in the physical site conditions?	No	Construction of the Outfall 200 MTF and the associated MTF headworks site continues. Deactivation/demolition of select facilities is ongoing
Have there been any changes in the toxicity factors for COCs?	Yes	The UEFPC Phase I Interim ROD addressed only mercury toxicity. No CSFs were established for mercury (evaluated as methylmercury). The final ROD will use the most up-to-date toxicity values
Were there significant changes in the standardized risk assessment methodologies?	No	The performance goal (200 ppt) at the UEFPC IP (Station 17) is based on an adult recreator consuming fish. Risk methods for assessing fish ingestion have not substantially changed since the last FYR
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	Yes	The ROD required monitoring of mercury in fish to support a decision in the final ROD for EFPC. Historical actions have reduced mercury uptake by ecological receptors upstream of Lake Reality. Future actions are anticipated to further reduce available mercury for biouptake. Closure on ecological risk will occur under the EFPC Surface Water ROD
Is the site located in an area subject to natural disasters?	Yes	Portions of UEFPC are within the 100-year floodplain. There is a low probability of tornados and earthquakes in the region

Table 2.17. 2024 FYR summary for UEFPC Phase I Interim ROD (cont.)

ARAR = applicable or relevant and appropriate requirement	IP = integration point
AWQC = ambient water quality criteria	LUC = land use control
BSWTS = Big Spring Water Treatment System	LUM = Land Use Manager
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980	MTF = Mercury Treatment Facility
ChR = Chestnut Ridge	NA = not applicable
CMP = Comprehensive Monitoring Plan	ppt = parts per trillion
CMTS = Central Mercury Treatment System	RAR = Remedial Action Report
COC = contaminant of concern	ROD = Record of Decision
COLEX = column-exchange	TBC = to be considered
CSF = cancer slope factor	UEFPC = Upper East Fork Poplar Creek
EFPC = East Fork Poplar Creek	WAC = waste acceptance criteria
FY = fiscal year	WEMA = West End Mercury Area
FYR = Five-Year Review	Y-12 = Y-12 National Security Complex

2.1.4.5 Costs

Overall CERCLA program-level O&M and S&M costs are discussed in Section 1.5.4. During the site interview, the BSWTS operations team indicated the approximate annual O&M cost for BSWTS from 2021–2023 was \$502,441. This is similar to the average annual costs for the prior 5 years, as reported in the 2021 FYR (\$503,300). Unanticipated costs were not encountered, and system costs were in-line with previous forecasts for the program.

2.1.5 Technical Assessment

Table 2.17 summarizes the 2024 FYR technical assessment for the UEFPC Phase I Interim ROD.

2.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Station 17: Station 17 mercury concentrations between FYs 2021–2023 did not attain the UEFPC Phase I Interim ROD goal of 200-ng/L total mercury. Mercury concentrations have decreased dramatically since the late 1950s. Since 2000, concentrations increased in FYs 2011–2014 and FYs 2018–2021 associated with the WEMA storm drain cleanouts and West COLEX demolition project, respectively. At Station 17, mercury concentrations averaged 954 ng/L in FY 2023, and the annual mercury discharge fluxes have fallen steadily from FY 2018 (12.4 kg) to 6.7 kg in FY 2023.

Uranium and zinc are COCs; however, there are no performance standards. The average uranium and zinc annual concentrations measured at Station 17 within the FYs 2021–2023 FYR period were all less than their respective MCL screening concentrations. The annual uranium flux is generally proportional to annual rainfall, with higher uranium fluxes occurring during years of higher rainfall.

BSWTS (effluent): Since July 2008, BSWTS effluent is sampled continuously, and weekly composite samples are analyzed for total mercury. The average mercury concentration in BSWTS effluent during FY 2021 was 45 ng/L, during FY 2022 was 77 ng/L, and during FY 2023 was 140 ng/L, which are all below the 200-ng/L goal specified in the UEFPC Phase I Interim ROD. For the FYR period between FYs 2021–2023, the effluent met the 200-ng/L UEFPC Phase I Interim ROD goal for 96.7% of the 154 weekly composite samples, with the 200-ng/L goal for mercury exceeded in five weekly composite samples ranging from 206 ng/L to 855 ng/L. All exceedances occurred in FY 2023.

CMTS (Outfall 551): Effluent samples were collected from weekly 24-hr composites at CMTS (Outfall 551) and analyzed for mercury. CMTS effluent monitoring in FYs 2021–2023 indicates that, during the past 3 years, CMTS effluent has met the NPDES goal.

WEMA (Outfalls 150, 160, 163, 169A, and 200A6; the WEMA IP): During the FYs 2021–2023 evaluation period, the highest measured mercury discharge from WEMA occurred during FY 2021 when elevated mercury discharge (4208 g) occurred in the Outfall 150 branch of the storm drain network. A number of activities occurred in the Outfall 150 contributing area, including activities associated with demolition of the East COLEX facilities. Annual mercury discharge fluxes from the four monitored storm drain branches in WEMA are variable, with the most upstream monitoring at Outfall 169A tending to dominate. The Outfall 200 MTF is currently under construction to address mercury releases from the WEMA area. Enhanced water-management activities during excavation at the Outfall 200 MTF headworks ensured compliance with substantive requirements of Tennessee General NPDES Permit No. TNR100000, Stormwater Discharges from Construction Activities.

UEFPC Station 8: In addition to Station 17 and the monitoring conducted in WEMA, weekly composite samples are also collected in UEFPC at Station 8. Results for FYs 2021–2023 indicate dissolved mercury that predominates the discharge from Outfall 200A6 tends to become bound to sediment and periphyton in the UEFPC stream channel. The average proportion of dissolved mercury at Station 8 is approximately 10% compared to approximately 67% dissolved mercury at Outfall 200A6 and approximately 6% dissolved mercury at Station 17. Transport of mercury-contaminated sediment in the UEFPC channel causes an increase in the total mercury flux exacerbated by storm flow scour in UEFPC.

Elemental mercury removal: During FY 2021, approximately 1.1 kg to 1.47 kg of metallic mercury was recovered from the storm drain 150 basin where visible mercury accumulates. During FYs 2022–2023, several attempts were made to recover elemental mercury at this location, but there was insufficient mercury to allow recovery.

Costs associated with monitoring and LUC implementation associated with the UEFPC Phase I Interim ROD are provided in Section 1.5.4. Costs are consistent with forecasted costs for the project.

2.1.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2) and Appendix B (Section B.2), a FYR process was used to determine if the key chemical-specific ARAR and risk-assessment assumptions used at the time of the UEFPC Phase I Interim ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B and summarized below.

2.1.5.2.1 ARARs

The recreational AWQC for mercury is unchanged (0.051 µg/L), although this AWQC was waived in the UEFPC Phase I Interim ROD under an interim action waiver. The AWQC is identified as the long-term end goal for mercury concentrations in UEFPC. Outfall 200 MTF construction has complied with all other ARARs related to the construction stage of the project (i.e., floodplain requirements, fugitive dust from construction activities, Tennessee Aquatic Resource Alteration Permit requirements for construction of intake and outfall structures).

2.1.5.2.2 Risk

The land use/receptor/exposure pathway assumptions for UEFPC included in the UEFPC Phase I Interim ROD have not changed, and land remains under strict DOE control. The UEFPC Phase I Interim ROD includes a 200-ppt performance standard for mercury in surface water at the UEFPC IP (Station 17) based on an adult recreator consuming fish. Surface water monitoring at Station 17, including analysis for uranium and zinc, is conducted to gauge cumulative effects of the various actions as they are completed. The toxicity values for these chemicals have not changed. Risk methods for assessing fish ingestion have not

substantially changed. To achieve watershed-wide mercury-reduction objectives, individual components of the Phase I remedy have action-specific performance standards.

As additional actions are implemented, a cumulative risk evaluation will be conducted using current regional screening levels (RSLs)/preliminary remediation goals (PRGs) to confirm cleanup levels meet current risk criteria. The most current risk information will be summarized in post-ROD documentation.

2.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Fish in UEFPC continue to have elevated concentrations of total mercury and methylmercury. Aqueous mercury concentrations at Station 17 have remained variable, with increasing concentrations in FYs 2021–2022, but concentrations in FY 2023 show a decrease of almost 50% from the spike in FY 2018 associated with the West COLEX demolition project. Fish tissue concentrations increased accordingly in FYs 2021–2022 and remain elevated compared to concentrations in 2018.

Portions of UEFPC are within the 100-year floodplain; however, the stream is mostly channelized. There is a low probability of tornadoes and earthquakes in the region. Climate change and associated vulnerabilities were recently evaluated in the *Fiscal Year 2023 UCOR Vulnerability Assessment and Resilience Plan, Oak Ridge, Tennessee* (UCOR-5593; Vulnerability Assessment and Resilience Plan [VARP]) for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. On the ORR, heat waves were the only climate hazard that is predicted to have an overall increase in the future. Annual inches of precipitation are expected to remain as is, but the frequency and intensity of precipitation events will increase. Synergistic effects (e.g., drier soils due to hotter temperatures), combined with more intense rainfall events, are expected to occur and will lead to more damaging impacts (e.g., runoff and flooding with increased soil erosion). Additional adaptive and resilience solutions were considered where gaps were noted, and they were evaluated by their anticipated effectiveness, cost, community impact, and environmental impact.

The VARP did not identify any specific UEFPC facilities or areas requiring further evaluation, with the exception of worker health and safety resilience issues (e.g., heat stress and strain, heat-related illness, cardiovascular and respiratory disorders). This was identified as a highly vulnerable asset and a physiological/monitoring program was developed in FY 2023.

Additionally, an Integrated Watershed process model was developed for UEFPC. This model can be used to predict the effectiveness of various remediation technologies under various future climate conditions to be considered in the Final UEFPC ROD (Nair et al. 2022).

The VARP, in its early stage of a comprehensive program, identifies specific measures to be evaluated annually. Evaluation includes assessing the resilience actions in regard to new information. A comprehensive reassessment of the VARP is completed at least once every 4 years. The state of climate science and adaptation technologies is rapidly evolving; efforts to consider those factors will be built into future planning, including the Final UEFPC ROD and the EFPC Surface Water ROD.

2.1.6 Issues/Recommendations

Mercury concentrations at Station 17 are above the 200-ppt performance goal. Mercury concentrations in fish in UEFPC have yet to respond to commensurate reductions of mercury from historical response actions. Remedial measures have not been completed under the UEFPC Phase I Interim ROD. Implementation of actions under the UEFPC Phase I Interim ROD is incomplete. Construction of the Outfall 200 MTF, per the Mercury Mitigation Strategy, is ongoing (Table 2.18).

Table 2.18. Issues, recommendations, and follow-up actions identified in 2024 FYR for UEFPC Phase I Interim ROD

Issue number	Issue	Recommendation and follow-up action	Party responsible	Oversight agency	Milestone date	Affects protectiveness?	
						Current	Future
UEF-1	Mercury concentrations at Station 17 are above the 200-ppt performance goal. Mercury concentrations in fish in UEFPC have yet to respond to commensurate reductions of mercury from historical response actions	Remedial measures have not been completed under the UEFPC Phase I Interim ROD (DOE/OR/01-1951&D3). Implementation of actions under the UEFPC Phase I Interim ROD is not complete. Construction of the Outfall 200 MTF per the Mercury Mitigation Strategy is ongoing	DOE	EPA/TDEC	Outfall 200 MTF start-up date: Upon completion of ongoing construction (PCCR FFA Appendix J date 09/30/2025)	Yes	Yes

DOE = U.S. Department of Energy

EPA = U.S. Environmental Protection Agency

FFA = Federal Facility Agreement

FYR = Five-Year Review

MTF = Mercury Treatment Facility

PCCR = Phased Construction Completion Report

ppt = parts per trillion

ROD = Record of Decision

TDEC = Tennessee Department of Environment and Conservation

UEF = Upper East Fork Poplar Creek issue

UEFPC = Upper East Fork Poplar Creek

2.1.6.1 Other findings

There were no additional findings identified in this 2024 FYR for the UEFPC Phase I Interim ROD.

2.1.7 Protectiveness Statement

The UEFPC Phase I Interim ROD remedy (removal, treatment, and LUCs) will be protective for ecological receptors with the reduction in mercury concentrations passing Station 17 (i.e., exiting OU-28) through ongoing and future actions, including the new MTF identified in the UEFPC Phase I Interim ROD Amendment and the Mercury Mitigation Strategy. The remedy is protective of human health; LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the Anderson and Roane Counties Court House, Register of Deeds office. Additionally, land transfer deeds within this area contain land use and groundwater use restrictions and are in place at the Anderson County Court House, Register of Deeds office. Remedy components are in place to ensure integrity of the treatment systems is being maintained and to remain effective and protective.

Additional actions under the UEFPC Phase I Interim ROD and the Mercury Mitigation Strategy will ensure protectiveness (FFA Appendix J date RAR 2047). Additional future actions include the Final UEFPC ROD (groundwater, soil, sediment, ecological, and LUCs; FFA Appendix J date 2034; RAR 2035) and the EFPC Surface Water ROD (surface water, creek bank and bed sediments, ecological, and LUCs; FFA Appendix J date 2035; RAR 2037).

2.1.8 Next Review

The next (seventh) CERCLA FYR on the UEFPC Phase I Interim ROD will be due August 2029.

2.2 RECORD OF DECISION FOR PHASE II INTERIM REMEDIAL ACTIONS FOR CONTAMINATED SOILS AND SCRAPYARD IN UPPER EAST FORK POPLAR CREEK

ROD:	DOE/OR/01-2229&D3: 04/21/06
PCCR – Scrap Removal:	DOE/OR/01-2481&D1: 10/11/11
PCCR Addendum:	DOE/OR/01-2481&D1/A1: 02/11/14
PCCR – Soil:	DOE/OR/01-2564&D1: 11/01/12
NSC to ROD	DOE/OR/01-2229&D3: 09/03/19; partial withdrawal of NSC: submitted 02/05/20

Decision document: *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee*

EPA SEMS OU: 50 – OU50 UEFPC Soils

2.2.1 Introduction

Contaminants have been left in place in UEFPC at levels that do not allow for UU/UE. The purpose of this review is to determine whether the remedies in place associated with the UEFPC Phase II Interim ROD (along with the NSC issued) are protective of human health and the environment.

2.2.1.1 Site chronology and background

Table 2.19 provides a chronology of CERCLA activities related to the UEFPC Phase II Interim ROD.

Table 2.19. Chronology of events associated with UEFPC Phase II Interim ROD

Event	Date
The Y-12 Scrap Yard began to be used as an area for accumulating, sorting, processing, and storing scrap metal and equipment from Y-12 operations	1968
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
Outdoor, non-containerized storage of scrap metal ceased, and all scrap metal received was placed into B-24 containers and B-25 boxes	1995
Operations at the Y-12 Scrap Yard ended	1999
The UEFPC soil and Scrap Yard FS was approved	August 2004
The UEFPC Phase II Interim ROD (DOE/OR/01-2229&D3) was signed	2006
The RDR/RAWP for scrap metal removal was approved	January 2009
Scrap metal removal from the Y-12 OSY began	May 2009
The UEFPC Soils RAWP for soil removal was approved (DOE/OR/01-2423&D2), and Y-12 OSY soil excavation began	August 2011
The OSY PCCR for scrap metal removal was approved (DOE/OR/01-2481&D1)	November 2011
The Soil Removal PCCR for Y-12 OSY area was approved (DOE/OR/01-2564&D1)	November 2012
EU-9 (including the Building 81-10 former mercury recovery process site) characterization was completed and indicated RA was required	FY 2012
Removal of five additional tanks stored to the southwest of the West End Treatment Facility and to the north of Oil Dike 9 and one B-25 box began	September 2012
The PCCR Addendum for Y-12 Salvage Yard Scrap Removal (five additional tanks) was approved (DOE/OR/01-2481&D1/A1)	February 2014
RDR for Soils EU-9 with erratum was approved	2014
UEFPC Phase II was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D2)	2016
UEFPC Phase II was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021
Attachment C.4 (<i>Phase 2 Technical Memorandum for Exposure Unit 5 at Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee</i>) to the UEFPC Soils RAWP was approved and recommended no action required	September 2022
DOE = U.S. Department of Energy EPA = U.S. Environmental Protection Agency EU = exposure unit FFA = Federal Facility Agreement FS = feasibility study FY = fiscal year FYR = Five-Year Review ORR = Oak Ridge Reservation OSY = Old Salvage Yard	PCCR = Phased Construction Completion Report RA = remedial action RAWP = Remedial Action Work Plan RDR = Remedial Design Report ROD = Record of Decision TDEC = Tennessee Department of Environment and Conservation UEFPC = Upper East Fork Poplar Creek Y-12 = Y-12 National Security Complex

The UEFPC Phase II Interim ROD was approved in 2006. The Old Salvage Yard (OSY) scrap removal and salvage yard soil removal projects are complete (Figure 2.6). The characterization of EU-5 is complete and no action was required to meet the requirements of the UEFPC Phase II Interim ROD. EU-9 has been characterized, and a future RA for mercury-contaminated soils has been recommended at Building 81-10 in EU-9 (Figure 2.6).

Key documents reviewed for this 2024 FYR include:

- UEFPC RI.
- *Upper East Fork Poplar Creek Soil and Scrapyard Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2083&D2).
- UEFPC Phase II Interim ROD.

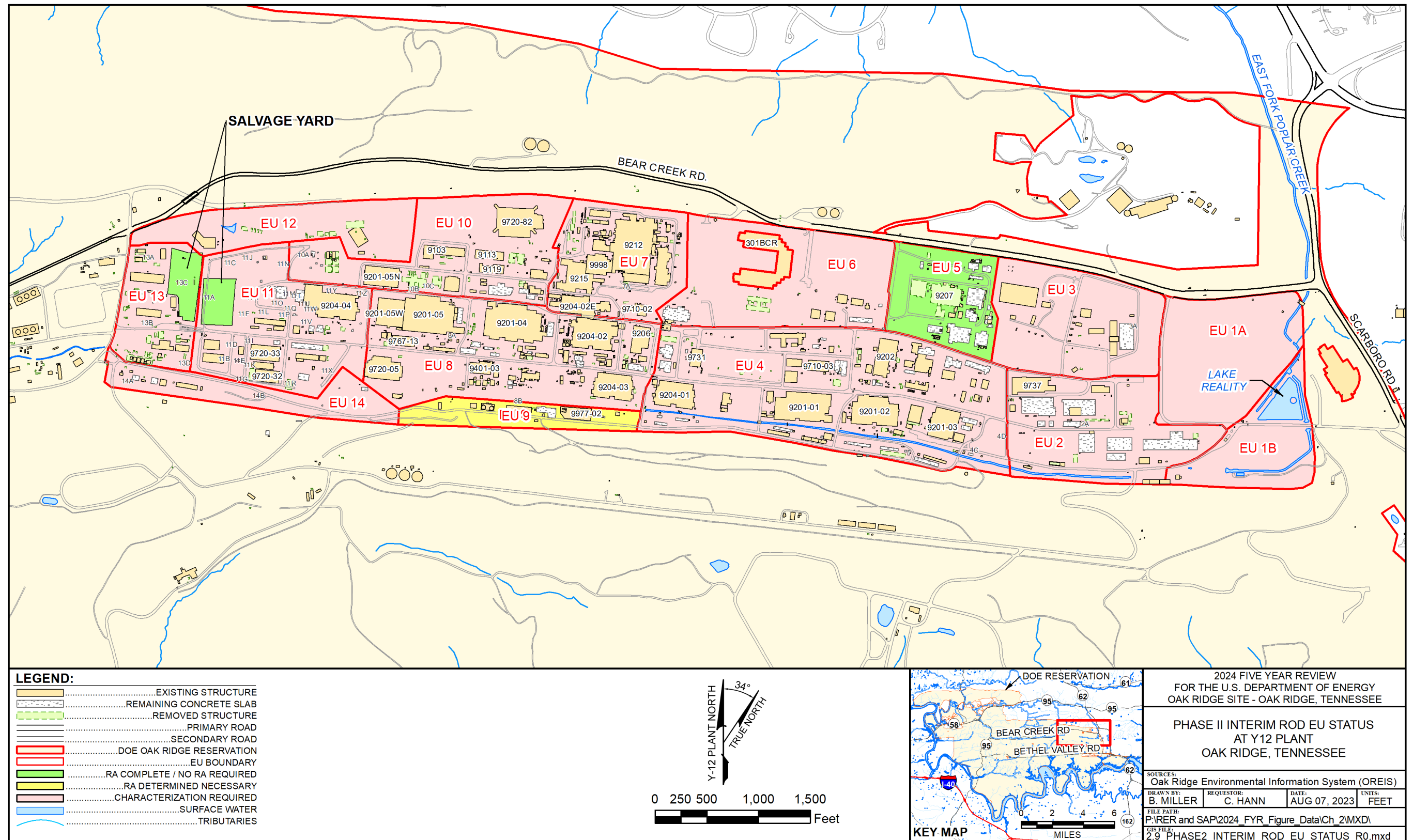


Figure 2.6. UEFPC Phase II Interim ROD estimated areas of soil excavation.

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- *Upper East Fork Poplar Creek Soils Remedial Action Work Plan, Oak Ridge, Tennessee* (DOE/OR/01-2423&D2; UEFPC Soils RA Work Plan [RAWP]).
- *Phased Construction Completion Report for Scrap Metal Removal at the Y-12 Old Salvage Yard, Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2481&D1; OSY PCCR).
- *Addendum to the Phased Construction Completion Report for Scrap Metal Removal at the Y-12 Old Salvage Yard, Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2481&D1/A1; PCCR Addendum for Y-12 Salvage Yard Scrap Removal).
- *Remedial Design Report for Soils in Exposure Unit 9 at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2581&D2) with erratum.
- *Phase 2 Technical Memorandum for Exposure Unit 5 at Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, which is Attachment C.4 to the UEFPC Soils RAWP.

2.2.1.2 Physical characterization

The original topography of the UEFPC characterization area was altered substantially by grading activities during construction of what is now known as Y-12. Before construction, UEFPC surface water had tributaries flowing from Pine Ridge to UEFPC at the base of ChR to the south. During construction, the entire western half of the UEFPC system was captured in subsurface drains.

Fill material consists of reworked natural materials mixed with construction debris. The unconsolidated materials are predominantly clayey silts and silty clays. Very few areas within the UEFPC characterization area have a sequence of natural soil horizons because extensive cut-and-fill grading during construction of Y-12 reworked much of the pre-existing unconsolidated material. In addition, the tributary system to UEFPC and a portion of the main channel in the central and western portions of the complex were captured in an extensive storm drain system. The thickness of fill material placed along former UEFPC tributaries is quite variable, ranging from a few feet to nearly 30 ft in the north-central portion of the complex. In most areas of the characterization area, the water table lies within the unconsolidated zone or just beneath the bedrock-unconsolidated zone interface at depths ranging from less to 10 ft in the southern portion of the complex to more than 30 ft in the northern portions. Portions of the storm drain system flow continuously because they capture groundwater base flow as well as storm drain runoff.

2.2.1.3 Land and resource use

The UEFPC watershed encompasses a drainage area of about 1170 acres in the eastern portion of the ORR. It is dominated by the heavily industrialized portions of Y-12, which occupies about 600 acres (refer to Figure 2.1). Y-12 is an active production and special nuclear materials management facility; strict security and access limitations apply. The identified land use goals from the UEFPC Phase II Interim ROD, as shown on Figure 2.1, include the following:

- The central and western Y-12 areas will be remediated to meet a controlled industrial land use. Industrial use in the upper 2 ft of the area will be unrestricted. Use of the subsurface below the depth of 2 ft will be authorized by DOE NNSA for federal use, or if transferred, by the FFA parties.
- The eastern side of the Y-12 area will be remediated to meet an unrestricted industrial land use for the upper 10 ft of the area.

2.2.2 Response Action Summary

2.2.2.1 Basis for taking action

The UEFPC RI indicated shallow soil contamination throughout Y-12 from mercury and other contaminants, primarily from historical radiological processing operations, including chemical-separation techniques; weapons manufacturing; research and development; waste storage, management, and disposal; and physical plant-maintenance activities. Leaks and spills from aboveground and underground pipelines, leaks in underground storage tanks (USTs), and spills in storage areas have also contributed to soil contamination from radionuclides, chlorinated organics, PCBs, and other metals.

The UEFPC Phase II Interim ROD presents the selected interim RA for contaminated areas within the industrialized part of the UEFPC watershed at Y-12 on the DOE ORR. The remedy addresses contaminated soils, scrap, buried waste, and subsurface structures (including slabs). The decision establishes RLs to protect site-specific industrial users of the site and to protect groundwater and surface water. The UEFPC Phase II Interim ROD does not include actions to address inaccessible soils, previously contaminated groundwater, contaminated surface water, or contaminated buildings, which will be addressed in future decisions. The decisions in this ROD apply to the 600-acre industrialized area of Y-12. Remediation consists primarily of removal (i.e., excavation and disposal) of existing contamination. LUCs are selected to ensure residual contamination remaining after completion of response actions does not pose a short- or long-term threat to human health and the environment.

2.2.2.2 Response actions

The primary objective of the remediation measures presented in the UEFPC Phase II Interim ROD is to protect industrial workers from exposure to hazardous substances at Y-12 by reducing existing contamination at the site (i.e., soil, buried waste, and subsurface structures) to below risk-based levels for workers onsite. Another objective of the UEFPC Phase II Interim ROD is to protect groundwater and surface water by removing mercury, VOCs, and radionuclide contamination in soil, buried waste, or subsurface structures that could contribute to future contamination above industrial risk-based levels.

The RAOs for UEFPC watershed soil for controlled industrial land use are listed below:

- Protect workers in the industrial complex area by achieving a cumulative risk for all significant or primary COCs combined not to exceed a residual cumulative remediation goal of 10^{-4} individual lifetime cancer risk (ILCR), excluding radium and thorium, or a hazard index (HI) of 1 allowed for each organ-specific effect.
- Minimize further contamination of groundwater by remediating accessible (i.e., not under buildings or pavement) soil, buried waste, or subsurface structures that contribute significantly to groundwater contamination at an ILCR greater than 10^{-4} or an HI greater than 1 for industrial use of groundwater. Pavement includes major roads, buildings, and major usage parking lots.
- Minimize further contamination of surface water in UEFPC by remediating accessible soil, buried waste, or subsurface structures that contribute significantly to surface water contamination by mercury in exceedance of the UEFPC Phase I Interim ROD goal of 200 ppt at Station 17 (only mercury is being evaluated because it is the primary COC in surface water, as identified in the UEFPC Phase I Interim ROD).

The UEFPC Phase II Interim ROD addressed contaminated soils, scrap, buried waste, and subsurface structures (including storage tanks, waste and utility lines, slabs, etc.) located within the industrialized main plant area of Y-12. The UEFPC Phase II Interim ROD established soil RLs to protect future users of the site.

and established decision criteria to protect groundwater and surface water. The UEFPC Phase II Interim ROD did not include actions to address previously contaminated groundwater or surface water, which will be addressed in future decisions. The decisions in the UEFPC Phase II Interim ROD applied to the 600-acre industrialized area of Y-12.

The selected remedy includes the following principal actions:

- Conduct predesign characterization to confirm and fully delineate areas of contamination and to identify sources of unacceptable releases to groundwater and surface water.
- Excavate accessible, contaminated soils (defined as that not under buildings or critical active utilities or roads) exceeding the RL to allow for controlled industrial¹ land use up to a depth of 2 ft. Excavate accessible, contaminated soils in the easternmost areas of Y-12 up to a depth of 10 ft to allow for more-aggressive future DOE development. This remedy includes all Y-12 soils as, over time, currently inaccessible soil will become accessible and will be addressed.
- Excavate accessible, unacceptably contaminated soils exceeding the RLs for protection of groundwater and surface water to the water table or bedrock to protect against unacceptable releases to underlying groundwater or surface water.
- Remove scrap located in the Y-12 Salvage Yard (i.e., OSY). Characterize and size-reduce scrap as needed.
- Conduct limited groundwater monitoring near deep soil excavation areas for a minimum of 5 years to assess effectiveness of source removal to protect groundwater. Surface water monitoring is already being conducted under the UEFPC Phase I Interim ROD, and no additional surface water monitoring is included as part of the UEFPC Phase II Interim ROD.
- Implement LUCs to prohibit use of land for any non-industrial activity and to prevent unacceptable exposures to residual contamination in that area. The LUCs extend to the entire Y-12 industrial area.

The PCCR Addendum for Y-12 Salvage Yard Scrap Removal was approved in February 2014 for disposing and removing five tanks stored to the southwest of the West End Treatment Facility to reduce the potential for mercury releases and the potential for worker exposure to mercury vapor.

The RAs in the UEFPC Phase II Interim ROD are considered interim actions to protect future workers based upon anticipated DOE-controlled land use. The RAs implemented under the UEFPC Phase II Interim ROD will be completed, evaluated, and used as the basis for determining what, if any, additional RAs may be necessary to meet final goals. Decisions regarding final land use and final goals, and to address state policy for perpetual LUCs for soils, surface water, and groundwater, will be determined in future decision documents.

Because WEMA soil actions (hydraulic isolation and horizontal wells) were removed from the UEFPC Phase I Interim ROD with the expectation major mercury-use buildings will now be demolished, the UEFPC Phase II Interim ROD will also address WEMA mercury-contaminated soils.

A dynamic characterization approach is defined in the UEFPC Soils RAWP for characterization and remediation (i.e., excavation) of soil, slabs, and subsurface structures to achieve the RAOs in the UEFPC Phase II Interim ROD.

¹ Controlled industrial—defined by the Oak Ridge Reservation End Use Working Group as industrial land use with excavation limited to 2 ft.

Several key source areas included in the UEFPC Phase II Interim ROD as a result of the UEFPC RI are listed below (Figure 2.6). Additional areas are expected to be identified for soil remediation as a result of spills, leaks, and deposition through the dynamic characterization strategy described in the UEFPC Soils RAWP:

- **OSY:** Located on the western end of Y-12, this area contains five Resource Conservation and Recovery Act of 1976 (RCRA) solid waste management units (SWMUs), including the oil storage tanks, the oil/solvent drum storage area, the drum deheader, the scrap metal storage area, and Tank 2063-U.
- **Building 9201-2 (Alpha-2):** Contaminated media within the building include soil beneath and adjacent to the building with shallow groundwater.
- **East End Garage:** Includes former fuel storage, USTs, and distribution facilities.
- **Beta 4 Security Pits:** Disposal areas located adjacent to and inside the Perimeter Intrusion Detection and Assessment System corridor at the western end of the complex.
- **Coal Pile Trench:** Disposal area located in the southwestern Y-12 area within the western exclusion area.

2.2.2.3 Status of implementation

The initial project of the UEFPC Phase II Interim ROD was removal of scrap from the Y-12 OSY. Removal of all scrap was completed in FY 2011, as documented in the OSY PCCR. A follow-on project, removal and disposal of Y-12 OSY contaminated soil (portions of EUs 11 and 13), was completed in FY 2012, as documented in the *Phased Construction Completion Report for the Y-12 Old Salvage Yard Soil Remediation Project, Y-12 National Security Complex Oak Ridge, Tennessee* (DOE/OR/01-2564&D1). Approximately 29,225 yd³ of scrap and related solid waste and soil from the OSY were removed and disposed at the EMWMF, Y-12 Landfill, and off-site disposal facilities. Following scrap and soil removal, restoration grading was performed at the OSY to establish final surface contours, permeable geotextile filter fabric was installed, and approximately 4 to 6 in. of gravel was placed on the site to promote infiltration and reduce runoff. LUCs are discussed below in Section 2.2.2.4.

A tank removal project was initiated in FY 2012 under the UEFPC Phase II Interim ROD to dispose of five tanks used for mercury-related activities at Y-12. These tanks were removed from service in the 1980s. Characterization and disposal were completed in FY 2013. The site containing the storage tanks was restored by adding four loads of topsoil, returning the site to the natural contours, hydroseeding, and watering.

Characterization of 12.6-acre EU-9 and 22-acre EU-5 was completed in FY 2012 and FY 2022, respectively. The studies included radiation walkover surveys and soil sampling and analyses in accordance with the UEFPC Soils RAWP. Results for EU-9 indicated an RA is required in the Building 81-10 area to protect the industrial work force. Results in EU-5, which includes the footprint of the former Biology complex, indicated no action is required. No actions are required for groundwater and surface water protection in either EU.

2.2.2.4 LUC requirements

LUCs established under the UEFPC Phase II Interim ROD are listed in Table 2.4. The EFPC and ChR RAR CMP was approved in February 2023 and serves as the LUCIP for the EFPC administrative watershed. The certification of LUC implementation for FY 2023 for UEFPC is included in Appendix D. Refer to Section 2.2.4.4 for evaluation of the identified UEFPC Phase II Interim ROD LUCs.

2.2.2.5 Engineered remedy

There are no UEFPC Phase II Interim ROD actions that include engineered remedies.

2.2.3 Progress Since Last Five-Year Review

The 2021 FYR of the UEFPC Phase II Interim ROD concluded:

The remedy implemented at UEFPC under the Phase II Interim ROD (removal and LUCs) will be protective of human health and the environment upon completion. Protectiveness will be achieved by identifying and removing contaminated media. In the interim, LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the County Court House, Register of Deeds office.

Additional actions (i.e., groundwater) will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).

There were no issues or additional findings identified during the 2021 FYR.

2.2.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 2.2.1.1.
- Reviewed information since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - Changes in land use and verifying LUCs.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing watershed LUCs, as specified in the associated decision documents.

2.2.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this 2024 FYR.

2.2.4.2 Data review

There are no detailed performance standards for the scrap metal interim RA in the UEFPC Phase II Interim ROD or in the UEFPC Soils RAWP. The effectiveness of the OSY scrap removal component of the action is demonstrated by all scrap metal having been removed from the site. RLs were established in the UEFPC Phase II Interim ROD for the target COCs. Trigger levels were established in the UEFPC Soils RAWP to indicate when (i.e., once exceeded) the groundwater/surface water modeling and evaluation is required. Recommendations for remedial action/no action for EU soils, subsurface structures, and buried waste are determined by comparing concentrations of the primary COCs to the RLs for the protection of Y-12

industrial workers and by evaluating contaminated areas exceeding trigger levels for potential impacts to groundwater from VOCs and surface water from mercury, as described in the UEFPC Phase II Interim ROD and the UEFPC Soils RAWP, including specific decision criteria. Trigger levels are currently under review by the Project Team.

RAs for the protection of industrial workers are required to a depth of 2 ft in EU-2 through EU-14 and to a depth of 10 ft in EU-1a and EU-1b. RAs for the protection of groundwater and surface water are conducted to the depth required to remove contamination above the water table or bedrock (whichever is shallower). Recommendations for RA/no RA for OSY, EU-5, and EU-9 are documented in technical memoranda that are attached to the UEFPC Soils RAWP as follows:

- **OSY:** The *Technical Memorandum for the Y-12 Old Salvage Yard Located in Exposure Units 11 and 13 of the Upper East Fork Poplar Creek (UEFPC) Characterization Area*, which is Attachment A.2 to the UEFPC Soils RAWP, summarized results of the soil characterization and evaluation against the RLs and trigger levels and recommended RA at the Drum Deheader Facility in the West OSY to reduce VOC concentrations evaluated as a potential threat to groundwater.
- **EU-5:** The *Phase 2 Technical Memorandum for Exposure Unit 5 at Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, which is Attachment C.4 to the UEFPC Soils RAWP, summarized results of the soil characterization and evaluation against the RLs and trigger levels and recommended no action required for EU-5 soils.
- **EU-9:** The *Technical Memorandum for Exposure Unit 9 of the Upper East Fork Poplar Creek (UEFPC) Characterization Area*, which is Attachment B.2 to the UEFPC Soils RAWP, summarized results of the soil characterization and evaluation against the RLs and trigger levels and recommended RA for soils at Building 81-10.

RAs have only been completed at OSY at the present time. Completion of the RAs taken at OSY for scrap removal and at the OSY Drum Deheader Facility for soil removal for protection of groundwater is documented in the OSY PCCR and the PCCR Addendum for Y-12 Salvage Yard Scrap Removal.

The OSY PCCR and the PCCR Addendum for Y-12 Salvage Yard Scrap Removal document the OSY meets the RAOs in the UEFPC Phase II Interim ROD by achieving scrap removal and conducting RAs to ensure concentrations in soil, subsurface structures, and buried waste meet the RLs for protection of Y-12 industrial workers to a depth of 2 ft and do not pose a threat to surface water or groundwater contamination.

2.2.4.3 Site inspection

As part of the 2024 FYR process for the UEFPC Phase II Interim ROD, a virtual site interview was conducted on August 21, 2023, and a site visit was conducted on September 17, 2020. The purpose of the site inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place as required by the UEFPC Phase II Interim ROD. See Section 2.1.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

2.2.4.4 LUC verification and certification and engineered remedy verification

2.2.4.4.1 LUCs

Per the EFPC and ChR RAR CMP, LUCs in UEFPC Phase II Interim ROD areas were maintained, including surveillance patrols and an ongoing EPP program. The OSY is located within the Y-12 Property Protection Area and, as such, is under work controls by the nature of its location at Y-12 (e.g., access controls – fencing, badging, gates, security patrols, and signs) that prevent intrusions into the site, deter public access, and help ensure protectiveness of the remedy.

Other requirements are pending completion of all RAs within the industrial area comprising the UEFPC watershed and/or if particular areas are transferred to another entity prior to RA completion.

Implementation verification and status of the UEFPC LUCs are summarized in Section 2.1.4.4. This section also includes a status of the property transfers from FYs 2021–2023. The certification of LUC implementation for FY 2023 for the UEFPC watershed is included in Appendix D.

2.2.4.4.2 *Engineered remedy*

There were no engineered remedy components to any of the UEFPC Phase II Interim ROD actions.

2.2.5 Technical Assessment

Table 2.20 summarizes the FYR technical assessment for the UEFPC Phase II Interim ROD for contaminated soils and scrapyards in UEFPC.

Table 2.20. FYR summary for UEFPC Phase II Interim ROD

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	NA	To date, three removal projects (OSY scrap, OSY soils, and five tanks) have been completed under the UEFPC Phase II Interim ROD. Characterization of EU-5, which includes the footprint of the former Biology Complex, was completed in FY 2022 and indicated no action for soil or protection of groundwater or surface water is required. There are no post-remediation performance standards in the decision documents. RA is recommended for EU-9 in the Building 81-10 area
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	No problems identified in this 2024 FYR
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	LUCs are being implemented and maintained per the EFPC and ChR RAR CMP, approved in February 2023. LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	There were no additional actions to address immediate threats
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There is no operating system in place under this remedy

Table 2.20. FYR summary for UEFPC Phase II Interim ROD (cont.)

Question	Response	Note
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	No	There have been no substantive changes to the ARARs/TBC criteria cited in the UEFPC Phase II Interim ROD that would affect the protectiveness of the remedy. Trigger levels are currently under review by the Project Team
Have there been any changes in land use or expected land use on or near the site?	No	Y-12 remains government-controlled, industrial land use. Several parcels of land adjacent to Y-12 were transferred for private-sector buildings (Section 2.1.2.4, Table 2.5). LUCs were appropriately transferred with the land
Have new human health or ecological exposure pathways or receptors been identified?	No	The exposure pathways/receptors identified in the UEFPC Phase II Interim ROD are valid
Have new contaminants or contaminant sources been identified?	No	No additional contaminants or contaminant sources have been identified since the time of the action
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	No	No toxic byproducts of the remedy were identified
Have there been any changes in the physical site conditions?	Yes	Contaminated scrap has been removed and disposed offsite, and contaminated soils have been excavated and excavations filled with flowable fill material. The sites were restored following RAs. The sites remain under government control on DOE property
Have there been any changes in the toxicity factors for COCs?	Yes	Changes to the toxicity factors for several COCs have occurred that would increase some and reduce other risk-based RLs (see Section 2.2.5.2.2). The final ROD will use updated factors
Were there significant changes in the standardized risk assessment methodologies?	No	There have been no significant changes in the standardized risk assessment methodologies since the last FYR
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	NA	Ecological risk was not addressed by the action; future evaluation will be addressed on a watershed-scale in a final UEFPC ROD
Is the site located in an area subject to natural disasters?	Yes	Portions of the site are adjacent to the UEFPC 100-year floodplain, but the stream is mostly channelized and contained in those areas. There is a low probability of earthquakes or tornadoes in the region

Table 2.20. FYR summary for UEFPC Phase II Interim ROD (cont.)

ARAR = applicable or relevant and appropriate requirement
ChR = Chestnut Ridge
CMP = Comprehensive Monitoring Plan
COC = contaminant of concern
DOE = U.S. Department of Energy
EFPC = East Fork Poplar Creek
EU = exposure unit
FY = fiscal year
FYR = Five-Year Review
LUC = land use control

LUM = Land Use Manager
NA = not applicable
OSY = Old Salvage Yard
RA = remedial action
RAR = Remedial Action Report
RL = remediation level
ROD = Record of Decision
TBC = to be considered
UEFPC = Upper East Fork Poplar Creek
Y-12 = Y-12 National Security Complex

2.2.5.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended by the decision documents. To date, three remedial projects (OSY scrap, OSY soils, and five tanks) have been completed under the UEFPC Phase II Interim ROD. No action was determined for soil and protection of groundwater and surface water for EU-5. There are no post-remediation performance standards in the decision documents. LUCs are maintaining protectiveness in the UEFPC watershed area.

2.2.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2) and Appendix B (Section B.2), a FYR process was used to determine if the key chemical-specific ARAR and risk-assessment assumptions used at the time of the UEFPC Phase II Interim ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B and summarized below.

2.2.5.2.1 ARARs

There have been no substantive changes in ARARs and to-be-considered (TBC) criteria that would affect protectiveness of the remedy. TDEC has changed the citations for its regulations that are cited in the document but has not changed the substantive requirements under those citations. Similarly, DOE has rescinded DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (issued in February 1990 [Change 2, January 7, 1993]), and replaced it with DOE Order 458.1 (Change 2, July 2011) and its implementing manual and guidance, but the substantive requirements in original DOE Order 5400.5 cited as TBC guidance in the UEFPC Phase II Interim ROD were not changed in new DOE Order 458.1.

2.2.5.2.2 Risk

The land use/receptor/exposure pathway assumptions for UEFPC included in the UEFPC Phase II Interim ROD have not changed. Y-12 is an active industrial facility, and use of buildings and facilities throughout the plant is anticipated for the foreseeable future; the unrestricted (i.e., residential) land use scenario was eliminated as a likely future use.

As detailed in Appendix B, several toxicity factors have changed since the time of the UEFPC RI. Most of these changes are minor. The cancer slope factor (CSF) for the polycyclic aromatic hydrocarbons is 10 times lower (less toxic) than was reported at the time of the UEFPC RI, while the CSF for Ra-226 via the inhalation route increased by a factor of 10. Several other toxicity values changed by much smaller amounts. The risk assessment for the UEFPC Final ROD will use the updated toxicity factors.

Because VOCs remain in the soil, a vapor exposure evaluation was performed for industrial workers at the OSY site in EU-11 and EU-13. A vapor intrusion (VI) screening level (VISL) does not provide results for soil; therefore, the maximum detected concentrations of VOCs from soil samples remaining after the RA at the OSY was completed were compared to the inhalation RSLs for a composite worker receptor (working both indoors and outdoors). No VOCs exceed their respective industrial RSL at an HI = 0.1 or ILCR = 1E-6 (Appendix B).

2.2.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The baseline ERA prepared for the UEFPC watershed focused almost exclusively on UEFPC surface water and sediment. Because there is no suitable habitat in the industrial area and there will be none in the foreseeable future, ecological risk from soil to terrestrial communities was not evaluated. Portions of the site are adjacent to the UEFPC 100-year floodplain; however, the stream is mostly channelized and contained in those areas. There is a low probability of earthquakes or tornadoes in the region. RAs under the UEFPC Phase II Interim ROD entail scrap and media removal with no required monitoring. The VARP (see Section 2.1.5.3) did not identify any issues associated with action.

2.2.6 Issues/Recommendations

There were no issues/recommendations identified in this 2024 FYR of the UEFPC Phase II Interim ROD.

2.2.6.1 Other findings

There were no additional findings identified in this 2024 FYR for the UEFPC Phase II Interim ROD.

2.2.7 Protectiveness Statement

The remedy implemented at UEFPC under the UEFPC Phase II Interim ROD (removal and LUCs) will be protective of human health and the environment upon completion. Protectiveness will be achieved by identifying and removing contaminated media. In the interim, LUCs are in place to prevent human exposure. Watershed-wide access controls (signs and security patrols) and EPP controls are in place. A property record notice containing land use and groundwater use restrictions is in place at the Anderson and Roane Counties Court Houses, Register of Deeds office.

Additional actions (i.e., groundwater, soil, sediment, ecological, LUCs) will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).

2.2.8 Next Review

The next (seventh) FYR of the UEFPC Phase II Interim ROD will be due August 2029.

2.3 UNION VALLEY INTERIM RECORD OF DECISION

Interim ROD: DOE/OR/02-1545&D2: 07/10/97

Decision document: *Record of Decision for an Interim Action for Union Valley, Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*

EPA SEMS OU: 42 – Union Valley

2.3.1 Introduction

A carbon tetrachloride-dominated plume originating under Y-12 was detected in groundwater below privately owned, industrial-zoned land in Union Valley. There were no current users of the groundwater; however, it was determined there was a potential risk to human health from ingestion of contaminated groundwater and a possibility that actions taken by property owners (e.g., groundwater pumping) could cause the contaminated plume to expand. Figure 2.7 shows the parcels included in the Union Valley Interim ROD (hatched purple areas). Additional parcels held by the University of Tennessee are also under license agreements for groundwater use (non-hatched purple areas). The purpose of this review is to determine whether the remedies in place associated with the Union Valley Interim ROD are protective of human health.

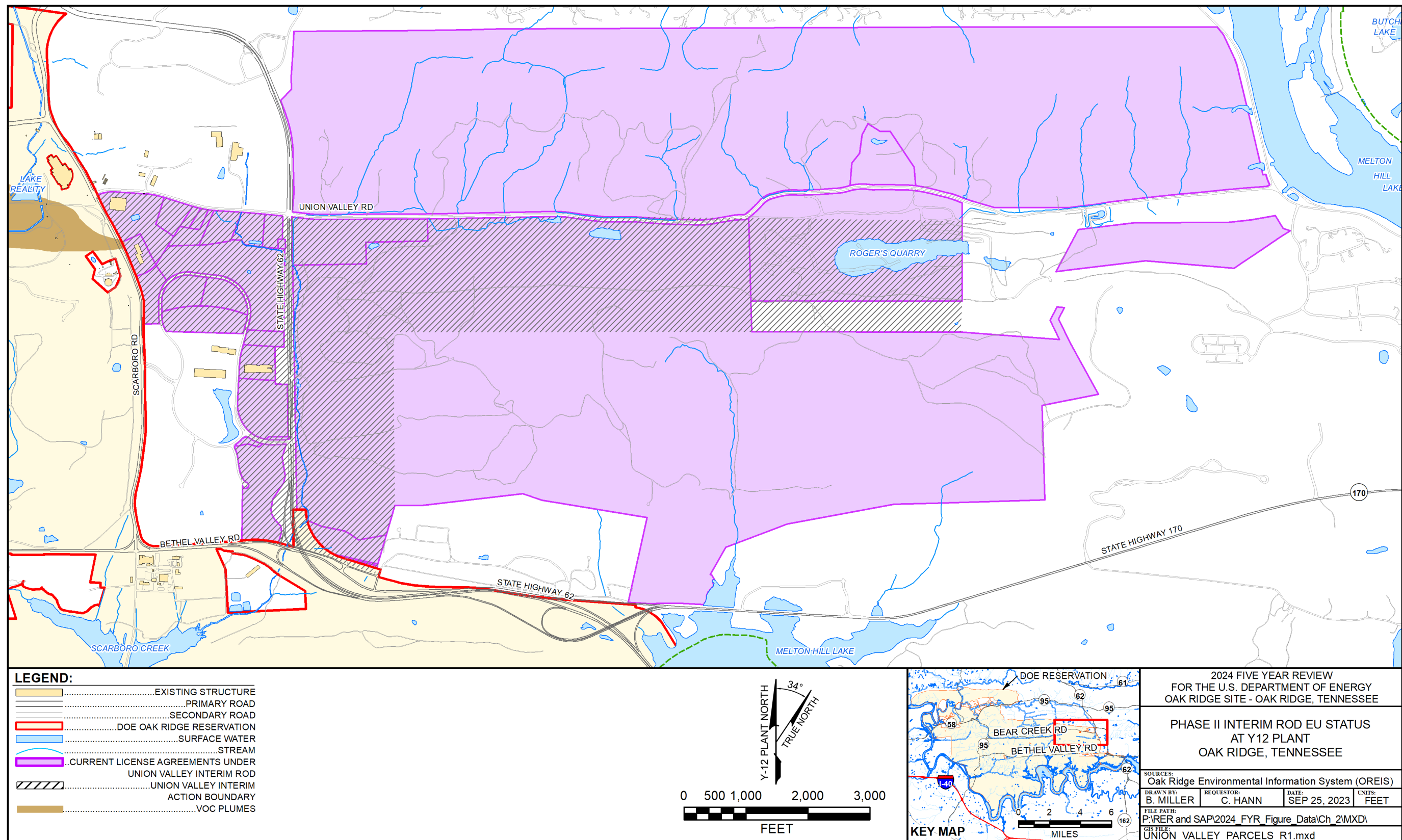


Figure 2.7. Areas with license agreements under the Union Valley Interim ROD.

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2.3.1.1 Site chronology and background

Table 2.21 presents the site chronology for the Union Valley interim action.

Table 2.21. Site chronology for Union Valley interim action

Event	Date
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
Human health screening risk evaluation in the Union Valley Interim Study (Y-ER-206/R1) indicated contaminants in groundwater and springs would pose a threat to human health if ingested; however, the lack of an exposure pathway (no residential groundwater or spring users) precludes risk	1995
The Union Valley Proposed Plan (DOE/OR/02-1452/D2) was approved	1996
The Union Valley Interim ROD was signed by the FFA parties	1997
UEFPC RI (DOE/OR/01-1641&D2) baseline HHRA demonstrated potential risk but no exposure pathway for groundwater. Cancer risk was determined to be $< 10^{-6}$ and chemical HI < 1	1998
Union Valley was included in the initial 2001 FYR of the ORR (DOE/OR/01-1941&D2/R1)	2001
Union Valley was included in the second 2006 FYR for the ORR (DOE/OR/01-2289&D3)	2006
Union Valley was included in the third 2011 FYR for the ORR (DOE/OR/01-2516&D2)	2011
Union Valley was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D2)	2016
Union Valley was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021

DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
FFA = Federal Facility Agreement
FYR = Five-Year Review
HI = hazard index
HHRA = human health risk assessment

ORR = Oak Ridge Reservation
RI = remedial investigation
ROD = Record of Decision
TDEC = Tennessee Department of Environment and Conservation
UEFPC = Upper East Fork Poplar Creek

Key documents reviewed for this 2024 FYR include:

- Union Valley Interim ROD.
- EEVOC Plume AM.
- 2021 FYR.
- 2022 RER; specifically Chapter 5, “UEFPC Watershed.”
- 2023 RER; specifically Chapter 5, “UEFPC Watershed.”
- 2024 RER; specifically Chapter 5, “UEFPC Watershed.”

2.3.1.2 Physical characterization

Union Valley lies east of Y-12 and extends about 3.6 mi from Scarboro Road eastward to CR in the city of Oak Ridge, Tennessee (Figure 2.7). Illinois Avenue (State Route 62) crosses the valley about 0.6 mi east of Scarboro Road. Union Valley Road runs the length of the valley. VOC contamination associated with releases (spills, leaks, etc.) from Y-12 has been detected in the groundwater below privately owned land in Union Valley east of the facility.

2.3.1.3 Land and resource use

The Union Valley area is state or privately owned property currently zoned for light industrial and commercial use only. Most properties in Union Valley are privately owned tracts of variable size. The city of Oak Ridge and the University of Tennessee also hold property within the valley. Changes in land use have occurred since the decision in the vicinity of the site and include constructing several new office/commercial buildings in the area and completing construction to widen Illinois Avenue between Union Valley Road and Edgemoor Road. No groundwater users currently exist in Union Valley, as water service is provided to the industrial corridor by the city of Oak Ridge.

2.3.2 Response Action Summary

2.3.2.1 Basis for taking action

The *Union Valley Interim Study Remedial Site Evaluation* (Y/ER-206/R1; Union Valley Interim Study) was conducted to support the Union Valley Interim ROD in 1995. A human health screening risk evaluation indicated some contaminants in groundwater and springs would pose a threat to human health if ingested. However, the lack of an exposure pathway (no residential groundwater or spring water users) precluded unacceptable risks.

Principal plume contaminants that have migrated offsite are carbon tetrachloride and its degradation product, chloroform. Carbon tetrachloride was used in large quantities during the early 1940s in electromagnetic uranium-separations processes in the eastern portion of Y-12 (Building 9201-2). The historical sources of VOCs in the EEVOC Plume underlying Union Valley have not been identified; however, spills or leaks are suspected to be the primary release mechanism of carbon tetrachloride to the groundwater system. Monitoring data and other characteristics of the plume are discussed in Section 2.4, which describes a pump-and-treat remedy consisting of treating groundwater to remove particulates, iron, manganese, and VOCs using an automated filtration and air stripper system.

2.3.2.2 Response action

The primary objective of this interim action was to protect human health from a contaminated plume originating from beneath Y-12 and detected in the groundwater below privately owned, industrial-zoned land in Union Valley. LUCs were selected as the interim remedy to accomplish the following goals: ensure public health is protected while final actions are being developed and implemented; and identify and prohibit, if necessary, future activities with a potential to accelerate the rate of contaminant migration from the characterization area or increase the extent of the contaminant plume. The Union Valley Interim ROD addressed LUC interim remedies:

- License agreements with property owners notifying them of the potential contamination and requiring them to notify DOE of any changes in use of groundwater or surface water in certain areas.
- Appropriate verification of compliance with the agreements.

2.3.2.3 Status of implementation

Administrative actions instituted by DOE during the term of the Union Valley Interim ROD include the following:

- Establish license agreements between DOE and all affected property owners within the interim RA boundary that require property owners to notify DOE 90 days before extraction or use of groundwater is proposed.

- Conduct annual title searches to determine whether any affected property changed ownership, and verify any new owner has been notified of the provisions of the license agreement.
- Notify affected property owners and the city of Oak Ridge to remind them of their obligations under the agreement.
- Survey owners, by telephone, to determine whether any new groundwater wells have been constructed or planned, or if there are any new uses for surface water.
- Notify licensed well drillers in Tennessee of the license agreements and their terms.

2.3.2.4 LUC requirements

LUCs established under the Union Valley Interim ROD are listed in Table 2.4.

2.3.2.5 Engineered remedy

There are no engineered remedy components to the Union Valley Interim ROD.

2.3.3 Progress Since Last Five-Year Review

The 2021 FYR of the Union Valley Interim ROD concluded:

The remedy implemented at Union Valley (LUCs) is protective of human health and the environment. Protectiveness is achieved through administrative controls. LUCs are in place to prevent human exposure. License agreements with non-federal property owners in Union Valley are in place and contain groundwater and surface water restrictions.

Additional actions, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).

There were no issues or actions identified during the FY 2021 FYR.

2.3.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 2.3.1.1.
- Reviewed effectiveness evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - Changes in land use and verifying LUCs.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing LUCs as specified in the associated decision documents.

2.3.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this 2024 FYR.

2.3.4.2 Data review

The Union Valley Interim ROD is an administrative control action. The license agreements in place with the property owners under the Union Valley Interim ROD footprint require DOE be notified prior to sale of their property. Several parcels have changed ownership in the last 5 years, and the required annual title search tracks these sales.

No surface water or groundwater monitoring is required as part of this interim action. An associated action, the EEVOC Plume RmA, included constructing a groundwater treatment facility to prevent further migration of the VOC-contaminated groundwater plume off the ORR into Union Valley (see Section 2.4 for a full discussion and evaluation of the performance).

2.3.4.3 Site inspections

As part of this 2024 FYR, the site manager was interviewed on August 21, 2023, and a virtual site visit was conducted in conjunction on September 17, 2023 (see Appendix A). The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place for the Union Valley Interim ROD. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

2.3.4.4 LUC verification and certification and engineered remedy verification

Compliance with all LUC requirements is verified yearly. The certification of LUC implementation for FY 2023 for the UEFPC watershed is included in Appendix D.

2.3.4.4.1 LUCs

Compliance with all requirements was verified for FYs 2021–2023. Table 2.22 summarizes the specific LUC verification activities for the Union Valley Interim ROD. WRRP ensured property owners; the Oak Ridge City Manager; and TDEC/DOE Oversight Office, now called TDEC, Division of Remediation Oak Ridge Office, had been notified of their respective obligations and that Tennessee-licensed well drillers were notified of the license agreements and terms. Documentation that all required title searches were conducted and that property owners were surveyed by telephone, as required, was provided by WRRP in conjunction with DOE. A copy of the documentation is maintained by WRRP for use in the annual RER, and verification by WRRP is tracked in LUM.

2.3.4.4.2 Engineered remedies

There were no engineered remedy components to the Union Valley Interim ROD.

2.3.5 Technical Assessment

The Union Valley Interim ROD is an administrative decision. There are no technical issues to discuss unique to this decision. LUCs are in place to ensure protectiveness, and no additional LUCs were identified that need to be added. Treatment of the VOC plume underlying Union Valley is addressed by the EEVOC Plume RmA. Please refer to Section 2.4.5 for a full discussion of the technical assessment under that action. Table 2.23 presents the 2024 FYR summary for the Union Valley Interim ROD.

Table 2.22. Verification of LUCs for Union Valley Interim ROD

Affected area	Project document	LUC	Frequency/implementation
Union Valley	Interim ROD (DOE/OR/02-1545&D2)	License agreements with property owners notifying them of the potential contamination and requiring them to notify DOE of any changes in use of groundwater or surface water in certain areas: • Appropriate verification by DOE of compliance with the agreements and notification of state and local agencies • DOE's management and operations contractor is responsible for: (1) completing the annual title search by the anniversary date of this ROD to determine whether any affected property has changed hands; (2) notifying property owners, the Oak Ridge City Manager, and the TDEC/DOE Oversight Division (now called the TDEC/DOE Oversight Office) of their obligations under the agreements and updating them on the status of the environmental investigations; (3) surveying owners by telephone to determine whether any new groundwater wells have been constructed or planned or if there are any new uses for surface water; and (4) notifying licensed well drillers in Tennessee of the license agreements and their terms	WRRP shall report search results to the DOE Program Office annually

DOE = U.S. Department of Energy

LUC = land use control

ROD = Record of Decision

TDEC = Tennessee Department of Environment and Conservation

WRRP = Water Resources Restoration Program

Table 2.23. FYR summary for Union Valley Interim ROD

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	NA	This is an administrative action only. There are no performance standards associated with this Union Valley Interim ROD
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	No problems were identified
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	LUCs are being implemented and maintained per the EFPC and ChR RAR CMP, approved in February 2023. LUCs are also tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	There were no additional actions in the Union Valley Interim ROD. A separate RmA was completed (EEVOC Plume RmA, see Section 2.4)
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There are no operating procedures associated with the Union Valley Interim ROD
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the Interim ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	NA	No ARARs were identified in the Union Valley Interim ROD
Have there been any changes in land use or expected land use on or near the site?	No	The site remains unrestricted industrial
Have new human health or ecological exposure pathways or receptors been identified?	No	No risk assessment was performed for this action
Have new contaminants or contaminant sources been identified?	No	This is an administrative action only
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	NA	This is an administrative action only
Have there been any changes in the physical site conditions?	Yes	Several parcels have changed ownership in the last 5 years, and the required annual title search tracks these sales. A recent example is the construction of a Weigel's convenience store on the property at the corner of Union Valley Road and Highway 62
Have there been any changes in the toxicity factors for COCs?	NA	This is an administrative action only
Were there significant changes in the standardized risk assessment methodologies?	NA	Risk-based performance standards are not specified in the Union Valley Interim ROD

Table 2.23. FYR summary for Union Valley Interim ROD (cont.)

C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	NA	Ecological risk is not addressed by the action; future evaluation will be addressed on a watershed-scale
Is the site located in an area subject to natural disasters?	Yes	There is a low probability of earthquakes or tornadoes in the region
ARAR = applicable or relevant and appropriate requirement ChR = Chestnut Ridge CMP = Comprehensive Monitoring Plan COC = contaminant of concern EEVOC = East End Volatile Organic Compound EFPC = East Fork Poplar Creek FYR = Five-Year Review LUC = land use control LUM = Land Use Manager NA = not applicable RAR = Remedial Action Report RmA = removal action ROD = Record of Decision TBC = to be considered		

2.3.5.1 Question A: Is the remedy functioning as intended by the decision documents?

The remedy is functioning as intended. Protectiveness is maintained through administrative LUCs.

2.3.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

The Union Valley Interim ROD was an administrative LUC decision. The assumptions at the time of the remedy are still valid.

2.3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Ecological risk was not addressed by the Union Valley Interim ROD. Future ecological evaluations will be addressed on a watershed-scale.

2.3.6 Issues/Recommendations

There were no issues/recommendations identified in this 2024 FYR of the Union Valley Interim ROD.

2.3.6.1 Other findings

There were no additional findings identified in this 2024 FYR for the Union Valley Interim ROD.

2.3.7 Protectiveness Statement

The remedy implemented at Union Valley (LUCs) is protective of human health and the environment. Protectiveness is achieved through administrative controls. LUCs are in place to prevent human exposure. License agreements with non-federal property owners in Union Valley are in place notifying them of the potential contamination and requiring them to notify DOE of any changes in use of groundwater or surface water in certain areas.

Additional actions for Union Valley groundwater, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).

2.3.8 Next Review

The next (seventh) FYR of the Union Valley Interim ROD will be due August 2029.

2.4 EAST END VOLATILE ORGANIC COMPOUND PLUME ACTION MEMORANDUM

AM: DOE/OR/01-1819&D2: 06/25/99
NSC: (establishes monitoring point of compliance [POC]): 03/06/2013
RmAR: DOE/OR/01-2297&D1: 06/07/06
RmAR Erratum: (establishes monitoring POC): submitted 3/05/13 (no approval required)

Decision document: *Action Memorandum for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee*

EPA SEMS OU: 42 – Union Valley

2.4.1 Introduction

A plume of contaminated groundwater extends from the eastern UEFPC watershed through Union Valley (see Section 2.3), where it discharges to springs (i.e., SCR7.1SP and former spring SCR 7.18SP) in the Scarboro Creek headwaters (Figure 2.8). The Union Valley Interim ROD provides protection for the public through a series of administrative controls (see Section 2.3). The purpose of this review is to determine whether the EEVOC Plume RmA, as described in the EEVOC Plume AM, is effective and protective of human health.

2.4.1.1 Site chronology and background

Table 2.24 presents the site chronology for the EEVOC Plume RmA.

Key documents reviewed for this 2024 FYR include:

- EEVOC Plume AM.
- *Removal Action Report for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee* (DOE/OR/01-2297&D1; EEVOC Plume RmAR).
- Union Valley Interim ROD.
- EFPC and ChR RAR CMP.
- 2022 RER; specifically Chapter 5, “UEFPC Watershed.”
- 2023 RER; specifically Chapter 5, “UEFPC Watershed.”
- 2024 RER; specifically Chapter 5, “UEFPC Watershed.”

2.4.1.2 Physical characterization

The EEVOC Plume treatment system is situated at the eastern end of Y-12 (industrial complex) and captures and treats a groundwater plume that flows eastward underneath Scarboro Road (light industrial/business park) toward Illinois Avenue. The hydrogeologic conceptual model for the eastern end area of Y-12 on DOE-controlled property reflects highly complex interactions between surface water and groundwater in the karst groundwater flow system of the Maynardville Limestone. Various construction activities in the eastern plant area also have affected groundwater and surface water flow patterns. Three preferential groundwater flow pathways are recognized based on data collected to date:

- Rapid, strike-parallel flow from west to east along karst conduits and fractures at intermediate and deep intervals (100 to 400 ft) in the Maynardville Limestone.

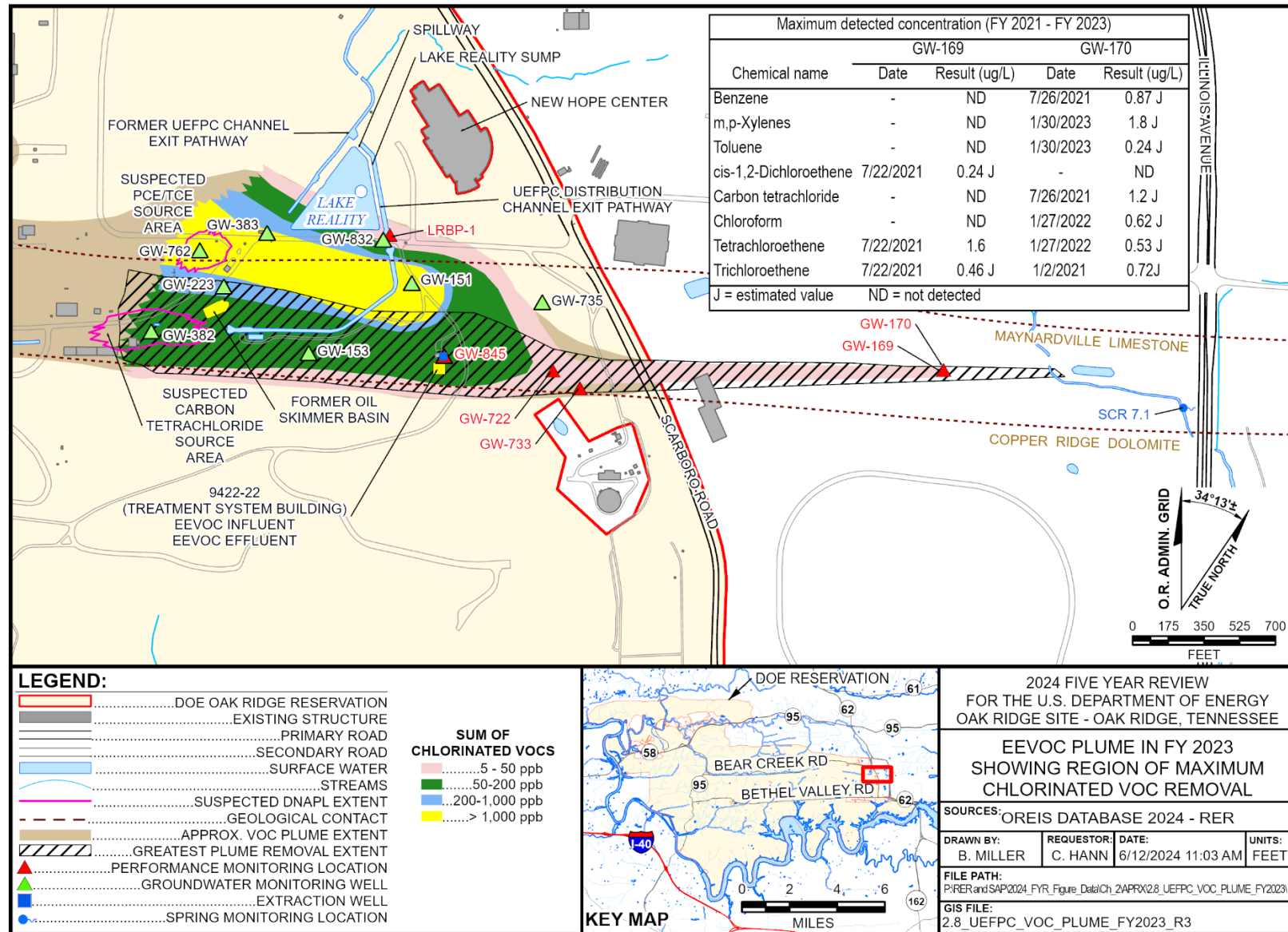


Figure 2.8. EEVOC Plume in FY 2023 showing extent of VOC contamination and monitoring locations.

Table 2.24. Site chronology for EEVOC Plume RmA

Event	Date
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
A non-TC RmA was initiated in FY 1998 to evaluate more permanent alternatives for preventing further migration of contaminated groundwater off of the ORR	1998
A deep, bedrock groundwater extraction well (GW-845) was installed and tested	1998
An EE/CA (DOE/OR/01-1764&D4) concluded containment of the dissolved-phase plume was the most feasible remedy, given the absence of proven technologies for remediating DNAPL in fractured bedrock	1999
The RmA Work Plan was completed in June 1999 (DOE/OR/01-1825&D1)	1999
The EEVOC Plume AM was issued in August 1999 (DOE/OR/01-1819&D2)	1999
Construction of a groundwater treatment facility began in May 2000 and culminated with testing of the system in August and September 2000. Full operation of the system began in October 2000	2000
The EEVOC Plume AM was included in the second 2006 FYR for the ORR (DOE/OR/01-2289&D3)	2006
The EEVOC Plume RmAR (DOE/OR/01-2297&D1) was completed in FY 2006, following completion of the first 5 years of operations, which concluded in October 2005	2006
The EEVOC Plume AM was included in the third 2011 FYR for the ORR (DOE/OR/01-2516&D2)	2011
An erratum to EEVOC Plume RmAR was submitted to establish the monitoring POC (no approval required)	2013
DOE issued NSC to codify monitoring station LRBP-1 as the POC for EEVOC effluent monitoring	2013
The EEVOC Plume AM was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D3)	2016
The EEVOC Plume AM was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021
An aboveground discharge swale was constructed to mitigate repeated repairs/replacement of underground discharge piping	2023

AM = Action Memorandum

DNAPL = dense nonaqueous-phase liquid

DOE = U.S. Department of Energy

EE/CA = engineering evaluation/cost analysis

EEVOC = East End Volatile Organic Compound

EPA = U.S. Environmental Protection Agency

FFA = Federal Facility Agreement

FY = fiscal year

FYR = Five-Year Review

LRBP = Lake Realty Bypass

NSC = non-significant change

ORR = Oak Ridge Reservation

POC = point of compliance

RmA = removal action

RmAR = Removal Action Report

TC = time-critical

TDEC = Tennessee Department of Environment and Conservation

- Shallow groundwater flow along preferential pathways (fractures or fracture zones) of the former UEFPC channel west of Lake Realty, which was infilled during construction of Y-12.
- Shallow groundwater flow through an underdrain system constructed beneath the UEFPC distribution channel.

2.4.1.3 Land and resource use

The EEVOC Plume treatment system is currently situated in an area of unrestricted industrial land use and is expected to remain as such. EEVOC system operation has reduced off-site groundwater concentrations of individual VOCs to levels below 5 µg/L, the lowest drinking water MCL of detected VOCs (Figure 2.8).

2.4.2 Response Action Summary

2.4.2.1 Basis for taking action

Existing human health and ecological risks specific to groundwater were evaluated during the UEFPC RI and a Union Valley Interim Study and were incorporated into the EEVOC Plume AM. The risk assessments presented in the Union Valley Interim Study addressed hypothetical risks related to groundwater use, as well as potential risk related to exposure to spring discharges in Union Valley (see Section 2.3.2). These risk estimates form a comparative baseline for future performance evaluations.

Principal plume contaminants that have migrated offsite are carbon tetrachloride and its degradation product, chloroform. Carbon tetrachloride was used in large quantities during the early 1940s in electromagnetic uranium-separations processes in the eastern portion of Y-12 (Building 9201-2). The historical sources of VOCs in the EEVOC Plume have not been identified; however, spills or leaks are suspected to be the primary release mechanism of carbon tetrachloride to the groundwater system. Monitoring data show the center of mass of the carbon tetrachloride plume is within the intermediate and deep intervals (60 to 120 m [200 to 400 ft] bgs) of the Maynardville Limestone in the vicinity of well GW-382 (Figure 2.8). Historical dissolved carbon tetrachloride concentrations exceeding 8000 µg/L in the center of the plume indicate the possible presence of DNAPL.

Additional VOCs occurring in the plume include tetrachloroethene (PCE) and its degradation products, including trichloroethene (TCE); 1,2-dichloroethene (DCE) isomers; and low levels of vinyl chloride (VC). The original source of these constituents is unknown. PCE was used in large quantities in machining coolants and other various industrial purposes. Leaks or spills are also suspected to have been the primary release mechanism to groundwater. VOCs migrate along strike in the Maynardville Limestone from multiple upgradient sources in the western and central portions of Y-12. High concentrations of PCE and degradation products have commingled extensively in the unconsolidated, shallow, and intermediate bedrock intervals northeast of Building 9720-6 (well GW-762 vicinity in the eastern Y-12 area); historical concentrations of dissolved-phase PCE of 1,400 µg/L indicate the possible presence of DNAPL.

The Former Oil Skimmer Basin overlies the Maynardville Limestone immediately west of New Hope Pond. This unit, demolished during closure of New Hope Pond, captured sediments prior to inflow into New Hope Pond. A residual, localized area of radiological (uranium) and metals contamination has been identified at this site within the shallow groundwater interval. Although this unit is not a recognized source for VOCs, potential mobilization of uranium as a result of EEVOC Plume interception system operations was taken into consideration in the development of supplemental monitoring for this action.

The Maynardville Limestone underlies the southern portion of BCV and Y-12, as well as Union Valley. This geologic unit is a principal pathway for contaminant migration within the valley. Contaminants, including carbon tetrachloride, chloroform, and other VOCs, have been detected in several of the six monitoring wells completed in the Maynardville Limestone in Union Valley (e.g., GW-169 and GW-170). The contamination signature is consistent with that observed in the Maynardville Limestone at the east end of Y-12.

2.4.2.2 Response action

The goals of the action are to “reduce health and environmental risks associated with the migration of VOC-contaminated groundwater from the east end of Y-12.” In addition, the action will “reduce the potential risk from exposure to this contamination in offsite areas.” The EEVOC Plume AM also includes a goal to mitigate off-site migration of contaminants. No specific numeric performance standards for groundwater were established for the selected alternative.

The remedy consists of treating groundwater to remove particulates, iron, manganese, and VOCs using an automated filtration and air stripper system housed in Building 9422-22 (Figure 2.9). Treatment system capacity is set at 25 gpm; the system generally operates between 20 and 25 gpm. Although no requirements are specified other than O&M of the EEVOC Plume treatment system, the site remains protected by DOE 229 Boundary access controls (this security boundary is designated pursuant to Section 229 of the AEA, which prohibits unauthorized entry) and is regularly patrolled by security personnel. The building is locked, and access to the site is restricted to authorized personnel. In addition, groundwater use remains restricted within Y-12 and Union Valley.



Interior view of treatment system building

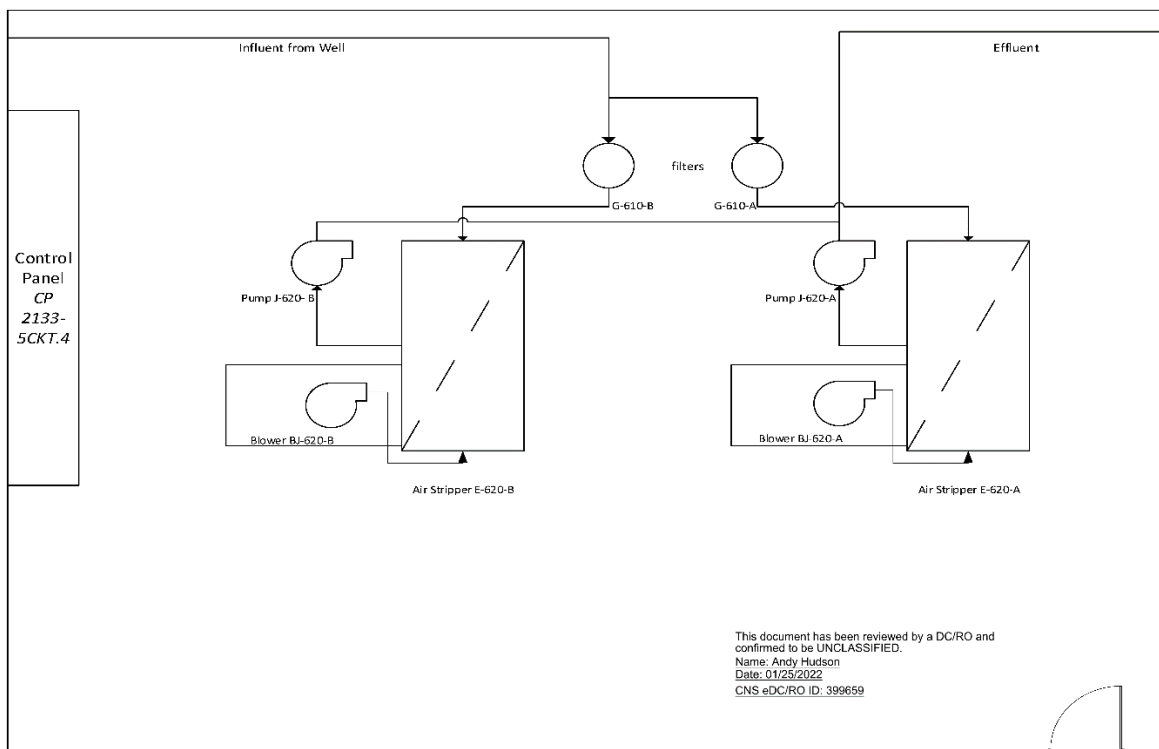


Figure 2.9. Photograph and schematic of Y-12 EEVOC Plume groundwater treatment system.

2.4.2.3 Status of implementation

A treatability study to evaluate enhanced biodegradation of the VOC source as a potential technology to augment or replace plume containment was initiated in 2002. Installation of a multiport monitoring well near the center of mass of the carbon tetrachloride plume was completed in FY 2003 as part of ongoing studies to further evaluate the characteristics of the plume. Data from the well indicated the carbon tetrachloride plume extended to greater depths and had more variability than previously identified.

DNAPL remediation technologies for fractured and karst bedrock aquifers have not developed extensively since issuance of the *Engineering Evaluation/Cost Analysis for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee* (DOE/OR/01-1764&D4). Costs for maintaining the EEVOC Plume interception system have been lower than originally planned, and the system has effectively lowered contaminant concentrations in the primary groundwater exit pathway off of the ORR from the UEFPC watershed. Consequently, efficacy of conducting the treatability study was evaluated in FY 2005, and a decision was made to cancel the remaining tasks of the treatability study. The evaluation and decision to cancel the remaining treatability study tasks were included in the EEVOC Plume RmAR. Additional actions for the EEVOC Plume will be prioritized and implemented consistent with the Groundwater Strategy for the ORR and under FFA schedule agreements.

Treated groundwater is continuously discharged into the 2700-ft-long, channelized, concrete-lined section of UEFPC. The point of entry of the discharge water into the stream is approximately 800 ft from the downstream end of the concrete channel, which terminates with a vertical fall of several feet into the natural channel of EFPC downstream. The EEVOC Plume RmAR required at least quarterly sampling and analysis of influent and effluent for VOCs, metals, nitrate, and uranium. An erratum to the EEVOC Plume RmAR was submitted in 2013 to establish an in-stream POC monitoring location, designated LRBP-1. The TDEC AWQC for carbon tetrachloride (revised from 44 µg/L to 16 µg/L in 2004) is the ARAR applicable at the POC from this treatment system.

2.4.2.4 LUC requirements

LUCs were not specified for the EEVOC Plume RmA.

2.4.2.5 Engineered remedy

Engineered remedy requirements established for the EEVOC Plume RmA are listed in Table 2.6. Refer to Section 2.4.4.4 for the FYR evaluation of the identified EEVOC Plume action engineered remedy requirements.

2.4.3 Progress Since Last Five-Year Review

The 2021 FYR of the EEVOC Plume AM concluded:

The RmA implemented for the EEVOC Plume is protective of human health and the environment. This RmA consists of an operating water treatment system to remove VOCs. Treated water is discharged downstream from the EEVOC treatment system into EFPC at the POC. There have been no performance goal exceedances since monitoring at the POC began in FY 2011. Remedy components are in place to ensure integrity of the treatment system is maintained to remain effective and protective. LUCs are in place to prevent human exposure.

Additional actions, as necessary, will be addressed under a final ROD (FFA Appendix J date FY 2034, 09/30/2034; RAR 09/30/2035).

There were no issues identified with the EEVOC Plume RmA during the 2021 FYR.

2.4.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 2.4.1.1.
- Reviewed effectiveness and performance monitoring data and evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M inspections and maintenance information.
 - Surface and groundwater monitoring data.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing EEVOC monitoring information and engineered remedy requirements as specified in the associated decision documents.

2.4.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this 2024 FYR.

2.4.4.2 Data review

Current monitoring for the EEVOC Plume RmA is included in the EFPC and ChR RAR CMP; see Section 1.5.2.

2.4.4.2.1 Treatment system performance monitoring

As stated in the EEVOC Plume AM, system performance is measured by evaluating reductions in VOC concentrations downgradient of the extraction well (GW-845). Per the EFPC and ChR RAR CMP, quarterly sampling is performed on extracted groundwater from GW-845 (EEVOC INF), with analysis including VOCs, metals, nitrate, and uranium. Additional analysis is performed on the effluent from the treatment system discharging to UEFPC (EEVOC EFF).

Treatment system performance monitoring began in November 2000, following system startup, and has run with only minor downtimes for maintenance since startup. During FYs 2021–2023, the treatment system operated fairly reliably, although both air strippers were replaced during FY 2023 after metal fatigue cracking was discovered in one of the units. Because of EEVOC Plume groundwater chemistry, scale accumulation in the discharge pipe that transports the treated groundwater from Building 9422-22 to a storm drain required costly replacement of the pipe on multiple occasions since plume treatment started. During FY 2023, the discharge pipe was abandoned, and treated effluent was routed to the storm drain via a rock-filled trench.

The total annual water treatment volume is slightly greater than 12 million gal. To evaluate effectiveness of the EEVOC Plume treatment system, influent and corresponding effluent samples have been collected since operations began. In FY 2023, concentrations of carbon tetrachloride in treatment system influent (from well GW-845 [EEVOC INF]) ranged from 98 µg/L to 140 µg/L and averaged 122 µg/L for the year (Table 2.25). The concentration range for carbon tetrachloride in the effluent stream (EEVOC EFF) was not detectable at 0.19 U µg/L to a maximum of 5.8 µg/L and averaged < 1.3 µg/L. Removal efficiency for carbon tetrachloride ranged from about 95% to 100% and averaged about > 99% in FY 2023.

Table 2.25. EEVOC Plume treatment system performance data, FY 2023

Chemical	Date	Influent result (µg/L)	Effluent result (µg/L)	Percent reduction (%)	Estimated net mass removal (kg) ^a
Carbon tetrachloride	10/03/22	140	0.57 UJ	100	> 0.571
Carbon tetrachloride	11/08/22	140	0.32 J	100	0.569
Carbon tetrachloride	12/08/22	130	0.25 J	100	0.535
Carbon tetrachloride	01/09/23	120	0.19 U	100	> 0.502
Carbon tetrachloride	02/06/23	130	2.9	98	0.454
Carbon tetrachloride	03/15/23	110	3.6	97	0.446
Carbon tetrachloride	04/10/23	110	5.8	95	0.420
Carbon tetrachloride	05/08/23	130	0.5 J	100	0.525
Carbon tetrachloride	06/05/23	130	0.19 U	100	> 0.527
Carbon tetrachloride	07/17/23	110	0.19 U	100	> 0.460
Carbon tetrachloride	08/22/23	110	0.69 J	99	0.458
Carbon tetrachloride	09/05/23	98	0.6 J	99	0.398
FY 2023 annual average:		122	<1.3	>99%	NA
FY 2023 annual mass removal:		NA	NA	NA	5.9 kg

^aEstimated net mass removal is based on treated volume for the sample month. Influent and effluent concentrations are assumed to be applicable to total treated volume.

EEVOC = East End Volatile Organic Compound

FY = fiscal year

J = analyte detected; concentration estimated

NA = not applicable

U = result is less than method reporting limits or minimum detectable activity

Table 2.26 summarizes total mass removals for the principal VOCs since operations began in 2000. A long-term, decreasing trend in the EEVOC influent (well GW-845) carbon tetrachloride concentration is evident in Figure 2.10. During FYs 2021–2023, the annual carbon tetrachloride mass removed has fluctuated between 5.0 kg and 5.9 kg, although annual water treatment volumes have remained stable.

Table 2.27 includes the maximum detected EEVOC Plume treatment system influent and effluent concentrations for monitored groundwater contaminants for the evaluation period of FYs 2021–FY 2023. An effluent concentration limit was not stipulated for the treatment system. The AWQC for carbon tetrachloride (16 µg/L) was only identified for the POC at LRBP-1; therefore, comparison of the treatment effluent to the AWQC is used as a screening criterion. To maintain protectiveness of the environment and to monitor effectiveness of the treatment system, the EEVOC Plume treatment system effluent is sampled and analyzed monthly for VOCs. During FYs 2021–2022, the maximum EEVOC Plume effluent carbon tetrachloride concentrations were 34 µg/L and 21 µg/L, respectively, both of which were greater than the 16-µg/L AWQC screening concentration. In FY 2023, the maximum carbon tetrachloride effluent concentration (5.8 µg/L) was below the AWQC screening concentration. To evaluate potential impacts in surface water in UEFPC, grab samples were collected at LRBP-1, the POC in the receiving stream downstream of the location where treated water is discharged to UEFPC. There were no exceedances of the 16-µg/L AWQC for carbon tetrachloride at LRBP-1 during FYs 2021–2023, with maximum concentrations of 1.4 µg/L in FY 2021, 1.3 µg/L in FY 2022, and 1.5 J µg/L in FY 2023.

Table 2.26. Estimated mass removals for key EEVOC Plume constituents since inception of treatment operations

FY	Carbon tetrachloride (kg)	PCE (kg)	Chloroform (kg)
2001	9.2	0.74	0.81
2002	7.7	0.81	0.39
2003	9.9	1.03	0.44
2004	7.4	0.83	0.27
2005	6.3	0.86	0.29
2006	6.7	0.86	0.34
2007	5.7	0.63	0.22
2008	7.2	1.1	0.37
2009	6.8	0.88	0.20
2010	4.9	0.68	0.21
2011	2.7	0.31	0.04
2012	5.5	0.73	0.22
2013	3.9	0.64	0.19
2014	5.1	0.72	0.23
2015	5.1	0.77	0.26
2016	7.5	1.5	0.83
2017	6.0	0.74	0.3
2018	6.6	0.95	0.4
2019	5.6	0.8	0.3
2020	5.6	0.74	0.23
2021	5.9	0.77	0.24
2022	5.0	0.76	0.29
2023	5.9	0.36	0.96
Totals	142	18.3	8.1

EEVOC = East End Volatile Organic Compound

FY = fiscal year

PCE = tetrachloroethene

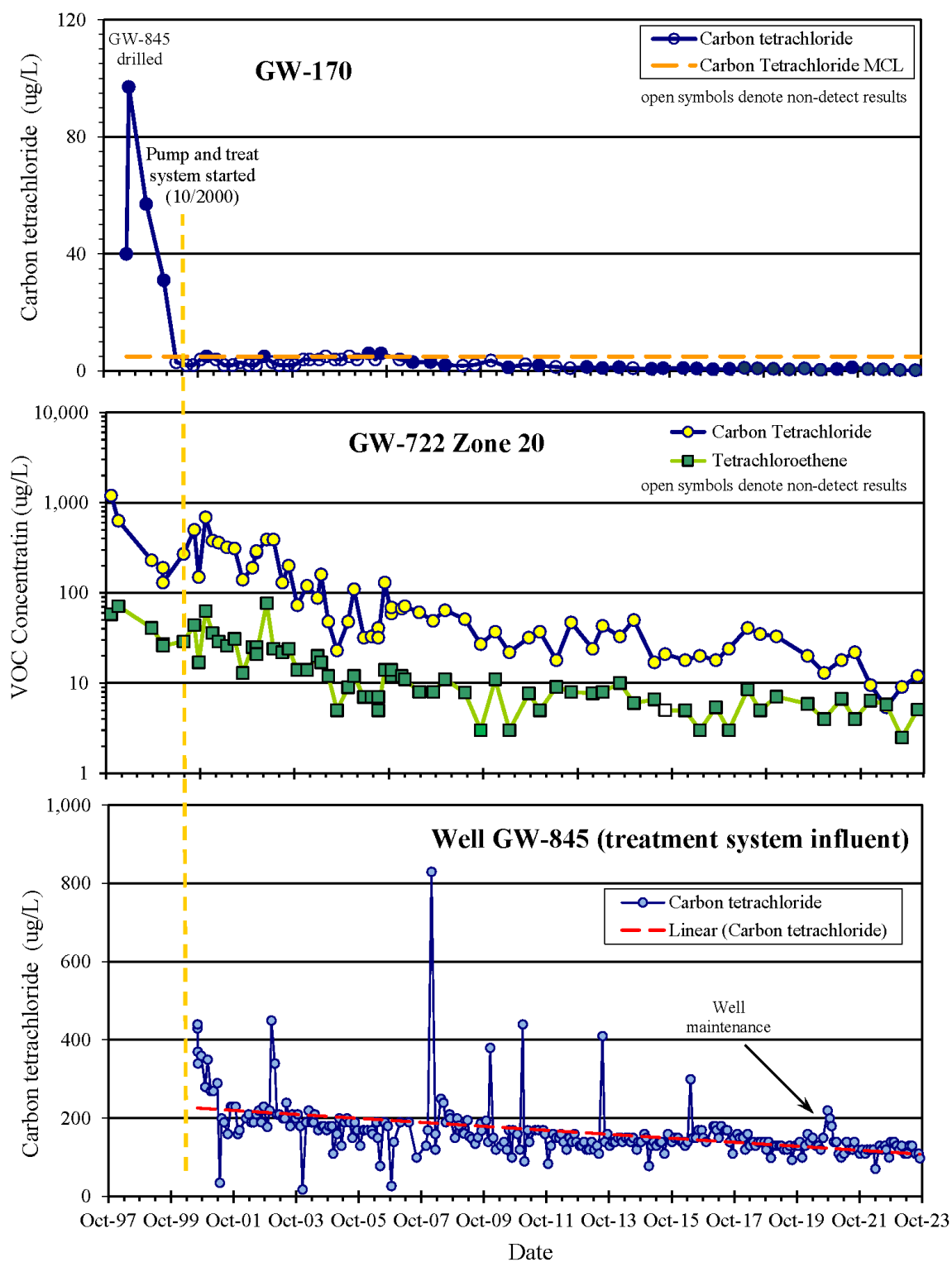


Figure 2.10. Selected VOC trends in the Maynardville Limestone exit pathway.

Table 2.27. Summary of Y-12 EEVOC Plume groundwater treatment system performance results, FYs 2021–2023

Analyte ^{a,b}	Units	Maximum detected influent result (GW-845)	Maximum detected effluent result
Carbon tetrachloride	µg/L	200	34
Chloroform	µg/L	11	5.9
1,1-DCA	µg/L	0.55 J	0.32 U
1,1,1-Trichloroethane	µg/L	1.8 U	0.39 UJ
cis-1,2-DCE	µg/L	4.3	2.5
trans-1,2-DCE	µg/L	2.1 U	0.42 U
PCE	µg/L	29	7.1
TCE	µg/L	4.1	1.7
Nitrate	mg/L	2.2	2.2
Total uranium	mg/L	0.0095	0.0097
U-234	pCi/L	6.3	6.8
U-235	pCi/L	0.32	0.36
U-238	pCi/L	4.2	4.3

^aAll volatile organic compounds detected are listed.

^bSystem design and remedy are targeted for volatile organic compounds, but nitrate and uranium were also detected.

DCA = dichloroethane

DCE = dichloroethene

EEVOC = East End Volatile Organic Compound

FY = fiscal year

J = analyte detected; concentration estimated

PCE = tetrachloroethene

TCE = trichloroethene

U = result is less than method reporting limits or minimum detectable activity

Y-12 = Y-12 National Security Complex

The EEVOC Plume AM acknowledged the potential for other contaminants to increase in the EEVOC Plume-collected groundwater over time as a result of the groundwater withdrawals. The EEVOC Plume AM recognized the possibility the treatment process could be modified to accommodate treatment of other contaminants, as warranted.

Maximum FY 2023 results of selected organic and radiological constituents in both influent and effluent samples are listed in Table 2.27. Reductions were observed for other signature VOCs detected in the influent stream, although removal efficiencies were lower than those observed for carbon tetrachloride.

2.4.4.2.2 Maynardville Limestone exit pathway monitoring

The EFPC and ChR RAR CMP specifies semiannual sampling of one downgradient well GW-722 (Ports 14, 17, 20, and 22) for VOCs. Well GW-722 is located approximately 180 m (600 ft) downgradient of the extraction well (Figure 2.8).

In addition, the EEVOC INF station has a valved sample port that allows collection of water before treatment to represent groundwater concentrations from well GW-845 completed in the Maynardville Limestone exit pathway (Figure 2.8). Data obtained to date indicate carbon tetrachloride concentrations in the pumping well have gradually decreased throughout the operating history, and the average concentration for FY 2023 was 122 µg/L. Likewise, chloroform concentrations have stabilized at less than 10 µg/L (see Section 2.4.4.2.1).

Signature VOCs within the intermediate and deep intervals of the Maynardville Limestone directly downgradient of the pumping well also decreased significantly relative to baseline data. This pathway is monitored via well GW-722 (Port 14 at 425 ft bgs, Port 17 at 385 ft bgs, Port 20 at 333 ft bgs, and Port 22 at 313 ft bgs). The ports discussed here contain the highest concentrations of contaminants. Sample Port 20 has historically shown some of the highest and most consistent VOC results; therefore, data from this sampling point are used to best illustrate carbon tetrachloride trends over time (Figure 2.10).

Since operation of the extraction system, carbon tetrachloride concentrations have decreased from the 200- to 1000- $\mu\text{g/L}$ range to the FY 2023 average of 122 $\mu\text{g/L}$. Overall, since system operations began, concentrations of PCE have decreased by a factor of about 10, and similar trends have been noted for TCE and DCE. The other sampling zones in well GW-722 show similar decreases in VOC concentrations.

Other ports in well GW-722 are sampled by the Y-12 Groundwater Protection Program. Monitoring of the other GW-722 ports since the pump and treatment operation started confirms carbon tetrachloride, PCE, and TCE are generally not detected or are occurring at concentrations below MCLs.

2.4.4.2.3 Union Valley groundwater monitoring

The EFPC and ChR RAR CMP specifies semiannual sampling for VOCs of two downgradient wells in Union Valley—wells GW-169 and GW-170 located about 730 m (2400 ft) east of the extraction well along geologic strike in Union Valley (Figure 2.8).

In Union Valley, east of Scarboro Road (Figure 2.8), signature VOCs (carbon tetrachloride, chloroform, PCE, and TCE) have historically been detected in well GW-169 (water table interval) and well GW-170 (intermediate interval; 120 ft bgs). Well GW-170 has historically had the highest levels of carbon tetrachloride and chloroform, with highly variable concentrations, but with an overall decline since 1994 (Figure 2.10). Since the system became fully operational in 2000, carbon tetrachloride concentrations have stabilized at about 5 $\mu\text{g/L}$ or less, and since 2007, concentrations have further decreased to levels below 2 $\mu\text{g/L}$, with some non-detection results. A sharp decrease of carbon tetrachloride concentrations occurred in well GW-170 prior to EEVOC Plume treatment system startup in October 2000, which correlated to an increase in pH. The available data suggest water quality in the Union Valley area west of Illinois Avenue may have been affected by large-scale construction activities near Scarboro Road, resulting in elevated pH conditions and increased surface water dilution in the shallow and intermediate zones of the Maynardville Limestone in this area. Signature VOCs observed in well GW-169 have remained consistently low over time, at between 1 $\mu\text{g/L}$ and 4 $\mu\text{g/L}$.

2.4.4.3 Site inspections

As part of this FY 2024 FYR, a site interview was conducted on August 21, 2023, and a site visit of the UEFPC EEVOC facility was conducted on September 17, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and watershed monitoring information required in the EFPC and ChR RAR CMP. See Section 1.5.1.2 and Appendix A for details of the 2024 FYR site interviews and visits.

2.4.4.4 LUC verification and certification and engineered remedy verification

2.4.4.4.1 LUCs

No LUC requirements were specified in the decision documents for this site. The site is on DOE-controlled property. The bar gate on the access road from the east is open during normal business hours. The building and site are well marked and well maintained. By the very nature of its location on DOE property, the EEVOC facility is subject to the Y-12 EPP program, strict access controls, and surveillance patrols.

2.4.4.4.2 Engineered remedy

O&M parameters, such as influent/effluent concentrations, system uptime versus downtime, unusual occurrences, average pumping rates, and total volume treated, are recorded, and system performance is evaluated annually. The cartridge filters are changed out as fine particles and grit collect on filter media. The air stripper trays are removed and cleaned as scale builds up on the surface. The scale is removed to prevent plugging of holes in the trays resulting in reduced stripper efficiency.

During the 2024 FYR Site Interview, the only reoccurring problem noted is calcium scale buildup in the stripper pump, stripper tray, and piping. In summary, calcium scale buildup in the underground discharge line kept limiting the flow through the piping, thus necessitating replacement of the piping, equipment, and associated lines. After replacement of the underground discharge line, scale buildup was still occurring; therefore, the underground discharge line was replaced with a discharge swale that directed the effluent directly to the receiving ditch. Additionally, the stripper units were replaced to maintain reliability of the system.

The above changes were made on the following dates:

- **10/27/21:** Replace A Side air stripper and associated piping and equipment.
- **06/08/22:** Replace B Side air stripper and associated piping and equipment.
- **07/12/22:** Repair damaged underground discharge line.
- **10/04/22:** Repair underground discharge line.
- **03/23:** Replace the underground piping with a discharge swale to catch and direct the effluent to the receiving ditch.

It was noted during the 2024 FYR Site Interview that the system is still operated by the original central processing unit (CPU); however, a complete backup of the CPU and the input and output modules is available. The CPU is preprogrammed with the ladder logic. Additionally, some of the hand valves are hard to manipulate, but they are easily replaced, if needed.

System maintenance includes daily operations inspections. Heat tracing is inspected every 6 months to prevent frozen piping. System filters are changed approximately every 6 weeks, and the system is fitted with an alarm system to indicate when changeout is required. The system is also fitted with an automated low-flow alarm set to provide early indications of filtration system clogging prior to the filter changeout alarm. Inspections and maintenance activities are tracked in LUM.

2.4.4.5 Costs

Overall CERCLA program-level O&M and S&M costs are discussed in Section 1.5.4. During the site interview, the EEVOC Plume operations team estimated the approximate annual O&M costs for EEVOC from 2021–2023 were \$306,283 per year. This is in line with the average annual costs for the previous 5 years, as reported in the 2021 FYR (\$305,600). No unanticipated operating costs were associated with the system. Costs were in line with forecasts.

2.4.5 Technical Assessment

A summary of the FY 2024 FYR for the EEVOC Plume action is provided in Table 2.28.

Table 2.28. FYR summary for Y-12 EEVOC Plume RmA

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	Yes	This action is complete. No numeric performance standards for groundwater are specified by the action. The performance goal of the treatment system discharge measured at the downstream POC (LRBP-1) is to meet recreational (for organisms only) AWQC (16 µg/L carbon tetrachloride). No AWQC exceedances were measured for carbon tetrachloride or the other signature VOCs in regular samples from the EEVOC effluent at the POC during FYs 2021–2023
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	Groundwater use remains restricted within Y-12 and in Union Valley. The groundwater use restriction was included in the EFPC and ChR RAR CMP, approved in February 2023. No new data have been acquired that would call into question protectiveness of the remedy
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	NA	No site-specific LUCs were stipulated in the decision documents
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	No additional actions are specified by the remedy. A final remedy for groundwater and surface water in UEFPC is planned as a future final ROD decision
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	Yes	Operations are being implemented and maintained per the Washington Safety Management Solutions Operation Manuals: Y50-41-WT-13.01, and Y57-41-EEVOC-CP2133-5
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	No	The chemical-specific ARARs (e.g., treatment system effluent discharge requirements) include a requirement to meet AWQC. Recreational organisms-only AWQC for the COC, carbon tetrachloride, changed from 44 µg/L to 16 µg/L in 2004. There have been no changes to this AWQC since that time. There have been no substantive changes to the other ARARs and TBC criteria cited in the EEVOC Plume AM
Have there been any changes in land use or expected land use on or near the site?	No	The EEVOC site is in the unrestricted industrial use area in the easternmost portion of the Y-12 Plant (Figure 2.1) and is within the DOE 229 Boundary. Land use in the western and central Y-12 Plant area in UEFPC remains government-controlled industrial. Groundwater use restrictions at Y-12 and in Union Valley remain in place. Construction in Union Valley within the performance footprint of the action has included several new office buildings.
Have new human health or ecological exposure pathways or receptors been identified?	Yes	The 2011 VI modeling of the EEVOC Plume was updated in 2024, indicating there are no new complete pathways (Appendix B)

Table 2.28. FYR summary for Y-12 EEVOC Plume RmA (cont.)

Question	Response	Note
Have new contaminants or contaminant sources been identified?	No	Contaminants present in off-site groundwater and in EEVOC Plume treatment system influent have decreased in concentration over time, and no new contaminants have been identified in these areas
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	No	Water is treated and discharged to UEFPC, meeting AWQC performance criteria
Have there been any changes in the physical site conditions?	Yes	A new Visitor Center opened within the eastern Y-12 area in 2007. This facility (New Hope Center) was constructed with a vapor barrier, as this is germane to the VI concern expressed by EPA. Construction in Union Valley within the performance footprint of the action has included several new office buildings. Land use remains as government-controlled industrial within the DOE 229 Boundary
Have there been any changes in the toxicity factors for COCs?	NA	Risk-based performance standards are not specified in the AM
Were there significant changes in the standardized risk assessment methodologies?	NA	Risk-based performance standards are not specified in the AM

C. Has any other information come to light that could call into question the protectiveness of the remedy?

Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	Yes	No ecological RAOs were identified in the remedy. Signature VOCs observed in well GW-169 (a water table well located upgradient of Scarboro Creek) have remained consistently low over time, at between 1 µg/L and 4 µg/L.
Is the site located in an area subject to natural disasters?	Yes	Portions of the east end of Y-12 are within the UEFPC 100-year floodplain. There is a low probability of tornados and earthquakes in the region

AM = Action Memorandum
 ARAR = applicable or relevant and appropriate requirement
 AWQC = ambient water quality criteria
 ChR = Chestnut Ridge
 CMP = Comprehensive Monitoring Plan
 COC = contaminant of concern
 DOE = U.S. Department of Energy
 EEVOC = East End Volatile Organic Compound
 EFPC = East Fork Poplar Creek
 EPA = U.S. Environmental Protection Agency
 FY = fiscal year
 FYR = Five-Year Review
 LRBP = Lake Reality Bypass

LUC = land use control
 NA = not applicable
 POC = point of compliance
 RAO = remedial action objective
 RAR = Remedial Action Report
 RmA = removal action
 ROD = Record of Decision
 TBC = to be considered
 UEFPC = Upper East Fork Poplar Creek
 VI = vapor intrusion
 VOC = volatile organic compound
 Y-12 = Y-12 National Security Complex

2.4.5.1 Question A: Is the remedy functioning as intended by the decision documents?

During the FYs 2021–2023 FYR period, one EEVOC effluent sample had a carbon tetrachloride concentration of 34 µg/L that was greater than the 16-µg/L AWQC screening concentration. To evaluate potential impacts in surface water in UEFPC, grab samples are collected at LRBP-1, the POC in the receiving stream downstream of the location where treated water is discharged to UEFPC. There were no exceedances of the 16-µg/L AWQC screening concentration for carbon tetrachloride at the POC during the FYs 2021–2023 FYR period, with maximum concentrations of 1.4 µg/L in FY 2021, 1.3 µg/L in FY 2022,

and 1.5 J µg/L in FY 2023. Removal efficiency for carbon tetrachloride ranged from about 95% to > 99% and averaged about 99% in FY 2023.

2.4.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2) and Appendix B (Section B.2), a FYR process was used to determine if the key chemical-specific ARAR and risk-assessment assumptions used at the time of the EEVOC Plume AM have changed significantly enough to affect protectiveness. This analysis is included in Appendix B and summarized below.

2.4.5.2.1 ARARs

The AWQC (organism only) standard for carbon tetrachloride to be maintained downstream of the treatment unit discharge point was updated in 2004 from 44 µg/L to 16 µg/L. The standard remains the same for the current FYR.

2.4.5.2.2 Risk

Risk-based performance standards are not specified in the EEVOC Plume AM. EPA published draft guidance for evaluating the VI-to-indoor air pathway (EPA 2002) after the EEVOC Plume AM was approved. In 2015, EPA published the *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (EPA 2015), along with an online tool for calculating VISLs (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>). It is unlikely the soil vapor pathway is complete in the EEVOC Plume area. However, comparison to the most-current VISLs was performed for this 2024 FYR to confirm this. Although it is likely future building construction would be designed to reduce the intrusion of vapors from the surrounding soils, to provide a level of conservatism in the evaluation, these protective design measures are assumed to not be implemented. Measured groundwater concentrations are below commercial/industrial VISLs (at a target risk of 1E-06 or an HI of 0.1), indicating VI is not a potentially complete pathway for the current and anticipated future commercial/industrial land use. Groundwater monitoring will continue at the EEVOC Plume to evaluate contaminant trends and effectiveness of the plume containment action. DOE will consider the potential presence of VOCs in soil in future site development plans in the plume-affected areas. No VOCs detected in off-site wells exceed their respective commercial screening level; therefore, the remedy is protective of off-site workers.

2.4.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No ecological RAOs were identified in the remedy. Ecological risks were addressed in the UEFPC RI, which included ecological exposures to spring discharges. Ecological receptors will be addressed under a future ROD. Portions of the east end of Y-12 are within the UEFPC 100-year floodplain. There is a low probability of tornados and earthquakes in the region. As described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability.

2.4.6 Issues/Recommendations

There were no issues or recommendations identified with the EEVOC Plume action during this 2024 FYR.

2.4.6.1 Other findings

There were no additional findings identified in this 2024 FYR for the EEVOC Plume RmA.

2.4.7 Protectiveness Statement

The RmA implemented for the EEVOC Plume is protective of human health and the environment. This RmA consists of an operating water treatment system to remove VOCs. Treated water is discharged downstream from the EEVOC Plume treatment system into EFPC at the POC. There have been no performance goal exceedances at the POC since it was established in FY 2011. Remedy components are in place to ensure integrity of the treatment system is maintained to remain effective and protective. UEFPC LUCs are in place to prevent human exposure.

Additional actions, as necessary, will be addressed under a final UEFPC ROD (FFA Appendix J date 2034; RAR 2035).

2.4.8 Next Review

The next (seventh) FYR of the EEVOC Plume action will be due August 2029.

2.5 REFERENCES

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3. Y-12 NATIONAL SECURITY COMPLEX – CHESTNUT RIDGE

ChR is located south of Y-12 on the ORR (Figure 3.1) and is not physically situated within one of the five established watersheds. All completed remedies along ChR have been single-project decisions to address known or potential sources of releases. A future ROD will address any remaining legacy operations as well as groundwater, surface water, and ecological concerns (FFA Appendix J date 2036; ROD 2038; RAR 2041). Based on CERCLA requirements for performing FYRs and agreements with the regulators, the following three actions are included in this review (Table 3.1):

- UNC ROD (DOE 1991)
- KHQ ROD (DOE/OR/02-1398&D2)
- FCAP ROD (DOE/OR/02-1410&D3)

3.1 UNITED NUCLEAR CORPORATION DISPOSAL SITE

UNC ROD Declaration: DOE 1991: 06/28/91
UNC Post-Construction Report (PCR): DOE/OR/01-1128&D1: 09/06/94

Decision document: *Record of Decision, United Nuclear Corporation Disposal Site Declaration, Y-12 Plant, Oak Ridge, Tennessee*

EPA SEMS OU: 01 – Y-12, CR OU 3 (UNC LF)

3.1.1 Introduction

3.1.1.1 Site chronology and background

Following shutdown of uranium-recovery operations in 1980, UNC decontaminated its Wood River Junction Rhode Island facilities, excavated contaminated soil and sludge from associated ponds and trenches, and removed low-level radioactive waste. Material was transported to Y-12 for disposal between June 1982 and November 1984 and included some 11,000 55-gal drums of cement-fixed sludge; 18,000 drums of contaminated soil; and 288 wooden boxes of contaminated building and process equipment demolition debris. In addition, between October 1991 and January 1992, about 7000 yd³ of radioactively contaminated soil and concrete were disposed of at the UNC Disposal Site. This material was excavated as part of the Elza Gate Site remediation under DOE's Formerly Utilized Sites RA Program. Material in the landfill is classified as nonhazardous waste, as defined by RCRA. A chronology of events associated with the UNC Disposal Site is provided in Table 3.2.

Key documents reviewed for this FYR include:

- UNC ROD.
- *Feasibility Study for the United Nuclear Corporation Disposal Site at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (ES/ER-15&D2; UNC FS).
- *Post-Construction Report for the United Nuclear Corporation Disposal Site at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1128&D1; UNC PCR).
- 2021 FYR (DOE/OR/01-2895&D2); specifically, Chapter 7, "ChR."
- 2022 RER (DOE/OR/01-2916&D2); specifically, Chapter 6, "ChR."
- 2023 RER (DOE/OR/01-2938&D2); specifically, Chapter 6, "ChR."
- 2024 RER (DOE/OR/01-2960&D1); specifically, Chapter 6, "ChR."
- EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

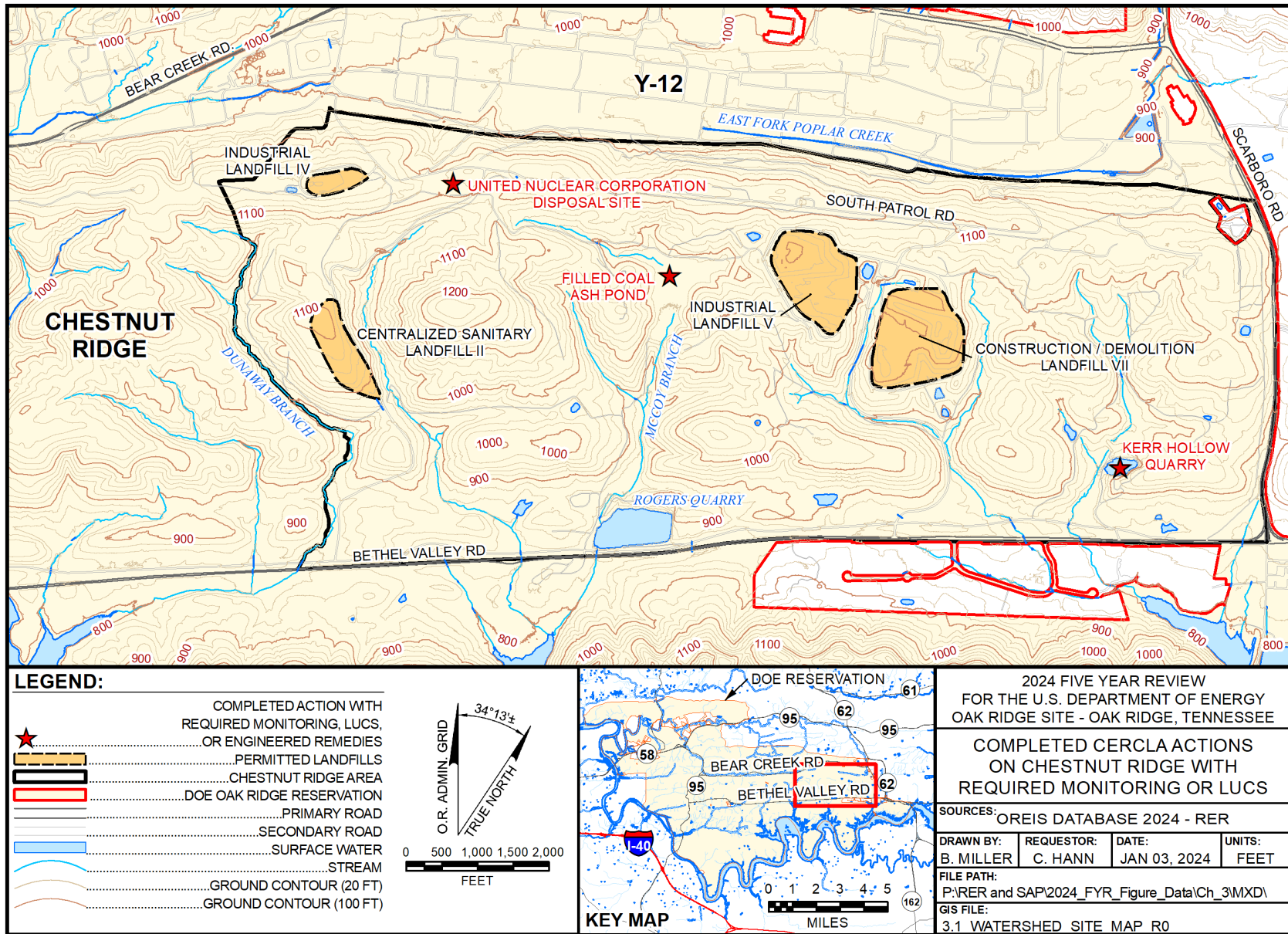


Figure 3.1. CERCLA actions and monitoring locations in ChR.

Table 3.1. CERCLA actions on ChR

CERCLA action	Decision document, date signed	Action/Document status
FYR actions		
UNC Disposal Site RA	ROD Declaration (DOE 1991): 06/28/91	UNC PCR (DOE/OR/01-1128&D1) approved: 09/06/94
KHQ RA	NFA ROD (DOE/OR/02-1398&D2) ^a : 09/29/95	RA completed under approved ChR RCRA PCP (TDEC 1996): June 1996 2006 ChR RCRA PCP Renewal (TDEC 2006): September 2006 ChR RCRA PCP termination and integration into CERCLA (TDEC 2018): February 2018
FCAP/Upper McCoy Branch RA	ROD (DOE/OR/02-1410&D3): 02/21/96	FCAP RAR (DOE/OR/01-1596&D1) approved: 06/03/97

^aThe CERCLA NFA *Record of Decision for Kerr Hollow Quarry at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/02-1398&D2) defers all monitoring and long-term stewardship/land use control requirements to the *RCRA Post-Closure Permit for the Chestnut Ridge Hydrogeologic Regime, TNHW-088, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (TDEC 1996; ChR RCRA PCP); subsequently applicable substantive requirements under the ChR RCRA PCP for post-closure care, monitoring, and reporting were integrated into the CERCLA process in February 2018 (TDEC 2018).

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

ChR = Chestnut Ridge

FCAP = Filled Coal Ash Pond

FYR = Five-Year Review

KHQ = Kerr Hollow Quarry

NFA = no further action

PCP = post-closure permit

PCR = Post-Construction Report

RA = remedial action

RAR = Remedial Action Report

RCRA = Resource Conservation and Recovery Act of 1976

ROD = Record of Decision

UNC = United Nuclear Corporation

Table 3.2. Chronology of events associated with UNC Disposal Site

Event	Date
Following shutdown of uranium-recovery operations, UNC decontaminated its Rhode Island facilities, excavated contaminated soil and sludge from associated ponds and trenches, and removed low-level radioactive waste	1980
Material was transported to Y-12 for disposal and included some 11,000 55-gal drums of cement-fixed sludge; 18,000 drums of contaminated soil; and 288 wooden boxes of contaminated building and process equipment demolition debris	June 1982–November 1984
The UNC FS (ES/ER-15&D2) was approved	April 1991
The UNC ROD (DOE 1991) was approved	June 1991
Approximately 5350 m ³ (7000 yd ³) of additional radioactively contaminated soil and concrete from the Elza Gate Site under DOE's Formerly Utilized Sites RA Program were disposed of at the UNC Disposal Site	October 1991–January 1992
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
RA field activities began for construction of a multilayer cover system and access controls	May 1992
Field activities were completed. Remediation included a multilayer cover system and access controls	August 1992
The UNC PCR (DOE/OR/01-1128&D1) was approved and specified implementation of a groundwater monitoring program	September 1994
The UNC Disposal Site was included in the initial 2001 FYR (DOE/OR/01-1941&D2/R1)	2001
The UNC Disposal Site was included in the second 2006 FYR (DOE/OR/01-2289&D3)	2006
The UNC Disposal Site was included in the third 2011 FYR (DOE/OR/01-2516&D2)	2011

Table 3.2. Chronology of events associated with UNC Disposal Site (cont.)

Event	Date
The UNC Disposal Site was included in the fourth 2016 FYR (DOE/OR/01-2718&D2)	2016
The UNC Disposal Site was included in the fifth 2021 FYR (DOE/OR/01-2895&D2)	2021
An engineering assessment and evaluation was completed for the UNC Disposal Site	July 2022

DOE = U.S. Department of Energy
EPA = U.S. Environmental Protection Agency
FFA = Federal Facility Agreement
FS = feasibility study
FYR = Five-Year Review
PCR = Post-Construction Report

RA = remedial action
ROD = Record of Decision
TDEC = Tennessee Department of Environment and Conservation
UNC = United Nuclear Corporation
Y-12 = Y-12 National Security Complex

3.1.1.2 Physical characterization

The UNC Disposal Site is a 1.3-acre landfill located near the crest of ChR, south of Y-12 (Figures 3.1 and 3.2). The site is currently a gently sloped, open, grass-covered area. The majority of the cap slopes to the south-southwest. Drainage controls consist of a rip-rap-lined ditch along South Patrol Road at the northern boundary of the site, and a drainage swale oriented east-west that directs storm runoff from the cap west toward the drainage ditch noted above.

3.1.1.3 Land and resource use

The entire ChR area comprises active industrial land use and includes SWMUs—industrial and construction landfills and sewage sludge application areas. The UNC Disposal Site is a SWMU within the ChR administrative watershed.

3.1.2 Response Action Summary

3.1.2.1 Basis for taking action

Risks to an individual consuming groundwater contaminated with nitrates and Sr-90 were evaluated in the UNC FS and the *Proposed Plan for the United Nuclear Corporation Disposal Site at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (ES/ER-16&D2). The estimated HQ for nitrate was 3.4 and the ILCR was 8.3E-05. The major goal of the RA, per the UNC ROD, is to “ensure that mobile contaminants in the UNC Disposal Site waste, principally nitrate and Sr-90, are not leached to groundwater at a rate that would result in concentrations of these contaminants above safe drinking water standards.” As a result, the COCs for the UNC Disposal Site are nitrate and Sr-90.

3.1.2.2 Response actions

The remedy selected in the UNC ROD was to construct a multilayer cap to limit percolation of rainwater into the waste and prevent contaminants buried at the site from leaching into groundwater. The remedy also included monitoring existing groundwater wells and S&M inspections. The UNC ROD stated the expected performance of the remedy is to control contaminant migration so that nitrate is less than the MCL limit of 10 mg/L and Sr-90 is less than the MCL-derived concentration (MCL-DC) limit of 8 pCi/L. The UNC PCR specifies implementation of a groundwater monitoring program. Although specific frequencies, locations, and analytes are not mandated by the UNC PCR, groundwater is monitored per the EFPC and ChR RAR CMP for COCs (nitrate and Sr-90) on which performance assessment is based.

3.1.2.3 Status of implementation

The UNC ROD was approved in June 1991. Field activities began in May 1992 and were completed in August 1992. Remedial activities included constructing a multilayer cover system and implementing a groundwater monitoring program using existing wells.

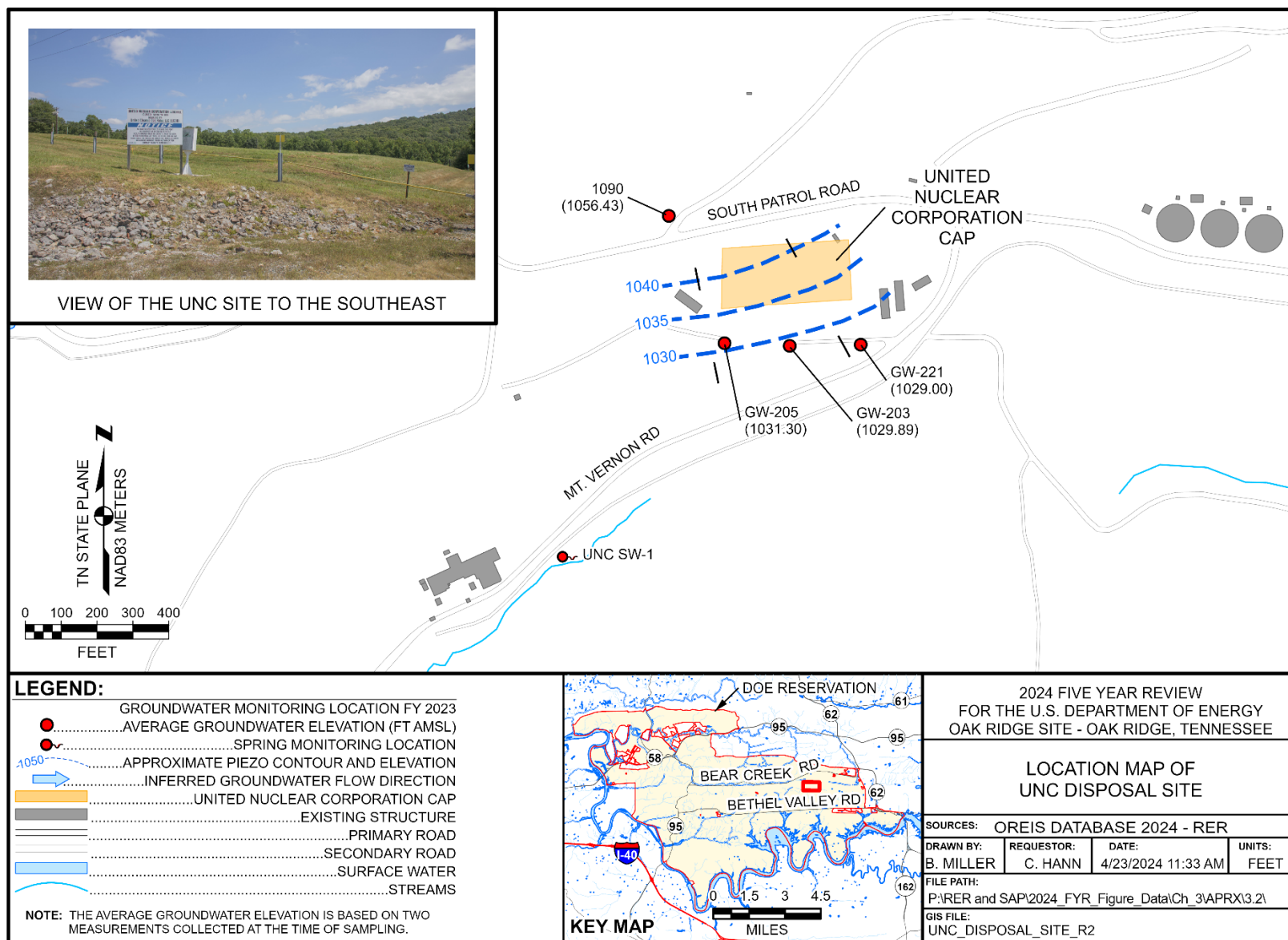


Figure 3.2. UNC Disposal Site map and monitoring locations.

3.1.2.4 LUC requirements

There are no LUC requirements specified in the decision documents for the UNC Disposal Site; however, the location of the UNC Disposal Site within the administratively controlled Y-12 industrial complex requires the posting of signs, surveillance patrols, and work controls to eliminate non-official access to and incompatible uses of the site. S&M inspections are conducted for the UNC Disposal Site.

3.1.2.5 Engineered remedies

Engineered remedy requirements for the UNC Disposal Site are listed in Table 3.3. The UNC PCR requires surveillance activities continue for 30 years from RA completion to ensure the cap is adequately containing the waste at the site. UNC Disposal Site RA construction was completed in August 1992. Specific requirements include a visual inspection of the cap to be conducted quarterly for the first 2 years after construction and at least semiannually thereafter. If necessary, restorative measures are implemented. Minor deficiencies, such as damaged drains or signs, are noted on the inspection forms and corrected. However, major deficiencies, such as collapse of the cap or major erosion problems, will be reported. Required routine maintenance of the site includes mowing and replacing any topsoil and vegetation, as required. Verification of remedy integrity is discussed in Section 3.1.4.4.

Table 3.3. Engineered remedy summary for UNC Disposal Site

Affected area/ type of remedy	Purpose	Implementation	Verification frequency
UNC Disposal Site – capping	Isolate contaminant sources from surrounding soils and groundwater	O&M by DOE	Verify purpose and O&M annually

DOE = U.S. Department of Energy

O&M = operation and maintenance

UNC = United Nuclear Corporation

3.1.3 Progress Since Last Five-Year Review

The 2021 FYR concluded:

The remedy implemented at the UNC Disposal Site (containment) is protective of human health and the environment. Protectiveness is achieved through a multilayer cap. Remedy components are in place to ensure the integrity of the multilayer caps is being maintained and to remain effective and protective. Although not specified in the UNC ROD, access controls (signs, fencing, and security patrols) and EPP controls are in place. The UNC Disposal Site is located entirely within a DOE-controlled boundary designated pursuant to Section 229 of the AEA. Within the boundary, public access is restricted and security patrols are maintained.

Additional actions (i.e., groundwater) will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

No issues were identified during the 2021 FYR.

3.1.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 3.1.1.1.
- Reviewed effectiveness and performance monitoring data and evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M inspections and maintenance information.

- Changes in land use.
- Surface water and groundwater monitoring data.
- Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data and engineered remedy requirements as specified in the associated decision documents.

3.1.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this FYR.

3.1.4.2 Data review

Groundwater and spring monitoring are conducted on a semiannual basis at the UNC Disposal Site. Although specific analytes are not mandated by the UNC PCR, groundwater is monitored for COCs on which performance assessment is based (nitrate and Sr-90). Current monitoring includes the following: one upgradient groundwater well (1090), three downgradient wells (GW-221, GW-203, and GW-205), and one downgradient spring location (UNC SW-1); see Figure 3.2. Analyses include Sr-90, gross alpha, gross beta, metals, alkalinity, chloride, fluoride, sulfate, and nitrate. FYs 2021–2023 data for nitrate, gross alpha and beta activity, and Sr-90 analyses for all wells and the downgradient spring location are provided in Table 3.4. Additional isotopic analyses (K-40) were conducted on samples collected from wells GW-205 and UNC SW-1.

In FYs 2021–2023, nitrate concentrations in wells downgradient of the site have remained well below the 10-mg/L MCL. The maximum measured nitrate concentration was 2.5 mg/L between FYs 2021–2023.

Table 3.5 provides the detection summary for Sr-90 results for the monitoring locations at the UNC Disposal Site from February 1999 to September 2023. Strontium-90 has been detected sporadically at low concentrations in groundwater adjacent to the UNC Disposal Site. The FY 2006 17.8 pCi/L result from well GW-205 exceeded the MCL-DC of 8 pCi/L but was below the UNC Disposal Site FS estimate of a maximum groundwater Sr-90 concentration of 50 pCi/L. The 2006 exceedance is the only result of 50 analyses for Sr-90 at well GW-205 that exceeded the MCL-DC. The most recent detection of Sr-90 at well GW-205 occurred in 2012. The sporadic history of Sr-90 detection in well GW-205 and the singular instance of a criterion exceedance do not justify additional subsurface investigation. Between FYs 2021–2023, Sr-90 was detected in six samples collected from three of the site sample locations, including well 1090 (one sample) and well GW-203 (two samples), and in three surface water samples collected at UNC-SW1. The maximum measured concentration was 0.89 pCi/L, measured in surface water at the UNC-SW1 location in February 2022.

Table 3.4. Analytical results for performance indicator constituents at UNC Disposal Site, FYs 2021–2023

Date	Upgradient well	Downgradient well		Downgradient spring	
	1090	GW-203	GW-205	GW-221	UNC SW-1
Conductivity (µmhos/cm)					
Q2-FY21	405	194	203.5	241.3	80
Q4-FY21	438	233	280	277	136.1
Q2-FY22	431	227	263	240	74.3
Q4-FY22	447	239	328	249	169.4
Q2-FY23	367	222	263	213	79.2
Q4-FY23	419	284	379.7	333	100.9
pH (units)					
Q2-FY21	7.04	7.64	8.8	7.55	7.24
Q4-FY21	7.63	7.79	8.27	7.6	6.71
Q2-FY22	6.92	7.63	9.73	7.49	6.69
Q4-FY22	7.51	8.0	10.56	7.99	6.48
Q2-FY23	7.18	7.72	10.25	7.69	6.42
Q4-FY23	7.08	7.71	9.8	7.25	6.82
Nitrate (mg/L)					
Q2-FY21	2.5	0.82	0.27	0.73	0.14
Q4-FY21	1.1	0.95	0.33	0.78	0.63
Q2-FY22	1.0	0.70	0.019 UJ	0.67	0.23
Q4-FY22	1.1	0.97	0.08	0.98	0.50
Q2-FY23	0.89 J	0.68	0.17 J	0.66	0.57
Q4-FY23	1.0	0.91	0.40	0.86	0.31
Gross alpha (pCi/L)					
Q2-FY21	1.94 J	0.23 U	0.75 UJ	0.726 U	-0.132 U
Q4-FY21	-0.77 U	-0.27 U	1.8	0.5 U	7.9
Q2-FY22	1.1 U	0.039 U	0.62 U	1.2	0.28 U
Q4-FY22	1.9 U	1.6 U	0.96 U	1.0 U	2.5
Q2-FY23	0.51 U	1.3 U	0.35 U	0.57 U	1.7
Q4-FY23	1.8 U	0.48 U	1.0	0.53 U	2.2
Gross beta (pCi/L)					
Q2-FY21	1.18 U	1.53 U	8.3 J	2.84 J	1.03 U
Q4-FY21	1.2	0.92	7.3	0.89	3.8
Q2-FY22	1.6	0.99	51	1.9	0.92
Q4-FY22	1.9	1.3	48	1.3	2.2
Q2-FY23	0.47 U	0.79	41	1.2	1.6
Q4-FY23	1.4	0.63	17	0.93	3.4

Table 3.4. Analytical results for performance indicator constituents at UNC Disposal Site, FYs 2021–2023 (cont.)

Date	Upgradient well	Downgradient well		Downgradient spring	
	1090	GW-203	GW-205	GW-221	UNC SW-1
Sr-90 (pCi/L)					
Q2-FY21	-0.0801 U	0.127 U	0.0532 U	-0.224 U	0.151 U
Q4-FY21	0.26	0.21	-0.032 U	0.082 U	0.18
Q2-FY22	0.014 U	0.038 U	-0.072 U	0.082 U	0.89
Q4-FY22	-0.19 U	0.32	-0.13 U	0.16 U	0.51
Q2-FY23	-0.33 U	-0.22 U	0.22 U	-0.02 U	0.45 U
Q4-FY23	-0.0062 U	-0.0021 U	0.16 U	0.081 U	0.15 U

FY = fiscal year

GW = groundwater well

J = analyte detected; concentration estimated

Q2 = quarter 2

Q4 = quarter 4

SW = surface water

U = not detected

UJ = not detected at the estimated detection limit

UNC = United Nuclear Corporation

Table 3.5. UNC Disposal Site groundwater Sr-90 detection summary, February 1999–September 2023

Sample location	Number of results	Number of detections	Maximum concentration (pCi/L)	Date of maximum
1090	50	6	2.22 J	August 2000
GW-203	50	3	1.34 J	July 2006
GW-205	50	3	17.8	July 2006
GW-221	50	4	2.83	July 2006
UNC SW-1	18	5	0.89	February 2022

Bold indicates Sr-90 result exceeds the 8-pCi/L maximum contaminant level-derived concentration.

GW = groundwater well

SW = surface water

J = analyte detected; concentration estimated UNC = United Nuclear Corporation

Evaluation of groundwater monitoring data shows the primary goal of the action—preventing migration of mobile COCs (nitrate and Sr-90) to groundwater in excess of drinking water standards—has been achieved to date. This conclusion is consistent with results of previous CERCLA FYRs conducted in FYs 2001, 2006, 2011, 2016, and 2021.

3.1.4.3 Site inspections

As part of this 2024 FYR, a site manager interview was conducted on August 23, 2023, and a site visit of the UNC Disposal Site was conducted on October 18, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and monitoring information required in the UNC ROD. There were no deficiencies identified during the site visit. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

3.1.4.4 LUC verification and certification/engineered remedy verification

There are no LUCs specified for the UNC Disposal Site; however, the location of the UNC Disposal Site within the administratively controlled Y-12 industrial complex requires posting of signs, surveillance patrols, and work controls to eliminate non-official access to and incompatible uses of the site. In addition, S&M inspections are conducted for the UNC Disposal Site. Remedy components are in place to ensure the integrity of the multilayer caps is being maintained and they remain effective and protective for as long as necessary. The engineered remedy specified in Table 3.3 was verified for this 2024 FYR. Results are summarized in Table 3.6, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of the table identifies the specific table listing the requirements and the section providing detail of the verifications.

Table 3.6. Verification of engineered remedy integrity at UNC Disposal Site

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirement/status review
Engineered remedy	UNC Disposal Site	Implemented	See Table 3.3 and text below

UNC = United Nuclear Corporation

Over the last 3 years, the UNC Disposal Site underwent S&M on a regular schedule. Routine inspections of the UNC Disposal Site cap and monitoring wells are conducted semiannually by the DOE S&M Program, including inspecting for erosion or settlement of the cover, integrity of surface drainage, evidence of rodent damage, proper signage, and integrity of benchmarks and monitoring wells. The need for any maintenance is identified during the visual inspections and repair of the cap is conducted, as needed. S&M is conducted in accordance with the *Y-12 Remedial Action Long-Term Surveillance and Maintenance Program Facility Inspection and Training Manual for the Y-12 National Security Complex, Oak Ridge, Tennessee* (UCOR-4199; Y-12 Facility Inspection and Training [FIT] Manual). The LUM application documents S&M inspections.

The post-closure monitoring period (30 years) for the UNC Disposal Site was reached in August 2022. To gauge the integrity of the cap, an engineering assessment of the UNC Disposal Site was conducted and documented in the *Engineering Inspection and Evaluation of United Nuclear Corporation (UNC) Landfill, Chestnut Ridge, Y-12-Plant* (RPC-9Y1200-H967; UNC Engineering Evaluation). The UNC Engineering Evaluation is also included in Appendix E of this 2024 FYR. The evaluation assessed landfill settlement based on site observations; review of construction records, including type of waste located within the facility; review of the compacted clay; and literature review of the expected performance of the polyvinyl chloride (PVC) membrane used in the facility cap. To date, groundwater wells downgradient of the facility do not indicate any movement of any COCs from the facility to the monitoring locations. The assessment concluded the facility was judged acceptable at present and no detrimental trends were observed. However, as the life of the cap is dependent on acceptable levels of differential settlement, which is unpredictable due to the nature of buried drums, the following actions were recommended:

- Continue semiannual inspections of the cap, with an emphasis on surface erosion and differential settlement of the cap.
- Conduct a light detection and ranging (LiDAR) survey of the facility (along with other landfill facilities in the area) at a frequency of approximately 5 years to readily identify differential settlement that may be of concern.
- Conduct a complete reevaluation of the cap, including PVC membrane and integrity testing, in preparation of the future ChR ROD in 2038 (FFA Appendix J date).

Maintenance from FYs 2021–2023 included replacing and/or fixing signs around the site. Additionally, the UNC Disposal Site is located within the Y-12 Property Protection Area and, as such, is not accessible to the public and is under work controls by the nature of its location at Y-12 (e.g., EPP controls) that prevent subsurface intrusions into the site. The area is routinely patrolled by Y-12 security personnel to deter public access and help ensure protectiveness of the remedy. These stewardship activities exceed the requirements of the UNC ROD and the UNC PCR.

3.1.5 Technical Assessment

Table 3.7 summarizes the technical assessment performed for the UNC Disposal Site.

Table 3.7. FYR summary for UNC Disposal Site

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	Yes	COCs have not been detected in groundwater at concentrations above performance standards, with the exception of an exceedance of the Sr-90 MCL-DC in FY 2006
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	There has been no evidence of cap failure, subsidence, etc., during inspections to date. In addition, an engineering assessment and evaluation was conducted in 2022 that concluded the UNC Disposal Site was acceptable and that no detrimental trends were observed. Costs are consistent with forecasted costs for the project
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	NA	The site is in the Y-12 Property Protection Area; Y-12 signs and security patrols are in place. LUCs are not specified in the UNC ROD
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	No additional actions were specified
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There is no operating system in place under this remedy
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	No	Performance standards for nitrate and Sr-90 (i.e., MCL/MCL-DC) are unchanged from the time of the UNC ROD. No other ARARs were specified in the UNC ROD
Have there been any changes in land use or expected land use on or near the site?	No	The site remains under government control on DOE property. The site is within the Y-12 Property Protection Area, and there is no change in future land use anticipated
Have new human health or ecological exposure pathways or receptors been identified?	No	Based on systematic monitoring results, contamination has not reached groundwater
Have new contaminants or contaminant sources been identified?	No	Performance monitoring data do not indicate new COCs
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	NA	No chemical treatment remedies were employed
Have there been any changes in the physical site conditions?	No	The site remains within the Y-12 Property Protection Area

Table 3.7. FYR summary for UNC Disposal Site (cont.)

Question	Response	Note
Have there been any changes in the toxicity factors for COCs?	Yes	The UNC ROD performance standards (MCLs/MCL-DCs) have not changed. The toxicity factors for Sr-90 (oral and inhalation) have changed since the UNC ROD was approved, resulting in slightly higher risk than previously determined. However, the cap and Y-12 controls make associated exposure pathways incomplete
Were there significant changes in the standardized risk assessment methodologies?	No	See Section 3.1.5.2.2 and Appendix B
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	No	The ERA was not addressed by the UNC ROD. Ecological risk will be addressed in a final ROD for ChR
Is the site located in an area subject to natural disasters?	Yes	There is a low probability of earthquakes and tornadoes in the region
ARAR = applicable or relevant and appropriate requirement ChR = Chestnut Ridge COC = contaminant of concern DOE = U.S. Department of Energy ERA = ecological risk assessment FY = fiscal year FYR = Five-Year Review LUC = land use control		MCL = maximum contaminant level MCL-DC = maximum contaminant level-derived concentration NA = not applicable ROD = Record of Decision TBC = to be considered UNC = United Nuclear Corporation Y-12 = Y-12 National Security Complex

3.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Evaluation of groundwater monitoring data between FYs 2021–2023 shows the primary goal of the action—preventing migration of mobile COCs (nitrate and Sr-90) to groundwater in excess of drinking water standards—has been achieved. This conclusion is consistent with results of previous CERCLA FYRs.

Information from the interview with the S&M manager indicated all engineered remedy requirements are being met (Table 3.6). The cap appears to be well maintained with sufficient vegetative cover and no evidence of erosion was observed. Although not specified as LUCs, Y-12 signs and security controls are in place. No problems with the remedy or site-specific concerns were noted during the interview. No other changes in physical site conditions were observed.

The estimated annual O&M costs for Y-12 are presented in Section 1.5.4. O&M costs are consistent with forecasted costs for the project.

3.1.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2), a FYR process was used to determine if the key chemical-specific ARAR and risk-assessment assumptions used at the time of the UNC ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B (Section B.4) and summarized below.

3.1.5.2.1 ARARs

Performance standards are based on the MCL for nitrate and the MCL-DC for Sr-90, which are unchanged from the time of the UNC ROD. No other ARARs were specified in the UNC ROD.

3.1.5.2.2 Risk

The prescribed performance standard for nitrate and Sr-90 was not established based on the CERCLA risk range, but rather the MCL or MCL-DC; therefore, protectiveness of the remedy is not affected by the change in toxicity factors.

Noncancer toxicity values for nitrate have not changed since they were adopted in 1991. The toxicity values (i.e., CSF) for Sr-90 have changed slightly since the UNC ROD was approved. The cap and Y-12 controls make the exposure pathways incomplete; therefore, these changes have no impact to the risk originally estimated for this site. In FYs 2021–2023, nitrate and Sr-90 were detected at low concentrations in downgradient monitoring well samples and the downgradient surface water spring location (UNC SW-1); however, the change in the Sr-90 CSF has no impact on potential risk due to the low detected concentrations.

3.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has been identified that could call into question the protectiveness of the remedy. A future decision is planned to address soils at sites in ChR and to reduce the potential for future releases from remaining sources to exit pathways from ChR. This future decision will also include groundwater and ecological components. There is a low probability of earthquakes or tornadoes in the region. In 2022, the UNC Engineering Evaluation recommended semiannual inspections of the cap continue and a LIDAR survey be conducted at a frequency of approximately once every 5 years to help identify if there is any differential settlement and to provide an accurate measurement of cap subsidence, erosion, or other damage in the future. These recommendations would support the evaluation of cap erosion due to climate change. Additionally, as described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability.

3.1.6 Issues/Recommendations

There were no issues or recommendations identified in this 2024 FYR for the UNC Disposal Site.

3.1.6.1 Other findings

There were no additional findings identified in this 2024 FYR for the UNC Disposal Site.

3.1.7 Protectiveness Statement

The remedy implemented at the UNC Disposal Site (containment) is protective of human health and the environment. Protectiveness is achieved through a multilayer cap. Remedy components are in place to ensure the integrity of the multilayer caps is being maintained and to remain effective and protective. Although not specified in the UNC ROD, access controls (signs, fencing, and security patrols) and EPP controls are in place. The UNC Disposal Site is located entirely within a DOE-controlled boundary designated pursuant to Section 229 of the AEA. Within the boundary, public access is restricted and security patrols are maintained.

Additional actions (i.e., groundwater) will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

3.1.8 Next Review

The next (seventh) CERCLA FYR on the ORR will be due August 20, 2028.

3.2 KERR HOLLOW QUARRY REMEDIAL ACTION

KHQ ROD: DOE/OR/02-1398&D2: 09/29/95

ChR RCRA PCP: TNHW-088, June 1996 (TDEC 1996)

2006 ChR RCRA PCP Renewal: TNHW-128, September 2006 (TDEC 2006)

Decision document: *Record of Decision for Kerr Hollow Quarry at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*

EPA SEMS OU: 38 – Kerr Hollow Quarry

3.2.1 Introduction

The KHQ ROD presents the decision for NFA at the KHQ site. The RCRA closure of KHQ was to prevent physical exposure to contaminants within the quarry and to mitigate migration of contaminants to groundwater or surface water runoff. The RCRA closure was deemed protective of human health and the environment under CERCLA, resulting in the NFA decision. The NFA decision deferred all inspection/maintenance (including security), monitoring, and reporting requirements for KHQ to the *RCRA Post-Closure Permit for the Chestnut Ridge Hydrogeologic Regime, TNHW-088, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (TDEC 1996; ChR RCRA PCP) and the renewed *RCRA Post-Closure Permit for Chestnut Ridge Hydrogeologic Regime, TNHW-128, Y-12 National Security Complex, Oak Ridge, Tennessee* (TDEC 2006; 2006 ChR RCRA PCP Renewal). In February 2018, the substantive RCRA requirements for post-closure care, monitoring, and reporting for KHQ transitioned to CERCLA and were incorporated into the EFPC and ChR RAR CMP.

3.2.1.1 Site chronology and background

KHQ served as a source of stone construction material until it filled with water and was abandoned in the late 1940s. From 1951–1988, the quarry was used as a treatment site for water-reactive, corrosive, or ignitable wastes from Y-12 and ORNL. The site received containers of waste in various sizes, consisting mainly of gas cylinders, drums, and buckets, with the breached containers remaining in the quarry. RCRA closure action was initiated in 1991. Material was removed from beneath the water in the quarry between 1991–1993, and an NFA determination was approved for the KHQ ROD in 1995. KHQ was added to the ChR RCRA PCP (TDEC 1996 and updated in TDEC 2006). DOE requested from TDEC-Division of Solid Waste Management in May 2017 that re-application of the ChR RCRA PCP be denied and the applicable substantive requirements for post-closure care, monitoring, and reporting for KHQ be integrated into the CERCLA process (DOE 2017). TDEC-Division of Solid Waste Management granted the request in February 2018 (TDEC 2018). Table 3.8 provides a chronology of CERCLA activities related to KHQ.

Table 3.8. Chronology of events associated with KHQ

Event	Date
The quarry was used as a treatment site for water-reactive, corrosive, or ignitable wastes from Y-12 and ORNL. The site received containers of waste in various sizes, consisting mainly of gas cylinders, drums, and buckets, with the breached containers remaining in the quarry	1951–1988
RCRA closure actions were initiated. Containers and materials at the bottom of the quarry were removed, shredded, evaluated by health physics personnel, and placed in B-25 boxes	1991–1993
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
The KHQ ROD (DOE/OR/02-1398&D2) was approved with NFA	1995
The ChR RCRA PCP (TDEC 1996) stipulated post-closure requirements	06/11/96
KHQ was included in the initial 2001 FYR (DOE/OR/01-1941&D2/R1)	2001
The 2006 ChR RCRA PCP Renewal (TDEC 2006) was approved	2006
KHQ was included in the second 2006 FYR (DOE/OR/01-2289&D3)	2006
KHQ was included in the third 2011 FYR (DOE/OR/01-2516&D2)	2011
The ChR RCRA PCP re-application was submitted, ending RCRA groundwater monitoring at KHQ; however, this re-application was later denied in 2018	March 2016
KHQ was included in the fourth 2016 FYR (DOE/OR/01-2718&D2)	2016
Denial was requested for re-application of the ChR RCRA PCP, with substantive requirements to be integrated under CERCLA (DOE 2017)	May 2017
TDEC-Division of Solid Waste Management granted request of termination of the ChR RCRA PCP, and applicable substantive requirements for post-closure care, monitoring, and reporting were integrated into the CERCLA process (TDEC 2018)	February 2018
KHQ was included in the fifth 2021 FYR (DOE/OR/01-2895&D2)	2021

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

ChR = Chestnut Ridge

DOE = U.S. Department of Energy

EPA = U.S. Environmental Protection Agency

FFA = Federal Facility Agreement

FYR = Five-Year Review

KHQ = Kerr Hollow Quarry

NFA = no further action

ORNL = Oak Ridge National Laboratory

PCP = post-closure permit

RCRA = Resource Conservation and Recovery Act

TDEC = Tennessee Department of Environment and Conservation

Y-12 = Y-12 National Security Complex

Key documents reviewed for this FYR include:

- KHQ ROD.
- 2021 FYR; specifically, Chapter 7, “ChR.”
- 2022 RER; specifically, Chapter 6, “ChR.”
- 2023 RER; specifically, Chapter 6, “ChR.”
- 2024 RER; specifically, Chapter 6, “ChR.”
- EFPC and ChR RAR CMP.

3.2.1.2 Physical characterization

KHQ is located on the southeast side of ChR near BV Road (Figures 3.1 and 3.3). It is a 3-acre, flooded, limestone rock quarry about 55 ft deep, sheltered on three sides by 60-ft-high cliffs, with a drainage outlet on the southern side (Outfall 301). The quarry was used as a source of limestone rock and gravel until it was abandoned in the late 1940s and allowed to fill with water.

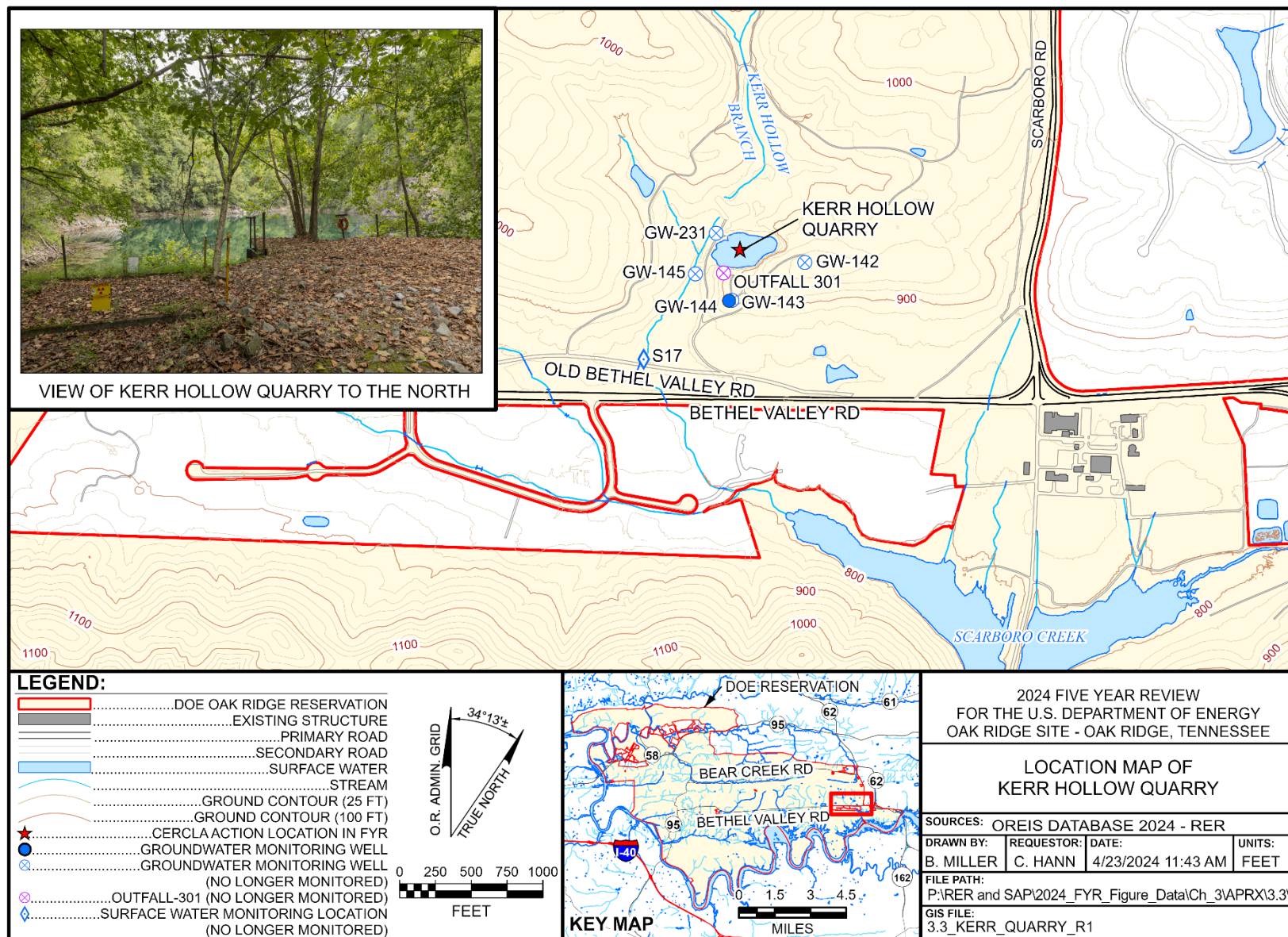


Figure 3.3. KHQ site map and monitoring locations.

3.2.1.3 Land and resource use

The quarry is located in a remote area on DOE-controlled land within the ChR administrative watershed. The ChR RCRA PCP required a 30-year post-closure care period that included LUCs (see Section 3.2.2.4). Groundwater and land use prohibitions are in place until a final decision is made, which will be based on concentrations of hazardous substances being at such levels to allow for unrestricted use.

3.2.2 Response Action Summary

3.2.2.1 Basis for taking action

The RCRA closure process was undertaken to prevent physical exposure to contaminants and to mitigate migration of contaminants to groundwater or surface water runoff. The RCRA closure was certified with waste (contaminated sediment and non-visible debris) remaining in place. KHQ sediments were sampled between 1990–1992, with results indicating minimal residual contamination (e.g., metals and isotopes). Low levels (less than 5 µg/L) of carbon tetrachloride, chloroform, and PCE have sporadically occurred in groundwater downgradient of the site, possibly as a consequence of wastes being disturbed during attempts to obtain clean closure of the site. Because of the closure status, a post-closure maintenance, monitoring, and reporting program was required. These requirements were stipulated in the ChR RCRA PCP, as modified on June 11, 1996. The RCRA closure activities were deemed protective of human health and the environment; therefore, NFA was required under the CERCLA KHQ ROD. Substantive requirements for post-closure care, monitoring, and reporting for KHQ were integrated into the CERCLA process in February 2018. VOCs, specifically carbon tetrachloride, are the contaminants of interest.

3.2.2.2 Response actions

The RCRA closure action, initiated in 1991, included removing containers and waste from the bottom of the quarry.

3.2.2.3 Status of implementation

From 1991–1993, containers and materials at the bottom of the quarry were removed, shredded, evaluated by health physics personnel, and placed in B-25 boxes. Shredded debris from the quarry was placed in concrete vaults and placed adjacent to the Walk-In Pits in the BCBG. Monitoring wells around the quarry were sampled before and during removal operations as part of RCRA interim status requirements. Restricted access provides the necessary protection of human health and the environment to satisfy CERCLA requirements. Therefore, an NFA determination was proposed for the site in 1995 and accepted by EPA and TDEC in the KHQ ROD approved shortly before the site was added to the ChR RCRA PCP on June 11, 1996. The 2006 ChR RCRA PCP Renewal that reduced the monitoring frequency from semiannual to annual groundwater sampling was issued in September 2006.

In March 2016, a ChR RCRA PCP renewal application (DOE-16-0127) that proposed ending RCRA detection monitoring at KHQ was submitted to TDEC. (Note the existing ChR RCRA PCP was set to expire on September 30, 2016.) However, in May 2017, DOE requested the re-application be denied and the applicable substantive requirements for post-closure care, monitoring, and reporting for the unit be integrated into the CERCLA process (DOE 2017). TDEC-Division of Solid Waste Management granted the request on February 23, 2018 (TDEC 2018), and substantive requirements for post-closure care and monitoring are now managed in the EFPC and ChR RAR CMP. After the KHQ sampling event in January 2017 and after RCRA detection groundwater monitoring ended, sampling was discontinued at all wells except well GW-144 (Figure 3.3). Since that time, groundwater monitoring at the site has consisted of annual sampling of well GW-144. The continued long-term care of the KHQ site complies with the KHQ ROD.

3.2.2.4 LUC requirements

LUCs, per the KHQ ROD, are consistent with the former ChR RCRA PCP, which transitioned to the CERCLA process in February 2018. The EFPC and ChR RAR CMP includes access controls as well as site signage for the former RCRA site. Final closure of the site was on February 22, 1995 (TDEC 1995). As a RCRA closure, a notation on the deed was required to be filed at the County Register of Deeds office.

LUCs for the KHQ site are listed in Table 3.9. Refer to Table 3.12 and Section 3.2.4.4 for the FYR evaluation of the identified KHQ site control requirements.

Table 3.9. LUC summary for KHQ

Type of control and frequency	Purpose of control	Duration	Implementation	Affected area ^a
Property record notices	Provide information to the public about existence and location of contaminated areas and media and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until final decision is made on groundwater	Notice recorded by DOE in accordance with state law at County Register of Deeds office and copied to appropriate zoning office (verified every 5 years): • Tennessee Code Annotated notice of land use restrictions after signing of the KHQ ROD	All WMAs and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • KHQ
Access controls: 1. Fences, gates, signs, and portals	Provide notice or warning to prevent unauthorized access	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until final decision is made on groundwater; as long as waste remains buried	Controls maintained by DOE (verified annually)	Remediation systems, all WMAs, and areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • KHQ

^aSpecific locations identified in post-ROD documents.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

DOE = U.S. Department of Energy

KHQ = Kerr Hollow Quarry

LUC = land use control

ROD = Record of Decision

UU/UE = unrestricted use/unlimited exposure

WMA = waste management area

3.2.2.5 Engineered remedies

Engineered remedy requirements for the KHQ site are listed in Table 3.10. The KHQ ROD does not specify any S&M requirements; however, the former ChR RCRA PCP required all security components, signage, survey benchmarks, and monitoring systems at KHQ be inspected throughout the post-closure care period of 30 years. The EFPC and ChR RAR CMP includes semiannual inspections of the site controls and annual inspections of the monitoring wells, including a comprehensive evaluation of well integrity (e.g., condition of cap and casings, presence of weep hole, well lock, well identification, concrete pad, guard posts), including below-grade components. Verification of remedy integrity is discussed in Section 3.2.4.4.

Table 3.10. Engineered remedy summary for KHQ

Affected area/ type of remedy	Purpose	Implementation	Verification frequency
KHQ Site – RCRA closure	Prevent physical exposure to contaminants within the quarry and mitigate migration of contaminants to groundwater/surface water runoff	O&M by DOE	Verify purpose and O&M annually

DOE = U.S. Department of Energy
KHQ = Kerr Hollow Quarry

O&M = operations and maintenance
RCRA = Resource Conservation and Recovery Act of 1976

3.2.3 Progress Since Last Five-Year Review

The 2021 FYR concluded:

The remedy implemented at KHQ (removal) is protective of human health and the environment. Protectiveness is achieved through debris removal. LUCs are in place to prevent human exposure. Access controls (signs, fencing, and security patrols) and EPP controls are in place. A property record notice containing land use restrictions is in place at the County Court House, Register of Deeds office.

Additional actions, as necessary, will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

No issues were identified during the 2021 FYR.

3.2.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 3.2.1.1.
- Reviewed effectiveness and monitoring data and evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M inspections and maintenance information.
 - Changes in land use and verifying LUCs.
 - Groundwater monitoring data.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact the protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data, LUCs, and engineered remedy requirements as specified in the associated decision documents.

3.2.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this FYR.

3.2.4.2 Data review

Well GW-144 has exhibited the presence of low levels of carbon tetrachloride in groundwater at KHQ (Table 3.11) and is sampled annually for VOC analysis, with samples collected in alternating wet and dry seasons. Carbon tetrachloride is the contaminant of interest. During the 3-year evaluation period, carbon tetrachloride has been detected at a maximum concentration of 1.6 µg/L, well below the MCL screening level for carbon tetrachloride (5 µg/L). Detections in the evaluation period include regular and field replicate samples collected in January 2021 (0.56 J µg/L and 0.54 J µg/L, respectively), regular and field replicate samples collected in July 2022 (1.4 µg/L and 1.6 µg/L, respectively), and regular and field replicate samples collected in January 2023 (0.66 J µg/L and 0.57 J µg/L, respectively). Groundwater monitoring data from well GW-144 continue to represent a long-term decreasing trend of carbon tetrachloride at KHQ.

Table 3.11. Summary of VOCs detected in downgradient wells at KHQ since January 1995

Well	Sampling date ^a	Carbon tetrachloride ^b	Chloroform ^b	Tetrachloroethene ^b
GW-144	01/18/95	3 J	ND	1 J
GW-144	04/25/95	4 J	1 J	ND
GW-144	11/14/95	2 J	ND	ND
GW-144	01/22/96	3 J	ND	ND
GW-144	04/24/96	4 J	ND	ND
GW-144	12/02/02	ND	ND	0.4 J
GW-144	10/16/06	1 J	ND	ND
GW-144	07/10/14	1.3	ND	ND
GW-144	08/28/14 ^c	3.6	ND	ND
GW-144	09/29/14 ^c	1.2	ND	ND
GW-144	07/07/15	1.1	ND	ND
GW-144	07/11/18	0.7 J	ND	ND
GW-144	01/07/19	0.33 J	ND	ND
GW-144	07/06/20	0.4 J	ND	ND
GW-144	01/05/21	0.56 J	ND	ND
GW-144	07/12/22	1.6	ND	ND
GW-144	01/09/23	0.66 J	ND	ND

^aOnly sampling events with at least one detected VOC are shown.

^bThe highest result of the regular and duplicate samples for each date is shown.

^cDate denotes samples collected for Resource Conservation and Recovery Act of 1976 detection monitoring purposes to confirm the July 2014 carbon tetrachloride result.

GW = groundwater well

J = analyte detected; concentration estimated

KHQ = Kerr Hollow Quarry

ND = not detected

VOC = volatile organic compound

3.2.4.3 Site inspections

As part of this 2024 FYR, a site manager interview was conducted on August 23, 2023, and a site visit of the KHQ site was conducted on October 18, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and monitoring information required in the KHQ ROD. There were no deficiencies identified during the site visit. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

3.2.4.4 LUC verification and certification/engineered remedy verification

All KHQ site LUCs and engineered remedies specified in Tables 3.9 and 3.10, respectively, were verified for this 2024 FYR. The certification of LUC implementation for FY 2023 for KHQ is included in Appendix D. Results are summarized in Table 3.12, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of the table identifies the specific table listing the requirements and the section providing detail of the verifications.

Table 3.12. Verification of LUCs and engineered remedy integrity at KHQ

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirement/status review
LUCs and engineered remedy	KHQ	Implemented	See Tables 3.9 and 3.10 and text below

KHQ = Kerr Hollow Quarry

LUC = land use control

Over the last 3 years, KHQ underwent S&M on a regular schedule in accordance with the Y-12 FIT Manual. Routine inspections of KHQ and monitoring wells are conducted by the DOE S&M Program, including inspecting for proper signage and integrity of benchmarks and monitoring wells; condition of the fences, gates, and locks; and condition of the access road. The LUM application documents S&M inspections.

Maintenance from FYs 2021–2023 included replacing and/or fixing signs, removing downed trees blocking access, and repairing fencing. Additionally, KHQ is located outside the Y-12 Property Protection Area; therefore, separate security fencing and signs exist at the site. The KHQ Property Record Notice was filed on April 28, 1994, at the Anderson County Register of Deeds office and remains in place.

3.2.5 Technical Assessment

Table 3.13 summarizes the technical assessment conducted for KHQ.

3.2.5.1 Question A: Is the remedy functioning as intended by the decision documents?

The primary goal of the action to prevent physical exposure to contaminants within the quarry has been achieved. Evaluation of groundwater monitoring data between FYs 2021–2023 shows the goal to mitigate migration of contaminants to groundwater has also been achieved. This is consistent with results of previous CERCLA FYRs conducted in FYs 2001, 2006, 2011, 2016, and 2021.

LUCs (property record notices and access controls) and quarterly S&M inspections are in place and are functioning as intended. Information from the interview with the S&M manager indicates all engineered remedy requirements are being met (Table 3.12). No problems with the remedy or site-specific concerns were noted during the interview. No other changes in physical site conditions were observed.

The estimated annual O&M costs for Y-12 are presented in Section 1.5.4. O&M costs are consistent with forecasted costs for the project.

Table 3.13. FYR summary for KHQ

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met?)	Yes	Low concentrations of carbon tetrachloride have been sporadically detected at KHQ over the last 10 years. All detections are near the detection limit and below the MCL
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	There were no identified problems. Costs are consistent with forecasted costs for the project
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	Controls are being implemented and maintained per the Y-12 S&M Program FIT Manual (UCOR-4199). LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	There have been no additional actions since the RA was completed
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There is no operating system in place under this remedy
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	NA	This was an NFA decision; no ARARs were identified in the decision
Have new human health or ecological exposure pathways or receptors been identified?	No	Based on systematic monitoring results, no contaminant releases to groundwater or surface water have been above screening levels
Have there been any changes in land use or expected land use on or near the site?	No	The site remains under government control on DOE property. There is no change in future land use anticipated
Have new contaminants or contaminant sources been identified?	No	Data collected under ongoing post-RA monitoring are continuing to be evaluated
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	NA	No chemical treatment remedies were employed
Have there been any changes in the physical site conditions?	No	The site remains under government control on DOE property
Have there been any changes in the toxicity factors for COCs?	NA	Risk-based performance standards are not specified in the KHQ ROD (only source removal to mitigate physical exposure and migration of contaminants)
Were there significant changes in the standardized risk assessment methodologies?	NA	Risk-based performance standards were not the basis for action in the KHQ ROD

Table 3.13. FYR summary for KHQ (cont.)

Question	Response	Note
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	NA	No ERA was performed, but qualitative evaluation of ecological risks at Outfall 301 prior to and following closure indicated no concern
Is the site located in an area subject to natural disasters?	Yes	There is a low probability of earthquakes and tornadoes in the region

ARAR = applicable or relevant and appropriate requirement
COC = contaminant of concern
DOE = U.S. Department of Energy
ERA = ecological risk assessment
FIT = Facility Inspection and Training
FYR = Five-Year Review
KHQ = Kerr Hollow Quarry
LUC = land use control
LUM = Land Use Manager

NA = not applicable
NFA = no further action
MCL = maximum contaminant level
RA = remedial action
ROD = Record of Decision
S&M = surveillance and maintenance
TBC = to be considered
Y-12 = Y-12 National Security Complex

3.2.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

All assumptions made at the time of the remedy are still valid. No changes in land use have occurred since the 2021 FYR. No changes in physical site conditions were noted during FYs 2021–2023 inspections, and no significant repairs or upgrades to the infrastructure at KHQ were conducted. The CERCLA decision was NFA, with monitoring to continue under the EFPC and ChR RAR CMP.

3.2.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The KHQ ROD states monitoring of the surface water discharge point (Outfall 301) from the quarry will be performed as a best management practice (BMP). However, because the large amount of historical data had not shown impacts to surface water and the outfall was typically dry, a recommendation was made in FY 2001 to discontinue sampling of Outfall 301. DOE initiated this recommendation by submitting a letter to the regulators. Surface water monitoring of the outfall was discontinued following TDEC approval on February 28, 2002. Prior to that time, risk to ecological receptors was addressed qualitatively by collecting surface water at Outfall 301 and restricting access to the site. Monitoring results for Outfall 301 were compared to generic ecological PRGs for acute and chronic exposure and MCLs as a BMP to evaluate any potential degradation of surface water quality. Qualitative evaluation of ecological risks at Outfall 301 prior to and following closure indicates no apparent concern.

There is a low probability of earthquakes or tornadoes in the region. As described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability.

3.2.6 Issues/Recommendations

There were no issues or recommendations identified in this 2024 FYR for KHQ.

3.2.6.1 Other findings

There were no additional findings identified in this 2024 FYR for KHQ.

3.2.7 Protectiveness Statement

The remedy implemented at KHQ (removal) is protective of human health and the environment. Protectiveness is achieved through debris removal. LUCs are in place to prevent human exposure. Access controls (signs, fencing, and security patrols) and EPP controls are in place. A property record notice containing land use restrictions is in place at the Anderson County Court House, Register of Deeds office.

Additional actions, as necessary, will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

3.2.8 Next Review

The next (seventh) CERCLA FYR on the ORR will be due August 20, 2028.

3.3 FILLED COAL ASH POND/UPPER MCCOY BRANCH REMEDIAL ACTION

FCAP ROD: DOE/OR/02-1410&D3: 02/21/96

FCAP RAR: DOE/OR/01-1596&D1: 06/03/97

Decision document: *Record of Decision for Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond and Vicinity), Oak Ridge, Tennessee*

EPA SEMS OU: 26 – CR-OU 2 FCAP, McCoyBr, Rog Y-12

3.3.1 Introduction

The scope of the FCAP ROD was to remediate FCAP and the vicinity. The *Remedial Action Report on Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond and Vicinity) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1596&D1; FCAP RAR) documented completed RAs.

3.3.1.1 Site chronology and background

The ChR OU 2 site includes a pond built in 1955 as a settling basin for coal ash from the Y-12 Steam Plant, with construction of a 62-ft-high earthen dam across Upper McCoy Branch. The pond had a storage capacity, when built, of approximately 42 million gal and was expected to have a 20-year capacity for ash. By 1967, ash had filled the pond, and slurry was allowed to overtop the dam and flow down Upper McCoy Branch to Rogers Quarry. This practice was stopped in 1989. Vegetation was allowed to grow on the dam and, with time, the dam and spillway deteriorated. Table 3.14 provides a chronology of CERCLA activities related to FCAP.

Table 3.14. Chronology of events associated with FCAP

Event	Date
Beginning with construction of the pond, a slurry composed of ash from the Y-12 Steam Plant and untreated CR water was pumped over the crest of ChR and flowed from there, by gravity, down the slope to the pond	1955
The ash pond reached its storage capacity	1967
Slurry additions continued in the pond and overtopped the dam, causing erosion of the spillway	1967–1989

Table 3.14. Chronology of events associated with FCAP (cont.)

Event	Date
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
The FCAP ROD (DOE/OR/02-1410&D3) was approved	February 1996
Remediation work to stabilize the dam was performed, and the PTS was installed	August 1996–April 1997
The FCAP RAR (DOE/OR/01-1596&D1) was approved	June 1997
FCAP was included in the initial 2001 FYR (DOE/OR/01-1941&D2/R1)	2001
FCAP was included in the second 2006 FYR (DOE/OR/01-2289&D3)	2006
FCAP was included in the third 2011 FYR (DOE/OR/01-2516&D2)	2011
FCAP was included in the fourth 2016 FYR (DOE/OR/01-2718&D2), which deferred protectiveness of aquatic life and included diminished performance of the PTS as an issue	2016
The Action Plan was performed to determine if improvements to the physical condition of the PTS were necessary and to evaluate abnormal fish health observations in Rogers Quarry	FYs 2017–2018
Based on Action Plan conclusions, maintenance activities were performed at the FCAP PTS and were described in the <i>2020 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee</i> (DOE/OR/01-2844&D2)	FY 2019
Additional maintenance activities, including installing erosion control structures, were performed to control the transport of ash across the surface of the FCAP	FY 2020
FCAP was included in the fifth 2021 FYR (DOE/OR/01-2895&D2)	2021

ChR = Chestnut Ridge

CR = Clinch River

DOE = U.S. Department of Energy

EPA = U.S. Environmental Protection Agency

FCAP = Filled Coal Ash Pond

FFA = Federal Facility Agreement

FY = fiscal year

FYR = Five-Year Review

PTS = passive treatment system

RAR = Remedial Action Report

ROD = Record of Decision

TDEC = Tennessee Department of Environment and Conservation

Y-12 = Y-12 National Security Complex

Key documents reviewed for this FYR include:

- FCAP ROD.
- FCAP RAR.
- 2021 FYR; specifically, Chapter 7, “ChR.”
- 2022 RER; specifically, Chapter 6, “ChR.”
- 2023 RER; specifically, Chapter 6, “ChR.”
- 2024 RER; specifically, Chapter 6, “ChR.”
- EFPC and ChR RAR CMP.

3.3.1.2 Physical characterization

FCAP is situated 0.5 mi south of Y-12 along the southern slope of ChR (Figures 3.1 and 3.4). The site is surrounded by fencing and is clearly marked with signs identifying the site and facility manager. The area behind the dam was mostly filled in with ash and is covered in mixed deciduous forest. A spillway constructed of concrete pillows runs along the side of the site, perpendicular to the dam, to convey overflow during storm events. The slope of the dam is covered with vegetation (mostly grass). At the toe of the slope is a small settling basin and oxygenation area below which influent water samples are taken; effluent samples are taken on the other side of a small, but well-established, passive treatment system (PTS). McCoy Branch then winds offsite from the PTS area.

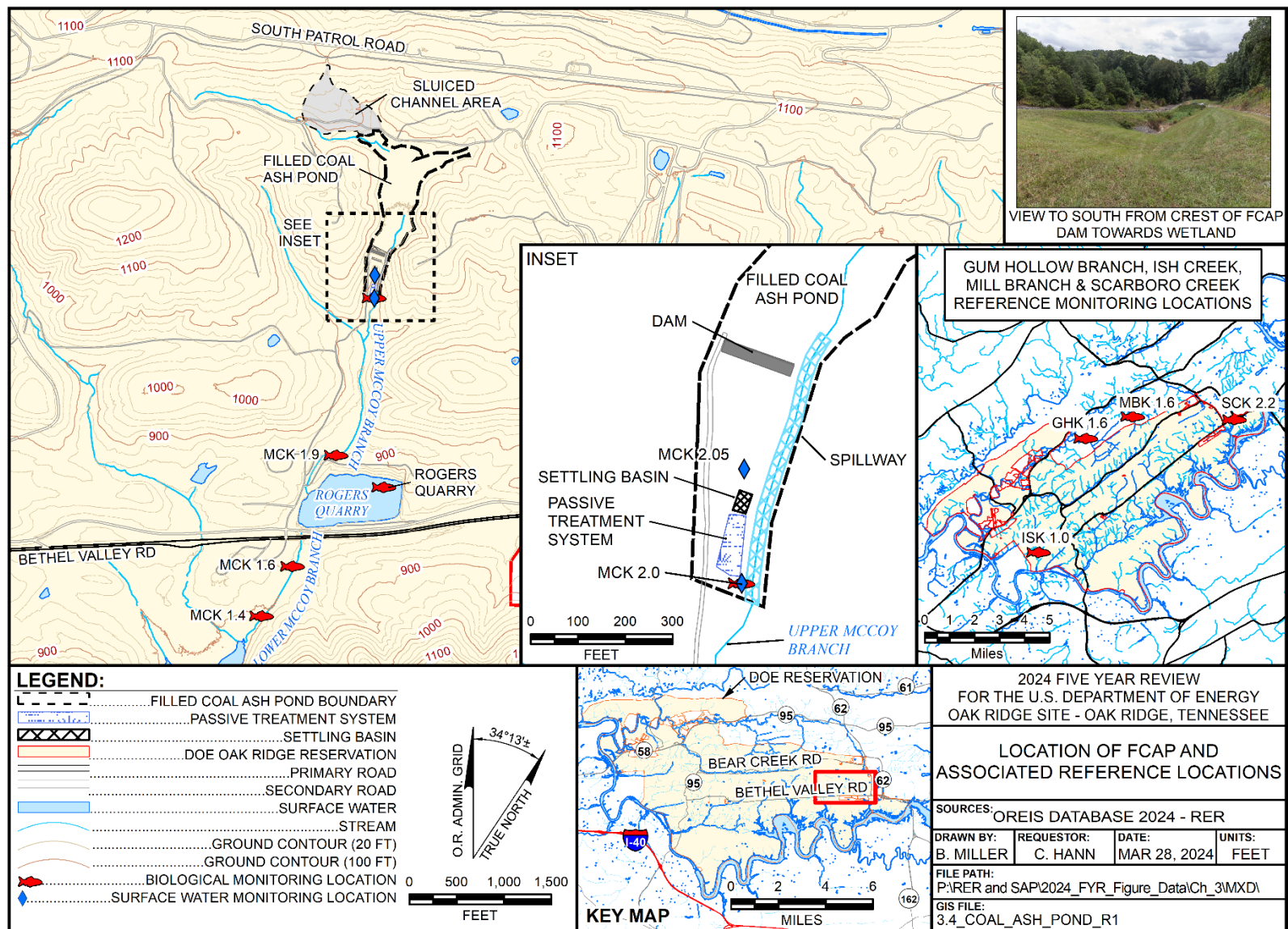


Figure 3.4. FCAP site map and monitoring locations.

3.3.1.3 Land and resource use

The FCAP site is located in a remote area on DOE-controlled land within the ChR administrative watershed. During fall ORR-wide deer hunts, the area surrounding FCAP is open for hunting (DOE-badged personnel only); however, “No Hunting” signs are posted at FCAP. Turkey hunts are not allowed in the vicinity of FCAP.

3.3.2 Response Action Summary

3.3.2.1 Basis for taking action

The *Remedial Investigation Report on Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond/Upper McCoy Branch) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1268&D2; FCAP RI) identified a human health risk to a hypothetical trespasser and future residential receptor from direct exposure to the ash from exposure to Th-228 and its daughters. The selected remedy identifies LUCs that would preclude residential land use. In addition, FCAP is within the Y-12 footprint (a highly secured government site). The RA was intended to stabilize the dam to prevent further release of coal ash slurry to Upper McCoy Branch and to construct an oxygenation weir and PTS to prevent release of contaminants from ash to surface water. The FCAP RAR specifies samples “be collected and analyzed for the primary COCs (aluminum, arsenic, iron, manganese, and zinc) and other constituents of relevance to evaluating wetland performance at the site.” These metals were identified as COCs in surface water emanating from the underdrain at the toe of the embankment by comparing those analytical results to reference surface water quality in an adjacent, undisturbed watershed.

3.3.2.2 Response action

The selected remedy used permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The selected remedy did not satisfy the statutory preference for treatment, which results in permanent and significant reduction of toxicity, mobility, or volume of the contamination, because treatment of the large volume of coal ash at this site was not practicable. The ash remains at the site and surface water receives limited treatment. The goals of the response action are to reduce risk from the site to “plants, animals and humans by: (1) upgrading containment of the coal ash with dam improvements and stabilization, (2) reducing contaminant migration into Upper McCoy Branch with a PTS (existing wetland), and (3) restricting human access to the contamination by implementing institutional controls.” The functional goals, per the FCAP ROD, are to:

- Minimize migration of contaminants into surface water.
- Minimize direct contact of humans and animals with the ash.
- Reduce potential for future failure of the dam.
- Preserve local habitat in the long term.

3.3.2.3 Status of implementation

The FCAP ROD was approved on February 21, 1996, to remediate FCAP and the vicinity. Field activities began in August 1996 and were completed in April 1997. The FCAP RAR was approved on June 3, 1997, documenting the following actions:

- Raising the crest of the dam.
- Reinforcing the face of the dam.

- Installing a subsurface toe drain.
- Removing large trees from the face of the dam.
- Repairing the emergency spillway (including removing the steep slope to the east of the spillway).
- Constructing a settling basin and oxygenation weir at the foot of the dam.
- Replacing a small, pre-existing, non-engineered wetland downstream of the settling basin.

The RA also includes LTM of the dam, periodic sampling of surface water to evaluate if the PTS requires maintenance, and LUCs to limit access.

3.3.2.4 LUC requirements

The FCAP RAR requires that, to prevent unauthorized access to the site, inspections will ensure the gate at the entrance to the facility is locked and in good condition and signs restricting unauthorized access are legible and in good condition. The inspections will also note any evidence of unauthorized access and the need for additional security measures. Additionally, the FCAP ROD required DOE to note on the deed for this property its former use and its status as an environmental remediation site.

LUCs for the FCAP site are listed in Table 3.15. Refer to Table 3.18 and Section 3.3.4.4 for the FYR evaluation of the identified FCAP site control requirements.

3.3.2.5 Engineered remedies

Engineered remedy requirements for FCAP are listed in Table 3.16. Current S&M for the FCAP site is included in the EFPC and ChR RAR CMP. The FCAP RAR requires inspections of the site be conducted quarterly throughout the post-remediation care period, and any required maintenance be conducted based on inspection findings. Post-remediation performance of FCAP is dependent on adequate inspection and maintenance of the dam, spillway channel, adjacent slopes, and PTS. To assess potential erosion damage associated with high-intensity rainfall events, the FCAP RAR specifies inspecting the dam and spillway following any 25-year, 24-hr rainfall event (approximately 5.44 in.). However, as a BMP, site components are inspected under a more-stringent criterion (i.e., following greater than or equal to 3 in. in 24-hr precipitation events). Verification of remedy integrity is discussed in Section 3.3.4.4.

3.3.3 Progress Since Last Five-Year Review

The 2021 FYR concluded:

The remedy implemented at FCAP (containment) is protective of human health and the environment. Protectiveness is achieved through dam reengineering and a small wetland. LUCs are in place to prevent human exposure. Access controls, including signs, fencing, and gates, are in place. A property record notice containing land use restrictions is in place at the County Court House, Register of Deeds office.

Additional actions as necessary will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

There were no issues identified with the FCAP decision during the 2021 FYR.

Table 3.15. LUC summary for FCAP

Type of control and frequency	Purpose of control	Duration	Implementation	Affected area^a
Property record notices	Provide information to the public about existence and location of contaminated areas and media and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater	Notice recorded by DOE in accordance with state law at County Register of Deeds office and copied to appropriate zoning office (verified every 5 years): • Tennessee Code Annotated notice of land use restrictions after signing of the FCAP ROD	All WMAs and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • FCAP
Access controls: 1. Fences, gates, signs, and portals	Provide notice or warning to prevent unauthorized access	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater; as long as waste remains buried	Controls maintained by DOE (verified annually)	Remediation systems, all WMAs, and areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: • FCAP

^aSpecific locations identified in post-ROD documents.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

DOE = U.S. Department of Energy

FCAP = Filled Coal Ash Pond

LUC = land use control

ROD = Record of Decision

UU/UE = unrestricted use/unlimited exposure

WMA = waste management area

Table 3.16. Engineered remedy summary for FCAP

Affected area/type of remedy	Purpose	Implementation	Verification frequency
FCAP Site – Construction of dam and spillway improvements	Reduce/eliminate contaminant entry into Upper McCoy Branch surface water through enhancement of wetland	O&M by DOE	Verify purpose and O&M annually
DOE = U.S. Department of Energy FCAP = Filled Coal Ash Pond O&M = operations and maintenance			

3.3.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 3.3.1.1.
- Reviewed effectiveness and monitoring data and evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M quarterly inspections and maintenance information.
 - Changes in land use and verifying LUCs.
 - Surface water monitoring data.
 - Biological monitoring data.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this 2024 FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact the protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data, LUCs, and engineered remedy requirements as specified in the decision documents.

3.3.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this FYR.

3.3.4.2 Data review

3.3.4.2.1 Surface water monitoring

The FCAP ROD requires surface water be periodically sampled and analyzed to verify that the passive treatment system reduces contaminant levels in water entering Upper McCoy Branch at least as well as the existing wetlands and to evaluate whether the passive treatment system requires maintenance. The FCAP RAR specifies surface water samples be collected and analyzed for the primary contaminants of concern (aluminum, arsenic, iron, manganese, and zinc) and other constituents of relevance to evaluating wetland performance at the site. Two locations, one at the influent to the PTS (McCoy Branch kilometer [MCK] 2.05) and one below the PTS

(MCK 2.0), are monitored semiannually for metals, anions, radionuclides, and water quality parameters. Both monitoring locations are downstream of the contaminant source.

The monitoring data evaluation for the FCAP RA compares metals contaminant concentrations to pre-action levels and overall reduction of metals between the inlet and outlet sampling locations at the PTS. DOE monitors a broad suite of metals in the PTS influent and effluent to evaluate the metals attenuation effectiveness of the action. AWQC are used as screening levels for evaluating performance of the remedy.

Data are presented in Table 3.17 for the metals arsenic, iron, manganese, selenium, and zinc. Aluminum and selenium were not analyzed in samples collected prior to site RA. Past monitoring results show arsenic is the most significant metal present in the site discharge based on comparison to screening levels. Iron and manganese are common and abundant metals present in coal ash leachate. These elements form solid metal oxide precipitates when the leachate water contacts free oxygen, such as when leachate contacts air or mixes with other water rich in dissolved oxygen. Lead, antimony, zinc, and mercury are present at concentrations far lower than their respective screening levels.

Results for 1996 pre-remediation baseline monitoring and FY 2023 monitoring are presented in Table 3.17. The upstream (PTS influent) sampling location is MCK 2.05, and the downstream (PTS effluent) is MCK 2.0. For the baseline event, the data summary is based on both filtered and unfiltered sample results for which four replicate samples were collected on the same date in 1996. Percent reduction of metals concentrations for average dissolved (filtered sample results) and average total (unfiltered sample results) shows that, for arsenic, concentrations in the PTS effluent were higher than in the influent. Because filtered results were non-detects for iron and zinc in the 1996 dataset, no reduction factor is calculated. The total iron concentration was reduced by about 17% in the 1996 dataset. Dissolved manganese was reduced by about 11%, although the total manganese concentration in the PTS effluent was over six times the level measured in the influent. The total zinc concentration in PTS effluent was slightly greater than twice the influent concentration.

In FY 2019, a maintenance project was conducted at FCAP to improve the residence time in the PTS. Monitoring of PTS influent and effluent consists of one grab sample per month in each of the 3 months in both FY quarter (Q) 2 and Q4. Field-filtered and non-filtered samples are analyzed for metals concentrations. Data from each fiscal quarter are presented as an average concentration of the three monthly grab samples, the maximum value of the three results, and the standard deviation of the three samples per fiscal quarter. Performance is calculated on the basis of the quarterly average concentrations.

FY 2023 PTS performance data (Table 3.17) show both total and dissolved arsenic concentrations were significantly reduced during the water residence in the PTS. Data for selenium concentrations showed less reduction to a slight increase in concentrations of dissolved selenium; however, the average selenium concentrations in the PTS effluent were less than the screening level. All measured zinc concentrations in the PTS effluent samples were less than the screening level.

Figure 3.5 shows the history of downstream (MCK 2.0, PTS effluent) total arsenic and filtered arsenic concentration results. Prior to the PTS maintenance in FY 2019, the arsenic concentrations were quite variable. In contrast, following the PTS maintenance, the arsenic concentrations in the PTS effluent exhibit less variability and hover near the screening AWQC level (0.010 mg/L).

The goal of FCAP remediation is to reduce metals discharges from the coal ash to surface water in McCoy Branch. Two metrics are used to evaluate overall performance of the FCAP remedy. The first metric of interest and the performance measure stipulated in the FCAP ROD, is the percentage reduction of total arsenic concentrations over time for both the upstream (MCK 2.05) and downstream (MCK 2.0) monitoring locations. Figure 3.6 shows the percent reductions in total arsenic concentrations for the period 1998–2023. This graph provides the “running percent decrease” factor that has been observed since dam stabilization. The pre-remediation values are those presented in Table 3.17.

Table 3.17. Summary of FCAP 1996 pre-remediation and FY 2023 monitoring results

Analyte	Units	AWQC	MCK 2.05 ^a (unfiltered)			MCK 2.0 ^b (unfiltered)			Percent reduction (%) ^c	MCK 2.05 ^a (filtered)			MCK 2.0 ^b (filtered)			Percent reduction (%) ^c
			Average	Maximum	Standard deviation	Average	Maximum	Standard deviation		Average	Maximum	Standard deviation	Average	Maximum	Standard deviation	
1996 pre-remediation surface water data																
Arsenic	mg/L	0.01	0.484	1.4	0.623	0.572	1.2	0.606	+18	0.007	0.011	0.004	0.014	0.017	0.003	+100
Aluminum	mg/L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	--	16.7	43	17.7	20.1	48	23.1	+21	0.091	0.260	0.114	0.007	0.014	0.010	-90
Manganese	mg/L	--	1.94	3.8	1.48	13.8	39	17.9	+511	0.089	0.17	0.087	0.079	0.15	0.077	-11
Selenium	mg/L	0.0031	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	0.12	0.035	0.056	0.023	0.072	0.2	0.091	+106	0.022	0.052	0.027	0.005	0.009	0.007	-79
FY 2023 Q2 PTS performance data																
Arsenic	mg/L	0.01	0.031	0.038	0.006	0.010	0.011	0.001	-67	0.019	0.020	0.002	0.010	0.011	0.001	-50
Aluminum	mg/L	--	0.027 J	0.031 J	0.006	0.034 J	0.059 J	0.016	+26	0.018 U	0.018 U	0.000	0.018 J	0.018 J	0.000	NA
Iron	mg/L	--	0.853	1.300	0.395	0.083 J	0.096 J	0.011	-90	0.203	0.210	0.006	0.013 J	0.025 J	0.006	-94
Manganese	mg/L	--	0.433	0.450	0.029	0.033	0.039	0.006	-94	0.390	0.430	0.036	0.008	0.010	0.002	-98
Selenium	mg/L	0.0031	0.0029 J	0.0035 J	0.0006	0.0027 J	0.0033 J	0.0004	-6	0.0026 J	0.0032 J	0.0006	0.0028 J	0.0034 J	0.0005	+4
Zinc	mg/L	0.12	0.0029 J	0.0032 J	0.0005	0.0021 J	0.0027 J	0.0003	-28	0.0024 J	0.0028 J	0.0004	0.0021 J	0.0023 J	0.0001	-30
FY 2023 Q4 PTS performance data																
Arsenic	mg/L	0.01	0.113	0.190	0.067	0.012	0.013	0.001	-90	0.023	0.030	0.006	0.010	0.011	0.001	-57
Aluminum	mg/L	--	0.122	0.190	0.073	0.040	0.065	0.018	-67	0.018 U	0.018 U	0.000	0.020	0.027	0.004	+8
Iron	mg/L	--	4.666	8.600	3.781	0.140	0.180	0.026	-97	0.210	0.280	0.070	0.022 J	0.041 J	0.011	-90
Manganese	mg/L	--	1.703	3.500	1.556	0.075	0.091	0.019	-96	0.700	0.970	0.240	0.037	0.049	0.011	-95
Selenium	mg/L	0.0031	0.0018 J	0.0030 J	0.0010	0.0015 J	0.0019 J	0.0003	-17	0.0015 J	0.0023 J	0.0007	0.0016 J	0.0020 J	0.0004	+3
Zinc	mg/L	0.12	0.0053 J	0.0082 J	0.0026	0.0021 J	0.0026 J	0.0002	-6	0.0023 J	0.0025 J	0.0002	0.0023 J	0.0031 J	0.0005	+1

^aDam effluent/PTS influent.^bPTS effluent.^cPercent reduction is difference between average upstream and downstream samples in proportion to the upstream concentration.**Bold** values indicate results that exceed AWQC screening levels.

-- = indicates no AWQC available or the metal was not analyzed.

AWQC = ambient water quality criteria

NA = not applicable

FCAP = Filled Coal Ash Pond

PTS = passive treatment system

FY = fiscal year

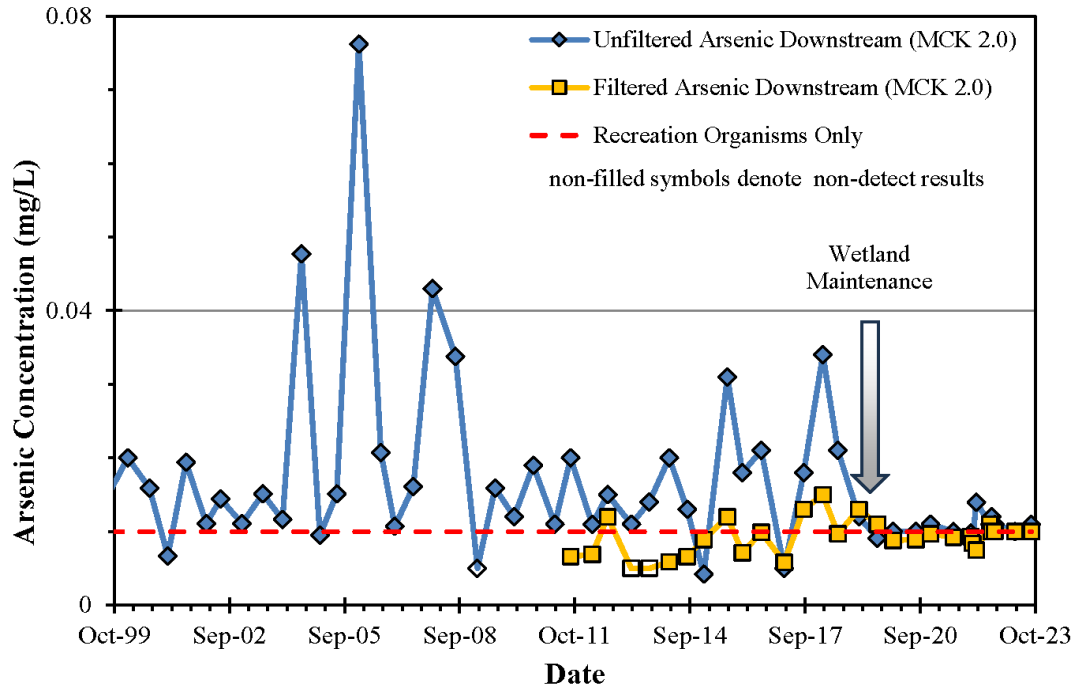
Q2 = quarter 2

J = analyte detected; concentration estimated

Q4 = quarter 4

MCK = McCoy Branch kilometer

U = not detected



Red dashed line is the screening ambient water quality criterion level.

Figure 3.5. History of arsenic concentrations in FCAP PTS effluent (MCK 2.0).

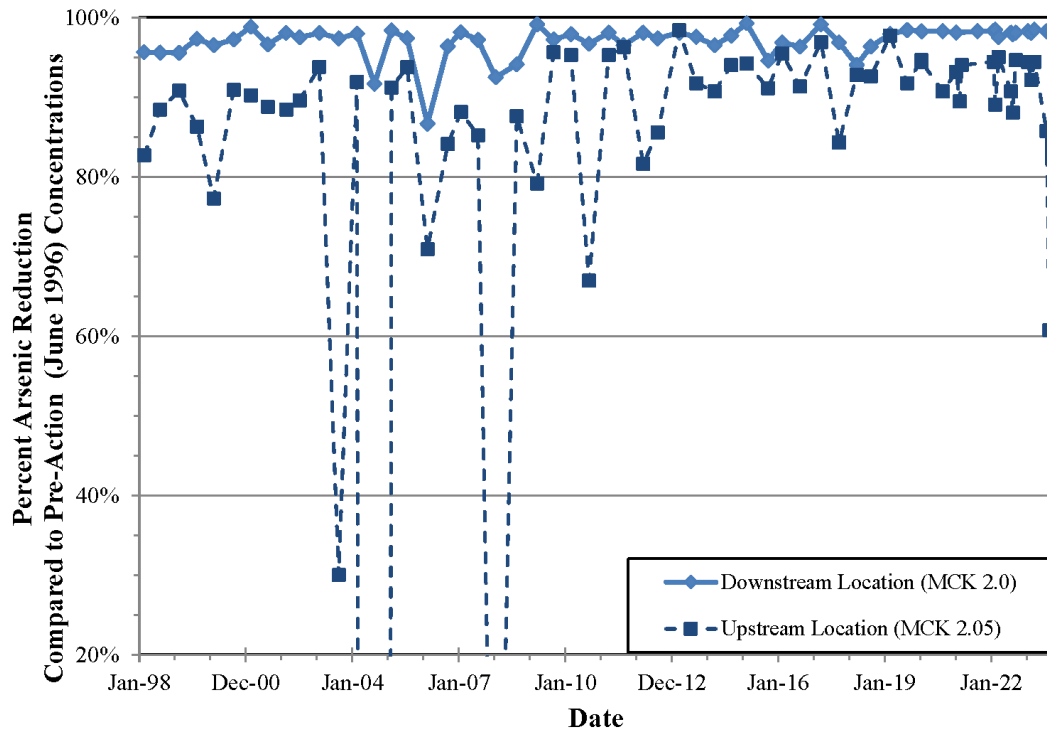


Figure 3.6. Post-remediation percent reduction of total arsenic concentrations in McCoy Branch compared to pre-RLs.

The second metric of interest is the percent reduction in arsenic concentration between water entering the PTS at MCK 2.05 and water leaving the downstream end of the PTS at MCK 2.0. Figure 3.7 shows the percent of total arsenic at MCK 2.0 compared to the average of arsenic concentrations measured in both the unfiltered regular sample and a field duplicate sample collected at MCK 2.05. The percent reduction of arsenic during flow through the PTS is typically greater than 20%, although the reduction factors are highly variable. As shown on Figure 3.7, there appears to have been decreasing arsenic removal effectiveness over time prior to the PTS maintenance action. Monitoring results since the maintenance activity show improvements in the PTS arsenic removal compared to pre-maintenance performance.

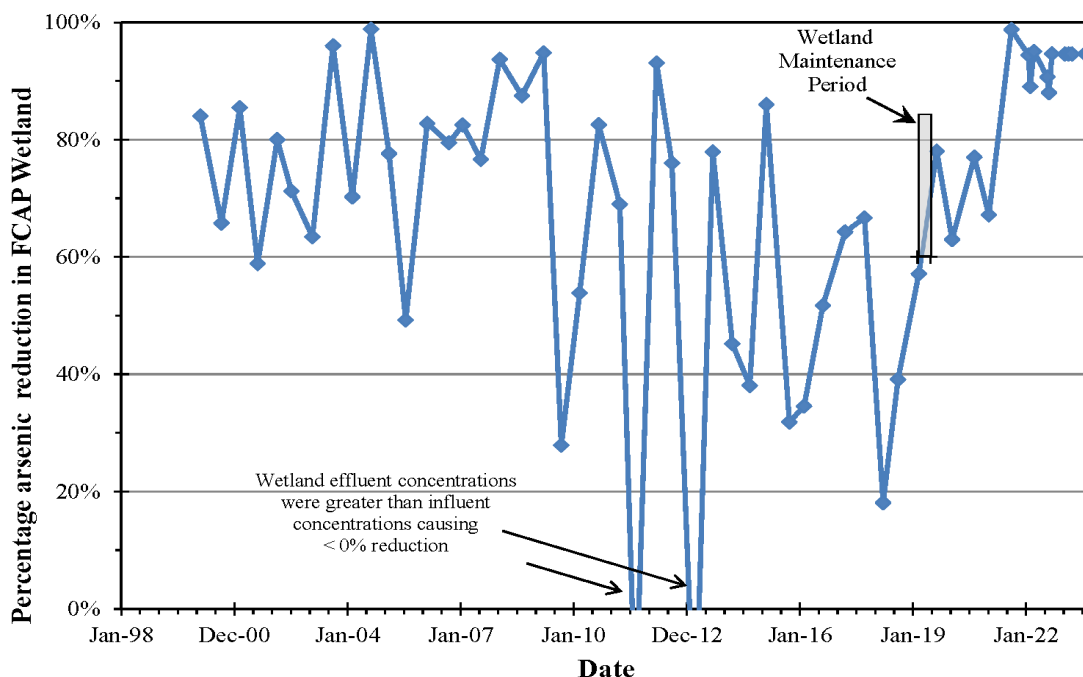
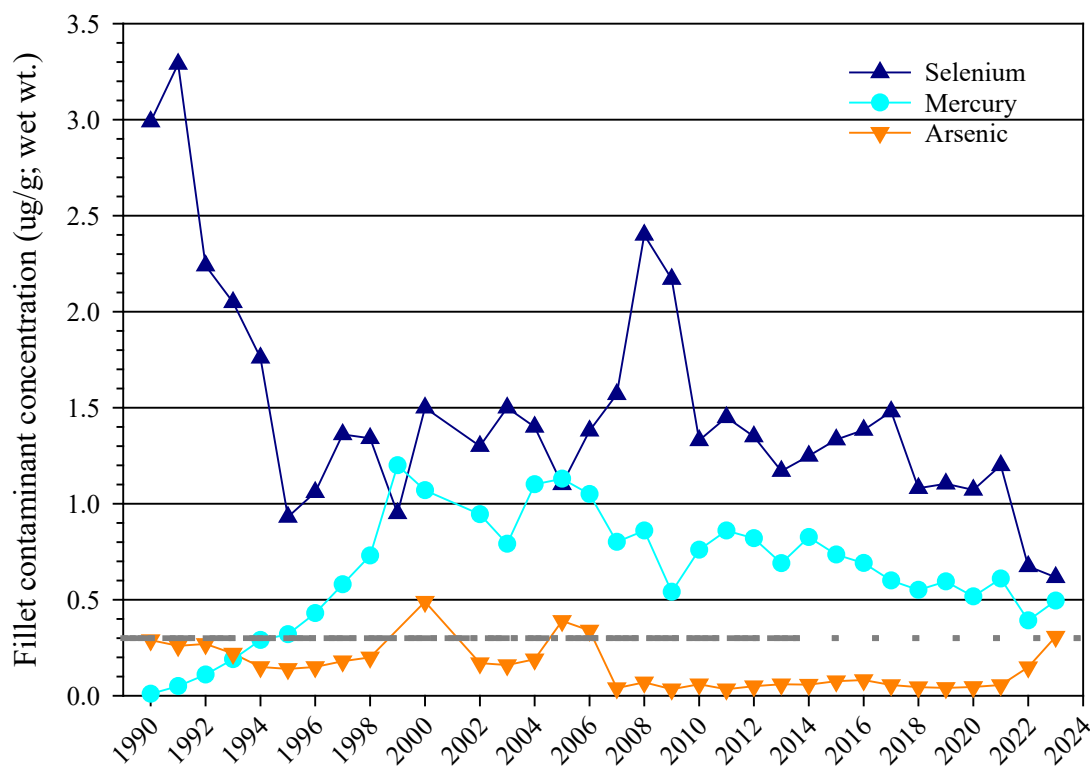


Figure 3.7. Percent reduction of total arsenic concentrations in flow through the FCAP PTS.

3.3.4.2.2 Biological monitoring

Biological monitoring is not specified in the FCAP ROD. Biological monitoring at FCAP and downgradient Rogers Quarry is conducted to monitor trends for the future ChR ROD, and those data are summarized in the annual RERs. In summary, fish sampling of Rogers Quarry in FYs 2016–2017 led to observations of physiological abnormalities in largemouth bass. The need for further investigation was identified as an issue in the 2016 FYR. In response to this issue, DOE completed an investigative Action Plan that included evaluating the fish population and health in McCoy Branch and Rogers Quarry; this is documented in the *2019 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/OR/01-2787&D2; 2019 RER). No fish deformities have been observed since FY 2017. Average wet-weight selenium concentrations in largemouth bass collected from Rogers Quarry have been decreasing over the past few years such that they were only slightly above typical background concentrations (approximately 0.5 µg/g) in 2023 (0.62 µg/g) (Figure 3.8); however, they are below the 11.3-µg/g tissue criterion for selenium in fillets. The average wet-weight selenium concentration in ovaries was 1.31 µg/g, which was lower than concentrations seen in ovaries in 2021 (2 µg/g) and is below the 15.1-µg/g tissue criterion for selenium in ovaries. Concentrations of arsenic in bass fillets from Rogers Quarry remained low, comparable with previous years. Average wet-weight mercury concentrations in largemouth



Dashed gray line indicates federal-recommended ambient water quality criteria for mercury in fish fillets (0.3 $\mu\text{g/g}$). Note these are screening criteria.

Figure 3.8. Mean concentrations of selenium, mercury, and arsenic in fillets of largemouth bass from Rogers Quarry, 1990–2023 (n=6 fish/year).

bass fillets increased slightly in 2023 (0.50 $\mu\text{g/g}$) but remained within the range of concentrations seen in recent years. The elevated selenium and mercury concentrations in fish from Rogers Quarry suggest continuing low-level inputs from FCAP. The FCAP ROD does not include Rogers Quarry, and the quarry will be evaluated in a future ROD.

Whole-body forage fish from MCK 1.6, MCK 1.9, and MCK 2.0 have been analyzed for selenium, mercury, and arsenic from 2017–2023 (Figure 3.9). Except for 2020, average selenium concentrations in forage fish collected at MCK 2.0 and MCK 1.9 were above screening level AWQC guidelines (8.5 $\mu\text{g/g}$ dry weight; used as screening level) for all sampling events. Generally, tissue selenium concentrations were highest at sites furthest upstream and decreased with distance downstream (Figure 3.9). These spatial patterns in element concentration reflect exposure, with the highest concentrations seen closest to FCAP. Arsenic concentrations in forage fish collected from MCK 2.0 decreased significantly over the 7-year sampling period, from 4.5 $\mu\text{g/g}$ in 2017 to 1.5 $\mu\text{g/g}$ in 2023, while concentrations at MCK 1.9 remained relatively stable. These trends suggest modifications to the PTS completed in FY 2019 were successful in decreasing exposure to ash-associated contaminants in the McCoy Branch watershed. Regardless, mercury concentrations in forage fish were well below AWQC (1.5 $\mu\text{g/g}$ dry weight) for mercury in fish fillets, though mercury concentrations were generally higher in forage fish from the downstream site (MCK 1.6). The FCAP ROD does not specify AWQC values are performance goals. AWQC are used as screening values for comparative purposes.

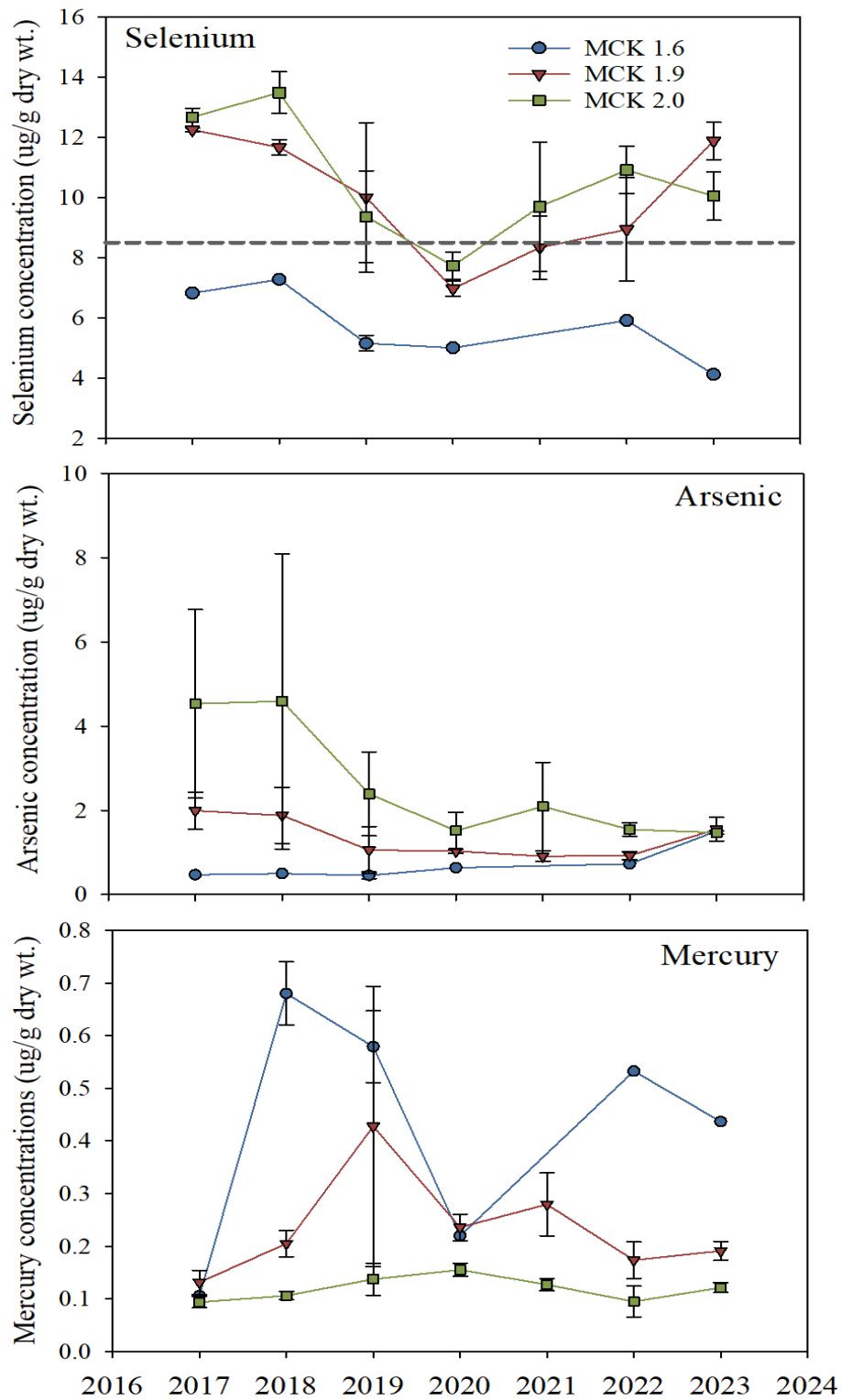


Figure 3.9. Mean dry-weight concentrations of selenium, arsenic, and mercury in whole-body forage fish from the McCoy Branch watershed, 2017-2023.

3.3.4.3 Site inspections

As part of this 2024 FYR, a site manager interview was conducted on August 23, 2023, and a site visit of FCAP was conducted on October 18, 2023. The purpose of the inspection was to assess the protectiveness of the remedy by reviewing identified controls currently in place and watershed monitoring information required in the FCAP ROD. There were no deficiencies identified during the site visit. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

3.3.4.4 LUC verification and certification/engineered remedy verification

All FCAP LUCs and engineered remedies specified in Tables 3.15 and 3.16 were verified for this 2024 FYR. Results are summarized in Table 3.18, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of the table identifies the specific table listing the requirements and the section providing detail of the verifications. The certification of LUC implementation for FY 2023 for FCAP is included in Appendix D.

Table 3.18. Verification of LUCs and engineered remedy integrity at FCAP

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirement/status review
LUCs and engineered remedy	FCAP	Implemented	See Tables 3.15 and 3.16 and text below

FCAP = Filled Coal Ash Pond

LUC = land use control

Over the last 3 years, FCAP underwent S&M on a regular schedule in accordance with the Y-12 FIT Manual. Quarterly inspections by the Y-12 S&M Program included dam and slope stability, vegetative cover of dam and adjacent slopes, settling basing, spillway, underdrain discharge pipe, PTS area, benchmarks, and site security and access controls. The LUM application documents S&M inspections.

Maintenance from FYs 2021–2023 included removing unwanted vegetation and grass from the spillway (FYs 2021 and 2023), deploying and adjusting the location of erosion wattles (FYs 2022–2023), and removing deep-rooted sycamore trees between the settling basin and the base of the dam (FY 2022).

Additionally, FCAP is located within the Y-12 Property Protection Area, and access to the site is controlled and limited to authorized personnel. A Property Record Notice for FCAP was filed on June 11, 1997, at the Anderson County Register of Deeds office and remains in place. An engineering assessment on the stability of the FCAP dam was performed in FYs 2019–2020. The analysis of modeled seismic and storm events determined overall risk to personnel and the public is low to extremely low.

3.3.5 Technical Assessment

Table 3.19 summarizes the technical assessment for FCAP.

3.3.5.1 Question A: Is the remedy functioning as intended by the decision documents?

The primary goal of the action to minimize migration of contaminants into surface water has been achieved through maintenance activities in FY 2019 that significantly increased hydrologic residence within the PTS from pre-maintenance conditions. Following maintenance activities, the percent reduction for arsenic ranged from 50% to 90% between the PTS influent (MCK 2.05) and effluent locations (MCK 2.0) during FY 2023. Additional maintenance activities were conducted in FYs 2022–2023, which included deploying and adjusting the location of erosion control wattles in the stormwater conveyance upstream of the revetment spillway to impede stormwater flow and ash transport across the surface of FCAP.

Table 3.19. FYR summary for FCAP/Upper McCoy Branch

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	Yes	Migration of contaminants into surface water has been achieved through maintenance activities in FY 2019 that significantly increased hydrologic residence within the PTS from pre-maintenance conditions. Arsenic reduction in the PTS ranged from 50% to 90% between the PTS influent (MCK 2.05) and effluent locations (MCK 2.0) during FY 2023
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	Improvements to the physical condition of the PTS to increase hydrologic residence time and metals removal efficiency within the unit were performed in 2019. Monitoring results since that time indicate performance is improving as the PTS is reestablished. The percent reduction for arsenic ranged from 50% to 90% between the PTS influent (MCK 2.05) and effluent (MCK 2.0) locations during FY 2023. The estimated annual O&M costs for the remedy are presented in Section 1.5.4. O&M costs are consistent with forecasted costs for the project
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	Controls are being implemented and maintained per the Y-12 S&M Program FIT Manual (UCOR-4199). LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	There have been no additional actions since the RA was completed
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	Yes	A non-routine maintenance action was recommended in the 2016 FYR (DOE/OR/01-2718&D2) to address diminishing PTS performance. Maintenance of the PTS was completed in 2019. Monitoring results since that time indicate performance is improving as the PTS is reestablished
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	Yes	Numerical performance standards are not required, and no chemical-specific ARARs were identified by the FCAP ROD (DOE/OR/02-1410&D3)
Have there been any changes in land use or expected land use on or near the site?	No	Site remains under government control on DOE property. There is no change in future land use anticipated
Have new human health or ecological exposure pathways or receptors been identified?	No	Site use remains unchanged; monitoring to date shows no new impacts to surface water in McCoy Branch
Have new contaminants or contaminant sources been identified?	No	Data collected under ongoing post-RA monitoring are continuing to be evaluated

Table 3.19. FYR summary for the FCAP/Upper McCoy Branch (cont.)

Question	Response	Note
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	NA	No chemical treatment remedies were employed
Have there been any changes in the physical site conditions?	No	The site remains under government control on DOE property
Have there been any changes in the toxicity factors for COCs?	NA	Risk-based performance standards are not specified in the FCAP ROD
Were there significant changes in the standardized risk assessment methodologies?	NA	Risk-based performance standards were not the basis for action in the FCAP ROD
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	Yes	A full baseline ERA was conducted during the FCAP RI (DOE/OR/01-1268&D2). Investigatory studies to characterize fish health in Rogers Quarry and fish bioaccumulation throughout the McCoy Branch watershed suggested actions taken in the FCAP PTS were effective at reducing exposure to ash-associated contaminants throughout the McCoy Branch watershed, and there is no evidence the health of fish populations is affected by exposure to ash
Is the site located in an area subject to natural disasters?	Yes	There is a low probability of earthquakes and tornadoes in the region. To assess potential erosion damage associated with high-intensity rainfall events, the dam and spillway are inspected following any 3-in., 24-hr rainfall event
ARAR = applicable or relevant and appropriate requirement COC = contaminant of concern DOE = U.S. Department of Energy ERA = ecological risk assessment FCAP = Filled Coal Ash Pond FIT = Facility Inspection and Training FY = fiscal year FYR = Five-Year Review LUC = land use control LUM = Land Use Manager MCK = McCoy Branch kilometer NA = not applicable O&M = operation and maintenance PTS = passive treatment system RA = remedial action RI = remedial investigation ROD = Record of Decision S&M = surveillance and maintenance TBC = to be considered Y-12 = Y-12 National Security Complex		

LUCs (property record notices and access controls) and quarterly S&M inspections are in place and are functioning as intended. Information from the interview with the S&M manager indicates all engineered remedy requirements are being met (Table 3.16). In FYs 2021–2023, no problems with the remedy or site-specific concerns were noted during the interview. No other changes in physical site conditions were observed.

The estimated annual O&M costs for the remedy are presented in Section 1.5.4. O&M costs are consistent with forecasted costs for the project.

3.3.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2), a FYR process was used to determine if key chemical-specific ARAR and risk-assessment assumptions used at the time of the FCAP ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B (Section B.4) and summarized below. The FYR evaluation was conducted using the most-current ARAR and risk-based criteria available.

3.3.5.2.1 ARARs

Numerical performance standards were not specified in the FCAP ROD, and no chemical-specific ARARs were identified by the FCAP ROD.

3.3.5.2.2 Risk

A comparison of toxicity values for the human health COC (i.e., Th-228 and its daughters) between the time of the remedy and now suggests the calculated human health risk to a hypothetical receptor would increase slightly as compared to that originally estimated. However, controls in place prevent access to the site, thus making exposure pathways associated with the ash incomplete.

3.3.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The scope of the FCAP action was source control of the ash to reduce releases from the ash to the environment. Surface water was evaluated as part of the action, and no action was taken on the surface water; therefore (because no action was taken pursuant to EPA guidance), no ARAR was triggered (EPA 1991).

A full baseline ERA was conducted during the FCAP RI. Data used to support the risk assessment included toxicity tests, vegetation sampling, media sampling, and community surveys. Risk was found to benthic invertebrates in the sediments adjacent to the ash. The ERA determined all lines of evidence available for fish, benthic macroinvertebrates, plants, soil invertebrates, small mammals, and wide-ranging mammals indicate potential for adverse effects from the current inorganic contaminant levels at the site. The remedy was selected to address these risks, and the goal of the remedy, as stated in the FCAP ROD, was solely to *reduce or eliminate contaminant entry into the Upper McCoy Branch surface waters... and the monitoring was to verify that the passive treatment system reduces contaminant levels in water entering Upper McCoy Branch at least as well as the existing wetlands*. Arsenic does continue to leach from the ash, but at quantities deemed acceptable in 1998 after the remedy was in place and continue to be considered protective of the environment. No information has changed with respect to arsenic impact on the environment at FCAP to change the conclusion made in the FCAP ROD in 1996. The final ChR ROD will include an ecological evaluation.

There is a low probability of earthquakes or tornadoes in the region. As described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability. To assess potential erosion damage associated with high-intensity rainfall events, the dam and spillway are inspected following any 3-in., 24-hr rainfall event.

3.3.6 Issues/Recommendations

There were no issues or recommendations identified in this 2024 FYR for FCAP.

3.3.6.1 Other findings

There were no additional findings identified in this 2024 FYR for FCAP.

3.3.7 Protectiveness Statement

The remedy implemented at FCAP (containment) is protective of human health and the environment. Protectiveness is achieved through dam reengineering and a PTS. LUCs are in place to prevent human exposure. Access controls, including signs, fencing, and gates, are in place. A property record notice containing land use restrictions is in place at the Anderson County Court House, Register of Deeds office.

Additional actions as necessary will be addressed under a future ChR ROD (FFA Appendix J date 2038; RAR 2041).

3.3.8 Next Review

The next (seventh) CERCLA FYR on the ORR will be due August 20, 2028.

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4. OAK RIDGE ASSOCIATED UNIVERSITIES SOUTH CAMPUS FACILITY

This chapter provides the FYR for the CERCLA ORAU SCF action. The FFA originally identified two “other” CERCLA actions that are not physically situated within one of the five established watersheds or the ChR administrative watershed but are located on the ORR. The second action, *Interim Record of Decision for the Oak Ridge National Laboratory, Waste Area Grouping 11 Surface Debris, Oak Ridge, Tennessee* (DOE/OR-1055&D4), will be included in the 2025 FYR along with actions in BCV. Table 4.1 lists the decision documents and action status for the ORAU SCF action.

Table 4.1. CERCLA action at ORAU SCF

CERCLA action	Decision document, date signed	Action status
ORAU SCF	ROD (DOE/OR/02-1383&D3): 12/28/95	RAR ^a (DOE/OR/02-1474&D2): approved 08/20/96

^aMonitoring and land use control requirements for ORAU SCF are managed in the *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2466&D5).

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

ORAU = Oak Ridge Associated Universities

RAR = Remedial Action Report

ROD = Record of Decision

SCF = South Campus Facility

4.1 OAK RIDGE ASSOCIATED UNIVERSITIES SOUTH CAMPUS FACILITY

ROD: DOE/OR/02-1383&D3: 12/28/95

RAR: DOE/OR/02-1474&D2: 08/20/96

Decision document: *Record of Decision for Oak Ridge Associated Universities, South Campus Facility, Oak Ridge, Tennessee*

EPA SEMS OU: 27 – ORAU – South Campus Fac

4.1.1 Introduction

ORAU SCF is a former experiment station where radionuclide effects on animals were studied (Figure 4.1). Activities and buildings at ORAU SCF either supported research on exposed animals or managed those animals before and after exposing them to radiation. ORAU SCF included pasture, barns, laboratories, mechanical buildings, surgical and necropsy rooms, carpentry shops, a steam power plant, storage areas, and wastewater treatment facilities and ponds. Potential contamination at ORAU SCF was investigated because operations at these facilities may have resulted in the release of chemical and/or radioactive substances to the environment.

4.1.1.1 Site chronology and background

To support the 1995 *Remedial Investigation/Feasibility Study South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1274/V1&D2; ORAU SCF RI/Feasibility Study [FS]), soil, surface water, sediment, and groundwater were sampled and analyzed for contamination. TCE and benzene were identified as COCs in groundwater. Most compounds were near background levels. TCE was detected in soil and groundwater just east of a mechanical building in a 22,400-ft² area approximately 5 ft deep. No historical or facility operations records document the release of TCE or suggest the original source of the TCE.

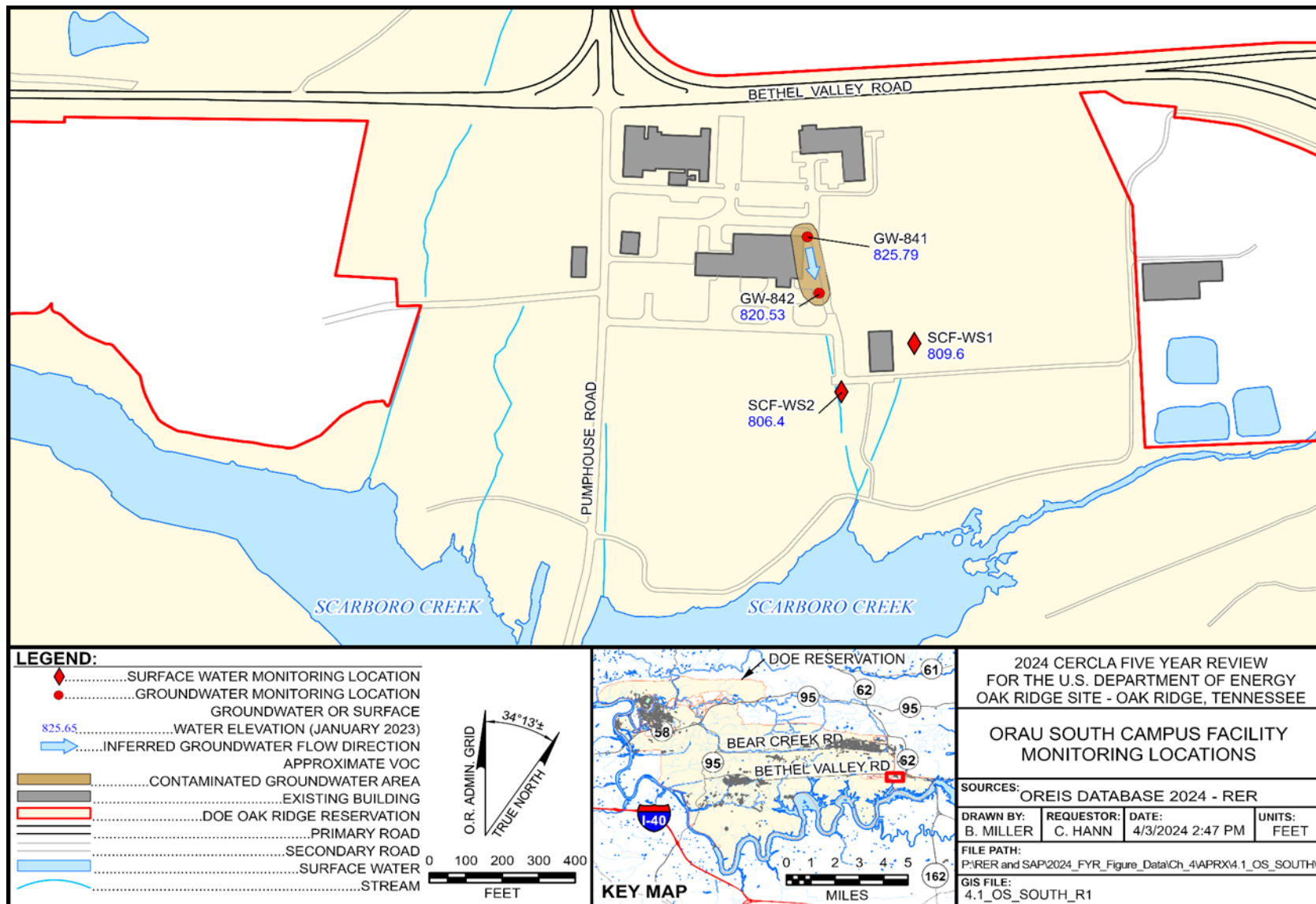


Figure 4.1. ORAU SCF location map and monitoring locations.

The nearby mechanical building was used as a maintenance garage. Detected groundwater concentrations ranged from 380 µg/L to 1400 µg/L. TCE concentrations up to 3 µg/L were detected in the shallow bedrock well at a depth of 23 ft bgs. Laboratory analysis detected TCE degradation products at the site, indicating local environmental factors naturally degrade TCE. Due to the low, estimated, overall quantity of TCE; its ability to degrade naturally; and the slow rate of migration; TCE was not likely to emerge into surface water at concentrations above regulatory limits. Benzene was detected at low levels in groundwater from one monitoring well. The well intercepted a bedding plane directly down-dip from the former location of the USTs that were removed in 1988. The location suggested benzene was residual from the USTs. Table 4.2 presents the site chronology for ORAU SCF.

Table 4.2. Site chronology for ORAU SCF

Event	Date
Five USTs and associated contaminated soil were removed and treated	1988
Groundwater monitoring wells were installed and sampled	1988–1989
A scoping survey was written, and existing data were reviewed	1989
A CERCLA site inspection was conducted	1991
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
CERCLA RI fieldwork was performed	1993
Groundwater was monitored quarterly	1994–1995
The ORAU SCF RI/FS (DOE/OR/02-1274/V1&D2) and Proposed Plan (DOE/OR/02-1310&D2) were completed	1995
The ORAU SCF ROD (DOE/OR/02-1383&D3) was approved	1995
The RAR (DOE/OR/02-1474&D2) was approved, and groundwater access/use limitations were added to the deed	1996
ORAU SCF was included in the initial 2001 FYR of the ORR (DOE/OR/01-1941&D2/R1)	2001
ORAU SCF was included in the second 2006 FYR for the ORR (DOE/OR/01-2289&D3)	2006
A recommendation to change the no action remedy to an MNA remedy was submitted	2007
ORAU SCF was included in the third 2011 FYR for the ORR (DOE/OR/01-2516&D2)	2011
ORAU SCF was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D2)	2016
ORAU SCF was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021
LUCs for ORAU SCF were incorporated into the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5), approved February 2023	2023

CERCLA = Comprehensive Environmental Response,
Compensation, and Liability Act of 1980
ChR = Chestnut Ridge
CMP = Comprehensive Monitoring Plan
DOE = U.S. Department of Energy
EFPC = East Fork Poplar Creek
EPA = U.S. Environmental Protection Agency
FFA = Federal Facility Agreement
FS = feasibility study
FYR = Five-Year Review

LUC = land use control
MNA = monitored natural attenuation
ORAU = Oak Ridge Associated Universities
ORR = Oak Ridge Reservation
RAR = Remedial Action Report
RI = remedial investigation
ROD = Record of Decision
SCF = South Campus Facility
TDEC = Tennessee Department of Environment and Conservation
UST = underground storage tank

Key documents reviewed for this FYR include:

- ORAU SCF ROD (DOE/OR/02-1383&D3).
- *Remedial Action Report for Post-Record of Decision Monitoring at Oak Ridge Associated Universities South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1474&D2).
- EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).
- 2021 FYR (DOE/OR/01-2895&D2).
- 2022 RER (DOE/OR/01-2916&D2); specifically Chapter 8, “CERLCA Actions at Other Sites.”
- 2023 RER (DOE/OR/01-2938&D2); specifically Chapter 8, “CERLCA Actions at Other Sites.”
- 2024 RER (DOE/OR/01-2960&D1); specifically Chapter 8, “CERLCA Actions at Other Sites.”

4.1.1.2 Physical characterization

The ORAU SCF is located southeast of Y-12 at the intersection of Pumphouse Road and Bethel Valley Road on the eastern edge of the ORR (Figure 4.1). Surface water at the site consists of Scarboro Creek, intermittent streams, drainage ditches, storm sewers, and swine water ponds. All of the features drain into the Scarboro Creek embayment and eventually into Melton Hill Lake. Shallow groundwater emerges as wet-weather springs near the embayment. At the time of the site visit in October 2023, a commercial building was noted to be under construction east-northeast of the ORAU SCF. The location of the building under construction is shown on Figure 4.1 in the white area (non-DOE property).

4.1.1.3 Land and resource use

Buildings in the northwest area of ORAU SCF are still used as federal offices and storage space. Hay is harvested from the pasture areas. DOE intends to maintain control of this site for the foreseeable future. Groundwater at ORAU SCF is not used at the facility or at any nearby locations, and there is little potential for future residential use of ORAU SCF groundwater. Municipal water serves the site and is expected to continue to serve the site, further reducing the need for future residential groundwater use.

4.1.2 Response Action Summary

4.1.2.1 Basis for taking action

A baseline HHRA conducted as part of the ORAU SCF RI/FS concluded TCE in groundwater would result in a carcinogenic risk of 4×10^{-3} and an HI of 19 for a future adult resident. However, groundwater in the impacted area is not considered a drinking water source. The ERA also determined the COCs do not present an unacceptable risk to wildlife or plants. The ORAU SCF RI/FS determined ORAU SCF posed no unacceptable risk to humans or the environment due to incomplete exposure pathways; therefore, no RA was necessary to ensure protection of human health and the environment, provided groundwater is not used as a drinking water source. The ORAU SCF ROD specified groundwater monitoring at the VOC-contaminated area and defined LUCs that include a groundwater use restriction. The ORAU SCF ROD also indicates a FYR is required by CERCLA Section 121(c) because hazardous constituents remain onsite. The reviews are to be conducted every 5 years until natural attenuation in the zone of contamination decreases TCE concentrations below regulatory levels of concern.

4.1.2.2 Response action

The selected remedy for ORAU SCF was no action; however, the alternative prescribed in the ORAU SCF ROD included periodic sampling to ensure evaluations completed in support of the ORAU SCF RI/FS are accurate and natural attenuation in the zone of contamination continues as expected. TCE was expected to naturally attenuate and, therefore, no RA was considered necessary.

4.1.2.3 Status of implementation

The ORAU SCF ROD specified monitoring for four wells (MW-19, MW-43a, MW-43b, and MW-43c—these wells were subsequently renamed GW-841, GW-842, GW-843, and GW-844, respectively) and a surface water seep location (SCF-WS2) approximately 180 ft downgradient of the MW-43 well cluster. Note the initial surface seep was subsequently covered by new construction at the site, so a second surface seep, SCF-WS2, was selected for monitoring approximately 300 ft downgradient of the MW-43 well cluster. These five locations were to be sampled once every 2 years for as long as TCE contamination above acceptable levels was present. The ORAU SCF ROD stipulated the first sampling event occur during the rainy season closest to and within 2 years of signing of the ORAU SCF ROD (by December 28, 1997). Sampling of well GW-844 was discontinued after 1997. In addition to required biannual monitoring beginning in FY 2001, DOE increased the frequency of sampling to collect wet- and dry-season samples on an annual basis to track seasonal variability in the results. Semiannual sampling and sampling of well GW-843 were discontinued at the end of FY 2006, and annual sampling of wells GW-841 and GW-842 and two surface water locations (SCF-WS1 and SCF-WS2) during the wet season has continued. SCF-WS1 is an additional surface seep that is southeast of well cluster MW-43 and has been sampled since FY 2004 for information purposes.

4.1.2.4 LUC requirements

LUCs are per the ORAU SCF ROD, which requires notification of the contamination be placed in the property title to alert potential owners of risk. Per the ORAU SCF ROD:

Because the site poses no unacceptable current or future risk to humans or the environment provided the TCE-contaminated groundwater is not used as a drinking water source, DOE has selected a no action remedy for the site. The no action alternative includes periodic sampling to ensure that natural attenuation in the zone of contamination continues as expected. In addition, a statement will be placed in the property title notifying owners of the contamination. The monitoring and the title statement will provide...ICs that help ensure the site continues to pose no unacceptable risk.

LUCs for ORAU SCF are listed in Table 4.3. Results of the FYs 2021–2023 verification of LUCs are summarized in Section 4.1.4.4.

4.1.2.5 Engineered remedies

There are no engineered remedies for ORAU SCF.

Table 4.3. LUC summary for ORAU SCF

Type of control	Duration	Implementation	Affected area ^a	Verification frequency
Property record notices	Until concentrations of hazardous substances are at such levels to allow for UU/UE; CERCLA groundwater use prohibitions are in place until the final decision is made on groundwater	Notice recorded by DOE in accordance with state law at County Register of Deeds office and copied to appropriate zoning office: Tennessee Code Annotated notice of land use restrictions after signing of the ORAU SCF ROD	All WMAs and other areas where hazardous substances are left in place at levels requiring land use and/or groundwater restrictions: ORAU SCF	Every 5 years

^aSpecific locations are identified in the *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2466&D5).

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

DOE = U.S. Department of Energy

LUC = land use control

ORAU = Oak Ridge Associated Universities

ROD = Record of Decision

SCF = South Campus Facility

UU/UE = unrestricted use/unrestricted exposure

WMA = waste management area

4.1.3 Progress Since Last Five-Year Review

The 2021 FYR concluded:

The remedy implemented at SCF (LUCs) is protective of human health and the environment. Protectiveness is achieved with LUCs to prevent human exposure until MNA parameters (all COCs below MCLs) are achieved. A property record notice containing groundwater use restrictions is in place at the county Court House, Register of Deeds office.

No issues were identified during the FY 2021 FYR.

4.1.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 4.1.1.1.
- Reviewed effectiveness and performance monitoring data and evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - S&M inspections and maintenance information.
 - Changes in land use and verifying LUCs.
 - Surface water and groundwater monitoring data.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data and LUCs, as specified in the associated decision documents.

4.1.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this FYR.

4.1.4.2 Data review

Current monitoring requirements for ORAU SCF are included in the EFPC RAR CMP. The ORAU SCF ROD did not establish clear goals for groundwater quality; however, it did specify periodic monitoring of groundwater at selected wells and at a surface seep location. One additional surface seep in the vicinity of ORAU SCF is also sampled. Per the ORAU SCF ROD:

Monitor the groundwater within the zone of contamination until attenuation reduces contaminant levels to below regulatory levels of concern.

During the FYs 2021–2023 evaluation period, a single TCE result greater than the MCL was reported at well GW-841 in 2023. All other groundwater samples from the site have exhibited TCE concentrations less than the MCL. Figure 4.2 shows VOC concentrations in wells GW-841 and GW-842 have exhibited long-term decreasing trends from FYs 1994–2023. During FY 2023, TCE was detected at a concentration of 6.6 µg/L in the January sample from well GW-841. TCE concentrations in samples from well GW-842 were less than the 5-µg/L MCL during the FYs 2021–2023 evaluation period. cis-1,2-DCE exhibited increasing concentrations in well GW-841 (0.71 J µg/L in FY 2021 to 15 µg/L in FY 2023) and a stabilizing trend in well GW-842 (0.93 J µg/L in FY 2021 to 1 µg/L in FYs 2022–2023). Maximum concentrations during FYs 2021–2023 were much less than the 70-µg/L MCL for cis-1,2-DCE (Figure 4.2). VC was not detected in samples from either groundwater monitoring well. No VOCs were detected in surface water at the site during FYs 2021–2023.

4.1.4.3 Site inspection

As part of this FY 2024 FYR, the site manager was interviewed on August 23, 2023, and a site visit was conducted on October 18, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and monitoring information required in the ORAU SCF ROD. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

4.1.4.4 LUC verification and certification and engineered remedy verification

4.1.4.4.1 LUCs

ORAU SCF LUCs specified in Table 4.3 were verified for this 2024 FYR. The certification of LUC implementation for FY 2023 for ORAU SCF is included in Appendix D. Results are summarized in Table 4.4, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of Table 4.4 identifies the specific table listing the requirements and the section providing details of the verifications.

A Property Record Notice for ORAU SCF was filed on August 28, 1996, at the Anderson County Register of Deeds office and remains in place. Over the last 3 years, land use restrictions have been maintained at the site. An online search of the Anderson County Register of Deeds website conducted annually verifies the notice remains in place. All LUCs are in place and verified, as well as tracked and archived, in LUM.

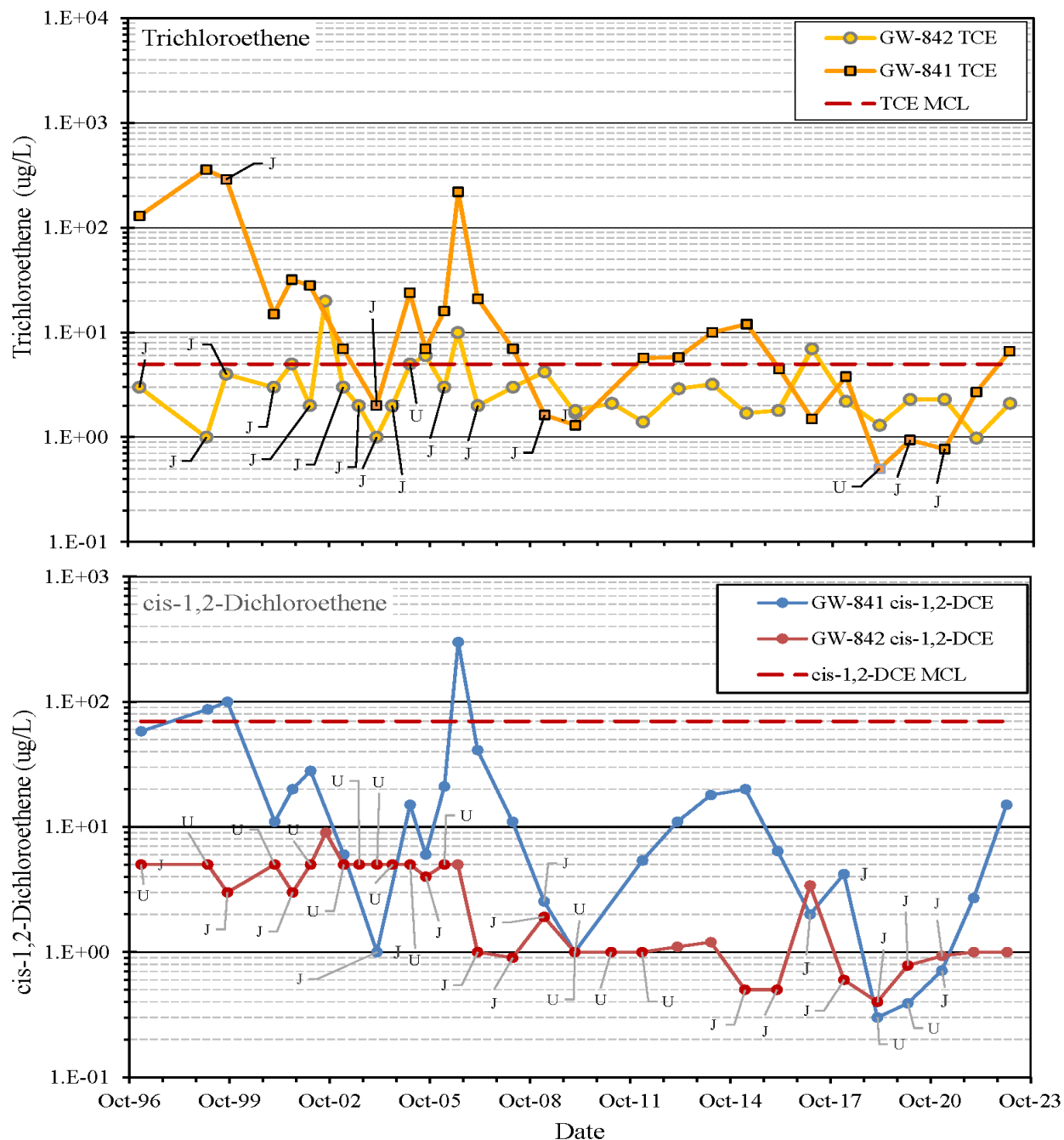


Figure 4.2. VOC concentrations in wells GW-841 and GW-842 at ORAU SCF.

Table 4.4. Verification of LUCs for ORAU SCF

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirement/status review
LUC	ORAU SCF	Implemented	See Table 4.3 and text below
LUC = land use control	ORAU = Oak Ridge Associated Universities	SCF = South Campus Facility	

4.1.4.4.2 Engineered remedy

There were no engineered remedy components to the ORAU SCF actions.

4.1.5 Technical Assessment

Table 4.5 summarizes the technical assessment performed for ORAU SCF.

Table 4.5. FYR summary for ORAU SCF

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	NA	No numerical performance standards were specified in the ORAU SCF ROD. Based on the FY 2006 FYR, the remedy is now treated as an MNA remedy for groundwater, with the goal of attaining < MCLs for VOCs
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	Property notice is effectively preventing any possible use of groundwater for drinking water. O&M costs are consistent with forecasted costs, indicating there are no unanticipated costs with the remedy
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	LUCs are implemented and maintained per the EFPC and ChR RAR CMP. LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	NA	There were no immediate threats associated with this action
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There is no operating system in place under this remedy
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	NA	Because this was identified as an NFA decision, there were no ARARs listed in the ORAU SCF ROD
Have there been any changes in land use or expected land use on or near the site?	No	The site remains industrial use on DOE-controlled property. Commercial development has occurred near the ORAU SCF
Have new human health or ecological exposure pathways or receptors been identified?	No	Administrative controls prevent use of groundwater as drinking water
Have new contaminants or contaminant sources been identified?	No	Monitoring indicates reduction in existing contaminants and no new chemicals identified
Have there been any changes in the toxicity factors for COCs?	NA	Risk-based performance standards are not specified in the no action ORAU SCF ROD
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	No	No chemical treatment remedies were applied as part of the RA at ORAU SCF
Have there been any changes in the physical site conditions?	No	A commercial building was under construction in the parcel east-northeast of the ORAU SCF at the time of the site visit
Were there significant changes in the standardized risk assessment methodologies?	NA	Risk-based performance standards were not the basis for action in the ORAU SCF ROD

Table 4.5. FYR summary for ORAU SCF (cont.)

Question	Response	Note
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	Yes	ERA determined TCE does not present an unacceptable risk to wildlife or plants
Is the site located in an area subject to natural disasters?	Yes	Portions of ORAU SCF are near the PC 100-year floodplain. There is a low probability of earthquakes and tornadoes in the region
ARAR = applicable or relevant and appropriate requirement		NA = not applicable
ChR = Chestnut Ridge		NFA = no further action
CMP = Comprehensive Monitoring Plan		O&M = operation and maintenance
COC = contaminant of concern		ORAU = Oak Ridge Associated Universities
DOE = U.S. Department of Energy		PC = Poplar Creek
EFPC = East Fork Poplar Creek		RA = remedial action
ERA = ecological risk assessment		RAR = Remedial Action Report
FY = fiscal year		ROD = Record of Decision
FYR = Five-Year Review		SCF = South Campus Facility
LUC = land use control		TBC = to be considered
LUM = Land Use Manager		TCE = trichloroethene
MCL = maximum contaminant level		VOC = volatile organic compound
MNA = monitored natural attenuation		

4.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

Under current technical protocol, this decision would be considered a monitored natural attenuation (MNA) decision, rather than a no action decision. The *2006 Remediation Effectiveness Report/Second Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/OR/01-2289&D3; 2006 FYR) recommended the remedy be continued as MNA for groundwater, with the ultimate goal of reaching MCLs for VOCs; annual sampling be continued; and remaining wells (except GW-841 and GW-842) be plugged and abandoned. The ORAU SCF remedy is currently functioning as planned, with sampling events reporting VOCs generally below their respective MCLs. VOC concentrations in wells GW-841 and GW-842 have exhibited long-term decreasing trends from FYs 1994–2023. There was a single exceedance of the MCL for TCE (5 µg/L) in well GW-841 (6.6 µg/L) during FYs 2021–2023. However, there is no unacceptable current or future use to humans or the environment because LUCs (property record notices) are in place and functioning as intended. The estimated annual costs for the remedy are included in the overall Y-12 S&M costs presented in Section 1.5.4. There have been no costs associated with the ORAU SCF remedy beyond the normal expected maintenance.

4.1.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2) and Appendix B (Section B.2), a FYR process was used to determine if key chemical-specific ARAR and risk-assessment assumptions used at the time of the ORAU SCF ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B (Section B.5) and summarized below.

4.1.5.2.1 ARARs

Because the original remedy was NFA, there were no ARARs included in the decision documents. Potential changes in assumptions used for the decision process at the ORAU SCF were reviewed for this FYR. No new chemical-specific standards for ORAU SCF COCs have become available since the ORAU SCF ROD was signed. Specifically, the standard for terminating monitoring in the ORAU SCF ROD, an “acceptable level of TCE” (TCE MCL = 5 µg/L), has not changed.

4.1.5.2.2 Risk

The land use/receptor/exposure pathway assumptions included in the ORAU SCF ROD have not changed, and the land remains under strict DOE control. The most important changes in toxicity values since the ORAU SCF ROD was signed are those for TCE, which is the primary COC. Changes in the TCE toxicity value result in higher risk than estimated in the ORAU SCF RI/FS. However, because the acceptable level for TCE is its MCL, and because groundwater is not currently being used or expected to be used in the future, this change does not affect the remedy selected in the ORAU SCF ROD.

Increasing commercial development exists in the area near ORAU SCF; however, this development has not led to increased exposure to contaminated groundwater because there is no use of the groundwater. Potential contact with contaminated groundwater at a wet-weather seep is no longer possible because the seep was covered during site construction, and no new exposure pathways have developed at ORAU SCF.

EPA published the *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA 2002) after the ORAU SCF ROD was approved. In 2015, EPA published the *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*, along with an online tool (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>) for calculating VISLs. The pathway for VOC vapors to intrude into buildings at the site would be volatilization of the chemicals from the groundwater table, or capillary fringe above the water table into air in soil pores with subsequent diffusion upward to the shallow subsurface beneath an occupied building. In this 2024 FYR, VISL was run for a commercial receptor for ORAU SCF groundwater using default parameters for commercial exposures. Between FYs 2021–2023, the maximum TCE concentrations in wells GW-841 and GW-842 were 6.6 µg/L and 2.3 µg/L, respectively, with the FY 2023 concentration in well GW-841 slightly above the 5-µg/L MCL for TCE. The analytical results for TCE in both wells exceed the default commercial VISL of 2.18 µg/L at an HI of 1 or ILCR of 1E-06, but do not exceed the VISL at an HI of 1 or an ILCR of 1E-05 (see Table B.11, Appendix B). Groundwater monitoring will continue at ORAU SCF. DOE will consider the potential presence of VOCs in soil in future site development plans.

4.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No additional information has been identified that could call into question the protectiveness of the remedy. There is a low probability of tornados and earthquakes in the region. As described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability.

4.1.6 Issues/Recommendations

No technical issues were identified for ORAU SCF during this 2024 FYR.

Currently, natural attenuation appears to be occurring at ORAU SCF, with VOC concentrations exhibiting a long-term decreasing trend (see Section 4.1.4.2). It is recommended the Project Team continue to review the interim action as an MNA decision.

4.1.6.1 Other findings

There were no additional findings identified in this 2024 FYR for ORAU SCF.

4.1.7 Protectiveness Statement

The remedy implemented at ORAU SCF (LUCs) is protective of human health and the environment. Protectiveness is achieved with LUCs to prevent human exposure until MNA parameters (all COCs below MCLs) are achieved. A property record notice containing groundwater use restrictions is in place at the Anderson County Court House, Register of Deeds office.

4.1.8 Next Review

The next (seventh) CERCLA FYR for ORAU SCF will be due August 2029.

4.2 REFERENCES

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- DOE/OR/02-1474&D2. *Remedial Action Report for Post-Record of Decision Monitoring at Oak Ridge Associated Universities South Campus Facility, Oak Ridge, Tennessee*, 1996, U.S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.
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5. OFFSITE: LOWER EAST FORK POPLAR CREEK

This chapter evaluates effectiveness and protectiveness of the completed CERCLA action for LEFPC (Table 5.1). LEFPC is located outside the DOE ORR boundary, and in previous FYRs was included with two other offsite decisions: LWBR and CR/PC. The LWBR and CR/PC decisions were evaluated in the 2023 FYR (DOE/OR/01-2947&D1). Because LEFPC and UEFPC (Chapter 2) are hydrologically connected, LEFPC is included in this 2024 FYR.

Table 5.1. CERCLA 2024 FYR actions at offsite locations

CERCLA action	Decision document, date signed	Action status
LEFPC	ROD (DOE/OR/02-1370&D2): 08/17/95 ESD (DOE/OR/02-1443&D2): 11/15/96	RAR (DOE/OR/01-1680&D5): 08/15/00

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ESD = Explanation of Significant Differences
FYR = Five-Year Review

LEFPC = Lower East Fork Poplar Creek
RAR = Remedial Action Report
ROD = Record of Decision

5.1 LOWER EAST FORK POPLAR CREEK

ROD: DOE/OR/02-1370&D2: 08/17/95
ESD: DOE/OR/02-1443&D2: 11/15/96
RAR: DOE/OR/01-1680&D5: 08/15/00

Decision document: *Record of Decision for Lower East Fork Poplar Creek*

EPA SEMS OU: 10 – LEFPC OU Y-12

5.1.1 Introduction

EFPC originates within Y-12 and flows through the city of Oak Ridge (Figure 5.1). The *East Fork Poplar Creek-Sewer Line Beltway Remedial Investigation* (DOE/OR/02-1119&D2; LEFPC RI) addressed all media associated with EFPC (surface water, stream channel sediments, floodplain soils, biota, and groundwater). For the purposes of cleanup, the creek was separated into UEFPC and LEFPC, with the separation point being the boundary of the ORR and the city at a monitoring station referred to as Station 17. The LEFPC ROD (DOE/OR/02-1370&D2) only included soil in the 100-year floodplain along LEFPC and the Sewer Line Beltway, terrestrial biota, and groundwater. A decision on the surface water, creek bank and creek bed sediment, and aquatic biota was deferred to a future decision document, primarily to account for upstream sources at Y-12 that are an ongoing source of contamination in the creek and should be remediated prior to making final decisions for EFPC inclusive of both the upper and lower portions. The UEFPC CERCLA efforts are addressed in Chapter 2.

5.1.1.1 Site chronology and background

From 1953–1983, operating the lithium isotope separation process at Y-12 resulted in the release of 239,000 lb to 470,000 lb of mercury into LEFPC. Although the primary mercury loss from Y-12 stopped in 1963, the inventory that had been released to the secondary sources (building drain systems, sewers, sumps, and connecting lines) within the plant site continued to be released into LEFPC. Some actions have been implemented and others under the UEFPC Phase I ROD are ongoing (Chapter 2) to reduce mercury releases to UEFPC flowing into LEFPC. Table 5.2 presents a detailed chronology of events surrounding LEFPC.

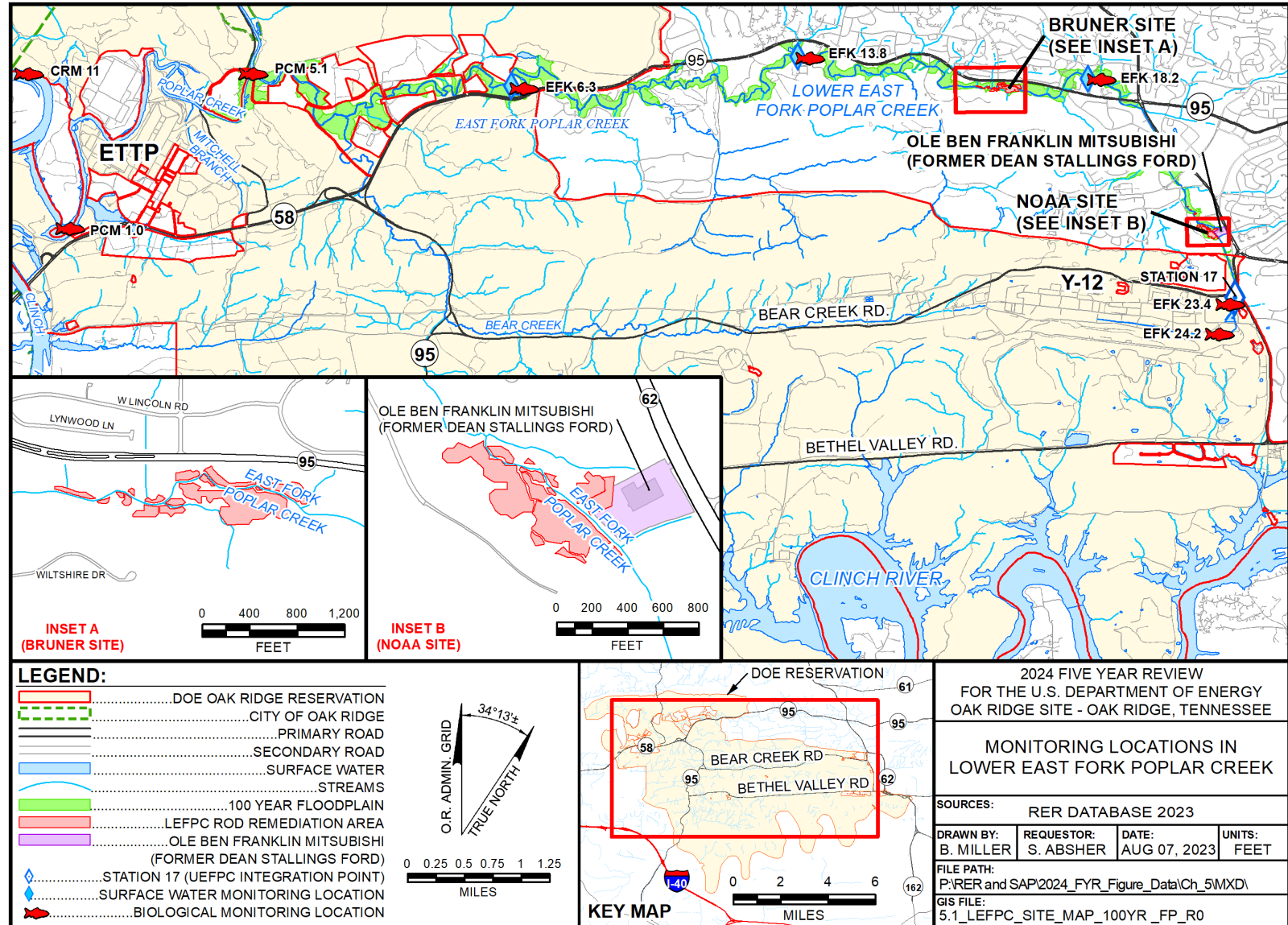


Figure 5.1. Site map of LEFPC.

Table 5.2. Chronology of events associated with LEFPC ROD

Event	Date
239,000 lb to 470,000 lb of mercury were released from lithium isotope separation processes at Y-12 into EFPC	1953–1983
Primary mercury loss from operations ceased	1963
Sediment and soil from the LEFPC floodplain were used as backfill during construction of the 10-mi Sewer Line Beltway	1982–1983
The state of Tennessee posted water and fish advisory signs warning the public that LEFPC is contaminated	1983
Portions of the Y-12 sewer were relined, which further reduced releases	1986–1987
The ORR was placed on the NPL for the Oak Ridge CERCLA site	1989
An FFA (DOE/OR-1014) was implemented between DOE, EPA, and TDEC	01/01/92
Twelve public meetings were held with citizens' groups to discuss the RI/FS and technical issues encountered during the studies	1993–1994
DOE submitted the LEFPC RI (DOE/OR/02-1119&D2)	1994
DOE submitted the LEFPC FS (DOE/OR/02-1185&D2)	1994
The LEFPC Proposed Plan (DOE/OR/02-1209&D3) was developed, and the public comment period was held	1995
The LEFPC ROD (DOE/OR/02-1370&D2) was signed by the FFA parties, which established the RL for mercury in floodplain soils at 400 ppm	August 1995
Confirmation sampling indicated excavation volumes would increase from 765 m ³ to 21,000 m ³	July 1995– March 1996
An ESD (DOE/OR/02-1443&D2) was prepared to document an increase in the volume of soil excavated during LEFPC remediation based upon results of confirmatory soil sampling and related cost changes	1996
4250 loose m ³ (5560 loose yd ³) of mercury-contaminated soils (> 400-ppm mercury) were removed from the floodplain near the NOAA area	07/08–09/14/96
29,970 loose m ³ (39,200 loose yd ³) of mercury-contaminated soils (> 400-ppm mercury) were removed from the floodplain near the Bruner site and to complete the NOAA area	03/03–10/24/97
Flow-management practices at Y-12 resulted in increased flow from the complex into LEFPC, as well as additional sediment load scoured from the UEFPC creek channel as flows increased	1998–2014
The LEFPC RAR (DOE/OR/01-1680&D5) was approved	2000
The initial, cursory FYR (DOE/OR/01-1941&D2/R1) of the LEFPC ROD, as part of the ORR-wide FYR, was performed after only 1 year of the signed LEFPC RAR	2001
The BSWTS (UEFPC remedial action) began operations (testing phase, March–August 2005)	March 2005
LEFPC was included in the second 2006 FYR for the ORR (DOE/OR/01-2289&D3)	2006
The State of Tennessee issued a new NPDES permit for mercury releases to surface water from Y-12 into LEFPC at Station 17	2006
LEFPC was included in the third 2011 FYR for the ORR (DOE/OR/01-2516&D2)	2011
The 2011 FYR identified a potential issue related to mercury uptake into biota and issued a protectiveness deferred determination	2011
To address the protectiveness deferred determination of the 2011 FYR, comprehensive ecological studies were performed along LEFPC to address mercury uptake in biota, concluding the original LEFPC ROD cleanup criteria were protective	2012–2015
NPDES permit reapplication was submitted	May 2016
LEFPC was included in the fourth 2016 FYR for the ORR (DOE/OR/01-2718&D2)	2016
Excavation/construction began for the Outfall 200 MTF (UEFPC remedial action)	FY 2020
LEFPC was included in the fifth 2021 FYR for the ORR (DOE/OR/01-2895&D2)	2021
The NPDES permit reapplication became effective October 1, 2022; however, much of the permit was still under appeal, including limits for legacy contamination including mercury	October 2022

Table 5.2. Chronology of events associated with LEFPC ROD (cont.)

BSWTS = Big Spring Water Treatment System	NOAA = National Oceanic and Atmospheric Administration
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980	NPDES = National Pollutant Discharge Elimination System
DOE = U.S. Department of Energy	NPL = National Priorities List
EFPC = East Fork Poplar Creek	ORR = Oak Ridge Reservation
EPA = U.S. Environmental Protection Agency	ppm = parts per million
ESD = Explanation of Significant Differences	RAR = Remedial Action Report
FFA = Federal Facility Agreement	RI = remedial investigation
FS = feasibility study	RL = remediation level
FY = fiscal year	ROD = Record of Decision
FYR = Five-Year Review	TDEC = Tennessee Department of Environment and Conservation
LEFPC = Lower East Fork Poplar Creek	UEFPC = Upper East Fork Poplar Creek
MTF = Mercury Treatment Facility	Y-12 = Y-12 National Security Complex

The key documents reviewed for this FYR include:

- LEFPC ROD.
- *Explanation of Significant Differences for the Lower East Fork Poplar Creek Record of Decision, Oak Ridge, Tennessee* (DOE/OR/02-1443&D2).
- *Remedial Action Report on the Lower East Fork Poplar Creek Project, Oak Ridge, Tennessee* (DOE/OR/01-1680&D5; LEFPC RAR).
- 2021 FYR (DOE/OR/01-2895&D2).
- EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).
- 2022 RER (DOE/OR/01-2916&D2); specifically Chapter 9, “Offsite.”
- 2023 RER (DOE/OR/01-2938&D2); specifically Chapter 9, “Offsite.”
- 2024 RER (DOE/OR/01-2960&D1); specifically Chapter 9, “Offsite.”

5.1.1.2 Physical characterization

EFPC originates within Y-12 and flows through the city of Oak Ridge (Figure 5.1). For the purposes of cleanup, the creek was separated into UEFPC and LEFPC, with the separation point being the boundary of the ORR and the city at a monitoring station referred to as Station 17. The UEFPC CERCLA efforts are addressed in Chapter 2.

The LEFPC ROD includes the soil in the 100-year floodplain along LEFPC and the Sewer Line Beltway. The LEFPC floodplain begins in UEFPC at the outfall at Lake Reality (upstream of Station 17), ends at the confluence of LEFPC and PC (Figure 5.1), and covers approximately 670 acres. The EFPC watershed covers approximately 19,072 acres. The Sewer Line Beltway includes parts of a sewer system for the city of Oak Ridge that was constructed in 1982–1983 and runs approximately 10 mi. This area was of concern because sediment and soil from the LEFPC floodplain were used as backfill during construction. The sewer system includes a northern portion located within residential and commercial areas and a southern section located within the LEFPC floodplain. In summary, the site includes portions of the ORR and commercial, recreational, and urban and rural residential areas within the city of Oak Ridge. The LEFPC RI concluded the Sewer Line Beltway soils presented no unacceptable risks; therefore, they are not specifically addressed further in this chapter.

5.1.1.3 Land and resource use

The LEFPC RI contained a series of maps presenting expected future land use. Figure 5.2 shows the future expected land use at the time of the LEFPC ROD (1994) and the most current land use available from the City of Oak Ridge (2023). Land uses displayed on the map are listed by RI segment and consist of the four land uses reviewed by the decision makers in the LEFPC ROD. They include: (1) *agricultural setting*, (2) *residential populations*, (3) *commercial setting*, and (4) *occasional use of open land*. Open land is land along the creek that had no commercial or residential development. The pathways evaluated for open land were recreational, including inadvertent ingestion of soil by children. The 2023 current land use map (Figure 5.2) further defines open land as municipal recreation (parks, golf courses, etc.) and greenbelt, based on the City of Oak Ridge 2023 zoning map. Segment 1 is closest to UEFPC/Y-12 and contains the National Oceanic and Atmospheric Administration (NOAA) site excavated as part of the RA. Segments 4 and 5 contain the former Bruner site excavated as part of the RA for LEFPC. Segment 9 ends at the confluence of LEFPC and PC.

At the time of the LEFPC RI, there were several tracts of land that were used as very low-density residential, small-farm agricultural use. The current land use was updated in the 2001, 2006, 2011, 2016, and 2021 FYRs, and again for this 2024 FYR. Land use changes since signing of the LEFPC ROD are provided in Table 5.3. Since the LEFPC ROD, residential use of the land adjacent to LEFPC has increased in three locations: (1) Wiltshire Drive, (2) Jackson Crossing, and (3) Southwood Subdivisions, as first noted in the 2006 FYR. In addition, Forest Creek Village was noted during the 2021 FYR survey (Figure 5.2). The status of these developments is detailed below:

- A residential development along Wiltshire Drive, downstream of the former Bruner remediation site – 12 residential parcels adjacent to LEFPC.
- Jackson Crossing Subdivision, with remaining agricultural areas now zoned residential – six residential parcels adjacent to LEFPC.
- Southwood Subdivision – 21 residential parcels adjacent to LEFPC.
- Forest Creek Village Subdivision is the newest subdivision and is located on the far west end of the residential use area identified on Figure 5.2 – approximately 30 residential parcels adjacent to LEFPC.

Within the Jackson Crossing and Southwood Subdivisions, the land located immediately adjacent to the creek is owned by the subdivision development group.

The City of Oak Ridge manages a greenbelt and two greenways (EFPC and Big Turtle Park Greenways) that are adjacent to LEFPC. Greenway trails are set aside for walking/jogging and some allow pets or cycling.

In January 1996, DOE executed a lease for 957-acre Parcel ED-1 (further downstream of residential developments) of the ORR to the Community Reuse Organization of East Tennessee (CROET) to develop a high technology-based industrial and business park (now known as the Horizon Center). The lease subsequently became effective in April 1998. On April 29, 2003, DOE transferred Parcel ED-1 from DOE to CROET. EPA concurred on the transfer of Parcel ED-1, excluding EFPC and Bear Creek and their associated floodplains (retained under DOE). The industrial and business park developable acreage is approximately 489 acres of the 957-acre parcel and consists of seven major development areas, ranging in size from 11 to 48 acres. DOE maintains ownership and control over the remainder of the parcel, which is referred to as the Natural Area (shown as greenbelt on Figure 5.2). No industrial development has occurred along EFPC.

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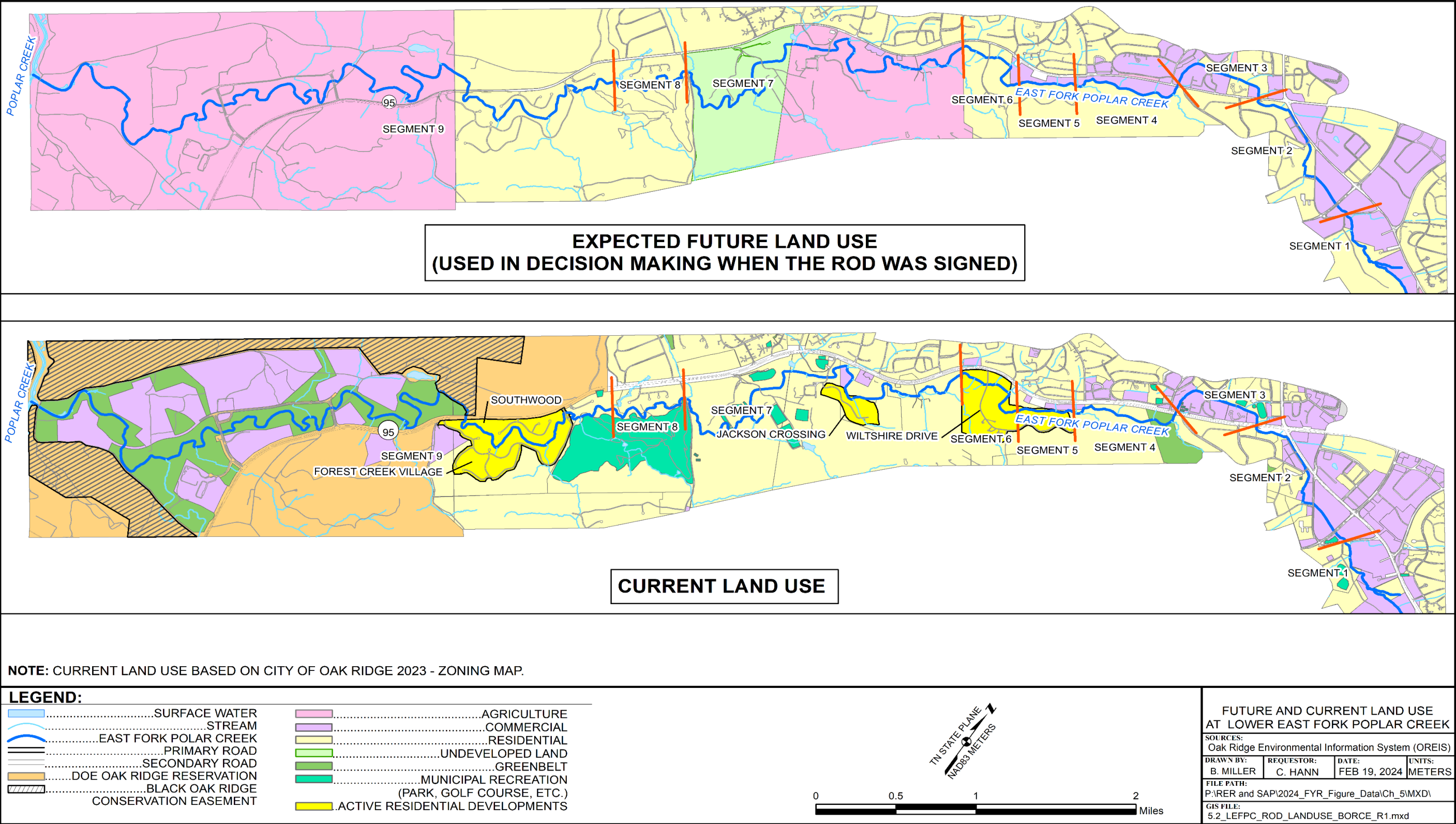


Figure 5.2. Expected future land use at time of LEFPC ROD (top) and current land use at LEFPC (bottom).

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Table 5.3. Changes in land use along LEFPC since ROD

Segment	RI/ROD land use assumption	Current land use (2024)	Note
1, 2, 3, 4, 5	Commercial, residential	Commercial, residential, municipal recreation, greenbelt	The greenbelt is located in segment 4. The EFPC Greenway is located in segments 3 through 5. Municipal recreation areas are small parcels scattered throughout segments 1 through 4, many near LEFPC. A portion of the Wiltshire Drive development is located in segment 5
6	Residential	Residential, commercial	This entire segment is now residential. A portion of the Wiltshire Drive development is located in this segment. There is a small commercial property north of Oak Ridge Turnpike (State Route 95)
7	Agriculture, commercial, open	Commercial, residential, municipal recreation	The majority of this segment is residential, with areas of municipal recreation and commercial development. Big Turtle Park Greenway trail and the Jackson Crossing Subdivision are located in this segment
8	Residential	Residential, municipal recreation	Municipal recreation located south of LEFPC
9	Residential, agriculture	Residential, municipal recreation, commercial, and greenbelt (within Horizon Center development), and DOE ORR property (including the Black Oak Ridge Conservation Easement recreational area)	Horizon Center commercial development; the Forest Creek Village residential development is on the south side of LEFPC in the vicinity of the Southwood Subdivision. Also note the Black Oak Ridge Conservation Easement area is on DOE property adjacent to the Horizon Center

DOE = U.S. Department of Energy
EFPC = East Fork Poplar Creek
LEFPC = Lower East Fork Poplar Creek

ORR = Oak Ridge Reservation
RI = remedial investigation
ROD = Record of Decision

5.1.2 Response Action Summary

5.1.2.1 Basis for taking action

The action was based on the outcome of the risk assessment, which evaluated potential exposure under: (1) an agricultural setting, (2) residential setting, (3) commercial setting, and (4) occasional use of open land:

- Floodplain soil:** Mercury was identified as the primary contaminant in floodplain soils, and direct exposure of children under a residential scenario to mercury via inadvertent soil ingestion and dermal contact was identified as the principal exposure route. Mercury was selected as the primary COC in floodplain soil, and a 400-ppm mercury RL was selected for floodplain soils in the LEFPC ROD (see Section 5.1.2.2 for more discussion). This RL was based on open land use and considered the site-specific form of mercury (mercuric sulfide) present in LEFPC. Based on this, the LEFPC ROD identified two primary areas of the floodplain that required excavation—the NOAA area, and the Bruner site. A third area of floodplain soils above the 400-ppm RL is located beneath the asphalt parking lot at the former Dean Stallings Ford automobile dealership (currently Ole Ben Franklin Mitsubishi). The LEFPC ROD determined this area did not require remediation as long as the area remained covered by the parking lot, with annual verification there were no land use changes. The process for identifying these areas considered technical, regulatory, and public input regarding three primary issues: (1) the concentration of mercury that would be considered health-protective, (2) the cost of remediation, and (3) land-owner wishes.

- **Groundwater:** Groundwater in the vicinity of the LEFPC floodplain was not being used at the time of the LEFPC ROD nor was it expected to be used in the future as a drinking water source. Thus, the determination of no unacceptable risk was made, even though there were concentrations greater than MCLs in the groundwater. Manganese and beryllium, the primary chemicals driving groundwater hazard and cancer risk, respectively, were found within background concentrations. The LEFPC ROD indicated DOE should monitor to detect any future residential use and mitigate any use if unacceptable exposure is detected.
- **Protection of ecological resources:** The majority of risk to aquatic biota came from water-borne contamination from the Y-12 area. The recommendation was to address upstream sources of contamination. Risk to terrestrial species led to a recommended floodplain soil cleanup level for mercury of 210 mg/kg. However, based on stakeholder input indicating remediation would cause more harm to the localized habitat than measurable improvement and the ecological risk process was overly conservative, risk managers indicated the 400-ppm RL established for human exposure would also be considered protective of terrestrial ecological receptors.

A decision on the surface water, creek bank and creek bed sediment, and aquatic biota was deferred to a future decision document, primarily as an acknowledgement that upstream sources at Y-12 were an ongoing source of contamination in the creek and should be remediated prior to making final decisions for EFPC inclusive of both the upper and lower portions.

5.1.2.2 Response action

The “Selected Remedy” section of the LEFPC ROD lists the goals of the action:

- *Excavate the identified floodplain soils with mercury contamination greater than 400 ppm from four areas, including three areas at the NOAA site and one area at the former Bruner’s Center site along the creek. The wetland area at the Bruner site will be restored in the same location.*
- *Dispose of contaminated soil in the existing, state-approved, permitted, lined, Subtitle D landfill at Y-12.*
- *Perform confirmatory sampling in the excavated areas to ensure all mercury concentrations above 400 ppm have been removed.*
- *Backfill excavated areas, including a 0.6-acre wetlands area, with clean borrow soil and vegetate appropriately.*
- *Monitor LEFPC to determine effectiveness of the remediation.*

Post-excavation confirmation sampling was conducted to confirm mercury concentrations in the soils of the remediated areas were statistically less than, or equal to, the cleanup standard of 400 ppm. EPA’s *Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media* (EPA 1989) methodology was used to determine the success of the cleanup. Two types of confirmation units were used. The excavation confirmation unit (ECU) was established to provide complete coverage of the excavated areas. The perimeter confirmation units (PCUs) bounded the ECUs. PCUs extended 3 m (10 ft) outward from the outer boundaries of the ECUs and established the clean boundaries of the areas to be excavated. This approach was detailed in the *Confirmatory Sampling and Analysis Plan for the Lower East Fork Poplar Creek Operable Unit, Oak Ridge, Tennessee* (LMES 1996; LEFPC Confirmatory Sampling and Analysis Plan). The LEFPC RAR details the confirmatory sampling. Additionally, a thorough review of historical data in OREIS was conducted in 2022–2023, and some entries erroneously identified as no action required were revised to excavated based on review of the data and the LEFPC RAR.

The LEFPC ROD does not address the entire hydrologic system. One concern of decision makers and the public regarding cleanup of LEFPC floodplain soils was the fact that mercury continues to be released from Y-12, and these releases could recontaminate the floodplain. To address recontamination, the creek bank and creek bed sediment will be addressed in a future ROD after remedial measures are completed upstream in UEFPC.

5.1.2.3 Status of implementation

From July 8 to September 14, 1996, approximately 5560 loose yd³ of mercury-contaminated soils (> 400 ppm mercury) were removed from the floodplain near the NOAA area (Figure 5.1). Between March 3 and October 24, 1997, an additional 39,200 loose yd³ of mercury-contaminated soils (> 400 ppm mercury) were removed from the floodplain near the NOAA area and the Bruner site (Figure 5.1). Soils were taken to Y-12 Industrial Landfill V for disposal in accordance with *TDEC Special Waste Approval (#01-0096)* (TDEC 1996). During both phases, several pockets of elevated, radiologically contaminated soils (> 250 counts per minute gross beta-gamma) were located. These soils were excavated, placed in containers, and stored at ETTP. Disposal of this and other legacy wastes located at ETTP was completed at the end of FY 2005. As described in the LEFPC RAR, a small strip of land (~3 ft wide × 300 ft long) adjacent to the Dean Stallings Ford (now Ole Ben Franklin Mitsubishi) automobile dealership parking lot was identified as to be excavated. However, the LEFPC ROD determined this area did not require remediation as long as the area remained covered by the parking lot, with annual verification there were no land use changes.

Two modifications were made to site restoration activities in response to site conditions and storm events—modifying wetland restoration so that only 6 in. of topsoil was removed, and restoring several island areas and sections of creek bank where large quantities of river rock were deposited during a 50-year storm event.

5.1.2.4 LUC requirements

The LEFPC ROD stated that, although residential use of soil horizon (shallow) groundwater is not realistic, as a safeguard, DOE will monitor to detect any future residential use of shallow groundwater.

The LEFPC RAR requires an annual survey to verify land use in the area of the former Dean Stallings Ford (now leased to Ole Ben Franklin Mitsubishi) (Figure 5.1) automobile dealership parking lot has not changed since issuance of the LEFPC ROD and exposure pathways remain protected. The baseline risk assessment for the UEFPC RI determined exposure pathways for the parking lot were incomplete under the current use scenario. This area is composed of fill material (e.g., crush and fill-type gravel substrate) and soil and asphalt over the mercury-contaminated soil. Therefore, this strip of land was left undisturbed because there is material on top of the native soils, thus eliminating an exposure pathway for any potential soil contamination.

The LEFPC RAR stated if significant land use changes have occurred that affect exposure pathways, necessary steps will be taken to determine if the land use changes have resulted in unacceptable risk to human health or the environment. If such risk is determined to exist, necessary steps will be taken to address such risk. Any necessary actions will be conducted only after receiving concurrence from all parties involved (including the property owner).

If the property is sold, contamination remaining under the asphalt would need to be disclosed and would need to be addressed if the asphalt were removed, as described in the 2011 FYR.

Controls for LEFPC are listed in Table 5.4. Results of the 2021–2023 verification of LUCs are summarized in Section 5.1.4.4.

Table 5.4. LUC summary for LEFPC ROD

Affected area	Project document	LUC	Frequency/ implementation
LEFPC	ROD (DOE/OR/02-1370&D2) ^a RAR (DOE/OR/01-1680&D5) ^{b,c}	• DOE will monitor to detect any future residential use of the shallow soil horizon groundwater • A survey to determine any changes in land use patterns along LEFPC • Annual survey to verify land use in the area of the former Dean Stallings Ford automobile dealership parking lot shall be performed to verify land use has not changed since issuance of the LEFPC RI (DOE/OR/02-1119&D2)	• An FYR will be required to evaluate whether the selected remedy remains protective • Before each FYR, land-use patterns will be reevaluated along LEFPC to ensure the land use assumption used to develop the 400-ppm mercury cleanup level remains valid

^aThe *Explanation of Significant Differences for the Lower East Fork Poplar Creek Record of Decision, Oak Ridge, Tennessee* (DOE/OR/02-1443&D2) stated, “Groundwater and sediment do not present an unacceptable risk to human health and the environment. If sufficient quantities of groundwater were extracted from the shallow soil horizon (0–6 m [0–20 ft]) for residential use, such groundwater could pose an unacceptable risk.”

^bThe *Remedial Action Report on the Lower East Fork Poplar Creek Project, Oak Ridge, Tennessee* (DOE/OR/01-1680&D5; LEFPC RAR) stated, “Although the majority of the site has been remediated to a final protective level for mercury of <400 ppm, which allows for unrestricted use, there is a small area adjacent to the NOAA area which was not addressed in this action. This area has been filled and is currently occupied by an automobile dealership parking lot. No RA was taken because the baseline risk assessment for the EFPC RI determined the exposure pathways for the parking lot were incomplete under the current use scenario. Because this area is not available for unrestricted exposure/unrestricted use, a FYR will be required to evaluate whether the selected remedy remains protective.”

^cThe LEFPC RAR stated, “The Five-Year Review will also address the uncertainty regarding the protectiveness of the 400-ppm limit for all species that may accumulate mercury via the food chain.”

DOE = U.S. Department of Energy

FYR = Five-Year Review

LEFPC = Lower East Fork Poplar Creek

LUC = land use control

ppm = parts per million

RAR = Remedial Action Report

RI = remedial investigation

ROD = Record of Decision

5.1.2.5 Engineered remedies

There are no engineered remedies included in the LEFPC ROD.

5.1.3 Progress Since Last Five-Year Review

The 2021 FYR concluded:

The remedy implemented at LEFPC (removal) is protective of human health and the environment. Mercury bioaccumulation in invertebrates along LEFPC has indicated original assumptions used to develop the 200- to 400-ppm mercury cleanup level for LEFPC floodplain soil remediation are valid. Protectiveness is achieved by removing floodplain soil. LUCs are in place to prevent human exposure to floodplain soils. Controls, including surveys to determine any changes in land use patterns along LEFPC, monitoring to detect residential use of shallow groundwater, and surveys to verify land use in the area of the automobile dealership parking lot, are in place.

Additional actions (i.e., LEFPC streambed, stream banks, surface water, and aquatic biota) will be addressed in the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037).

This protectiveness determination differed from the EPA protectiveness determination entered into EPA's Superfund Enterprise Management System, which concluded:

Protectiveness deferred. A protectiveness determination for the remedy at OU-10 cannot be made at this time until further information is obtained. While EPA agrees with the study design and data collection for the terrestrial insects and spiders in the Lower East Fork Poplar Creek (LEFPC) Floodplain, EPA disagrees on how the bioaccumulation factors (BAFs) derived in the study were modified prior to calculating preliminary remediation goals (PRGs). It is expected that resolution of this issue will take approximately a year to complete, at which time a protectiveness determination will be made.

EPA deferred protectiveness of LEFPC in the 2011, 2016, and 2021 FYRs. The 2011 FYR identified some specific issues that were addressed in an Action Plan and, consequently, the results were included in the 2016 FYR. EPA issued an Addendum to the 2016 FYR (EPA 2020) that indicated reevaluation and confirmation of hotspot areas to be remediated under the LEFPC ROD and evaluation of contaminant resuspension associated with the floodplain soils was necessary. Responses to these issues were addressed in the 2021 FYR. No issues were identified in the 2021 FYR.

5.1.4 Five-Year Review Process

The following tasks were performed as part of this 2024 FYR:

- Reviewed the key documents listed in Section 5.1.1.1.
- Reviewed effectiveness, performance monitoring, and ecological monitoring data evaluations since the 2021 FYR, as presented in the 2022, 2023, and 2024 RERs. This includes:
 - Changes in land use and verifying LUCs.
 - Surface water monitoring data.
 - Biological monitoring data.
 - Any issues or recommendations that may affect protectiveness of the remedy.
- Conducted planning meetings with FFA parties (DOE, EPA, and TDEC).
- Conducted site interviews and site visits for actions included in this FYR, as described in Section 1.5.1.2.
- Reviewed changes in risk assessment methodology, toxicity factors, and ARARs (Appendix B), and evaluated if changes impact protectiveness of the remedy.

Remedy effectiveness was evaluated by reviewing monitoring data and LUCs, as specified in the associated decision documents.

5.1.4.1 Community notification and involvement and site interviews

A description of community notification and involvement is provided in Section 1.5.1. The address of the DOE Information Center is provided in Section 1.5.1.1. Section 1.5.1.2 discusses the site interviews and visits that were conducted. Results of the site interviews and visits are documented on the FYR Site Interview and Site Visit Checklists contained in Appendix A of this FYR.

5.1.4.2 Data review

5.1.4.2.1 Station 17 (IP)

Mercury inputs from UEFPC to LEFPC are monitored at Station 17, the IP where the stream leaves the Y-12 site and DOE property. Station 17 mercury concentrations between FYs 2021–2023 did not attain the UEFPC Phase I Interim ROD (DOE/OR/01-1951&D3) goal of 200 ng/L total mercury, although concentrations have continued to decline from an average concentration 1860 ng/L in FY 2018, attributed to the West COLEX demolition project, to an average concentration of 954 ng/L in FY 2023. Annual mercury discharge fluxes at Station 17 increased slightly in 2021 but decreased in FY 2023 to the lowest level (6.7 kg) since 2016. Station 17 sampling results are discussed in detail in Chapter 2.

5.1.4.2.2 Biological sampling

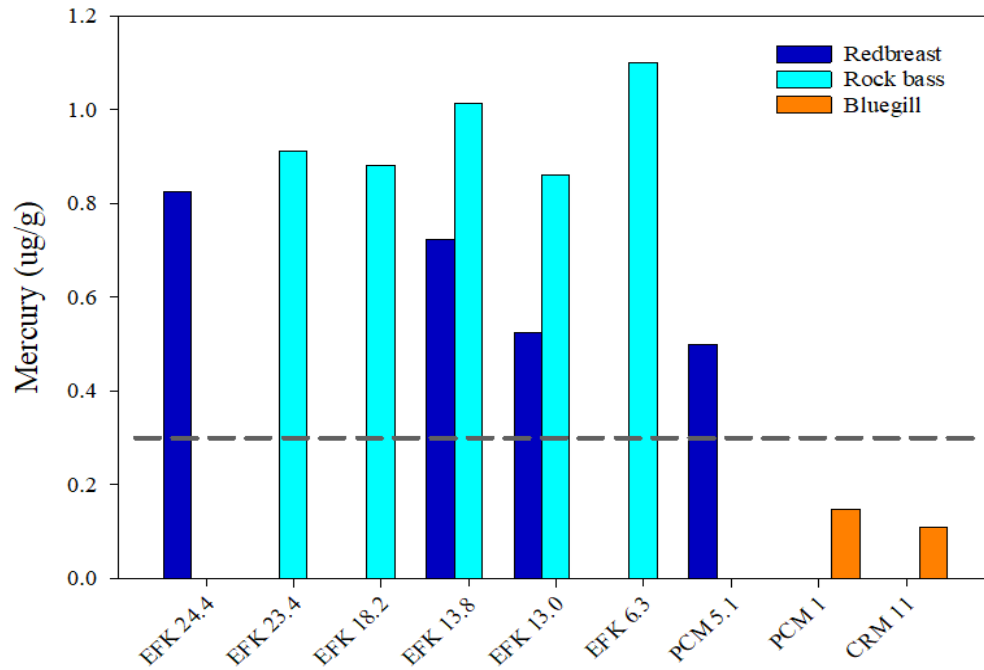
The ORNL biological monitoring program performs ongoing assessments of biota recovery on the ORR, including monitoring fish and macroinvertebrate communities and fish bioaccumulation in LEFPC.

The effect of the upstream mercury source on LEFPC and downstream spatial trends in mercury bioaccumulation in various sunfish species (rock bass, redbreast, and bluegill) is depicted in Figure 5.3. Although there is variability in mercury concentrations between sites and species of fish, mercury concentrations have been observed on the ORR to be highest in fish that feed at higher trophic levels, such that concentrations in rock bass are greater than those in redbreast, which are greater than those in bluegill collected at the same site and season. In FY 2023, concentrations were highest at EFK 6.3, with mean concentrations of 1.1 µg/g in rock bass in fall 2022 (Figure 5.3). Regardless of the sunfish species, the mercury content in fillets of sunfish is above EPA's national recommended water quality criteria for mercury (0.3 µg/g) throughout LEFPC and at the mouth of PC, but it decreases below this threshold within a few kilometers downstream in lower PC and the CR.

There has been a long-term trend since the 1980s of increasing mercury concentrations in fish at EFK 6.3 (Southworth et al. 2010). Trend analysis has been complicated by a change in fish species availability, since mercury concentrations typically increase with trophic level. There is also considerable seasonal variability in mercury concentrations in fish (especially rock bass) collected at EFK 6.3, with concentrations in the fall collections being significantly higher than in the spring. This is likely due to seasonal fluctuations in methylmercury concentrations, which drive mercury bioaccumulation in LEFPC.

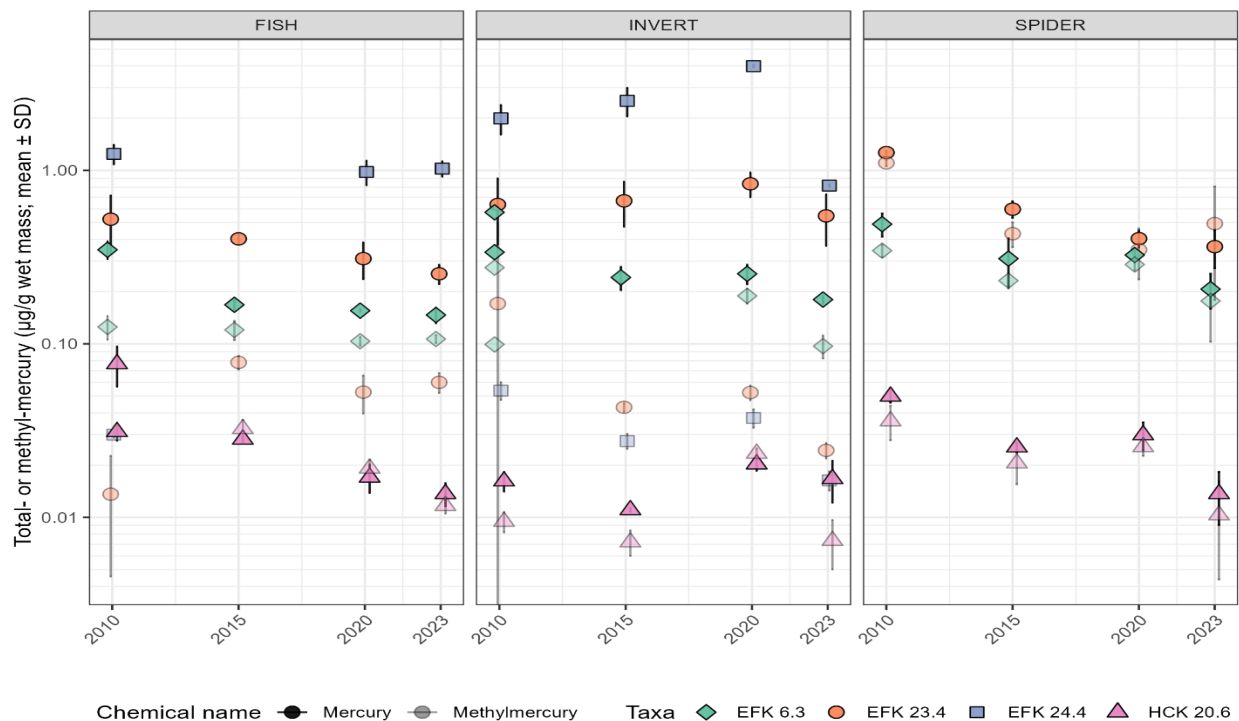
While fish fillet concentrations are used to assess potential exposure to humans or upper trophic level piscivores, contaminant concentrations in whole body forage fish and invertebrates have been used to evaluate the nature and extent of contaminant exposure and transfer through the food chain to ecological receptors. Biological sampling was conducted in FYs 2010, 2015, 2020, and 2023. The primary contaminants analyzed in the evaluation included mercury, methylmercury, PCBs, and a metals suite. Not all these chemicals were identified as COCs in CERCLA RODs and action plans. However, the sampling strategy provides a valuable spatial and temporal snapshot of ecology risk concerns associated with DOE facilities in Oak Ridge, and an important baseline for the future EFPC ROD. PCBs and metals are discussed in the 2024 RER.

Consistent with spatial patterns seen in total mercury concentrations in water, total mercury concentrations in invertebrates and forage fish were highest at the uppermost sampling sites (EFK 24.4 for invertebrates and fish and EFK 23.4 for spiders) and decreased with distance downstream (Figure 5.4). Temporal trends suggest total and methylmercury concentrations have decreased in biota over the past 13 years, and these decreases were also seen at the Hinds Creek reference site. Prior to 2023, mercury concentrations in invertebrates decreased and were comparable to concentrations found in fish. In contrast to total mercury, the percentage of methylmercury tended to increase with downstream distance. For biota collected in EFPC, the proportion of methylmercury in total mercury was highest in fishing spiders collected from EFK 23.4 (Figure 5.4).



Dashed line indicates U.S. Environmental Protection Agency national recommended water quality criteria for mercury ($0.3 \mu\text{g/g}$ in fish).

Figure 5.3. Spatial pattern of mercury bioaccumulation in filets of various fish species in UEPFC and LEFPC (EFK), PC (PCM), and CR (CRM), FY 2023.



Note: Target invertebrate taxa were aquatic insect larvae (i.e., caddisfly, damselfly, dragonfly, megaloptera larvae), and forage fish were stoneroller minnows. Fishing spiders were collected from EFK 23.4, EFK 6.3, and HCK 20.6.

Figure 5.4. Mean concentration of total mercury and methylmercury in biota at EFPC sites and the reference site, HCK 20.6, from 2010, 2015, 2020, and 2023 FYR collections.

5.1.4.3 Site inspection

As part of the 2024 FYR process for LEFPC, an interview was conducted on August 23, 2023, and a virtual site visit was conducted on October 17, 2023. The purpose of the inspection was to assess protectiveness of the remedy by reviewing identified controls currently in place and watershed monitoring information required in LEFPC. See Section 1.5.1.2 and Appendix A for a summary of the 2024 FYR site interviews and visits.

5.1.4.4 LUC verification and certification/engineered remedy integrity

All LEFPC LUCs in Table 5.4 were verified for this 2024 FYR. The certification of LUC implementation for FY 2023 for LEFPC is included in Appendix D. Results are summarized in Table 5.5, which lists the decision or remedy completion control type, the specific requirement, and the status. The final column of Table 5.5 identifies the specific table listing the requirements and the section providing details of the verifications.

Table 5.5. Verification of LUCs and engineered remedy integrity in LEFPC

Decision or remedy completion control type	Decision or remedy completion control requirement	Status	Requirements/status review
LUCs	LEFPC	Implemented	See Table 5.4 and text below

LEFPC = Lower East Fork Poplar Creek

LUC = land use control

Verification of LUC requirements listed in Table 5.4 for FYs 2021–2023 includes periodic surveys to detect residential use of shallow groundwater and annual surveys of the former Dean Stallings Ford property. The survey to determine any changes in land use patterns along LEFPC was conducted in the summer of 2023 for this FYR and is detailed in Section 5.1.1.3.

There is a small area on the former Dean Stallings Ford dealership property adjacent to the NOAA remediation site with mercury > 400 ppm that was not remediated as part of the action. At the time of the LEFPC RI, the area was underneath an asphalt parking lot owned by Dean Stallings Ford. Therefore, the LEFPC RI concluded there were not complete exposure pathways in the area because access to the soils was eliminated and, therefore, risks were acceptable. DOE visits the area annually to ensure land use has not changed since issuance of the LEFPC ROD. However, Dean Stallings Ford is now closed, and the property (Parcel No. 105D-A-016.00) was leased to Ole Ben Franklin Mitsubishi, a used car dealership, in January 2014. The contamination remaining under the asphalt lot should not cause problems, but it would need to be disclosed in the event the property is sold and would need to be addressed if the asphalt is removed.

Public documentation of the remaining contamination in the area of the Former Dean Stallings Ford dealership is in the LEFPC RAR. The LEFPC RAR references a letter transmitted from DOE to EPA and TDEC (DOE 1997) dated October 3, 1997, which is filed in the project public records. The letter stated, “DOE will also publish a public notice of this availability of this letter to ensure that the Oak Ridge community is aware that this strip of land does not fall within the scope of the LEFPC ROD and was not disturbed during the LEFPC Phase II remediation.” Public notices clarifying the disposition of the land under the former Dean Stallings Ford property were published in local newspapers in November 1997.

The LEFPC ROD stated that, although residential use of soil horizon (shallow) groundwater is not realistic, as a safeguard, DOE will periodically monitor to detect any future residential use of the shallow groundwater. A periodic survey to detect residential use of shallow groundwater was performed in FYs 2021, 2022, and 2023. There were no new wells identified for residential use along LEFPC.

All LUCs are in place and verified, as well as tracked and archived, in LUM.

5.1.5 Technical Assessment

Table 5.6 summarizes the technical assessment performed for LEFPC.

Table 5.6. FYR summary for LEFPC

Question	Response	Note
A. Is the remedy functioning as intended by the decision documents?		
Are performance standards being met (or likely to be met)?	Yes	This action is complete. Confirmation sampling during remediation verified soils with a mercury concentration statistically greater than 400 ppm at the NOAA and Bruner sites were excavated and disposed
Are there problems with the remedy that could lead to remedy failure or suggest that protectiveness is at risk?	No	Sampling and subsequent evaluations conducted since FY 2014 indicate there is no issue related to biouptake of mercury from floodplain soils. The erosion of creek banks and potential recontamination of the floodplain soils will be addressed in a future ROD. Costs for monitoring and LUC implementation are consistent with forecasted costs for the project
Are the LUCs (fencing, security guards, etc.) in place and preventing exposure?	Yes	LUCs are implemented and maintained per the EFPC and ChR RAR CMP. LUCs are tracked in the LUM application
Are additional actions, such as removals that were deemed necessary to ensure that immediate threats were addressed, completed?	Yes	All immediate threats were addressed; additional actions related to mercury (source) reduction in UEFPC are ongoing. Creek bank and creek bed sediments, surface water, and aquatic biota will be addressed in a future ROD
Are operating procedures, as implemented, maintaining the effectiveness of response actions?	NA	There is no operating system in place under this remedy
B. Are the assumptions used at the time of remedy selection still valid?		
Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in TBC criteria that could call into question the protectiveness of the remedy?	No	No chemical-specific ARARs were identified in the LEFPC ROD. All location- and action-specific ARARs/TBC criteria were met, and there have been no changes to ARARs that would affect protectiveness (Section 5.1.5.2 and Appendix B)
Have there been any changes in land use or expected land use on or near the site?	Yes	New residential and commercial development adjacent to portions of LEFPC continues (Section 5.1.1.3)
Have new human health or ecological exposure pathways or receptors been identified?	No	No new groundwater drinking water wells were established in the floodplain. Ecological exposure pathway (ingestion of spiders by wren) identified in the 2011 FYR was addressed in the 2016 FYR and 2021 FYR

Table 5.6. FYR summary for LEFPC (cont.)

Question	Response	Note
Have new contaminants or contaminant sources been identified?	No	Mercury is still being released into UEFPC from Y-12, and there is residual mercury in creek bank and creek bed sediments. Neither of these is a new source; the former was deferred to UEFPC watershed decisions, and the latter was deferred to the final EFPC ROD
Were there any unexpected toxic byproducts of the remedy not addressed by the decision documents?	No	No treatment occurred that would result in byproducts
Have there been any changes in the physical site conditions?	Yes	Various-sized construction projects have occurred along LEFPC since the LEFPC ROD, including widening Oak Ridge Turnpike (State Route 95) from 2009–2012, and continuing residential development adjacent to the creek, but there have been no significant changes since 2021
Have there been any changes in the toxicity factors for COCs?	Yes	A lower inhalation pathway reference dose for mercury has been established. However, the inhalation pathway was not considered complete and was not part of the soil remedial goal option determination. See Section 5.1.5.2 and Appendix B
Were there significant changes in the standardized risk assessment methodologies?	Yes	See Section. 5.1.5.2.2 and Appendix B
C. Has any other information come to light that could call into question the protectiveness of the remedy?		
Have ecological risks been adequately addressed at the site and, if not, is there a plan to address them through a future action?	Yes	Evaluations of mercury bioaccumulation in EFPC are included in the 2016 FYR and 2021 FYR. These site-specific studies indicate RAOs remain protective of ecological receptors. Threatened and endangered species (bats) have been identified since the LEFPC ROD and will be evaluated in the final EFPC ROD (see Section 5.1.5.3)
Is the site located in an area subject to natural disasters?	Yes	Portions of LEFPC are within the 100-year floodplain. There is a low probability of earthquakes and tornadoes in the region

ARAR = applicable or relevant and appropriate requirement
 ChR = Chestnut Ridge
 CMP = Comprehensive Monitoring Plan
 COC = contaminant of concern
 EFPC = East Fork Poplar Creek
 FY = fiscal year
 FYR = Five-Year Review
 LEFPC = Lower East Fork Poplar Creek
 LUC = land use control
 LUM = Land Use Manager

NA = not applicable
 NOAA = National Oceanic and Atmospheric Administration
 ppm = parts per million
 RAO = remedial action objective
 RAR = Remedial Action Report
 ROD = Record of Decision
 TBC = to be considered
 UEFPC = Upper East Fork Poplar Creek
 Y-12 = Y-12 National Security Complex

5.1.5.1 Question A: Is the remedy functioning as intended by the decision documents?

5.1.5.1.1 Performance standards

Performance standards for the LEFPC ROD were established for the excavation phase of the action, applying to both human and ecological receptors. Confirmation sampling during remediation verified soils with mercury concentrations > 400 ppm at the NOAA and Bruner sites were excavated and disposed.

The remedial approach used (i.e., removing all soils with a mercury concentration statistically greater than the 400-ppm cleanup goal) was conservative. Per EPA (<https://www.epa.gov/risk/calculating-preliminary-remediation-goals-prgs>): “A key concept is that a [cleanup goal] is the average concentration of a chemical in an exposure area that will yield the specified target risk ... it is not necessary that all concentration values above the [cleanup goal] be remediated. Rather, all that is required is that the average concentration be reduced to the [cleanup goal] or below.” The cleanup goal was met by removing all areas of soil having an average mercury concentration > 400 ppm, as verified during confirmation sampling (LEFPC Confirmatory Sampling and Analysis Plan). While limited individual samples with concentrations greater than 400 ppm remain within industrial or recreational land use segments, the average mercury concentration in each segment is less than 400 ppm (Figure 5.5; see also Appendix B, Attachment B.1). Additionally, there is only one concentration greater than 400 ppm located in a residential area within segment 4 (average in the segment is less than 400 ppm), and this sample location is in a wooded area near LEFPC. Figure 5.2 provides a map showing each segment along LEFPC.

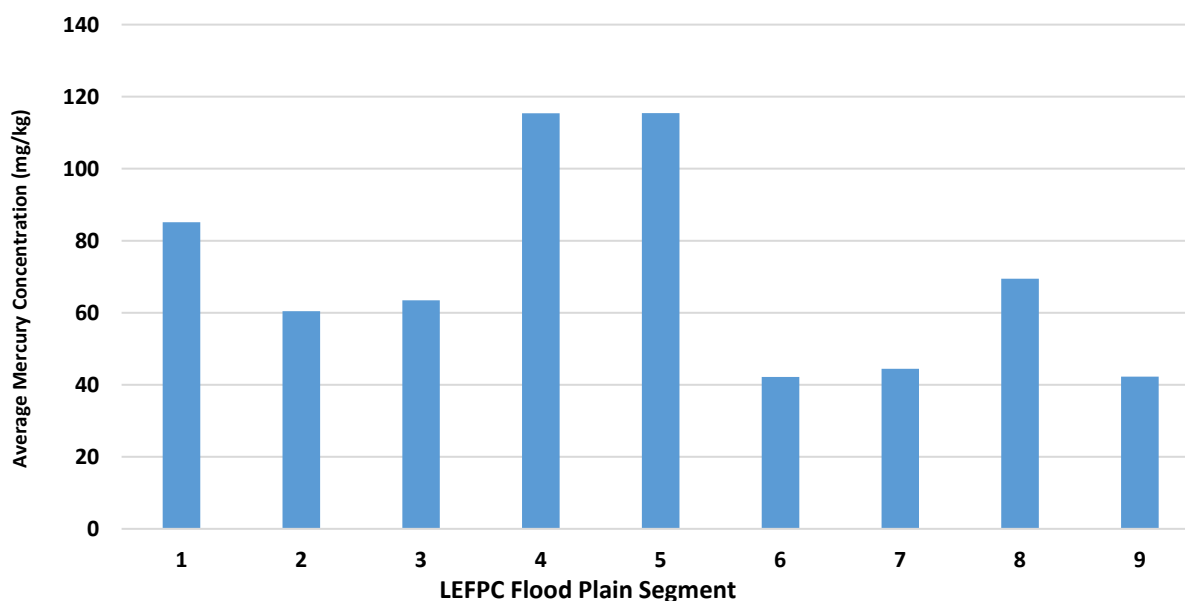


Figure 5.5. Average mercury concentration in LEFPC segments (detects only).

Well after completion of the RA, sampling of the floodplain soils was performed during 2014–2015 as part of Action Plan #2 published in the *2013 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee, Data and Evaluations* (DOE/OR/01-2594&D1; 2013 RER) (see Section 5.1.5.3). As presented in the 2016 and 2021 FYRs, floodplain soil sampling occurred in three distinct areas (sample areas) along LEFPC—upstream (also called the NOAA area), midstream (also called the Bruner area), and downstream (also called the Horizon Center area)—as well

as at a background location (called Brushy Fork site). The floodplain area with the highest mercury soils concentrations was the upstream NOAA area, outside of the previously remediated excavation area; however, there were also areas of low mercury concentrations. Sample plot mercury values across the entire study area ranged from average values of 4.68 ppm to 259.3 ppm, with the highest individual sample measured at 348 ppm at the NOAA site. None of the values exceeded the 400-ppm cleanup goal in the LEFPC ROD.

The LEFPC RAR described all measures taken during the remedial activities to comply with action-specific ARARs and supplemental monitoring activities needed to support later FYRs. The monitoring requirement summarized in Table 16 of the LEFPC RAR is:

- Appropriate monitoring to ensure effectiveness of the remediation. Mercury inputs from UEFPC to LEFPC are monitored at Station 17, as required by the UEFPC Phase I Interim ROD, and are presented in Chapter 2.

As required by the LEFPC RAR, mercury releases from Y-12 have been, and continue to be, measured at Station 17, the point at which the government land transitions to city property on EFPC. Monitoring is performed by WRRP, and data are collected from a flow-proportional sampler placed in the creek at an unimpeded location. Mercury concentrations measured at Station 17 from 2021–2023 were in excess of the 200-ppt (0.2-µg/L) performance standard. Concentrations in 2023 averaged 0.954 µg/L. Remediation activities in UEFPC are ongoing. A full discussion of the historical and current trends in mercury releases at Station 17 is presented in Section 2.1.4.2.1.

In response to the 2011 FYR UEFPC issue of mercury concentrations at Station 17 remaining above the 200-ppt performance goal and mercury concentrations in fish not yet responding to commensurate reductions of mercury from historical response actions, DOE submitted the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2605&D2; Mercury Mitigation Strategy) per the FFA (DOE/OR-1014), Section XXXI. Implementation of the Mercury Mitigation Strategy to date includes constructing the Outfall 200 MTF, which began in FY 2018 and continues to date.

Costs have been incurred for monitoring mercury at Station 17; the post-remediation fish mercury bioaccumulation studies; and LUCs, including an annual survey of the former Dean Stallings Ford automobile dealership parking lot and a survey of groundwater use to ensure shallow groundwater is not being used as a potable drinking water source. Costs associated with monitoring and LUC implementation associated with this LEFPC ROD are provided in Section 1.5.4. Costs are consistent with forecasted costs for the project.

5.1.5.2 Question B: Are the assumptions used at the time of remedy selection still valid?

As explained in Chapter 1 (Sections 1.6.1 and 1.6.2) and Appendix B (Section B.2), a FYR process was used to determine if the key chemical-specific ARAR and risk-assessment assumptions used at the time of the LEFPC ROD have changed significantly enough to affect protectiveness. This analysis is included in Appendix B (Section B.6) and summarized below.

5.1.5.2.1 ARARs

No chemical-specific ARARs were identified in the LEFPC ROD. All location- and action-specific ARARs/TBC criteria cited in the LEFPC ROD were met during ROD implementation. There have been no substantive changes in the ARARs in the LEFPC ROD that would affect protectiveness of the remedy.

5.1.5.2.2 Risk

Changes in land use can result in potential changes in human receptor-exposure pathways. Residential development has continued along the LEFPC corridor since the LEFPC ROD (Section 5.1.1.3). The greatest number of changes occurred between the 2001 and 2006 FYRs, when several large residential developments were built in the area of the LEFPC floodplain. The other significant change in land use since the time of the LEFPC RI was the April 29, 2003, transfer of Parcel ED-1 from DOE to CROET. The implications of these changes were addressed in detail in the 2006 FYR. No issues were identified stemming from that analysis. Since that time, there have been minor changes in land use, mostly a further increase in residential development (Section 5.1.1.3). This increase in residential use along the EFPC corridor also increases the potential for home gardens. However, recently developed residential lots generally exclude the floodplain. While a few recently developed lots extend to the creek, there is no indication of home gardens or other activity in the floodplain.

Uptake of mercury into plants was not included in the cleanup goal documented in the LEFPC ROD, in part, because uptake modeling relied on highly uncertain and overly conservative uptake factors. Subsequent studies have continued to confirm the form of mercury present in floodplain soil is relatively insoluble and is not being transferred to plants. However, risk from home gardens was evaluated for this FYR to confirm protectiveness in the unlikely case of a home garden in the floodplain.

Calculation of risk PRGs for ingestion of home-grown fruits and vegetables indicates the cleanup goal for LEFPC floodplain soil is protective of this pathway (see Appendix B). PRGs were calculated using fraction ingested (FI) parameters of 25% (i.e., a 10-ft × 15-ft residential garden) and 17% (i.e., a 10-ft × 10-ft residential garden) based on the minimum garden size of 600 ft² (i.e., a 20-ft × 30-ft residential garden) to feed a family of four year-round, and consumption of a limited number of fruit and vegetable types. PRGs for mercuric sulfide ranged from 162 mg/kg for consumption of a limited number of fruit and vegetable types at an FI of 25% to 900 mg/kg for a limited number of vegetables at an FI of 17%. Therefore, the original cleanup goals identified in the LEFPC ROD are still protective for current land uses.

In addition to these changes in receptors and exposure pathways since the time of the LEFPC ROD, there have been changes in risk methods and toxicity. A summary of overall changes in risk methods is presented in Section 1.6.2 and Appendix B. The oral reference dose for mercury used to develop the remedial goal option has not changed since the LEFPC ROD.

The potential for recontamination of the LEFPC floodplain remediated areas through overbank sediment deposition is assessed in the 2021 FYR.

5.1.5.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The 2011 FYR identified a potential issue related to uptake of mercury by invertebrates that resulted in the 2011 FYR protectiveness statement being deferred. To address the issue, Action Plan #2 (a mercury biouptake study) was developed and completed. As a result of Action Plan #2 (published in the 2013 RER), the LEFPC ecological conceptual site model was revisited, and more site-specific floodplain information was determined to be needed to decrease uncertainty. A series of interagency meetings to set data quality objectives was held in 2013 so that site-specific data could be collected to address the issue. After a rigorous data-collection process of more than 200 soil samples in 2014 and co-located biota samples (earthworms, pill bugs, leafhoppers, and spiders) in 2015, calculations from the original 1994 ERA were reproduced in the 2016 FYR and 2021 FYR using site-specific data and the revised conceptual site model. The original remedial goal option calculated in the LEFPC RI and recommended in the *Proposed Plan East Fork Poplar Creek – Sewer Line Beltway, Oak Ridge, Tennessee* (DOE/OR/02-1209&D3) was 200 ppm, which

was raised to 400 ppm in the LEFPC ROD based on several risk-management factors. The revised site-specific values resulting from Action Plan #2 are similar to those included in the LEFPC ROD, and thus reinforce the LEFPC ROD decisions regarding protection of ecological receptors. An analysis of residual mercury in floodplain soils done for the 2021 FYR confirms receptors would be exposed to 155-ppm to 178-ppm mercury in the most-contaminated areas left in the floodplain, less than both the 200-ppm and 400-ppm cleanup goals. The original cleanup goals identified in the LEFPC ROD are still protective.

At the time of the LEFPC ROD, there were no threatened and endangered species identified in the floodplain. However, due to the impact of white-nose syndrome (first identified in the United States in 2006) on bat populations, bat species are declining, and many have now been listed by the state or federal government. Several bat species, including state and federal threatened and endangered species, have been confirmed to occur on the ORR and may occur in the area of LEFPC. A 2011 pilot study (Hatch et al. 2011) identified three threatened and endangered listed species along LEFPC—the little brown bat, the northern long-eared bat, and the tricolored bat. Although diet and foraging range vary by species, floodplain soil is unlikely to be a major source of contamination to these bats. The northern long-eared bat forages more along wooded hillsides and ridgelines rather than valley-bottom streams or the edges of riparian forests. Many bat species, including the tricolored and little brown bat, feed largely or partially over water on emergent insects. Therefore, most of the impact to these species will be from aquatic sources (surface water and sediment), and these threatened and endangered species will be evaluated in the future EFPC Surface Water ROD.

Portions of LEFPC are within the 100-year floodplain. There is a low probability of earthquakes and tornadoes in the region. As described in Section 2.1.5.3, climate change and associated vulnerabilities were recently evaluated in the VARP for DOE OREM. Current and projected climate hazards were characterized and identified, including heat waves, precipitation, lightning, and winter weather. See Section 2.1.5.3 for additional details on climate change vulnerability.

5.1.6 Issues/Recommendations

There were no issues or recommendations identified in this 2024 FYR for LEFPC.

5.1.6.1 Other findings

There were no additional findings identified in this 2024 FYR for LEFPC.

5.1.7 Protectiveness Statement

The remedy implemented at LEFPC (removal) is protective of human health and the environment.

Protectiveness is achieved by removing floodplain soil. LUCs are in place to prevent human exposure to floodplain soils in the NOAA area (former Dean Stallings Ford automobile dealership) with mercury contamination > 400 ppm. Controls, including surveys to determine any changes in land use patterns along LEFPC, monitoring to detect residential use of shallow groundwater, and surveys to verify land use in the area of the automobile dealership parking lot, are in place.

Additional actions (i.e., LEFPC creek bank and creek bed sediment, surface water, and aquatic biota) will be addressed in the EFPC Surface Water ROD (FFA Appendix J date 2035; RAR 2037).

5.1.8 Next Review

The next (seventh) CERCLA FYR of LEFPC will be due August 2029.

5.2 REFERENCES

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APPENDIX A.
2024 FIVE-YEAR REVIEW SITE VISITS

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INTRODUCTION

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The source of the information provided in Question A.1 of the Five-Year Review (FYR) Site Visit/Site Manager Interview Forms contained herein is the *2023 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2916&D2) issued September 2023. With the exception of some ecological sampling data, these data were collected prior to, or in, Fiscal Year (FY) 2022 and were the most recent dataset available at the time of the FYR site visits/interviews. The reader is referred to the main text of the 2024 FYR for updated discussions and analysis of remedial action sites based on sample data collected in FY 2023. Table A.1 lists the key participants and dates of the site visits for the 2024 FYR.

Table A.1. Key participants and dates of the 2024 FYR site visits

UEFPC and LEFPC site visit – October 17, 2023	
DOE	Sam Scheffler and Roger Petrie
EPA	Samantha Urquhart-Foster and John Sayer
TDEC	Cody Juneau and Tab Peryam
SSAB	Harriett McCurdy and Amy Jones
UCOR Project Personnel	Eddie Arnold, Dick Ketelle, Lynn Sims, Crystal Hann, Sally Brown, Brianna Humphrey, Sally Absher, Terry Mathews, and Seth Cook
ChR and ORAU SCF site visit – October 18, 2023	
DOE	Sam Scheffler and Roger Petrie
EPA	Samantha Urquhart-Foster and John Sayer
TDEC	Cody Juneau and Bing Cao
SSAB	Harriett McCurdy and Amy Jones
UCOR Project Personnel	Eddie Arnold, Dick Ketelle, Lynn Sims, Crystal Hann, Sally Brown, Sally Absher, Terry Mathews, and Paul Waldschlager

ChR = Chestnut Ridge

DOE = U.S. Department of Energy

EPA = U.S. Environmental Protection Agency

LEFPC = Lower East Fork Poplar Creek

ORAU = Oak Ridge Associated Universities

SCF = South Campus Facility

SSAB = Site-Specific Advisory Board

TDEC = Tennessee Department of Environment and Conservation

UCOR = United Cleanup Oak Ridge LLC

UEFPC = Upper East Fork Poplar Creek

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ACRONYMS

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Acronyms used in 2024 Site Interview/Site Visit forms

AM	Action Memorandum
AWQC	ambient water quality criteria
BMP	best management practice
BSWTS	Big Spring Water Treatment System
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
ChR	Chestnut Ridge
CMP	Comprehensive Monitoring Plan
CMTS	Central Mercury Treatment System
CNS	Consolidated Nuclear Security
COC	contaminant of concern
CPU	computer processing unit
D&D	decontamination and decommissioning
DCE	dichloroethene
DOE	U.S. Department of Energy
EEMTS	East End mercury treatment system
EEVOC	East End Volatile Organic Compound
EFPC	East Fork Poplar Creek
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
EPP	excavation/penetration permit
ESD	Explanation of Significant Differences
EU	exposure unit
FCAP	Filled Coal Ash Pond
FFA	Federal Facility Agreement
FIT	facility inspection and training
FS	feasibility study
FY	fiscal year
FYR	Five-Year Review
IP	integration point
KHQ	Kerr Hollow Quarry
LEFPC	Lower East Fork Poplar Creek
LGWO	Liquid and Gaseous Waste Operations
LiDAR	light detection and ranging
LUC	land use control
LUCIP	Land Use Control Implementation Plan
LUM	Land Use Manager
MCK	McCoy Branch kilometer
MCL	maximum contaminant level
MTF	Mercury Treatment Facility
NA	not applicable
NFA	no further action
NNSA	National Nuclear Security Administration
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NSC	non-significant change
O&M	operation and maintenance
ORAU	Oak Ridge Associated Universities
OREIS	Oak Ridge Environmental Information System
OREM	Oak Ridge Environmental Management

ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OS&M	operations, surveillance, and maintenance
OSY	Old Salvage Yard
PCCR	Phased Construction Completion Report
PCP	Post-Closure Permit
PCR	Post-Construction Report
POC	point of compliance
PVC	polyvinyl chloride
Q	Quarter
RA	remedial action
RAO	remedial action objective
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act of 1976
RER	Remediation Effectiveness Report
RI	remedial investigation
RL	remediation level
RmA	removal action
RmAR	Removal Action Report
ROD	Record of Decision
RSI	RSI EnTech LLC
S&M	surveillance and monitoring
SCF	South Campus Facility
STR	Subcontract Technical Representative
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
UCOR	United Cleanup Oak Ridge LLC
UEFPC	Upper East Fork Poplar Creek
UNC	United Nuclear Corporation
UT	University of Tennessee
VOC	volatile organic compound
WEMA	West End Mercury Area
WQP	Water Quality Program
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex
YWQP	Y-12 Water Quality Program

**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORMS:
UPPER EAST FORK POPLAR CREEK**

Upper East Fork Poplar Creek Phase I Interim Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: Phase I Interim Source Control Actions in UEFPC (ROD [05/02/2002]; Phase 1 Interim ROD Amendment, Outfall 200 Water Treatment Facility [05/24/2016]; PCCRs for BSWTS [07/01/2005] and WEMA storm sewer remediation [08/31/2012])

Date(s) of Visit: 08/21/2023 (interview), 10/17/2023 (site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Dick Ketelle (RSI), YWQP Technical Lead; Sid Garland (RSI), Regulatory Support; Bri Humphrey (RSI), Y-12 Project Lead

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Removal, treatment, and LUCs. The UEFPC Phase I Interim ROD addresses mercury-contaminated soils, sediments, and groundwater, which contribute to contamination of surface water within UEFPC. The RAO for the selected remedy is to restore surface water to human health recreational risk-based values at Station 17. Principal components of the decision included:

- Hydraulically isolating (e.g., capping contaminated soils) WEMA. (Note: An ESD was approved in August 2012 to remove the capping of WEMA contaminated soils from the selected remedy.)
- Removing contaminated sediments from storm sewers and Lake Reality and sediment and soils from UEFPC.
- Treating discharge from Outfall 51 (including a large-volume spring) and Building 9201-2 sumps.
- Temporarily treating water using existing facilities—CMTS and EEMTS. (Note: Following BSWTS startup, the EEMTS is no longer in operation.)
- Implementing LUCs to prevent consumption of fish from UEFPC and to control/monitor access by workers and the public.
- Monitoring surface water (Station 17).

The BSWTS (see the BSWTS 2024 FYR Site Visit/Site Manager Interview Form) was constructed to treat discharge from Outfall 51 (including the large-volume spring) and to treat water from the Building 9201-2 sumps. Mercury-contaminated water was rerouted from the Building 9201-2 sumps and the EEMTS to the BSWTS in December 2006 (2023 RER Section 5.3).

An amendment to the UEFPC Phase I Interim ROD was approved in 2016 for construction of the Outfall 200 MTF (see the Outfall 200 MTF 2024 Site Visit/Site Manager Interview Form). The purpose of the Outfall 200 MTF (currently under construction) is to decrease mercury that is leaving the Y-12 site at Station 17. This facility will mitigate additional releases of mercury exiting Y-12 during demolition of WEMA process facilities that significantly used mercury in processing lithium.

Post-Action Monitoring Includes: (check all that apply)

- | | |
|---|---|
| ☐ NFA | ☒ Groundwater Pump and Treat |
| ☒ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☒ Other: <i>Biological monitoring and storm drain monitoring.</i> | |

Note: Groundwater from the Building 9201-2 sumps is collected and treated at the BSWTS.

LUC Requirements Include: (check all that apply)

- | | |
|--|---|
| ☐ NA | ☒ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☒ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☒ EPP | |

2024 Five-Year Review Site Visit/Site Manager Interview Form

Note: Per the UEFPC Phase I Interim ROD, the above LUCs apply to WEMA mercury-contaminated areas and UEFPC surface water (signs and surveillance patrols). The UEFPC Phase II ROD requires restrictions across the entire watershed. LUCs are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

Engineered Remedy and Other Requirements: (check all that apply)

☒ Engineered Remedy (caps, treatment systems, OS&M) ☐ Provisional Controls

☐ Former RCRA Site Controls

☐ Other:

Note: The engineered remedy includes inspection and O&M of the BSWTS (the CMTS is under the auspices of the NPDES permit). Engineered remedies are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☐ No ☒ NA ☐

Notes: The mercury discharge (flux) measured at Station 17 (the surface water IP for the UEFPC Watershed) was approximately 8.5 kg for FY 2022. The average total mercury concentration at Station 17 was 1112 ng/L compared to the UEFPC Phase I Interim ROD goal of 200 ng/L. The FY 2022 results show a slight decrease of both total mercury concentration and total flux compared to FY 2021, which is attributed to effects of lower annual rainfall and improved water management/treatment at the Outfall 200 MTF headworks excavation site. (Note: All CERCLA actions to eliminate or reduce mercury releases into the UEFPC Watershed are not yet fully implemented [see 2023 RER Section 5.3.1.2.1.2]).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: Per the UEFPC Phase I Interim ROD, all LUC requirements have been met and are verified annually in the RER. The LUM application documents that LUC requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: Inspections of the BSWTS are conducted in accordance with the CNS Operating Procedures and the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5). The LUM application documents S&M inspections.

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes: No problems are associated with completed actions. Remedy implementation is not yet complete.

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: Inspections of the treatment system (BSWTS) in UEFPC are implemented under the CNS Operating Procedures. Implementation of EPP requirements is per UCOR and CNS excavation and penetration procedures. (See also the BSWTS 2024 FYR Site Visit/Site Manager Interview Form.)

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

2024 Five-Year Review Site Visit/Site Manager Interview Form

7. Additional site-specific questions and concerns:

In FY 2021, CNS removed about 1.1 to 1.47 kg of elemental mercury from a junction box in the Outfall 150 storm drain network. NNSA made several attempts during FY 2022 to remove elemental mercury from a junction box in the Outfall 150 storm drain network; however, there was insufficient pooled mercury in the basin for successful removal. Attempts to remove elemental mercury from the storm drain network will continue.

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *As-builts are available for the CMTS and BSWTS and are up to date.*

Maintenance Work Packages for the BSWTS and CMTS are maintained and stored by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Groundwater, surface water, and biological monitoring records are available in OREIS. Inspection reports are filed and tracked in the LUM application.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *LUCs for the UEFPC Phase I ROD include an effective EPP program, signs to provide notice or warning to prevent unauthorized access, and surveillance patrols to control and monitor access by workers and the public. Also, because the UEFPC Watershed is mostly within the Y-12 industrial complex, public access is restricted through guarded portals, fencing, and gates, which are not explicit LUC requirements.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: *The Y-12 industrial complex is expected to remain under DOE control, with a controlled industrial end use. The easternmost end of the UEFPC Watershed is and will remain unrestricted industrial (Figure 1).*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *See question C.5.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

2024 Five-Year Review Site Visit/Site Manager Interview Form

Construction of the Outfall 200 MTF is ongoing, and D&D of selected buildings continues. Vegetation was noted to be dense along the riprap sides of the UEFPC channel. The site is well maintained and was recently mowed. See also notes to question C.1.

2024 Five-Year Review Site Visit/Site Manager Interview Form

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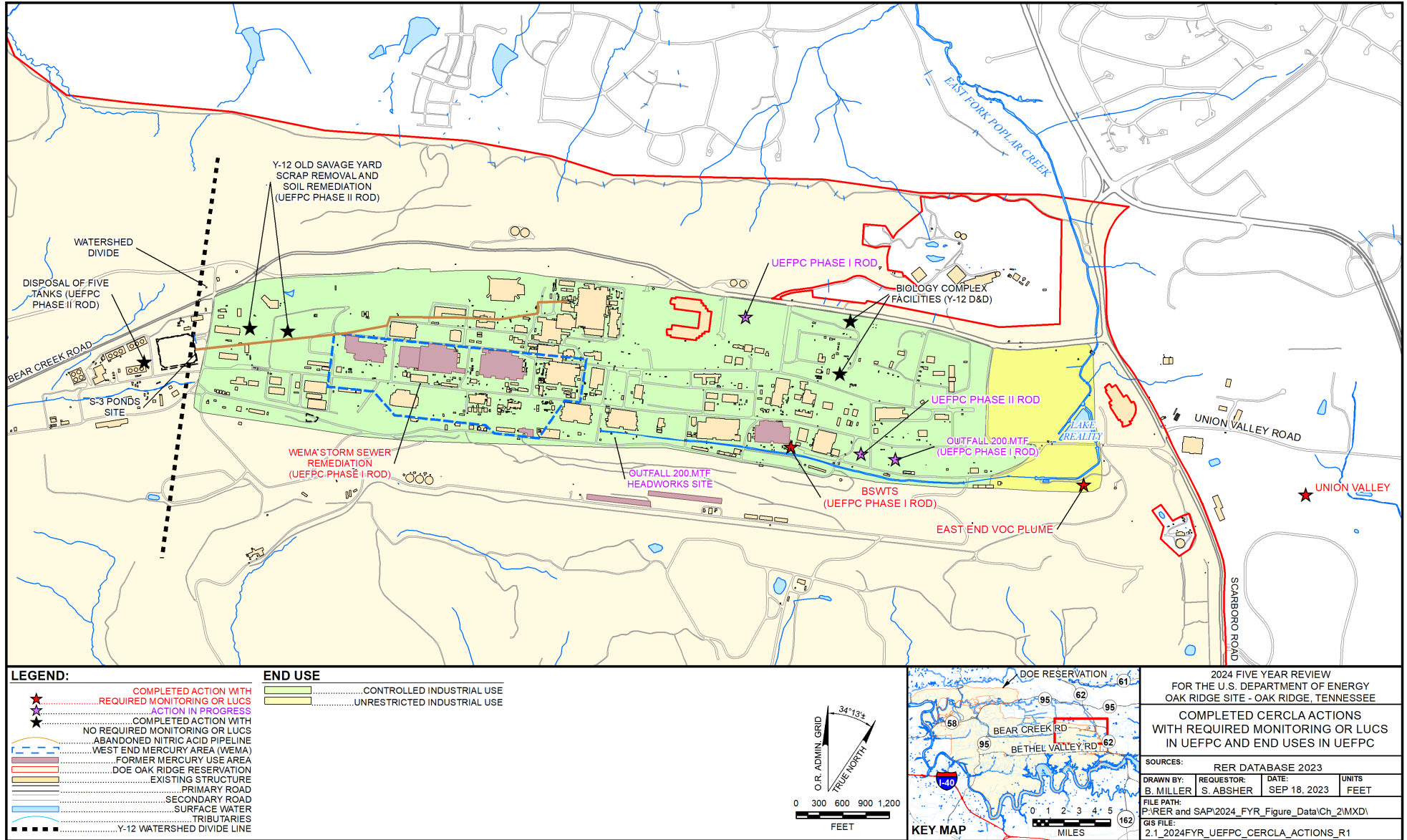


Figure 1. Phase I Interim Source Control Actions in UEFPC Watershed.

2024 Five-Year Review Site Visit/Site Manager Interview Form

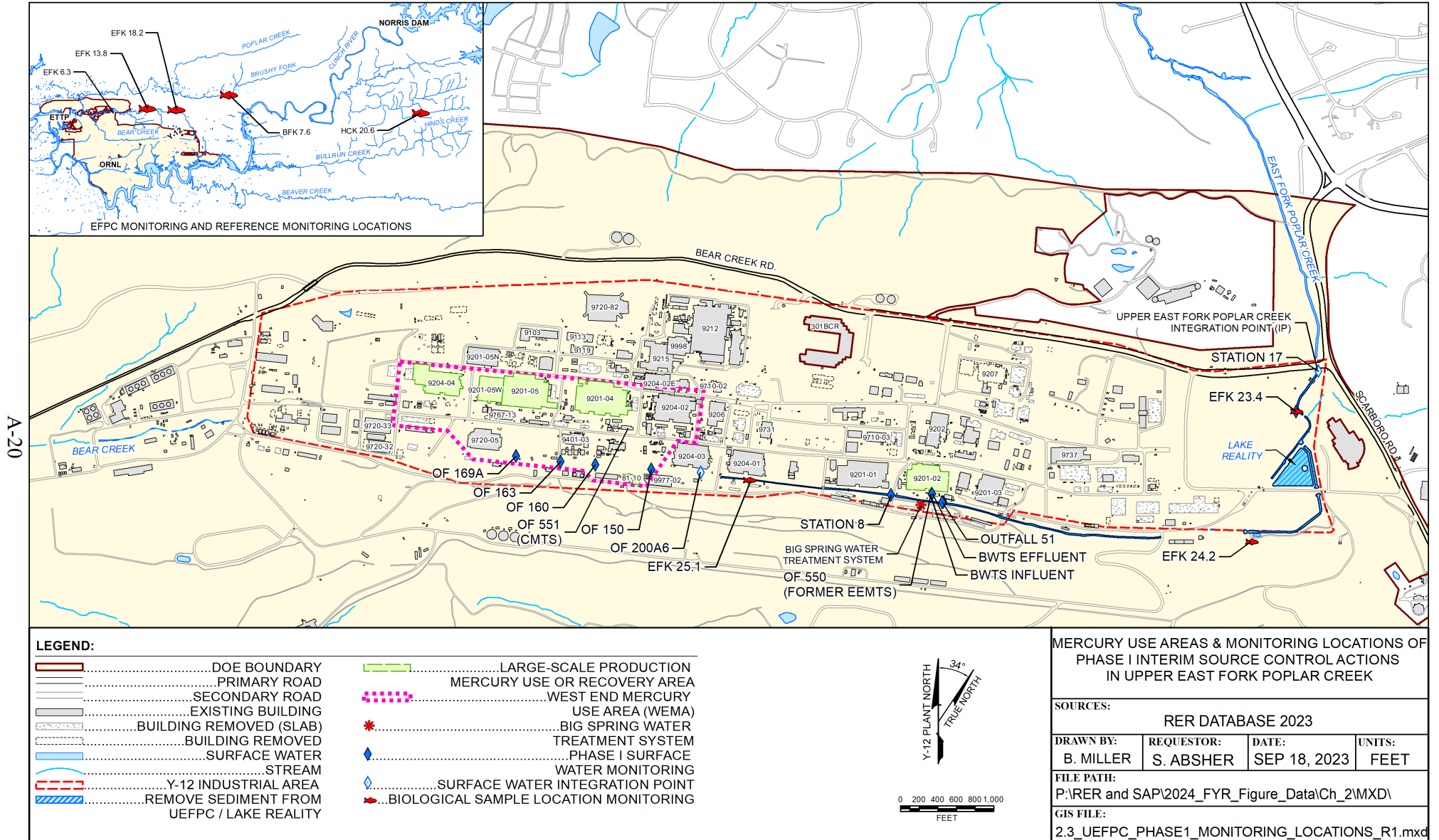


Figure 2. Monitoring locations in UEFPC Watershed.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 3. UEFPC; Lake Reality in background on other side of bridge.



Figure 4. View 1 of UEFPC stream channel within the Y-12 plant area.



Figure 5. View 2 of UEFPC stream channel within the Y-12 plant area.



Figure 6. UEFPC Station 17 IP surface water sampling station.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 7. View 1 of 2024 FYR site visit participants at UEFPC Station 17.



Figure 8. View 2 of 2024 FYR site visit participants at UEFPC Station 17.

**2024 CERCLA FIVE-YEAR REVIEW
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Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

Big Spring Water Treatment System

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: Building 9416-48 Water Treatment System (Big Spring) (UEFPC Phase I Interim ROD [05/02/2002], PCCR [07/01/2005])

Date(s) of Visit: 08/21/2023 (interview), 10/17/2023 (site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Dick Ketelle (RSI); Seth Cook (CNS), STA; Andy Hudson (CNS), Operations Manager; Jonathan Phillips (CNS), STR; Aaron Clements (CNS), Waste Operations Manager

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Treatment. A treatment system at Building 9416-48 to remove mercury from groundwater discharge from Outfall 51 (the main source is Big Spring) and groundwater collected in dewatering sumps in Alpha 2 (Building 9201-2). The system was designed to reduce mercury to 200 ppt or less in the system effluent. The system discharges at a rate of 250 to 300 gpm, with 30- to 50-gpm discharge at Outfall 51 (2023 RER Section 5.3.1.2.1).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☒ Groundwater Pump and Treat |
| ☐ Groundwater Monitoring | ☐ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☒ Other: <i>Storm drain monitoring</i> | |

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☒ NA | ☐ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☐ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs were not specified in the decision documents.

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|---|---|
| ☒ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☐ Other: |

Note: The engineered remedy includes inspection and maintenance of the BSWTS, as required. Engineered remedies are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☒ No ☐ NA ☐

Notes: The BSWTS experienced Big Spring groundwater treatment interruptions during FY 2022. During FY 2022, treatment of mercury-contaminated groundwater from the wet well was interrupted to limit adverse effects related to solids loading from grout injections at the Outfall 200 MTF headworks. Following June 2022, groundwater withdrawals from the Outfall 200 MTF headworks excavation significantly reduced groundwater flow volumes to the BSWTS and Outfall 51. However, the BSWTS continued to treat mercury in Building 9201-2 basement sump water throughout FY 2022. Treatment interruptions ceased when grout injections stopped in mid-2022. Monitoring data show that, during FY 2022, approximately 10 g of mercury were discharged in the BSWTS-treated effluent, approximately 49 g of mercury were discharged in mercury bypass flows, and approximately 508 g were discharged to UEFPC via Outfall 51. When water from the BSWTS wet well is not pumped into the treatment system, the flow rate and mercury discharge at Outfall 51 increase.

2024 Five-Year Review Site Visit/Site Manager Interview Form

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☐ No ☐ NA ☒

Notes: *No LUCs were specified for the BSWTS in the UEFPC Phase I Interim ROD.*

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: *S&M is performed daily and recorded on check sheets. Preventative maintenance is conducted on a regular schedule. An additional scheduled activity includes annual change-out of carbon in two of the six carbon columns.*

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *Operating procedures include the following:*

- *Y50-41-WT-14.01-R5 – Start-Up Operate and Shutdown*
- *Y50-41-WT-14.02-R8 – Backwashing and Carbon Column Changeout*
- *Y57-41-BSWTS-MAIN R6 – Alarm Response Procedure*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

Bolt corrosion is a problem, but it is being monitored and no leaks have occurred. Bolt hardware was replaced in FY 2022 with zinc-coated carbon steel to slow and minimize corrosion over time. The hardware is now more compatible with the metallurgy on the carbon columns. Also, over time, there is noticeable microbial growth on the exterior surface of the outdoor tanks. These tanks are periodically cleaned to remove dirt and microbial buildup.

Building 9201-2 has been turned over to UCOR for decommissioning; therefore, additional efforts are required to enter the building. The building sump water continues to be processed by the BSWTS. In addition, the carbon sample results show an increase in uranium concentrations. Due to the presence of uranium, the facility is posted as internal system contamination, and disposal of the carbon is at a commercial disposal facility in Oak Ridge (EnergySolutions).

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *As-builts for the BSWTS are available and are up to date. Maintenance Work Packages are maintained and stored by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

2024 Five-Year Review Site Visit/Site Manager Interview Form

Notes: Influent/effluent and storm drain monitoring records are available in OREIS. Inspection check sheets are filed by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: There were no LUCs specific to the BSWTS, but the UEFPC Phase I ROD specified the following LUCs: an effective EPP program, signs to provide notice or warning to prevent unauthorized access, and surveillance patrols to control and monitor access by workers and the public. Also, because the UEFPC Watershed is mostly within the Y-12 industrial complex, public access is restricted through guarded portals, fencing, and gates, which are not explicit LUC requirements.

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: The Y-12 industrial complex is expected to remain under DOE control, with a controlled industrial end use.

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☐ No ☒ NA ☐

Notes: D&D activities continue in the vicinity of the BSWTS, but there are no physical changes to the treatment facility itself.

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The BSWTS facility is clean and well organized, with all components clearly labeled. Site access controls are described in question C.1 per the UEFPC Phase I ROD. Treated water discharges via pipeline from Building 9416-48, travels underground, and enters the creek at the 01 CERCLA BSWTS discharge point (Figure 7). At the time of the site visit, the carbon columns had recently been rotated and a large roll-off container was in the building with spent carbon awaiting disposal at the EnergySolutions commercial disposal facility in Oak Ridge, Tennessee.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. Activated carbon column bank with particulate pre-filter on lower left.



Figure 2. Spent pre-filter cartridges drying prior to disposal.



Figure 3. View of treatment system left and right bank carbon columns.



Figure 4. Close-up of flange with zinc-coated carbon steel replacement bolts.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 5. Wet well (foreground) and equalization tank outside of Building 9201-2.



Figure 6. BSWTS backwash hold tank (F-410) and backwash feed tank (F-400).



Figure 7. BSWTS discharge to UEFPC.



Figure 8. BSWTS facility manager (left) explains treatment system operations to 2024 FYR site visit participants.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

Big Spring Water Treatment System (Operating System)

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BSWTS (08/21/2023)

The following procedures are available:

- Y50-41-WT-14.01-R5 – Start-Up Operate and Shutdown
- Y50-41-WT-14.02-R8 – Backwashing and Carbon Column Changeout
- Y57-41-BSWTS-MAIN R6 – Alarm Response Procedure

1. Equipment:

- a. Are there any primary equipment problems? If yes, please identify the most problematic areas (locations or system components/types) and any suggestions for operational improvement or reliability.

No.

- b. Are any components showing signs of deterioration? If yes, please identify the components and recommendations for replacement or upgrades.

The flange bolts for all the carbon columns suffer from corrosion resulting from combining stainless steel with high-carbon steel. Please see response to question 7 about repairs. All hardware (including flange bolts) was replaced in FY 2022.

2. Replacement materials:

- a. How frequently are the carbon filters replaced?

The facility consists of two treatment skid units of three carbon columns each. Per system design, the carbon in the lead column of each skid is replaced every year in September (the lead column is the oldest carbon in each skid), which then allows for the lead column to become the lag in the following FY (the lag column is the newest carbon in each skid). Each column has its carbon replaced once every 3 years. The columns rotate as follows after carbon replacement: lead becomes lag, lag becomes middle, and middle becomes lead. There are approximately 10,000 lb of carbon in each column.

3. Inspections:

- a. How often are inspections performed on the system?

Once a day.

- b. Have any abnormal conditions been discovered during the performance of the inspections?

Other than conditions requiring routine maintenance, no.

- c. How are the inspections documented?

Roundsheets and logbook.

- d. What corrective actions have been implemented and how are they documented?

Other than maintenance activities as needed, no corrective actions were implemented. Maintenance activities included replacing flange bolts and piping hardware with zinc-coated carbon steel, installing backwash filter housing, steam cleaning the tanks' exterior, and repairing pipe leaks due to microbial growth in the piping weld joints. Documentation is captured on Change Notice Forms and Job Work Packages and summarized monthly in the LUM application.

4. Were there upset conditions (power outage/loss) or maintenance activities that required the system to be shut down? If so, describe the conditions and durations.

Yes, the system has been shut down multiple times during the last 3 years, primarily due to the ongoing construction activities by Outfall 200:

- *Big Spring wet well pumps were shut down due to filter loading on 04/27/2021; wet well pumps were restarted on 05/17/2021.*
- *Wet well pumps were shut down on 05/24/2021 and restarted on 05/26/2021.*

- *Wet well pumps were shut down on 05/27/2021 for the long weekend; they were restarted on 06/21/2021 and experienced filter changes every 12 to 20 hr.*
 - *Wet well pumps were shut down on 06/24/2021 due to grouting activities and were restarted on 07/14/2021.*
 - *Wet well pumps were shut down 07/20/2021 to 9/27/2021.*
 - *Wet well pumps were shut down 11/02/2021 to 12/6/2021.*
 - *Wet well pumps were shut down 01/06/2022 to 1/10/2022.*
 - *Wet well pumps were shut down 01/14/2022 and were restarted on 06/13/2022, operating on days only until system repairs were complete on 11/02/2022.*
 - *The BSWTS was also shut down for 4 days in April 2023 due to a plant air outage.*
- Note that during the shutdown times listed above, collection of sump water continued at Building 9201-2 (Alpha 2). Other times, the system was offline for short durations for maintenance activities; those activities included the following:*
- *04/28/2021 – Replace valve HV-420-3.*
 - *10/27/2021 – Replace valve HV-330-A9.*
 - *02/16/2022 – Repair the leak (slight water seepage – no accumulation) around HV-400A.*
 - *04/13/2022 – Repair HV-110A on the discharge of the 110 tank.*
 - *11/03/2022 – Replace the level switch on the equalization tank.*
5. How frequently is backwashing of the carbon columns conducted?
Once per month.
 6. Have any leaks or spills been observed or recorded?
Nothing significant. The leak repair mentioned on 02/16/2022 in question 4 above did not result in any accumulation of water, nor did it require shut down of the system.
 7. Resolution of Operating System issues identified during inspections and documented in the previous FYR:
From the 2021 FYR:
 - a. *Program in place to replace approximately 20% of the flange bolts within the system due to an installation issue. (Note this was also identified in the 2016 FYR.)*
 - b. *Loss of plant air, causing the system to dead head due to failure of the throttle valves to close on the discharge side of the carbon columns.*
 - c. *Grout in the groundwater on two occasions from a construction project at Outfall 200.*

Have the flange bolts been replaced?
Yes, all hardware was replaced with zinc-coated carbon steel in FY 2022.

Has the issue with the throttle valves failing to close resulting in the system dead heading been resolved?
Yes, the issue was not with the valves, but with the loss or unplanned outage of plant air. If the plant air outage is planned, valves can be operated via compressor without system interruption. If there are unplanned plant air outages/interruptions, the compressor will then be used.

Have there been further instances of grout in the groundwater from construction at Outfall 200?
No further instances of grout since May 2022.
 8. What are the annual O&M costs associated with the BSWTS?
 - *FY 2021 – \$503,293*
 - *FY 2022 – \$466,684*
 - *FY 2023 – \$537,347 (month of September estimated)*

9. Are there system upgrades you would suggest to improve operation, reliability, or cost-effectiveness of this system?

No.



Figure 1. BSWTS.

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SITE VISIT/SITE MANAGER INTERVIEW FORM
Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

Outfall 200 Mercury Treatment Facility

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: Outfall 200 MTF, currently under construction (UEFPC Phase I Interim ROD Amendment [05/24/2016]; Addendum to the RDR/RAWP for Water Treatment at Outfall 200 in the UEFPC Characterization Area [11/09/2020])

Date(s) of Visit: 12/14/2023 (interview), 12/14/2023 (virtual site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Jimmy Massey (UCOR); Dick Ketelle (RSI)

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy will be: Treatment. As a subproject of the UEFPC Phase I Interim ROD, a new treatment system is under construction to reduce mercury concentrations in water exiting the Y-12 site at Station 17. Outfall 200 MTF construction includes installing an intake structure in UEFPC in the headworks area and installing an outfall structure located downstream in UEFPC at the treatment plant (Figure 1). The scope of the RA includes constructing and operating the facility with a treatment capacity of 3000 gpm of influent surface water. The facility will also store up to 2 million gal of additional stormwater collected during higher storm flow conditions. The goal of the treatment operation is to reduce mercury concentrations in the treated effluent to 51 ng/L, which will be discharged back into UEFPC. The UEFPC Phase I Interim ROD goal for mercury in surface water at Station 17 is 200 ng/L (2024 RER Section 5.1.2).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|---|--|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☐ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☒ Surface Water Collection and Treatment |
| ☐ Other: | |

LUC Requirements Include: (check all that apply)

- | | |
|--|---|
| ☐ NA | ☒ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☒ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☒ EPP | |

Note: Per the UEFPC Phase I Interim ROD Amendment, the above Phase I Interim ROD LUCs apply to the Outfall 200 MTF.

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|---|---|
| ☒ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☐ Other: |

Note: The engineered remedy will include inspection and maintenance of the Outfall 200 MTF upon completion and startup, as required.

A. Interview: (Note that remedy construction is addressed in Question A.7.)

1. Are monitoring requirements indicating that the performance standards are being met?
Yes ☐ No ☐ NA ☒

Notes: *The Outfall 200 MTF is still under construction.*

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2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: LUCs per the UEFPC Phase I Interim ROD (i.e., access controls [fencing, gates, portals, DOE-posted signs, surveillance patrols], property record restrictions, property record notices, and EPPs) are in place and are preventing exposure during construction.

3. Does the site undergo S&M on a regular schedule?

Yes ☐ No ☐ NA ☒

Notes: The system is still under construction. Upon construction completion and system startup, S&M will be performed as specified in the decision/design/completion documents.

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☐ NA ☒

Notes: The system is still under construction. See also Question 7c below.

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☐ No ☐ NA ☒

Notes: The system is still under construction. Operating procedures will be implemented upon construction completion and system startup.

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☐ NA ☒

Notes: The system is still under construction. Toxic byproducts of the remedy not addressed by the decision documents are not anticipated.

7. Additional site-specific questions and concerns:

- a. Is the remedy being constructed in accordance with the requirements of the decision documents and design specifications? Yes. There have been no changes to the final design of the system.
- b. Have any problems been encountered which required, or will require, changes to this remedial design or ROD? An amendment to the RDR/RAWP was approved by EPA and TDEC in FY 2021 (DOE/OR/01-2735&D2/A1/R1) to address approaches for construction ARAR compliance for the Outfall 200 MTF intake and outfall structures and for mitigation of the permanent loss of net resource value of the length of UEFPC between Outfall 200 and BSWTS. The RDR/RAWP amendment does not result in changes to the final design of the system.
- c. Have any problems or difficulties been encountered which have impacted construction progress or implementability? Yes, excavation, facility foundation construction, and dewatering activities have been affected by karst features at the site and associated water management concerns. In addition to the BMPs cited in the Water Management Requirements for the Outfall 200 Mercury Treatment Facility (UCOR-5172; November 2018), a more robust portable water treatment system was used to ensure compliance with the substantive requirements of Construction General Permit Number TNR10-0000. Mercury treatment was suspended during FY 2022, while solids treatment ceased in July FY 2023. The treatment system has been removed; however, stormwater management activities for the site continue.
- d. What is the current status of construction (e.g., budget and schedule)? The anticipated completion date and construction costs for the system have been adjusted based on delays caused by construction issues, as indicated above.

2024 Five-Year Review Site Visit/Site Manager Interview Form

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? NA Up to date? NA

Are Maintenance Logs readily available? NA Up to date? NA

Notes: *The Outfall 200 MTF is currently under construction. As-builts for the system will be available upon construction completion and system startup. Following system startup, Maintenance Work Packages will be maintained and stored by the operating contractor, UCOR, in their Document Control Center and will be summarized monthly in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? NA Up to date? NA

Are Inspection Reports readily available? NA Up to date? NA

Notes: *The Outfall 200 MTF is currently under construction. Applicable monitoring records will be available in OREIS upon construction completion and system startup. Following system startup, inspection check sheets will be filed by the operating contractor, UCOR, in their Document Control Center and will be summarized monthly in the LUM application.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *Per the UEFPC Phase I Interim ROD Amendment, the UEFPC Phase I Interim ROD LUCs apply to the Outfall 200 MTF. LUCs for the UEFPC Phase I Interim ROD include an effective EPP program, signs to provide notice or warning to prevent unauthorized access, and surveillance patrols to control and monitor access by workers and the public. Also, because the UEFPC Watershed is mostly within the Y-12 industrial complex, public access is restricted through guarded portals, fencing, and gates, which are not explicit LUC requirements.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: *The Y-12 industrial complex is expected to remain under DOE control, with a controlled industrial end use.*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

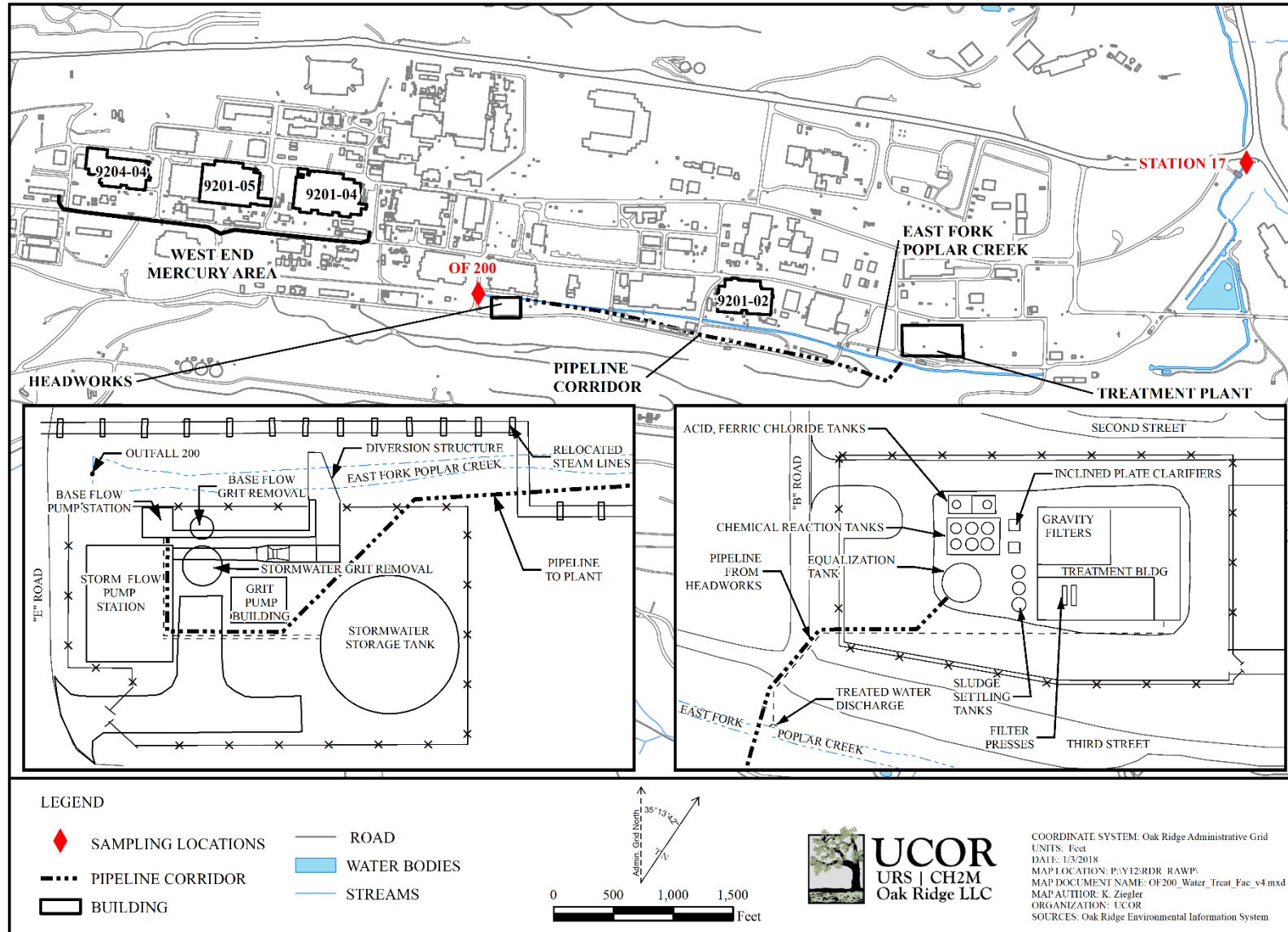
Notes: *Ongoing construction activities have resulted in changes to the physical site conditions.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The two components of the Outfall 200 MTF, the Headworks Site and the Treatment Site, are being maintained and controlled as construction sites, with signage, access controls, etc. See map and photographs on the following pages.

2024 Five-Year Review Site Visit/Site Manager Interview Form

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(Source: Addendum to the RDR/RAWP for Water Treatment at Outfall 200 in the UEFPC CA).

Figure 1. Outfall 200 MTF site location and components.

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Figure 2. Headworks Site - south side looking northwest. Storm Flow Pump Station (left side) and Grit Pump building (right side) under construction.



Figure 3. Headworks Site - east side looking west. Grit Pump building (center) and Storm Flow Pump Station (right) under construction.



Figure 4. Headworks Site - west side looking east. Storm Flow Pump Station in foreground, Grit Pump building behind. Secant wall and anchoring system on left.

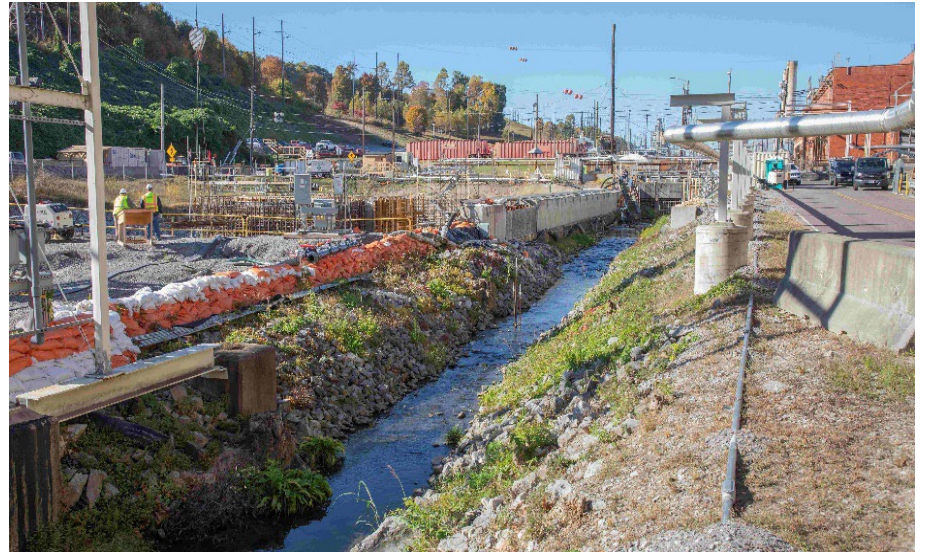


Figure 5. Headworks Site – view north side looking west. EFPC flowing east from Outfall 200.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 6. Treatment Site - southeast side looking west. Treatment building under construction.



Figure 7. Treatment Site - northeast side looking west. Treatment building under construction (center), chemical storage tanks on right.



Figure 8. Treatment Site - south side looking west. Treatment Filter building under construction, with second-level concrete slab held up with shoring.



Figure 9. Treatment Site - south side looking east. Chemical reaction tanks awaiting placement (left). Equalization tank (center) and treatment building (right) under construction.

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Upper East Fork Poplar Creek Phase II Interim Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: Phase II Interim RAs for Contaminated Soils and Scrapyard in UEFPC (ROD [04/21/2006], PCCRs for Y-12 Salvage Yard [10/11/2011] and Soils [11/01/2012], EU-5 completed with NFA per Attachments C.3 and C.4 to the UEFPC RAWP [09/17/2022])

Date(s) of Visit: 08/21/2023 (interview), 10/17/2023 (site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Dick Ketelle (RSI), YWQP Technical Lead; Bri Humphrey (RSI), Y-12 Project Lead; Sid Garland (RSI), Regulatory Support

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Removal and LUCs. The UEFPC Phase II Interim ROD addresses accessible contaminated soil, scrap, buried waste, and subsurface structures (including slabs) throughout the Y-12 industrial area. The focus is to eliminate or reduce existing contamination to protect workers (2023 RER Section 5.4).

To date, two RAs have been completed under the UEFPC Phase II Interim ROD. The OSY scrap metal RA and the OSY soil RA (which included removal of five tanks) were completed in 2011 and 2012, respectively. The OSY scrap metal RA applied to scrap located in the Y-12 OSY and included characterizing scrap metal; sorting and segregating scrap piles; and disposing in the EMWMF, Y-12 landfill, and off-site disposal facilities. Approximately 29,225 yd³ of scrap and related solid waste from OSY were removed and disposed.

The OSY soil RA included removing soil determined to exceed established RLs to protect future users of the site and to protect groundwater based on modeling. Approximately 800 yd³ of contaminated soil were excavated and disposed at the EMWMF. Additionally, five storage tanks previously located southwest of the West End Treatment Facility, with the potential to release mercury to the environment and the potential for worker exposure to mercury vapor, were removed and disposed offsite.

In 2022, an NFA determination was approved for EU-5 (soils around the Biology Complex).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☐ Groundwater Monitoring | ☐ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☒ Other: <i>None</i> | |

LUC Requirements Include: (check all that apply)

- | | |
|--|---|
| ☐ NA | ☒ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☒ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☒ EPP | |

Note: Per the UEFPC Phase II Interim ROD, access controls include security guards and surveillance patrols. LUCs are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|--|--|
| ☐ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls |
| ☐ Former RCRA Site Controls | ☒ Other: <i>None</i> |

Note:

2024 Five-Year Review Site Visit/Site Manager Interview Form

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☐ No ☐ NA ☒

Notes: *No monitoring requirements.*

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: *Per the UEFPC Phase II Interim ROD, all LUC requirements have been met. The LUM application documents that LUC requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.*

3. Does the site undergo S&M on a regular schedule?

Yes ☐ No ☐ NA ☒

Notes:

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *Implementation of EPP requirements is per UCOR and CNS excavation and penetration procedures.*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

None.

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? NA Up to date? NA

Are Maintenance Logs readily available? NA Up to date? NA

Notes:

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? NA Up to date? NA

Are Inspection Reports readily available? NA Up to date? NA

Notes:

C. Visual Survey: (Note: The OSY site was not photographed due to its location within active security controls; therefore, information was obtained through discussions.)

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

2024 Five-Year Review Site Visit/Site Manager Interview Form

Notes: *LUCs for the UEFPC Phase II Interim ROD include an effective EPP program, signs to provide notice or warning to prevent unauthorized access, and surveillance patrols to control and monitor access by workers and the public. Also, because the UEFPC Watershed is mostly within the Y-12 industrial complex, public access is restricted through guarded portals, fencing, and gates, which are not explicit LUC requirements.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: *The Y-12 industrial complex is expected to remain under DOE control, with a controlled industrial end use. The easternmost end of the UEFPC Watershed is and will remain unrestricted industrial (see the UEFPC Phase I Interim ROD site interview/site visit form, Figure 1).*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *Construction of the Outfall 200 MTF per the UEFPC Phase I Interim ROD Amendment is ongoing, and D&D of selected buildings continues.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

Dense vegetation along the riprap sides of the UEFPC channel was noted. The site is well maintained and was recently mowed.

2024 Five-Year Review Site Visit/Site Manager Interview Form

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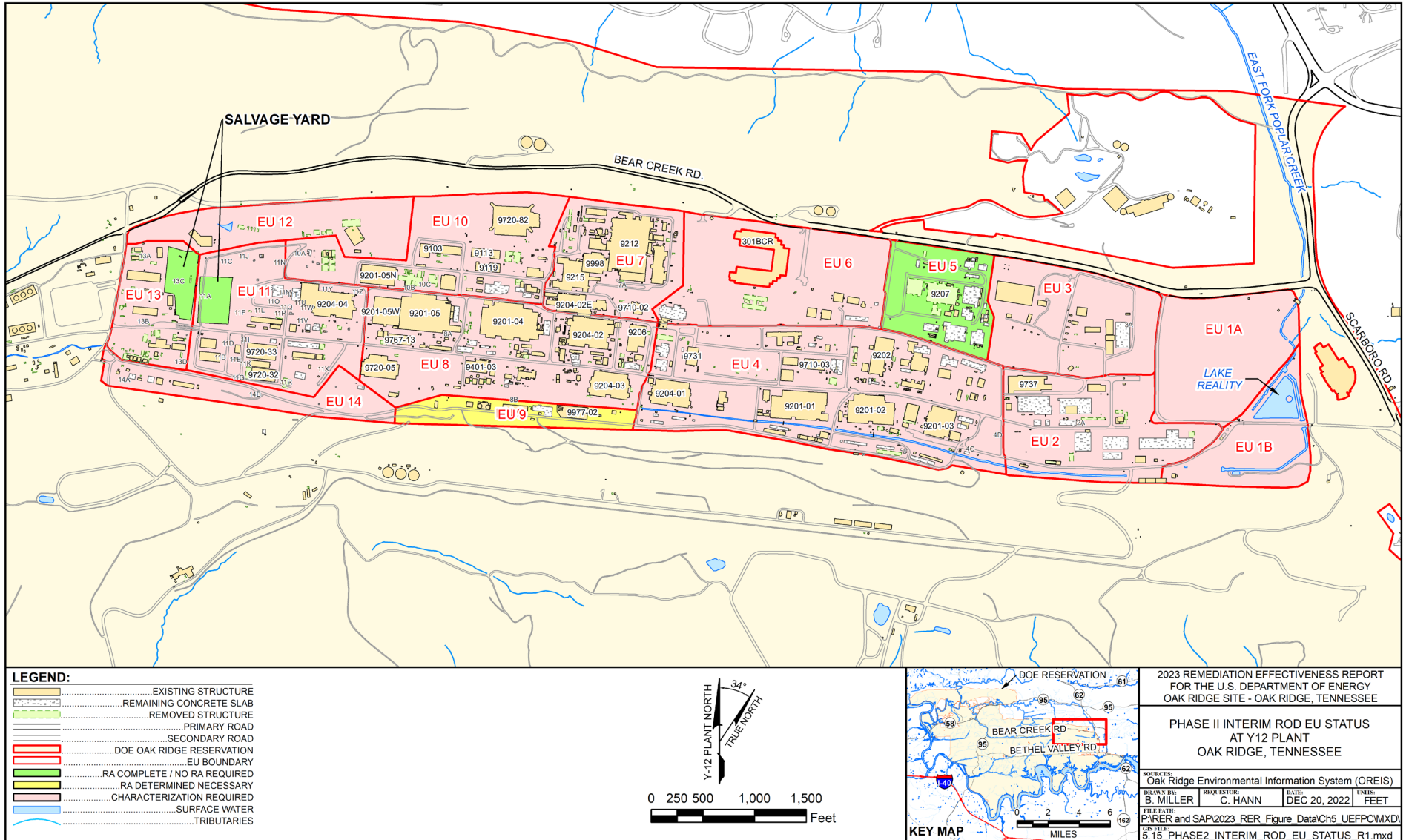


Figure 1. Current status of UEFPC Phase II Interim ROD.

**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

Union Valley Interim Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: Union Valley Interim Action (Interim ROD [07/10/1997], no RAR exists)
Date(s) of Visit: 08/21/2023 (interview), 10/17/2023 (site visit)
Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)
Project Personnel: Dick Ketelle (RSI), YWQP Technical Lead; Sally Brown (RSI), Union Valley Project Lead

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: LUCs. Administrative controls are to protect human health from the contaminated plume originating beneath Y-12 and detected in groundwater below privately owned land in Union Valley. Controls to be instituted by DOE during the term of the Union Valley Interim ROD include: (1) establishing license agreements between DOE and all affected property owners within the interim RA boundary that require property owners to notify DOE 90 days before extraction or use of groundwater is proposed; (2) conducting annual title searches to determine whether any affected property changed ownership and verifying any new owner has been notified of the provisions of the license agreement; (3) notifying affected property owners and the city of Oak Ridge to remind them of their obligations under the agreement; (4) surveying owners by telephone to determine whether any new groundwater wells have been constructed or planned, or if there are any new uses for surface water; and (5) notifying licensed well drillers in Tennessee of the license agreements and their terms (2023 RER Section 5.5.2).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|---|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☐ Inspections | ☐ Surface Water Monitoring |
| ☐ Groundwater Monitoring | ☐ Surface Water Collection and Treatment |
| ☐ Air Monitoring | ☒ Other: <i>None</i> |

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☐ NA | ☐ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☐ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |
| ☒ Other: <i>Annual verification of license agreements and notifications, title searches, phone surveys to inquire about new groundwater wells or surface water use, and notifying licensed well drillers in Tennessee of license agreements and terms. LUCs are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).</i> | |

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|--|--|
| ☐ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☒ Other: <i>None</i> |

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?
Yes ☐ No ☐ NA ☒

Notes: No surface water or groundwater monitoring is required as part of this interim action. An associated action, the EEVOC Plume RmA, included constructing a groundwater treatment facility to prevent further migration of the VOC-contaminated groundwater plume off of the ORR into Union Valley (see 2023 RER Section 5.5.1).

2024 Five-Year Review Site Visit/Site Manager Interview Form

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: *Per the Union Valley Interim ROD, all LUC requirements have been met and are verified annually in the RER. The LUM application documents that LUC requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.*

3. Does the site undergo S&M on a regular schedule?

Yes ☐ No ☐ NA ☒

Notes:

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☐ No ☐ NA ☒

Notes:

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

None.

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? NA Up to date? NA

Are Maintenance Logs readily available? NA Up to date? NA

Notes:

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? NA Up to date? NA

Are Inspection Reports readily available? NA Up to date? NA

Notes:

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *The license agreements in place with the approximately 20 property owners under the Union Valley Interim ROD footprint require DOE to be notified prior to sale of their property. Several parcels have changed ownership, and the required annual title search tracks these sales. The property at the corner of State Highway 62 and Union Valley Road has been sold. Construction of a new Weigel's convenience store began in FY 2023 after an environmental evaluation was conducted.*

2024 Five-Year Review Site Visit/Site Manager Interview Form

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: *The end use for the Union Valley area is and will continue to be unrestricted industrial.*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *A new Weigel's convenience store was constructed on the corner of State Highway 62 and Union Valley Road in FY 2023.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The properties within the Union Valley Interim ROD footprint (Figure 1) are primarily light industrial and commercial (Figure 2). The UT Arboretum, located on the eastern side of Highway 62, is also within the Union Valley Interim ROD footprint. The UT parcels extend beyond the Union Valley Interim ROD boundary and are also under current license agreements (Figure 1).

2024 Five-Year Review Site Visit/Site Manager Interview Form

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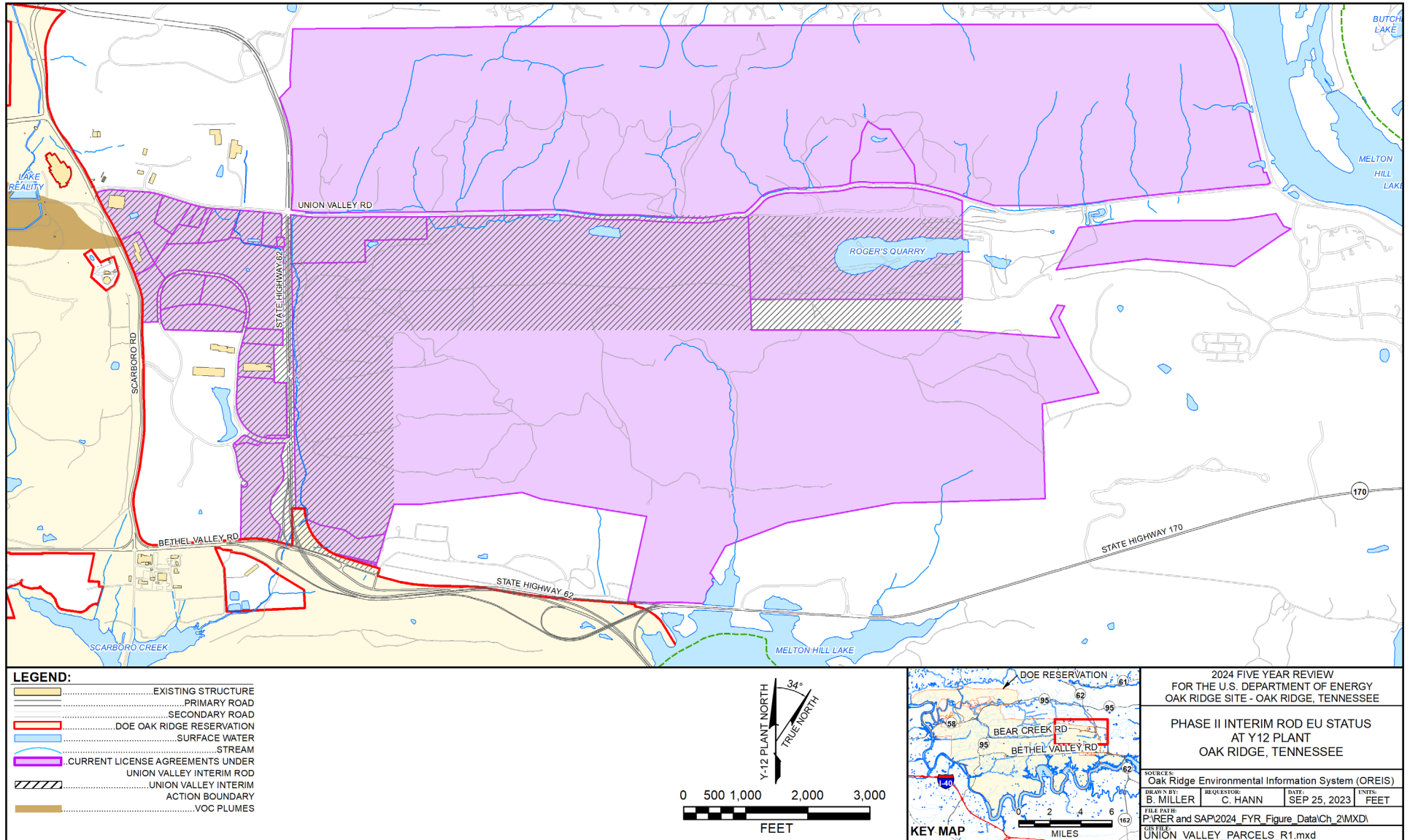


Figure 1. Union Valley parcels.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 2. Aerial photograph looking toward Union Valley. Y-12 Visitor Center is shown in bottom left and the EEVOC building is shown in bottom right.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

East End Volatile Organic Compound Plume Removal Action

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: EEVOC Plume (AM [06/25/1999], NSC [03/06/2013], RmAR [06/07/2006], RmAR erratum [03/05/2013])

Date(s) of Visit: 08/21/2023 (interview), 10/17/2023 (site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Dick Ketelle (RSI); Seth Cook (CNS), STA; Andy Hudson (CNS), Operations Manager; Aaron Clements (CNS), Waste Operations Manager; Jonathan Phillips (CNS), STR

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Removal (water treatment system, Building 9422-22). The selected alternative consisted of pump-and-treat technologies using well GW-845 installed within the plume onsite and treatment of groundwater to remove particulates, iron, manganese, and VOCs. Treatment system capacity was conservatively assumed to treat 20 gpm (2023 RER Section 5.5.1).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☒ Groundwater Pump and Treat |
| ☒ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☐ Other: | |

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☒ NA | ☐ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☐ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs were not specified in the decision documents.

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|---|---|
| ☒ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☐ Other: |

Note: The engineered remedy includes inspection and O&M of the EEVOC water treatment system. Engineered remedies are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?
Yes ☒ No ☐ NA ☐

Notes: Groundwater monitoring is conducted to demonstrate control of off-site VOC plume migration through pump-and-treat operations. The EEVOC water treatment system demonstrated a high effectiveness for VOC removal during FY 2022 following air stripper replacement and operating air temperature adjustments (see question 7). The off-site groundwater VOC concentrations continued to show migration of the plume into the Union Valley area is largely contained by the EEVOC water treatment system. Occasional carbon tetrachloride AWQC (used as a screening criterion) exceedances occur in effluent; however, instream sampling downstream of the outfall to UEFPC at the POC, LRBP-1, demonstrates no instream exceedances of carbon tetrachloride AWQC (16 µg/L). Off-site monitoring of wells in Union Valley shows that, although carbon tetrachloride, the principal contaminant in the plume, continues to be detected, its concentration is less than the 5-µg/L MCL. VOCs have not been detected in off-site spring samples collected during this FYR period (2023 RER Section 5.5.1).

2024 Five-Year Review Site Visit/Site Manager Interview Form

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☐ No ☐ NA ☒

Notes: *No LUCs were stipulated in the decision documents.*

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: *The site undergoes S&M daily (during operational days—Monday through Thursday); this is documented on check sheets. The cartridge filters are changed the first week of every month, and the stripper trays are changed out every 6 months or as needed.*

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *Operating procedures include the following:*

- *Y50-41-WT-13.01 R10 – System Start-Up Operation and Shutdown*
- *Y57-41-EEVOC-CP2133-5 R6 – Alarm Response Procedure*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

During the 2021 FYR Site Interview, a recurring problem with scale buildup in the stripper pump, stripper tray, and piping was noted. Regular cleaning of the two air stripper units is required to ensure proper VOC concentration reduction. Metal fatigue caused a crack to form in one air stripper in 2021. Both air stripper units were replaced during FY 2022. Aside from regular cleaning of the air stripper trays, routine valve/piping replacement is currently the mitigation strategy for scale-related equipment issues. A swale was constructed in March 2023 to catch and direct the effluent to the receiving ditch, thus bypassing the underground discharge piping to avoid replacing underground piping due to scale buildup.

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Builts:

Are As-Builts readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *Maintenance Work Packages are maintained and stored by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Groundwater and surface water monitoring records are available in OREIS. Inspection check sheets are filed by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.*

2024 Five-Year Review Site Visit/Site Manager Interview Form

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☐ No ☐ NA ☒

Notes: *LUCs were not specified in the decision documents; however, the EEVOC is located within the Y-12 footprint; therefore, the UEFPC LUCs per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) are in place.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes: *End use in this area is and is expected to remain unrestricted industrial.*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *In FY 2023, an above-ground swale was constructed to replace the underground discharge pipe from the treatment building. (See also response to question A.7.)*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The EEVOC facility building appears clean, orderly, and well organized, with all components clearly labeled.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. 2024 FYR site visit participants outside of the EEVOC treatment facility.



Figure 2. EEVOC air strippers inside the treatment facility building.



Figure 3. Discharge pipe showing clear plastic section to monitor scale buildup (below bucket in photo) inside the treatment facility building.



Figure 4. Concrete swale constructed in March 2023 to bypass the underground discharge piping.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 5. 2024 FYR site visit participant examining treatment system cartridge filter.



Figure 6. Sample location LRBP-1.



Figure 7. UEFPC concrete-lined channel viewed from LRBP-1.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
Y-12 UPPER EAST FORK POPLAR CREEK WATERSHED**

**East End Volatile Organic Compound Water Treatment System (Operating
System)**

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EEVOC Water Treatment System (08/21/2023)

The following procedures are available:

- Y50-41-WT-13.01 R10 – System Start-Up Operation and Shutdown
- Y57-41-EEVOC-CP2133-5 R6 – Alarm Response Procedure

1. Equipment:

- a. Are there any primary equipment problems? If yes, please identify the most problematic areas (locations or system components/types) and any suggestions for operational improvement or reliability.

The only recurring problem is scale buildup in the stripper pump, stripper tray, and piping. Both air stripper units were replaced during FY 2022. Ordinarily, the stripper pump is replaced approximately once a year; the stripper trays are cleaned every 6 months. Additionally, the entire piping from the treatment system to the discharge point was removed and replaced in April 2019, and a section of underground piping approximately 10 ft long was replaced in July 2022 due to collapse/crush. A swale was constructed in March 2023 to bypass the underground piping. (See also question 6b.)

- b. Are any components showing signs of deterioration? If yes, please identify the components and LGWO recommendations for replacement or upgrades.

The system is still operated by the original CPU; however, a complete backup of the CPU and the input and output modules is available. The CPU is preprogrammed with the ladder logic. Additionally, some of the hand valves are hard to manipulate, but they are easily replaced, if needed.

2. Inspections:

- a. How often are inspections performed on the system?

Daily.

- b. Have any abnormal conditions been discovered during the performance of the inspections?

Scale buildup continued to be an issue. Replacing the strippers was a proactive approach to maintain reliability of the system. Calcium-scale buildup in the underground discharge line limited the amount of flow through the piping, necessitating replacement of the underground discharge line. However, scale buildup continued to be an issue in the underground discharge piping.

The above conditions were remedied on the following dates:

- 10/27/2021 – Replace A side air stripper and associated piping and equipment.
- 06/08/2022 – Replace B side air stripper and associated piping and equipment.
- 07/12/2022 – Replace 10-ft section of collapsed/crushed underground discharge line.
- March 2023 – Complete the discharge swale to catch and direct the effluent to the receiving ditch as an alternative to replacing the underground discharge line. (See also question 6b.)

- c. How are the inspections documented?

Roundsheets and logbooks are filed by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.

- d. What corrective actions have been implemented and how are they documented?

Maintenance Work Packages are maintained and stored by the operating subcontractor, LATA-Atkins Technical Services, in their Document Control Center and are summarized monthly in the LUM application.

3. Were there upset conditions (power outage/loss) or maintenance activities that required the system to be shut down? If so, describe the conditions and durations.
There have been multiple power loss events due to electrical storms and plant activities; however, the system has an alarm notification; therefore, it is only down for short periods of time. The system alarm notifies operation personnel, and the system is turned back on once power is restored. The system averages roughly one power outage per year. Other outages include maintenance. The following is a list of maintenance activities (maintenance activities related to side discharge pumps and motors involve duplicate sets of impellers for the motors in the pump assembly; the impeller in use is rotated with the duplicate impeller to allow cleaning and descaling of the impeller that has been in use):
 - 01/07/2021 – Rotate A and B sides discharge pumps and motor impellers.
 - 04/29/2021 – Replace valves HW-620R and HV-620F.
 - 04/06/2022 – Rotate A and B sides discharge pumps and motor impellers.
 - 08/03/2022 – Rotate A and B sides discharge pumps and motor impellers.
 - 10/05/2022 – Rotate A and B sides discharge pumps and motor impellers.
 - 01/10/2023 – Rotate A and B sides discharge pumps and motor impellers.
 - 04/13/2023 – Replace valves HW-620R and HV-620F.
 - 05/31/2023 – Rotate A and B sides discharge pumps and motor impellers.
4. How frequently is air stripper tray maintenance conducted?
Twice a year, or as needed.
5. Have any leaks or spills been observed or recorded?
There was a leak in the discharge piping due to deterioration/corrosion; this section of the pipe was replaced in FY 2022.
6. Resolution of Operating System issues identified during inspections and documented in the previous FYR.
From the 2021 FYR:

“Well rehabilitation was initiated in August 2020. The EEVOC well pump rehabilitation is a proactive approach to remove calcified deposits in the well borehole and pump components. During the previous well pump replacement, deposits were identified on the casing and the intake screen. The rehabilitation will remove the calcified deposits, and in turn, maximize pump performance and life expectancy. The facility will be offline during well rehabilitation.”

 - a. Has the well rehabilitation resulted in improved system performance since completion?
There have been no interruptions associated with well pump operation since the well rehabilitation; therefore, the rehabilitation has improved system performance via improved reliability.
 - b. Is system scaling continuing to be a problem?
Yes, multiple valves and sections of piping have been replaced. To mitigate the need to dig up and replace underground piping, a swale was constructed in March 2023 to catch and direct the effluent to the receiving ditch due to scale buildup continuing to be an issue in the underground discharge piping.
7. What are the annual O&M costs associated with the EEVOC treatment system?
 - FY 2021 – \$305,591
 - FY 2022 – \$283,531
 - FY 2023 – \$329,721 (month of September estimated)
8. Are there system upgrades you would suggest to improve operation, reliability, or cost-effectiveness of this system?
None.



Figure 1. Inside the EEVOC treatment facility building.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORMS:
CHESTNUT RIDGE ADMINISTRATIVE WATERSHED**

United Nuclear Corporation Disposal Site Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: UNC Disposal Site (ROD [06/28/1991], PCR [09/06/1994])
Date(s) of Visit: 08/23/2023 (interview), 10/18/2023 (site visit)
Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)
Project Personnel: Paul Waldschlager (RSI), Project Manager/Facility Manager; Betsy Brucken (RSI), Environmental Compliance

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Containment. Construction of a multilayer cover system, S&M of the cap, and groundwater monitoring of the 1.3-acre landfill located near the crest of ChR (2023 RER Section 6.3).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☒ Groundwater Monitoring | ☐ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☐ Other: | |

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☒ NA | ☐ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☐ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs were not specified in the decision documents.

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|---|---|
| ☒ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☐ Other: |

Note: The multilayered cover system engineered remedy for the UNC Disposal Site includes S&M inspections. Engineered remedy requirements are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☒ No ☐ NA ☐

Notes: During FY 2022, monitoring data showed the UNC Disposal Site met its expected performance goal. Concentrations for nitrate remain below the screening criterion (10 mg/L) based on the drinking water standard. Nitrate is a known constituent in UNC Disposal Site waste. During FY 2022 Q4, one detection of Sr-90 at a concentration less than 1 pCi/L occurred in groundwater monitoring well GW-205 and was not detected in wells GW-203, GW-221, and 1090. At surface water monitoring location UNC-SW-1, Sr-90 was detected at concentrations less than 1 pCi/L in both the Q2 and Q4 sampling events. All detections were below the performance standard for Sr-90 (8 pCi/L) (see 2023 RER Section 6.3.1.2).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☐ No ☐ NA ☒

Notes: LUCs were not specified in the decision documents.

2024 Five-Year Review Site Visit/Site Manager Interview Form

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: *S&M inspections are conducted twice a year in accordance with the Y-12 FIT Manual. The LUM application documents S&M inspections.*

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *S&M inspections are conducted in accordance with the Y-12 FIT Manual.*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

The post-closure monitoring period (30 years) for the UNC Disposal Site was reached in 2022. To gauge the integrity of the cap, an engineering assessment of the UNC Disposal Site was conducted and documented in the "Engineering Inspection and Evaluation of United Nuclear Corporation (UNC) Landfill, Chestnut Ridge, Y-12-Plant" (UCOR RCP-9Y1200-H967, July 2022). The evaluation included an assessment of landfill settlement based on site observations; review of construction records, including type of waste located within the facility; review of the compacted clay; and literature review of the expected performance of the PVC membrane used in the facility cap. To date, groundwater wells downgradient of the facility do not indicate significant movement of any COCs from the facility to the monitoring locations. The assessment concluded the facility was judged acceptable at present and no detrimental trends were observed. However, as the life of the cap is dependent on acceptable levels of differential settlement, which is unpredictable due to the nature of buried drums, the following actions were recommended:

- Continue semiannual inspections of the cap, with an emphasis on surface erosion and differential settlement of the cap.*
- Conduct a LIDAR survey of the facility (along with other landfills facilities in the area) at a frequency of approximately 5 years to readily identify differential settlement that may be of concern.*
- Conduct a complete reevaluation of the cap, including PVC membrane and integrity testing, in preparation of the future ChR ROD in 2038 (FFA Appendix J date).*

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *Maintenance logs are filed and tracked in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Groundwater monitoring records are available in OREIS. Inspection reports are available in the LUM application.*

2024 Five-Year Review Site Visit/Site Manager Interview Form

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *LUCs were not specified in the UNC ROD, but as a BMP, access controls (signs and gates) are in place. Additionally, the site is within the Y-12 protected area.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes:

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☒ NA ☐

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☐ No ☒ NA ☐

Notes:

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The UNC Disposal Site was freshly mowed and well maintained with a good grass cover. Additional historical context was provided. There are thousands of drums from UNC in Connecticut buried at the UNC Disposal Site. The drums were placed in an unlined excavation into the soil. A multilayer cover system was constructed over the buried drums. Groundwater well GW-205 most often shows detections of Sr-90.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. View of UNC Disposal Site beyond the road and fence in the right middle ground (looking northeast).



Figure 2. UNC Disposal Site vegetation on cap (looking east).



Figure 3. View of UNC Disposal Site on ChR; note riprap around the perimeter of the site to control drainage (looking east).



Figure 4. UNC Disposal Site (looking east/southeast) with monitoring well in background.

**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
CHESTNUT RIDGE ADMINISTRATIVE WATERSHED**

Kerr Hollow Quarry Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: KHQ Site (ROD [09/29/1995], RA completed under RCRA closure plan)
Date(s) of Visit: 08/23/2023 (interview), 10/18/2023 (site visit)
Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)
Project Personnel: Paul Waldschlager (RSI), Project Manager/Facility Manager; Betsy Brucken (RSI), Environmental Compliance

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Removal. KHQ was closed according to RCRA regulatory guidance. Restricted access provides the necessary protection of human health and the environment. Therefore, an NFA determination was proposed for the site in 1995 and accepted by EPA and TDEC in the KHQ ROD approved shortly before the site was added to the ChR RCRA PCP. In 2018, the substantive requirements of the site were incorporated into CERCLA (2023 RER Section 6.4).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☒ Groundwater Monitoring | ☐ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☐ Other: | |

Note: The CERCLA KHQ ROD was NFA; however, groundwater monitoring continues, consistent with former RCRA Post-Closure Permit requirements.

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☐ NA | ☒ Access Controls (fencing, gates, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs, per the KHQ ROD, continue, consistent with the former RCRA PCP. LUCs are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|--|---|
| ☐ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☒ Former RCRA Site Controls | ☐ Other: |

Note: Former RCRA site; controls include quarterly S&M inspections. Engineered remedies and site control requirements are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☒ No ☐ NA ☐

Notes: RCRA PCP monitoring was incorporated into CERCLA in 2018. In FY 2022, well GW-144 showed a low detection (1.4 µg/L) of carbon tetrachloride, substantially below the drinking water MCL (5 µg/L). There have been no detections of carbon tetrachloride above the MCL for the past 10 years (see 2023 RER Section 6.4.1.2).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: Per the KHQ ROD, all LUC requirements have been met and are verified annually in the RER. The LUM application documents that LUC requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.

2024 Five-Year Review Site Visit/Site Manager Interview Form

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: *Quarterly S&M inspections are conducted in accordance with the Y-12 FIT Manual. The LUM application documents S&M inspections.*

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *Inspections of this site are implemented under the Y-12 S&M Program FIT Manual.*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns: *None.*

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? NA Up to date? NA

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *Maintenance logs are filed and tracked in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Groundwater monitoring records are available in OREIS. Inspection reports are available in the LUM application.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *Fencing, gates, and signs were noted.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes:

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☒ NA ☐

Notes:

4. Have there been any changes in the physical site conditions?

Yes ☐ No ☒ NA ☐

Notes:

2024 Five-Year Review Site Visit/Site Manager Interview Form

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The site is well posted with Radiological Fixed Contamination signs (and still undergoes radiation surveys). Access to the site was through locked gates with signs.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. Signs at entrance of KHQ.



Figure 2. Signs, gate, and fencing at KHQ entrance.



Figure 3. KHQ overlook.



Figure 4. KHQ.

**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM
CHESTNUT RIDGE ADMINISTRATIVE WATERSHED**

Filled Coal Ash Pond Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: FCAP (ROD [02/21/1996], RAR [06/03/1997])
Date(s) of Visit: 08/23/2023 (interview), 10/18/2023 (site visit)
Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)
Project Personnel: Paul Waldschlager (RSI), Project Manager/Facility Manager; Betsy Brucken (RSI), Environmental Compliance

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Containment. Specific components of the remedy included raising the crest of the dam, reinforcing the face of the dam, installing a subsurface drain, removing large trees from the face of the dam, repairing the emergency spillway (including removing the steep slope to the east of the spillway), constructing a settling basin and oxygenation weir at the foot of the dam, and replacing a small wetland downstream of the settling basin (2023 RER Section 6.5).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|---|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☐ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☒ Surface Water Collection and Treatment (<i>passive</i>) |
| ☐ Other | |

Note:

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☐ NA | ☒ Access Controls (fencing, gates, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs are per the FCAP RAR and the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|---|---|
| ☒ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Control | ☐ Other: |

Note: The FCAP engineered remedy includes dam improvements and stabilization and quarterly S&M inspections. Engineered remedy requirements are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☒ No ☐ NA ☐

Notes: Following significant maintenance activities at the FCAP wetland during FY 2019 to improve aquatic habitat for plant growth and to increase retention time for water within the unit, reestablishment of wetland vegetation continued throughout the FY 2022 growing season. The FY 2022 monitoring results show improving wetland performance for metals attenuation. Comparing pre-RA metals concentrations to FY 2022 data shows metals (aluminum, arsenic, iron, manganese, and zinc) concentrations have decreased at MCK 2.0 (wetland effluent).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: Per the FCAP RAR, all LUC requirements have been met and are verified annually in the RER. The LUM application documents that LUC requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.

2024 Five-Year Review Site Visit/Site Manager Interview Form

3. Does the site undergo S&M on a regular schedule?

Yes ☒ No ☐ NA ☐

Notes: *Quarterly S&M inspections are conducted in accordance with the Y-12 FIT Manual. The LUM application documents S&M inspections.*

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes: *Reservation-wide invasive species inspections are conducted annually by ORNL.*

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☒ No ☐ NA ☐

Notes: *Inspections of this site are implemented under the Y-12 S&M Program FIT Manual.*

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

Note: *ORNL reservation-wide invasive inspections are conducted annually. Invasive species, including Kudzu, are controlled in the FCAP area as necessary.*

Biological monitoring was not a component of the FCAP ROD, but baseline biological monitoring is conducted in support of a future ChR ROD (FFA Appendix J milestone 2038).

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? Yes Up to date? Yes

Notes: *Maintenance logs are filed and tracked in the LUM application.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Surface water and biological monitoring records are available in OREIS. Inspection reports are available in the LUM application.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *Gates, fencing, and signs with current information were in place.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes:

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☒ NA ☐

Notes:

2024 Five-Year Review Site Visit/Site Manager Interview Form

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *Following the wetland enhancements in FY 2019, vegetation continues to show increased thickness and the effectiveness of the passive treatment system continues to improve.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

The FCAP site is well maintained with gates and up-to-date signs. Wetland vegetation was thick with cattails and other desirable wetland plant species. The area had been recently sprayed for invasive species control (Kudzu), which had killed much of the Kudzu at the edge of the site. The Facility Manager explained they did not get all of it, as it was a windy day, and they were careful to prevent any overspray from damaging the wetland area.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. FCAP signs.



Figure 2. FCAP gate.



Figure 3. FCAP passive treatment wetland.



Figure 4. FCAP passive treatment wetland vegetation (cattails).

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 5. Leachate influent monitoring station (MCK 2.05) at head of passive treatment wetland.



Figure 6. FCAP berm and spillway.



Figure 7. Leachate effluent (MCK 2.0) monitoring station downstream of passive treatment wetland.



Figure 8. FCAP in background with the passive wetland and access roads in the foreground.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM:
OTHER SITES**

Oak Ridge Associated Universities South Campus Facility Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: ORAU SCF RA (ROD [12/28/1995], RAR [08/20/1996])

Date(s) of Visit: 08/23/2023 (interview), 10/18/2023 (site visit)

Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)

Project Personnel: Dick Ketelle (RSI), WQP Technical Lead; Sid Garland (RSI), Regulatory Support

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: NFA was identified for the facility; however, the no-action remedy includes periodic sampling to verify the natural attenuation of TCE in the zone of contamination. The RI/FS, completed in February 1995, concluded the site posed no unacceptable risk to human health or the environment, provided that groundwater is not used for human consumption. TCE, the primary COC in groundwater, is anticipated to naturally attenuate and, therefore, no RA was considered necessary. Surface water and groundwater monitoring are ongoing (2023 RER Section 8.4).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☒ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☐ Other: | |

LUC Requirements Include: (check all that apply)

- | | |
|---|--|
| ☐ NA | ☐ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☐ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs are per the ORAU SCF ROD and the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5).

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|--|--|
| ☐ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☒ Other: <i>None</i> |

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☒ No ☐ NA ☐

Notes: The ORAU SCF ROD specified groundwater monitoring for VOCs to ensure natural attenuation in the zone of contamination. In FY 2022, TCE and cis-1,2-DCE were the only VOCs detected in the two wells (GW-841 and GW-842); all detected concentrations were less than drinking water standards (MCLs). TCE and cis-1,2-DCE in GW-841 and GW-842 from FYs 1996–2022 have exhibited a long-term decreasing concentration history. MCLs are used for comparison purposes only and are not a specified goal in the ORAU SCF ROD. Samples were also collected from surface water sample locations SCF-WS1 and SCF-WS2 in FY 2022; no VOCs were detected (2023 RER Section 8.4.1.2).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: This site lies outside of restricted access areas. All contamination is subsurface, and no groundwater withdrawal/use is allowed to prevent contaminant exposure. Per the ORAU SCF ROD, the LUC requirement has been met and is verified annually in the RER. The LUM application documents that LUC

2024 Five-Year Review Site Visit/Site Manager Interview Form

requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.

3. Does the site undergo S&M on a regular schedule?

Yes ☐ No ☐ NA ☒

Notes:

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☐ No ☐ NA ☒

Notes:

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? NA Up to date? NA

Are Maintenance Logs readily available? NA Up to date? NA

Notes:

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? NA Up to date? NA

Notes: *Groundwater and surface water monitoring records are available in OREIS.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☐ No ☐ NA ☐

Notes: *Property record notices are in place specifying groundwater use/withdrawal restrictions to prevent exposure. This is verified annually and will be certified beginning with the 2024 RER. Access controls were not specified, as this site lies outside of restricted access areas.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☐ No ☒ NA ☐

Notes:

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☐ NA ☒

Notes:

2024 Five-Year Review Site Visit/Site Manager Interview Form

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐ NA ☐

Notes: *There is a commercial building under construction on the parcel northeast of the ORAU SCF property.*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

Groundwater wells are clearly marked with a well identifier and are aesthetically disguised in the SCF landscaping.

2024 Five-Year Review Site Visit/Site Manager Interview Form

A-98

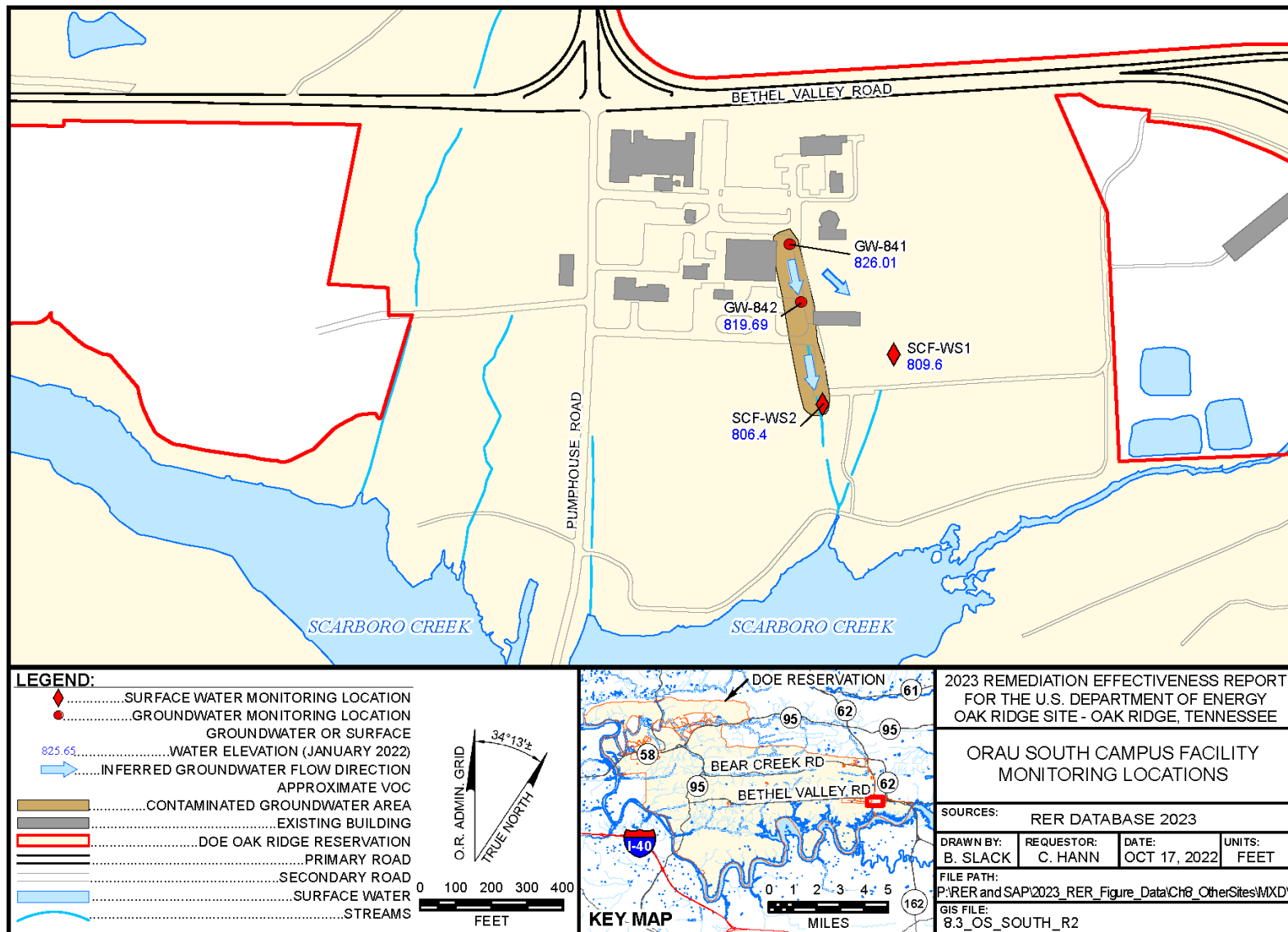


Figure 1. ORAU SCF site.

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 2. Monitoring well GW-841 (yellow posts at corner of building).



Figure 3. Monitoring well GW-842 at ORAU SCF, looking northeast.

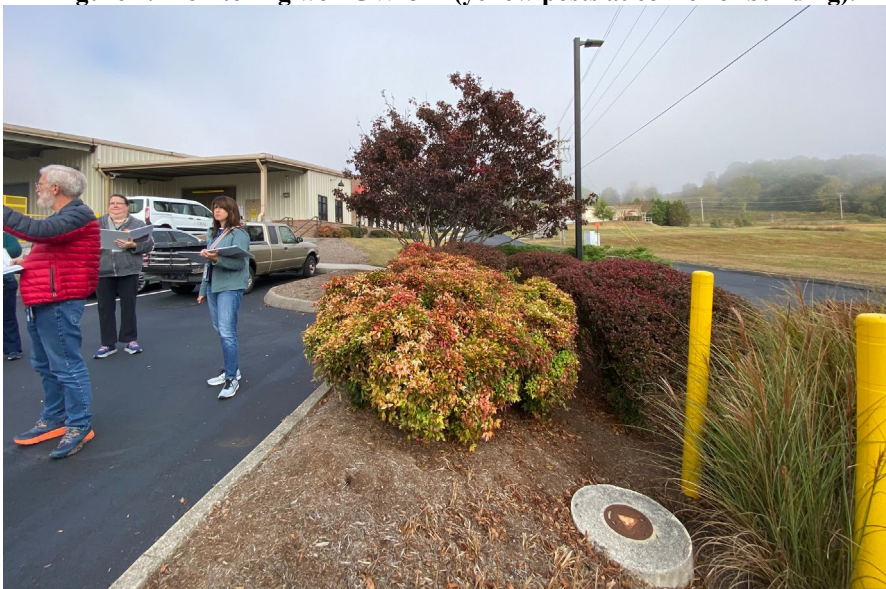


Figure 4. 2024 FYR site visit participants in parking area by monitoring well GW-842, view toward monitoring well GW-841 (behind tree).



Figure 5. 2024 FYR site visit participants in parking lot by monitoring well GW-842.

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**2024 CERCLA FIVE-YEAR REVIEW
SITE VISIT/SITE MANAGER INTERVIEW FORM:
OFFSITE ACTIONS**

Lower East Fork Poplar Creek Record of Decision

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2024 Five-Year Review Site Visit/Site Manager Interview Form

Name of Site: LEFPC (ROD [08/17/1995], RAR [08/15/2000])
Date(s) of Visit: 08/23/2023 (interview), 10/17/2023 (site visit)
Interview Team: Lynn Sims (RSI), Sally Brown (RSI), Sally Absher (Leidos)
Project Personnel: Diana Turner (RSI), Terry Mathews (ORNL Environmental Sciences Division),
Dick Ketelle (RSI)

Note: Acronyms are defined in the list at the beginning of this appendix.

Per the decision documents, the Remedy was: Removal. The remedy included excavating mercury-contaminated soil at the NOAA site and the former Bruner site, performing confirmatory sampling, backfilling and revegetating excavated areas, and monitoring (2023 RER Section 9.3).

Post-Action Monitoring Includes: (check all that apply)

- | | |
|--|---|
| ☐ NFA | ☐ Groundwater Pump and Treat |
| ☐ Groundwater Monitoring | ☒ Surface Water Monitoring |
| ☐ Air Monitoring | ☐ Surface Water Collection and Treatment |
| ☒ Other: <i>A stream channel survey (complete), biota sampling (complete), soil sampling (complete), and a wetland mitigation survey (complete).</i> | |

LUC Requirements Include: (check all that apply)

- | | |
|--|---|
| ☐ NA | ☒ Access Controls (fencing, gates, portals, DOE-posted signs, surveillance patrols) |
| ☒ Property Record Restrictions (upon transfer) | ☐ State Advisories/Postings |
| ☒ Property Record Notices | ☐ WBIWG Sediment Dredge Permit |
| ☐ EPP | |

Note: LUCs are per the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5). Other requirements for the LEFPC decision are included below.

Engineered Remedy and Other Requirements: (check all that apply)

- | | |
|--|--|
| ☐ Engineered Remedy (caps, treatment systems, OS&M) | ☐ Provisional Controls (slabs) |
| ☐ Former RCRA Site Controls | ☒ Other: <i>Annual land use survey at an automobile dealership, periodic shallow well survey records to detect residential use of groundwater, and survey every 5 years to determine changes in land use patterns along LEFPC.</i> |

A. Interview:

1. Are monitoring requirements indicating that the performance standards are being met?

Yes ☐ No ☐ NA ☒

Notes: There were no monitoring requirements specified in the LEFPC ROD. However, as a requirement of the LEFPC RAR, mercury input into the LEFPC system will be monitored continuously at Station 17. Monitoring at Station 17 is conducted to measure the concentration and mass flux of mercury that are discharged from the LEFPC Watershed into LEFPC. During FY 2022, the flow-paced continuous monitoring detected an average concentration of 1112 ng/L, down from 1265 ng/L in FY 2021, and a mass flux of 8.5 kg mercury, down from 9.6 kg in FY 2021 (2023 RER Section 5.2.1).

2. Are LUC requirements specified in the decision documents (see above) being met?

Yes ☒ No ☐ NA ☐

Notes: Per the LEFPC RAR, all LUC and other requirements have been met and are verified annually in the RER. The LUM application documents that these requirements are met. The EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) was approved 02/04/2023 and includes the LUCIP, which is to be certified annually beginning in the 2024 RER.

2024 Five-Year Review Site Visit/Site Manager Interview Form

3. Does the site undergo S&M on a regular schedule?

Yes ☐ No ☐ NA ☒

Notes:

4. Is the Site Manager aware of any problems with the remedy? What solutions have been applied?

Yes ☐ No ☒ NA ☐

Notes:

5. Are operating procedures, as implemented, maintaining the effectiveness of response actions?

Yes ☐ No ☐ NA ☒

Notes:

6. Were there any unexpected toxic by-products of the remedy not addressed by the decision documents?

Yes ☐ No ☒ NA ☐

Notes:

7. Additional site-specific questions and concerns:

B. Documentation: (answer yes, no, or NA)

1. O&M Manual and As-Built:

Are As-Built readily available? Yes Up to date? Yes

Are Maintenance Logs readily available? NA Up to date? NA

Notes: *Maps showing areas of floodplain soil excavation are available.*

2. Monitoring and Inspection Records:

Are Monitoring Records readily available? Yes Up to date? Yes

Are Inspection Reports readily available? Yes Up to date? Yes

Notes: *Post-remediation soil sample results are available in OREIS. Currently, collected data are added to OREIS as necessary. Results of the periodic groundwater well survey and the annual inspection of the former Dean Stallings Ford (currently Ole Ben Franklin Mitsubishi) parking lot are available in the LUM application.*

C. Visual Survey:

1. Are LUCs (fencing, security guards, etc.) in place and preventing exposure?

Yes ☒ No ☐ NA ☐

Notes: *The objective of the LUCs specified in the EFPC and ChR RAR CMP (DOE/OR/01-2466&D5) (i.e., periodic well usage, survey for land use changes) is being met and they are verified as required.*

2. Have there been any changes in land use or expected land use on or near the site?

Yes ☒ No ☐

Notes: *Commercial and residential development adjacent to LEFPC continues.*

3. If yes, do these changes result in potential new exposure pathways (ecological or human health)?

Yes ☐ No ☒ NA ☐

Notes: *The cleanup goal is based on a residential scenario (most conservative).*

2024 Five-Year Review Site Visit/Site Manager Interview Form

4. Have there been any changes in the physical site conditions?

Yes ☒ No ☐

Notes: *Commercial and residential development adjacent to LEFPC continues. Increased vegetative succession was noted in remediated areas (NOAA and former Bruner's sites).*

5. Briefly describe the physical appearance of the site, including presence or absence of site access controls, condition of surface water conveyances, evidence of S&M activities (mowing, inspections), presence of waste material remaining or appearing on the site, etc. Attach photographs if allowable and relevant.

Commercial and residential development adjacent to LEFPC continues, and remediated floodplain soil areas are well vegetated with grasses, shrubs, and small trees.

(The virtual site tour presentation for LEFPC from the October 17, 2023, Site Visit meeting is appended to the end of this form).

2024 Five-Year Review Site Visit/Site Manager Interview Form



Figure 1. LEFPC fish advisory sign, Midway Guard House, Scarboro Road.

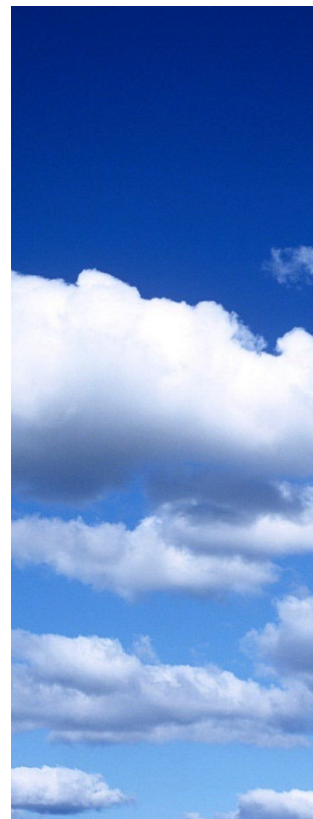


Figure 2. Aerial view of Ole Ben Franklin Mitsubishi car dealership parking lot adjacent to LEFPC floodplain (LEFPC on south end of parking lot and tributary along east side of parking lot).

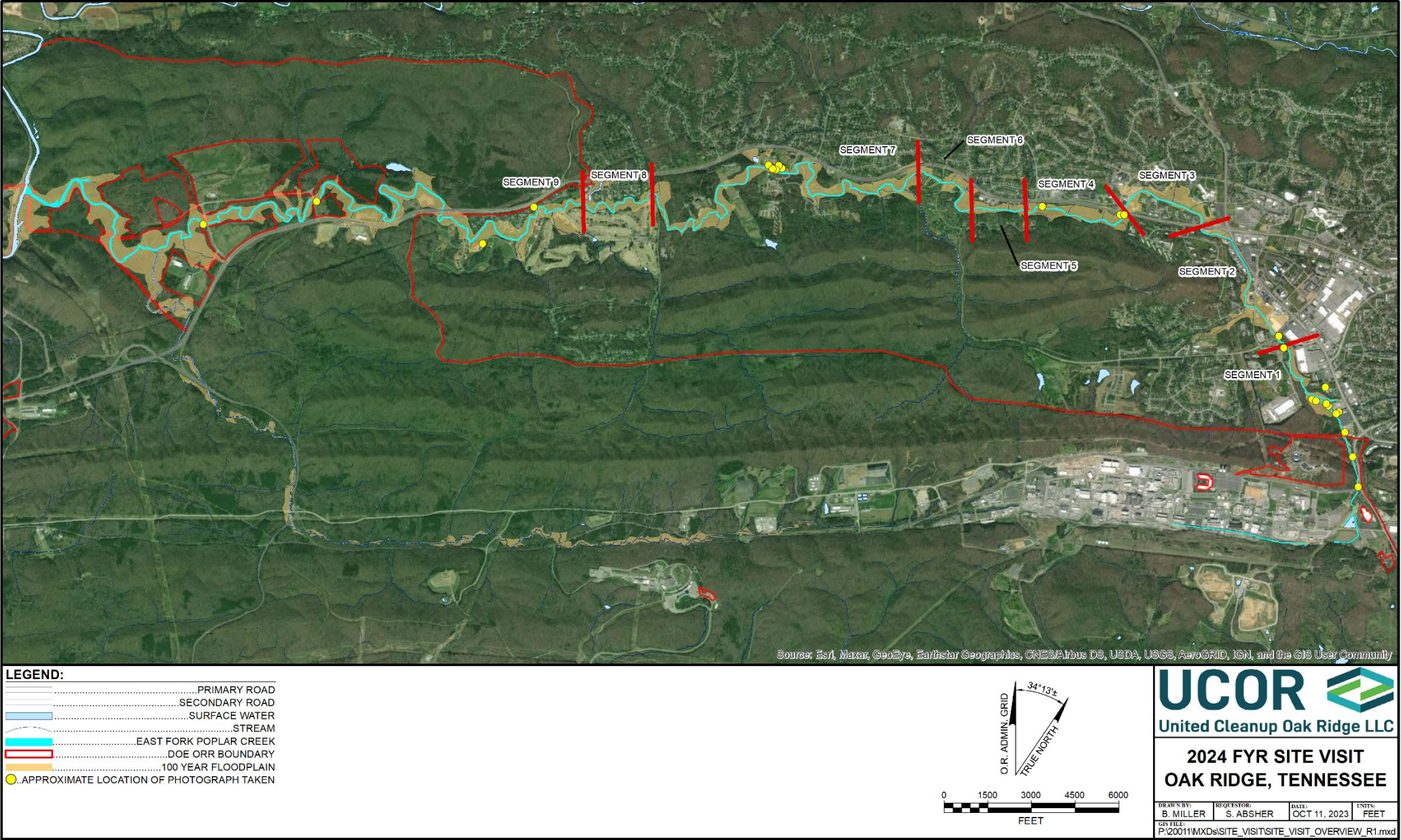


2024 Five-Year Review Virtual Site Visit: Lower East Fork Poplar Creek

October 17, 2023



2024 FYR Virtual Site Visit



LEFPC: Segments 1 and 2

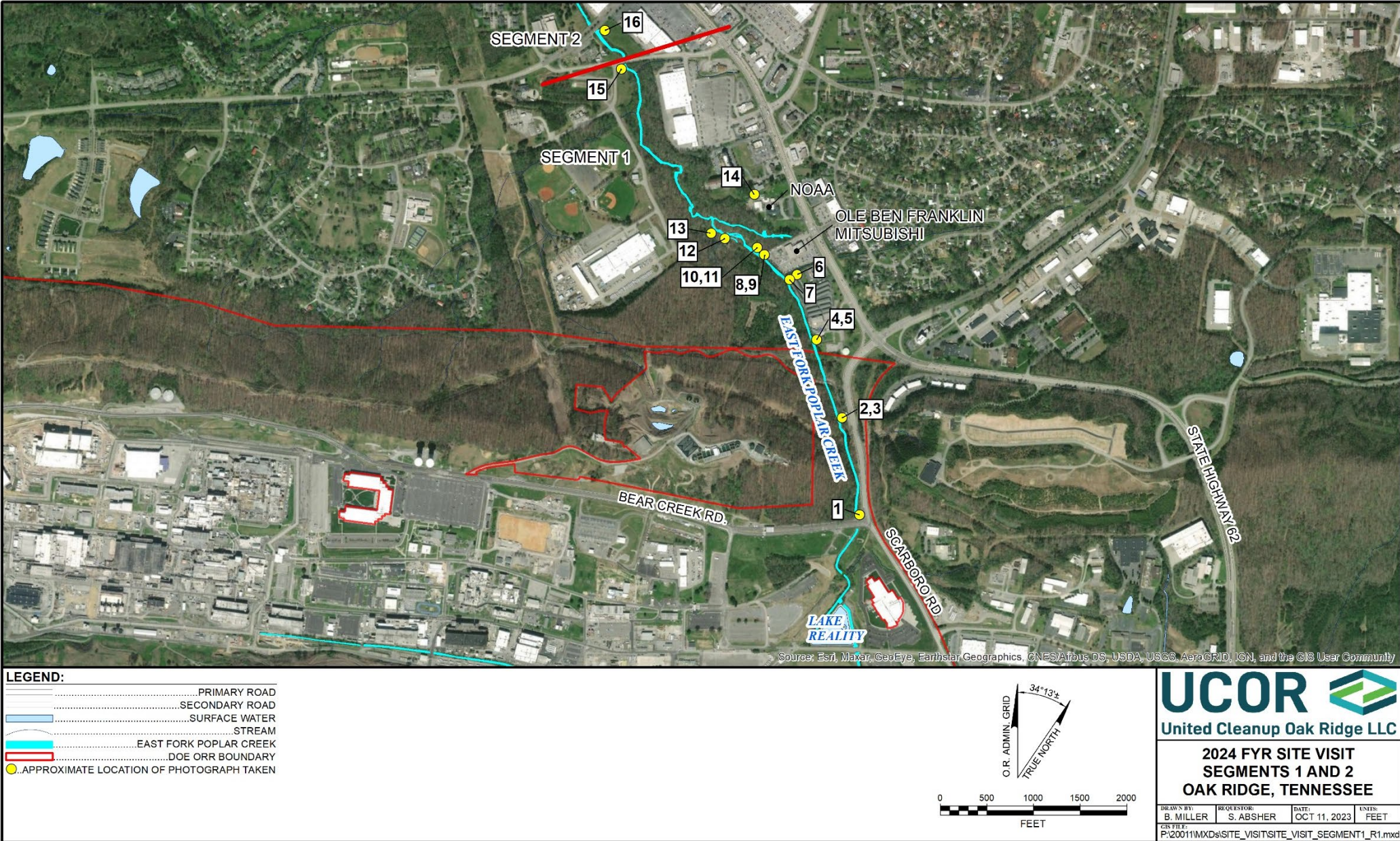


Figure 1. Intersection of Scarboro Road and Bear Creek Road



Fencing and signs at the corner of Scarboro and Bear Creek roads, exiting Y-12 (photo 1)

Figures 2 and 3. Scarboro Road at the Former Guard Shack



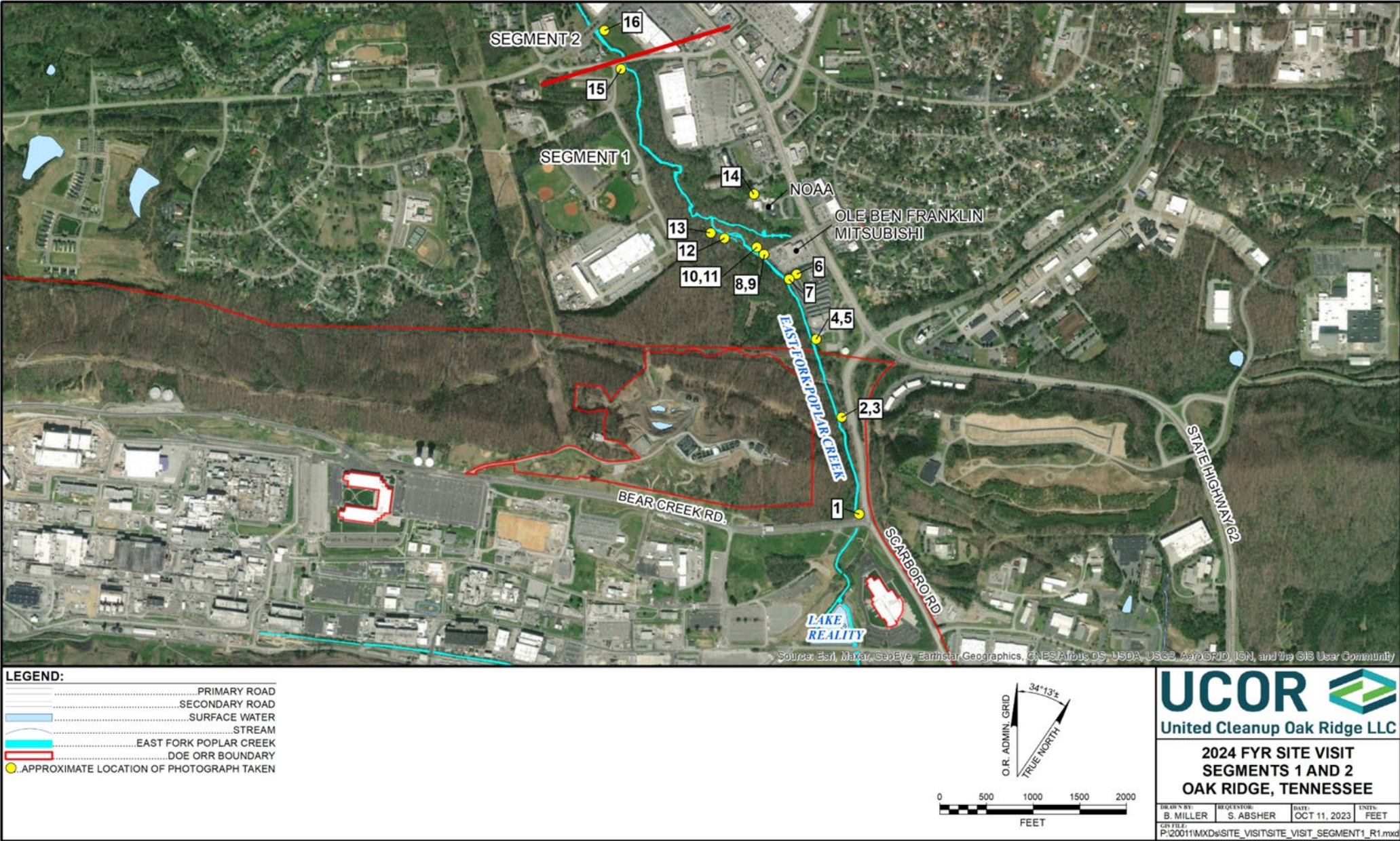
Close up of fencing
and signs behind
former guard
shack on Scarboro
Road

Figures 4 and 5. LEFPC Floodplain at Former Dental Office

Looking upstream
(left) and
downstream (right)
from the former
dental office
(between City of
Oak Ridge
stormwater
retention facility
and engineering
firm)



LEFPC: Segments 1 and 2



Figures 6 and 7. Self-Storage Facility and LEFPC

Oak Ridge Storage facility (next to Ole Ben Franklin Mitsubishi), and view of LEFPC behind facility



Figures 8 and 9. Parking Lot at rear of Ole Ben Franklin Mitsubishi UCOR United Cleanup Oak Ridge LLC



Ole Ben Franklin Mitsubishi car dealership back parking lot and close-up of intact asphalt

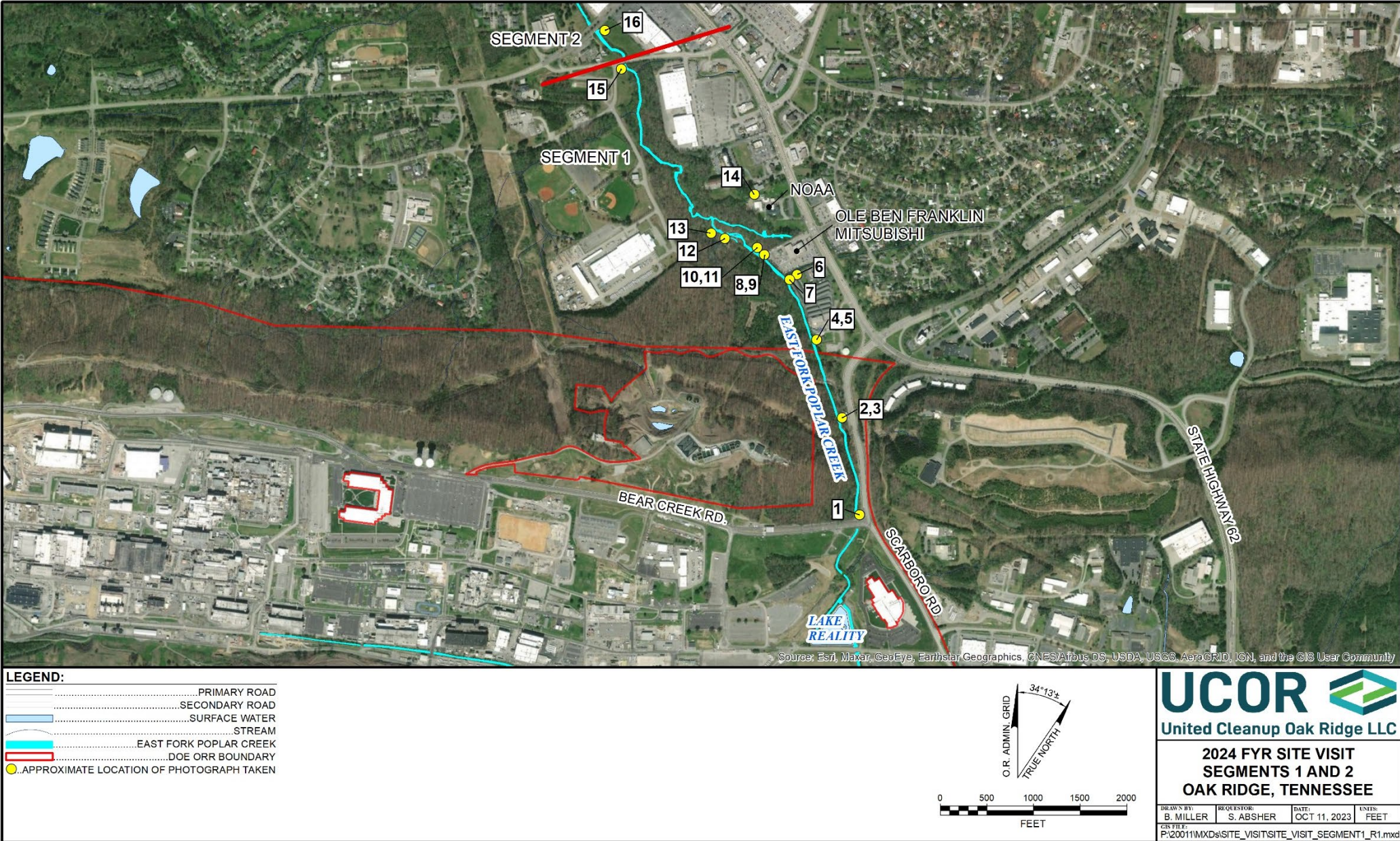


Figures 10 and 11. LEFPC Remediated Areas

Remediated areas
adjacent to Ole
Ben Franklin
Mitsubishi car
dealership



LEFPC: Segments 1 and 2



Figures 12 and 13. Remediated Areas Behind NOAA

Remediated areas
behind the NOAA
offices on Illinois
Avenue



Figure 14. Floodplain Downstream of NOAA

View toward LEFPC
between NOAA and
Carden Rentals



Figures 15 and 16. TDEC Signage Along LEFPC

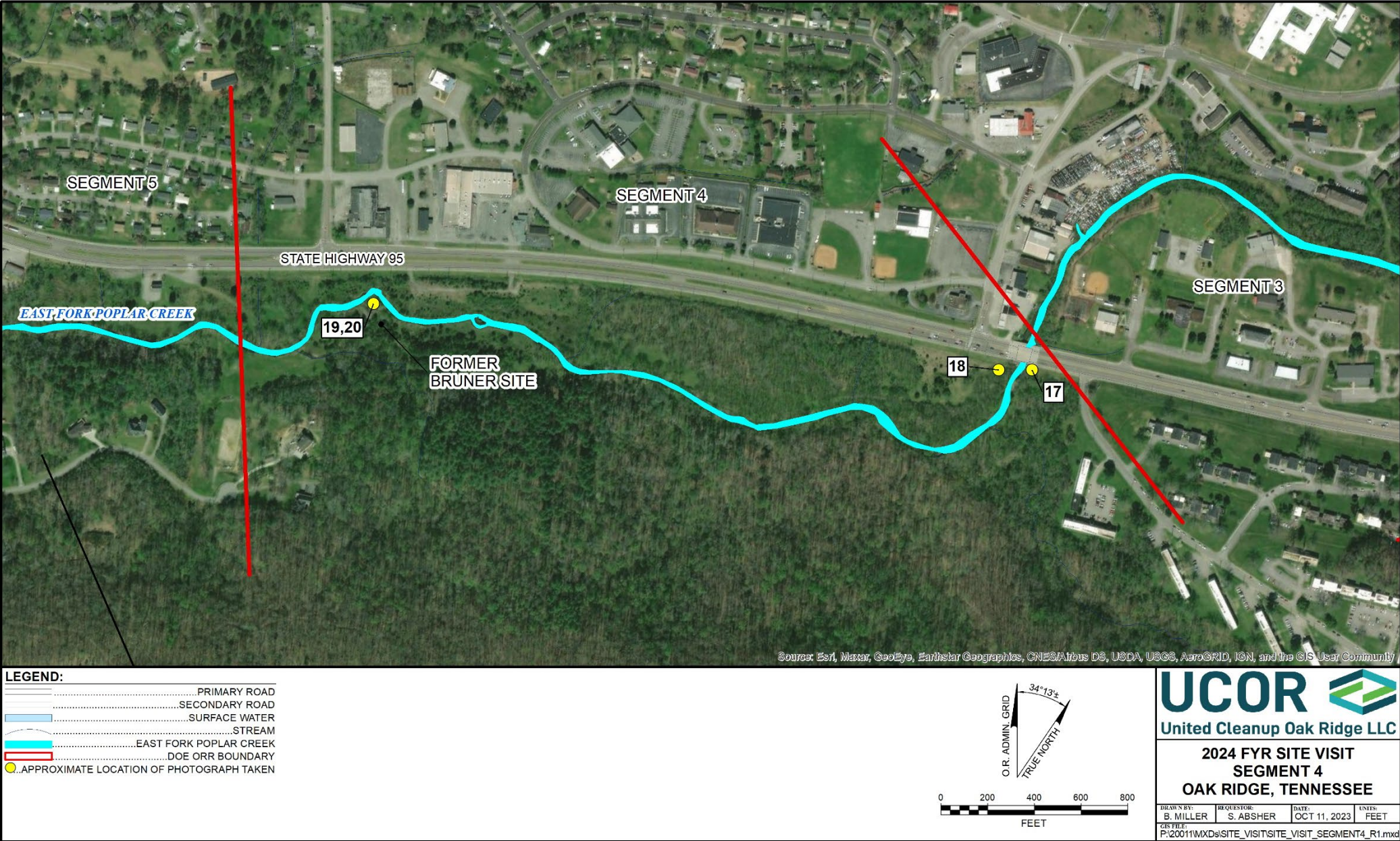
LEFPC at E.
Tulsa Road,
view upstream



LEFPC at
Tuskegee Road,
view upstream



LEFPC: Segment 4



Figures 17 and 18. TDEC signs and Riparian Trail

LEFPC at TN-95
(Oak Ridge
Turnpike), view
upstream

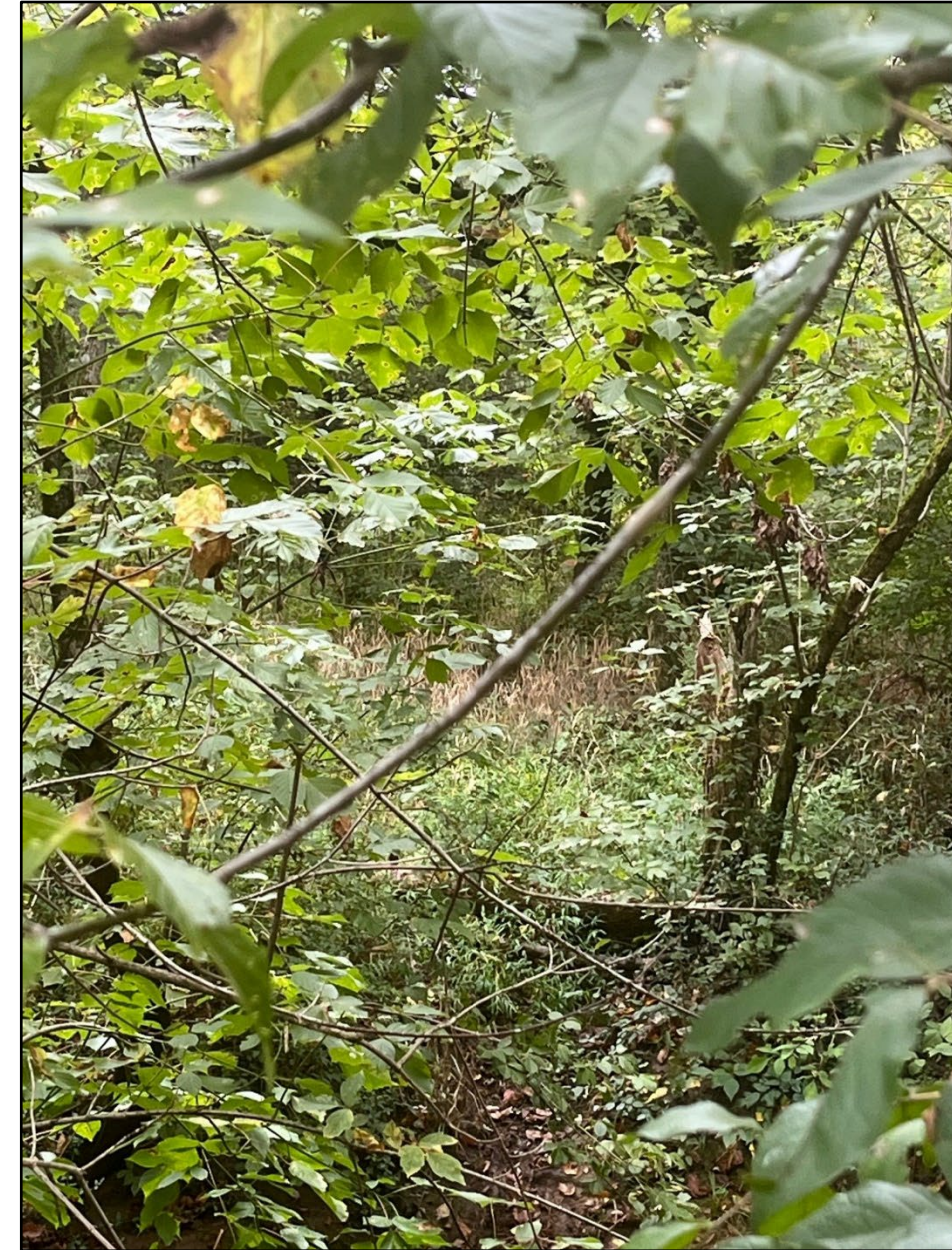


Riparian Trail sign
LEFPC at TN-95
(Oak Ridge
Turnpike)

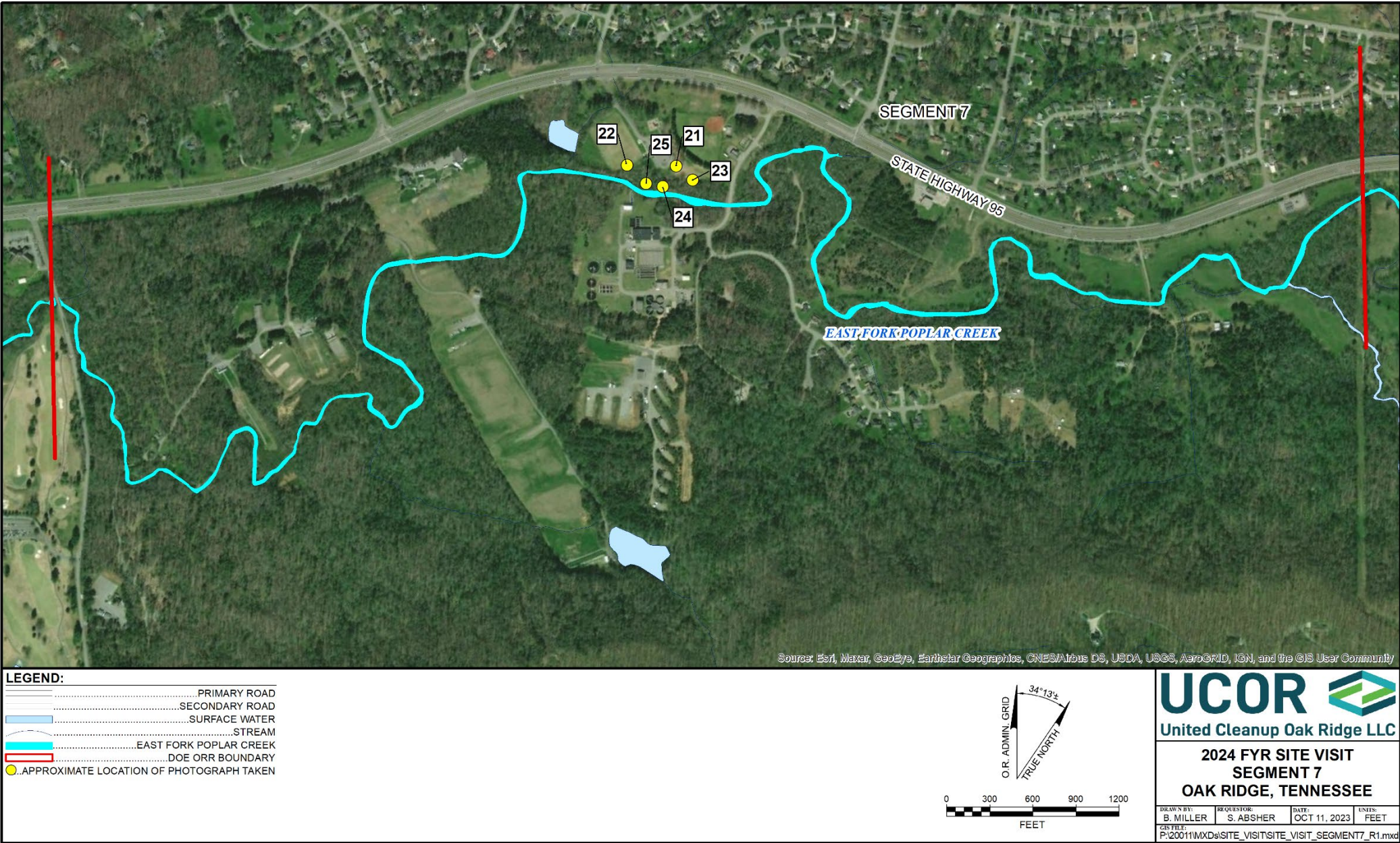


Figures 19 and 20. Remediated Areas Behind Bruner Site

Remediated areas
along LEFPC at the
former Bruner Site



LEFPC: Segment 7



Figures 21 and 22. Parks and Public Use Areas Near LEFPC



Fenced dog park with nature trail to rear between park and creek

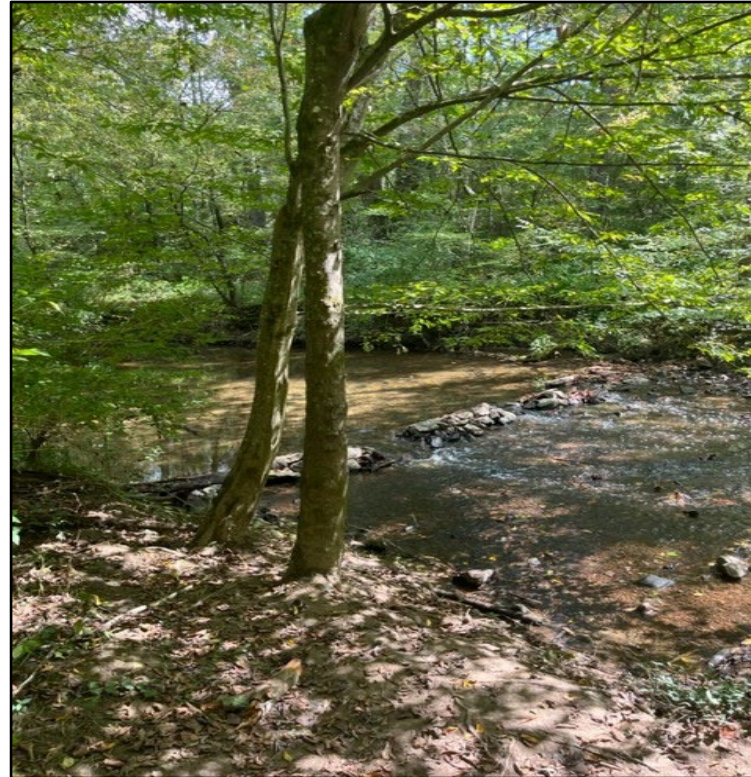
Athletic field next to dog park and adjacent to LEFPC



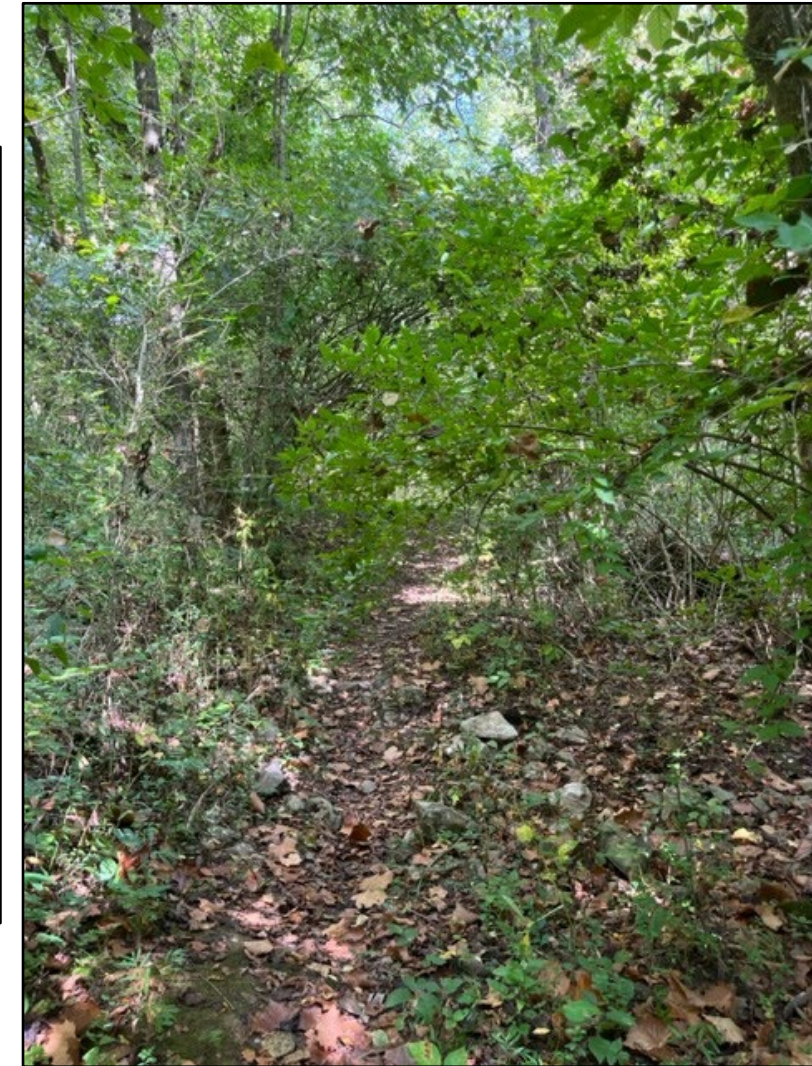
Figures 23, 24, and 25. Public Use Areas Near LEFPC



Trailhead sign for Big Turtle Nature Trail

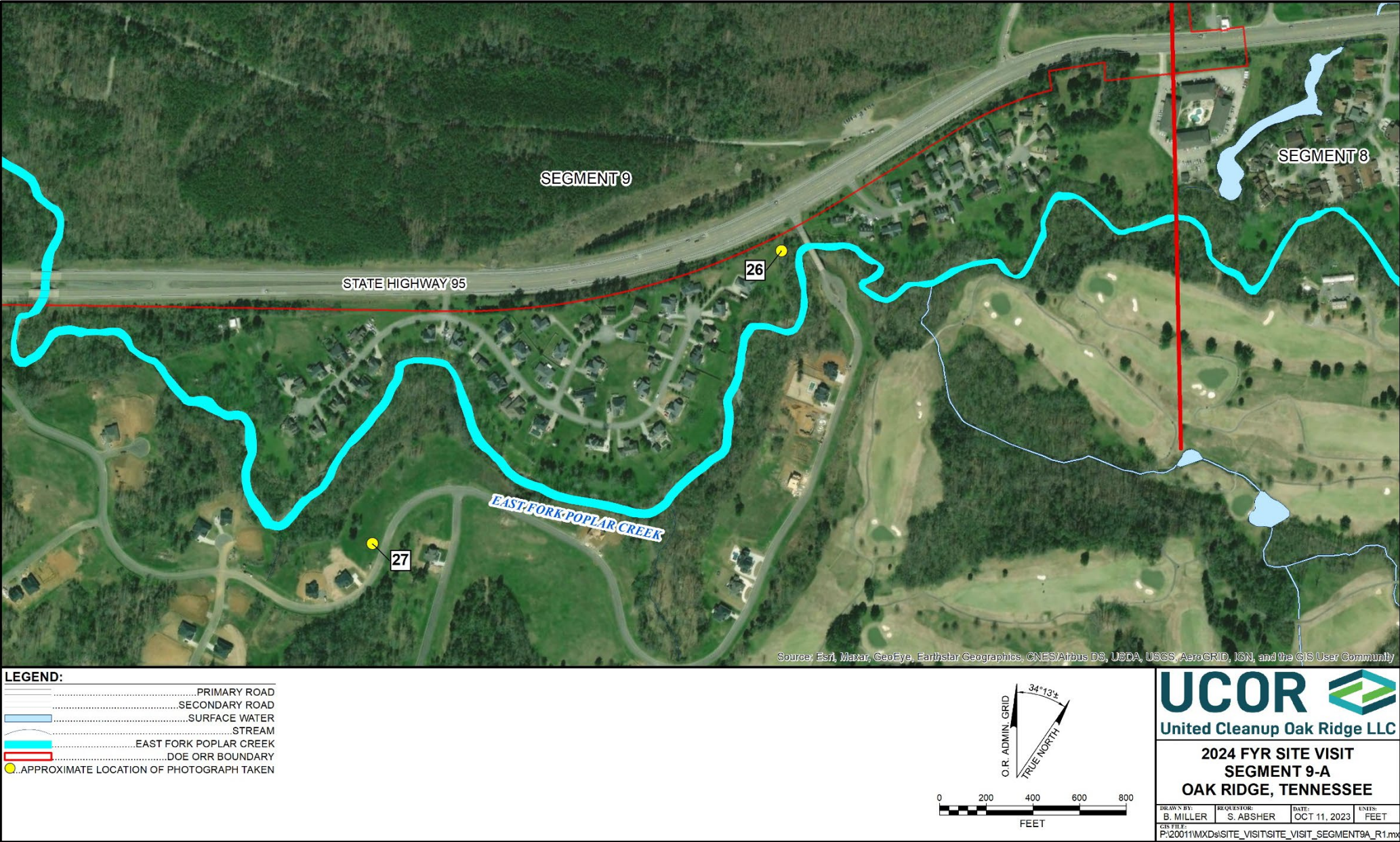


Big Turtle Nature Trail adjacent to
LEFPC



Big Turtle Nature Trail

LEFPC: Segment 9-A



Figures 26 and 27. Residential Areas Along TN-95

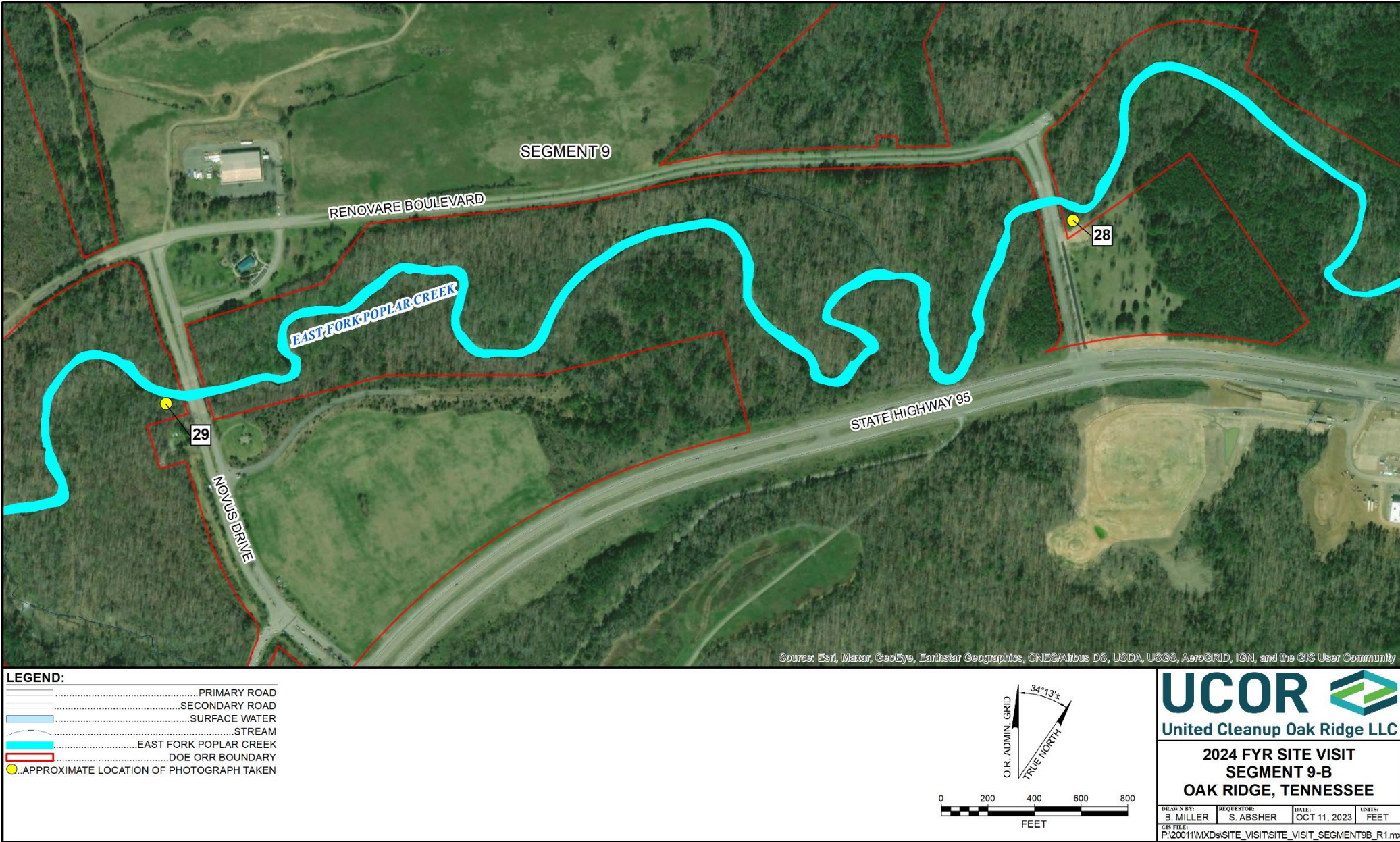
Residential
development
off TN-95 (Oak
Ridge Turnpike)



Typical lot
above the
LEFPC
floodplain



LEFPC: Segment 9-B



Figures 28 and 29. LEFPC Floodplain at Horizon Center



LEFPC and Imperium Drive (first entrance to Horizon Center heading west on TN-95)



LEFPC by trail to historic tree on Novus Drive

**APPENDIX B.
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENT
AND HUMAN HEALTH RISK UPDATES**

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ACRONYMS

AM	action memorandum
ARAR	applicable or relevant and appropriate requirement
AWQC	ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	contaminant of concern
CSF	cancer slope factor
CWA	Clean Water Act of 1972
DOE	U.S. Department of Energy
EEVOC	East End Volatile Organic Compound
EFPC	East Fork Poplar Creek
EPA	U.S. Environmental Protection Agency
FCAP	Filled Coal Ash Pond
FI	fraction ingested
FR	Federal Register
FS	feasibility study
FY	fiscal year
FYR	Five-Year Review
HI	hazard index
ILCR	individual lifetime cancer risk
IP	integration point
KHQ	Kerr Hollow Quarry
LEFPC	Lower East Fork Poplar Creek
LUC	land use control
MCL	maximum contaminant level
MNA	monitored natural attenuation
NFA	no further action
NNSA	National Nuclear Security Administration
ORAU	Oak Ridge Associated Universities
ORR	Oak Ridge Reservation
OSY	Old Scrap Yard
ppt	parts per trillion
PRG	preliminary remediation goal
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act of 1976
RfD	reference dose
RI	remedial investigation
RL	remediation level
ROD	Record of Decision
RSL	regional screening level
SCF	South Campus Facility
TBC	to be considered
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
UEFPC	Upper East Fork Poplar Creek
UNC	United Nuclear Corporation
VI	vapor intrusion
VISL	vapor intrusion screening level
VOC	volatile organic compound
Y-12	Y-12 National Security Complex

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APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENT AND HUMAN HEALTH RISK UPDATES

B.1. INTRODUCTION

The goal of the Five-Year Review (FYR) is to evaluate whether completed Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) actions on the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) site continue to be protective. Careful analysis of environmental monitoring data (soil, groundwater, sediment, surface water, and/or biological monitoring data), verification of land use controls (LUCs), engineered remedy integrity, and information gathered during the FYR site interviews and site visits was used to answer three primary questions:

- A. Is the remedy functioning as intended by the decision documents?
- B. Are the assumptions used at the time of remedy selection still valid?
- C. Has any other information come to light that could call into question the protectiveness of the remedy?

This appendix focuses on Question B: Are the assumptions used at the time of remedy selection still valid? The assumptions used for remedy selection fall into two major categories: applicable or relevant and appropriate requirements (ARARs) and risk assessment. Section B.2 evaluates both of these categories. The evaluation is followed by a detailed analysis of the individual Records of Decision (RODs) and Action Memoranda (AM) selected to be reviewed in this FYR, as presented in Chapters 2 through 5 of the *2024 CERCLA Five-Year Review for the Upper East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds and the Lower East Fork Poplar Creek and Oak Ridge Associated Universities South Campus Facility Operable Units on the U.S. Department of Energy, Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2962; 2024 FYR). Sections B.3 through B.6 of this appendix are organized by ORR watersheds and follow the same order as they are addressed in the 2024 FYR.

B.2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENT AND RISK ASSESSMENT INPUTS

B.2.1. Applicable or Relevant and Appropriate Requirements

The first question to be answered in evaluating whether assumptions used at the time of remedy selection are still valid is, Have there been changes in the standards identified as ARARs in the ROD, newly promulgated standards, and/or changes in to be considered (TBC) items that could call into question the protectiveness of the remedy?

In the preamble to the final National Oil and Hazardous Substances Pollution Contingency Plan, the U.S. Environmental Protection Agency (EPA) stated its policy that it will not reopen remedy selection decisions contained in RODs (i.e., ARARs are normally frozen at the time of ROD signature) unless a “new or modified requirement calls into question the protectiveness of the selected remedy” (55 Federal Register [FR] 8757; EPA 1990). The preamble goes on to state, “a policy of freezing ARARs at the time of ROD signing will not sacrifice protection of human health and the environment because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently if there is reason to believe that the remedy is no longer protective of human health and the environment (EPA 1990).” The preamble also noted a remedy would not necessarily need to be modified solely to attain a newly promulgated or modified requirement, but that such requirements “contribute to

[the] evaluation of the protectiveness” (EPA 1990). Therefore, although ARARs generally are frozen at the time of ROD signature, EPA’s 2001 *Comprehensive Five-Year Review Guidance* requests the reviewer to evaluate changes in chemical-, location-, and action-specific ARARs since the time of the decision.

Compliance with action- and location-specific ARARs identified at the time of the RODs is documented in regulator-approved Phased Construction Completion Reports or Remedial Action Reports. Great emphasis has been placed in the decision documents on the ARARs associated with handling, shipping, and disposing of waste. Compliance with waste disposal ARARs has been managed through the receiving waste facility’s waste acceptance criteria process.

Any newly promulgated action- and location-specific regulations published in FR are reviewed continuously to determine if they could affect protectiveness of the remedies on the Oak Ridge Site. A change in an ARAR may not necessarily result in a change in the resulting risk and, therefore, may not impact protectiveness. Based on ongoing reviews, changes to the action- and location-specific ARARs over the years have been determined to not affect protectiveness of the remedies on the ORR.

Changes to chemical-specific ARARs are covered within each of the individual ROD sections in this FYR. Of note in this review process is the low number of RODs with chemical-specific ARARs used to determine remediation levels (RLs). The only chemical-specific ARARs used as performance measures have been Clean Water Act of 1972 (CWA) ambient water quality criteria (AWQC). In some cases, the ROD refers to radiation dose rate goals. Some decisions on the ORR have referred to Safe Drinking Water Act of 1974 maximum contaminant levels (MCLs) as expected outcomes of a given action, but because no final groundwater decisions have been made on the ORR, no ROD to date includes compliance with MCLs other than to demonstrate progress toward achieving compliance with MCLs.

B.2.2. Human Health Risk

B.2.2.1. Risk Methods for Five-Year Review

EPA’s Comprehensive FYR Guidance (EPA 2001) was used to review key risk-assessment assumptions used in a decision and, more importantly, how to respond if the risk changes are significant. Since signing of the RODs on the ORR, changes in risk assessment methods and toxicity factors have occurred that necessitate a review of potential impacts to the decisions (as described below).

The cumulative impact of risk method and toxicity factor changes on any given CERCLA decision is most applicable to actions that have risk-based RLs defined that are part of the remedial action objectives codified in a ROD. Many of the remedial actions (RAs) on the ORR do not have defined RLs; rather, they have some other basis (e.g., source removal, action-based levels, ARAR-based levels). Per EPA’s Comprehensive FYR Guidance, key risk factors in any decision are reviewed, including:

- Changes in contaminants of concern (COCs).
- Changes in land use and exposure pathways.
- Changes in toxicity factors.

In addition to meeting these objectives of the Comprehensive FYR Guidance, this FYR provides a simple update of media concentrations at key locations throughout the ORR (e.g., at the integration points [IPs] for some watersheds for the purpose of comparing current potential risk conditions at those points. The IPs are the locations where contaminants migrate and exit each site [e.g., Station 17 at the ORR boundary is the Upper East Fork Poplar Creek (UEFPC) Watershed IP]). These IPs are key performance monitoring locations for the large watershed-scale RODs.

An example of the process used to update potential risk at these points is summarized in Table B.1. In general, this approach compares current concentrations measured at the IPs with risk-based RLs developed using site-specific exposure pathways and receptors identified in the approved CERCLA baseline risk assessment titled *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1641&D2; UEFPC Remedial Investigation [RI]). This comparison provides an update as to the level of protectiveness (e.g., industrial, recreational) that has been achieved at each of these locations.

Table B.1. Process used to update risk estimates at IPs to account for all new changes to risk methods and toxicity factors

IP	COC	Concentration in surface water (mg/L)	Residential RSL (mg/L)	Industrial RSL (mg/L)	Recreational risk-based level (mg/L)
Approach for this FYR					
UEFPC Station 17	Mercury	Results of monthly flow-paced sampling concentrations	Represents risk-based calculation for the resident defined in the UEFPC baseline risk assessment (UEFPC RI)	Represents risk-based calculation for the industrial sampler defined in the UEFPC baseline risk assessment. Exposure pathways include dermal exposure and inhalation of volatiles (if applicable)	Represents risk-based calculations assuming the dermal exposure pathway and assumptions identified in the UEFPC baseline risk assessment
Example updated action level (mg/L)					
Station 17	Mercury	Average = 0.0010; range = 0.00021 to 0.0031	0.011	1.77	12.3

COC = contaminant of concern
FYR = Five-Year Review
IP = integration point
RI = remedial investigation
RSL = regional screening level
UEFPC = Upper East Fork Poplar Creek

According to EPA's Comprehensive FYR Guidance, the outcome of this risk review in the FYR is captured in Exhibit G-4 within that guidance and is summarized below:

- Is the new, currently calculated risk still within EPA's risk range?
 - Yes: Analysis complete.
 - No: Recommend follow-up action, such as developing new protective cleanup levels through the appropriate decision document.

In some cases on the ORR, EPA's risk management range (10^{-6} to 10^{-4}) may be exceeded due to a combination of changes in radionuclide toxicity and/or default exposure parameters. However, in these situations, the risk-based decisions on the ORR are interim RODs and will be reevaluated in the final RODs. In the interim, LUCs mitigate potential risks.

B.2.2.2. Summary of Changes in Risk Approaches Used for the Oak Ridge Site Records of Decision

Because the process of quantitative risk assessment is a generally new science, risk assessment methods and inputs have been revised and updated continuously throughout the application of CERCLA on the Oak Ridge Site. These changes are summarized below for all RODs reviewed in this FYR.

In the 1970s, EPA signaled its intent to require rigorous assessments of health risk related to environmental releases of contaminants, laid out in a general framework for analyzing cancer risks of pesticides. In the 1980s, the agency published its first application of quantitative procedures used in risk assessment in water quality criteria documents for 64 contaminants issued under CWA, specifically under Section 304(a)(1). In 1983, the National Academies of Science published *Risk Assessment in the Federal Government: Managing the Process* (NRC 1983). EPA has integrated principles of risk assessment from this groundbreaking report into its practices to this day. During the 1980s, the agency also developed the Integrated Risk Information System, a database of human health effects and quantitative toxicity factors, which is still in use today.

In 1989, EPA published the first in the series of methods guidance for CERCLA risk assessments—*Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (EPA 1989; Risk Assessment Guidance for Superfund [RAGS] Part A). RAGS Part A was the only guidance available for several of the early ORR risk assessments. All RAGS documents and updates are available online at <https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part>. In addition to RAGS updates, the following changes in methods and model parameters have occurred:

- There have been continuous updates to toxicity factors used in the risk characterization process. A major update of note was the revision to virtually all radionuclide cancer slope factors (CSFs) in 2000, after many of the ORR RODs had been signed. This FYR uses the process outlined in Appendix G, Methods and Examples for Evaluating Changes in Standards and Toxicity, of the EPA's Comprehensive FYR Guidance (EPA 2001) to evaluate these changes. Tables are presented for the individual decisions.
- Default exposure factors (EPA 1997) for particular land uses have been updated in various guidance documents. Current default exposure parameters are presented in the *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors* (EPA 2014a). Examples of changes in default exposure parameters include updated body weights and tap water ingestion rates. According to *Frequently Asked Questions (FAQs) About Update of Standard Default Exposure Factors* (EPA 2014b), these changes are generally expected to result in a slight increase in most regional screening levels (RSLs), and conversely, a slight decrease in risk estimates for most chemicals.
- The method for evaluating the inhalation pathway was updated in 2009 to replace the inhalation reference dose (RfD) and CSF with an inhalation reference concentration and inhalation unit risk, respectively. This change negated the need for an inhalation rate because the units of the toxicity factors are mg/m³ and m³/μg.

These changes to risk parameters and toxicity values likely result in both increases and decreases to estimated risks and RLs depending on the pathways and chemicals evaluated at any given site. However, one of the largest impacts to risk assessment relates to a revision to the radionuclide CSFs. On April 16, 2001, EPA published the most-comprehensive database of radionuclide CSFs based on *Cancer Risk Coefficient for Environmental Exposure to Radionuclides, Federal Guidance Report No. 13* (EPA 1999), which was developed by EPA's Office of Radiation and Indoor Air. That report incorporated state-of-the-art models and methods that consider age- and gender-dependence of radionuclide intake, metabolism, dosimetry, radiogenic cancer risk, and competing risks.

Most of the large RODs on the ORR used the previous radiation CSFs. As such, protectiveness determinations will continue to be made against RLs presented in the RODs, with an evaluation of potential impacts to protectiveness using updated CSFs and RfDs but maintaining the exposure scenarios and associated exposure parameters codified in the RODs. This is appropriate because land uses for which RODs have been completed have not changed and, as previously mentioned, many of the RODs are interim in nature. The most up-to-date toxicity factors will be used in final watershed RODs, which will supersede interim action RODs, where applicable, and will encompass the most-current human health risk assessment protocols.

B.3. UPPER EAST FORK POPLAR CREEK WATERSHED

B.3.1. Phase I Interim Source Control Actions (Upper East Fork Poplar Creek Phase I Record of Decision)

B.3.1.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

Since approval of the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3; UEFPC Phase I Interim ROD), the state of Tennessee has revised AWQC five times—2004, 2008, 2013, 2015, and 2019. However, Table B.2 shows the numeric AWQC specified by Tennessee Department of Environment and Conservation (TDEC) Rule 0400-40-03 (TDEC 2019; supersedes Rule 1200-4-3) for mercury has not changed in these updates since the time of the UEFPC Phase I Interim ROD.

Table B.2. Changes in ARARs for chemicals with UEFPC Phase I Interim ROD performance goals

Contaminant	Medium	ROD performance goal	Standard (µg/L)			Citation and year for updated values
			1999 ^a	2019 ^a	Percent change	
Mercury	SW	AWQC HH	0.051	0.051	0%	TDEC 2019 ^b

^aFrom Tennessee Department of Environment and Conservation (TDEC) Chapter 0400-40-03, “General Water Quality Criteria” (TDEC 2019). Values in the table are fish and aquatic/HH recreation, organisms only. TDEC AWQC were updated in 2004, 2008, 2013, 2015, and 2019; new AWQC will be used to measure compliance.

^bTDEC 2019: <https://publications.tnsofiles.com/rules/0400/0400-40/0400-40-03.20190911.pdf>. The file indicates AWQC values have a date of September 2019 (revised).

ARAR = applicable or relevant and appropriate requirement

AWQC = ambient water quality criteria

HH = human health

ROD = Record of Decision

SW = surface water

UEFPC =Upper East Fork Poplar Creek

The recreational AWQC for mercury is unchanged (0.051 µg/L), although this AWQC was waived in the UEFPC Phase I Interim ROD under an interim action waiver, and a risk-based goal of 200 parts per trillion (ppt) as measured at Station 17 was set instead. The UEFPC Phase I Interim ROD established performance goals for mercury only.

B.3.1.2. Changes in Risk Assessment Assumptions

The land use/receptor/exposure pathway assumptions for UEFPC included in the UEFPC Phase I Interim ROD have not changed. The UEFPC Phase I Interim ROD includes a 200-ppt performance standard for mercury in surface water at the UEFPC IP (Station 17) based on an adult recreator consuming fish. The oral RfD for methylmercury has not changed since the time of the UEFPC RI. Therefore, the 200-ppt mercury goal for water is still valid.

Surface water monitoring at Station 17, including analysis for uranium and zinc, is conducted to gauge cumulative effects of the various actions as they are completed. The toxicity values for these chemicals have not changed.

B.3.2. Upper East Fork Poplar Creek Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard

B.3.2.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

There have been no substantive changes to the ARARs in the *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/01-2229&D3; UEFPC Phase II Interim ROD) that would impact protectiveness of the remedy. TDEC has changed the citations for its regulations that are cited in the document but has not changed the substantive requirements under those citations. Similarly, DOE has rescinded DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (issued in February 1990 [Change 2, 01-07-93]) and replaced it with DOE Order 458.1 (Change 2, July 2011) and its implementing manual and guidance, but the substantive requirements in original DOE Order 5400.5 cited as TBC guidance in the UEFPC Phase II Interim ROD were not changed in new DOE Order 458.1.

B.3.2.2. Changes in Risk Assessment Assumptions

The land use assumptions used in the UEFPC Phase II Interim ROD have not changed. The Y-12 National Security Complex (Y-12) is an active industrial facility and use of buildings and facilities throughout the plant is anticipated for the foreseeable future; the unrestricted (i.e., residential) land use scenario was eliminated as a likely future use. The DOE National Nuclear Security Administration (NNSA) activities at Y-12 will also continue for the foreseeable future. Because of security concerns and the ongoing modernization program, NNSA recommended the anticipated land use for the foreseeable future be controlled industrial throughout the entire facility. No new exposure pathways and no new contaminants or contaminant sources have been identified.

Several toxicity factors have changed since the risk assessment was completed for the UEFPC RI. These changes are identified in Tables B.3 and B.4, which compare the RfDs and CSFs, respectively, used at the time of the UEFPC RI to the most-current toxicity factors. This comparison is indicated as the ratio in the tables. For toxic effects, ratios < 1 indicate the current RfD is more potent than the old RfD. For cancer effects, ratios > 1 indicate the current CSF is more potent than the old CSF.

Because volatile organic compounds (VOCs) remain in the soil, a vapor exposure evaluation was performed for industrial workers at the Old Salvage Yard (OSY) site in Exposure Units 11 and 13. A vapor intrusion (VI) screening level (VISL) does not provide results for soil; therefore, the maximum detected concentration of VOCs from soil samples remaining after the RA at the OSY was completed were compared to inhalation RSLs for the composite worker receptor. No VOCs exceed their respective industrial RSL at a hazard index (HI) = 0.1 or individual lifetime cancer risk (ILCR) = $1\text{E-}6$ (Table B.5).

B.3.3. Union Valley Interim Record of Decision

The *Record of Decision for an Interim Action for Union Valley, Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/02-1545&D2; Union Valley Interim ROD) was an administrative LUC decision. The assumptions at the time of the remedy are still valid.

Table B.3. Changes in RfD toxicity factors since the UEFPC RI

Chemical COCs ^a	RfD					
	Oral (mg/kg-day)			Inhalation (mg/kg-day)		
	RI	2024	2024/RI	RI	2024 ^b	2024/RI
Arsenic	3.00E-04	3.00E-04	1	--	4.29E-06	--
Beryllium	5.00E-03	2.4E-03	0.40	--	5.71E-06	--
Cadmium (diet)	1.00E-03	1.00E-04	0.10	--	2.86E-06	--
Chromium (total)	--	--	--	--	--	--
Mercury (as mercuric chloride)	3.00E-04	3.00E-04	1	--	8.57E-05	--
Uranium (as soluble salts)	3.00E-03	2.00E-04	0.07	--	1.14E-05	--
3,3'-Dichlorobenzidine	--	--	--	--	--	--
Benz(a)anthracene	--	--	--	--	--	--
Benzo(a)pyrene	--	0.0003	--	--	5.71E-07	--
Benzo(b)fluoranthene	--	--	--	--	--	--
Dibenzo(a,h)anthracene	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	--	--	--	--	--	--
PCB-1242	--	--	--	--	--	--
PCB-1248	--	--	--	--	--	--
PCB-1254	--	2.00E-05	--	--	--	--
PCB-1260	--	--	--	--	--	--
Total PCB (high risk)	--	--	--	--	--	--

^aCOCs for surface and subsurface soil are from Table 2.2 of the *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/01-2229&D3). RI RfDs are taken from Tables F.4.1, F.4.2, and F.4.3 of the *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1641&D2).

^bInhalation RfD is converted from the inhalation reference concentration assuming a 70-kg adult and an inhalation rate of 20 m³/day.

Note: The U.S. Environmental Protection Agency's current methods assume an 80-kg adult body weight and no longer use the inhalation rate; rather, the methods use inhalation unit risk and inhalation reference concentration values that do not require the use of an inhalation rate.

Bold values indicate changes where the new RfD suggests the COC is more potent than previously considered (e.g., the RfD ratio < 1).

-- = No value available.

COC = contaminant of concern

PCB = polychlorinated biphenyl

RfD = reference dose

RI = remedial investigation

UEFPC = Upper East Fork Poplar Creek

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Table B.4. Changes in cancer slope toxicity factors since the UEFPC RI									
Chemical COCs ^a	CSFs								
	Oral (kg-day/mg)			Inhalation (kg-day/mg)					
	RI	2024	2024/RI	RI	2024 ^b	2024/RI			
Arsenic	1.50E+00	1.50E+00	1	5.00E+01	1.51E+01	0.3			
Beryllium	4.30E+00	--	--	8.40E+00	8.40E+00	1			
Cadmium (diet)	--	--	--	6.10E+00	6.30E+00	1			
Chromium (total)	--	--	--	--	--	--			
Mercury (as mercuric chloride)	--	--	--	--	--	--			
Uranium (as soluble salts)	--	--	--	--	--	--			
3,3'-Dichlorobenzidine	4.50E-01	4.50E-01	1	--	--	--			
Benz(a)anthracene	7.30E-01	1.00E-01	0.1	3.10E-01	2.10E-01	0.7			
Benzo(a)pyrene	7.30E+00	1.00E+00	0.1	3.10E+00	2.10E+00	0.7			
Benzo(b)fluoranthene	7.30E-01	1.00E-01	0.1	3.10E-01	2.10E-01	0.7			
Dibenzo(a,h)anthracene	7.30E+00	1.00E+00	0.1	3.10E+00	2.10E+00	0.7			
Indeno(1,2,3-cd)pyrene	7.30E-01	1.00E-01	0.1	3.10E-01	2.10E-01	0.7			
PCB-1242	2.00E+00	2.00E+00	1	2.00E+00	2.00E+00	1			
PCB-1248	2.00E+00	2.00E+00	1	2.00E+00	2.00E+00	1			
PCB-1254	2.00E+00	2.00E+00	1	2.00E+00	2.00E+00	1			
PCB-1260	2.00E+00	2.00E+00	1	2.00E+00	2.00E+00	1			
Total PCB (high risk)	2.00E+00	2.00E+00	1	2.00E+00	2.00E+00	1			
Radionuclide COCs ^a	CSFs								
	Oral (risk/pCi)			Inhalation (risk/pCi)			External exposure (risk/year)/(Ci/g)		
	RI	2024	2024/RI	RI	2024	2024/RI	RI	2024	2024/RI
Cesium-137 ^c	3.16E-11	4.26E-11	1.3	1.91E-11	1.12E-10	5.9	2.09E-06	2.53E-06	1.2
Neptunium-237 ^c	3.00E-10	1.41E-10	0.5	3.45E-08	2.87E-08	0.8	4.62E-07	8.55E-07	1.9
Radium-226 ^c	2.96E-10	6.77E-10	2.3	2.75E-09	2.82E-08	10.3	6.74E-06	8.37E-06	1.2
Thorium-232	--	2.17E-09	--	--	8.7E-08	--	--	4.04E-06	--
Uranium-235 ^c	4.70E-11	1.54E-10	3.3	1.30E-08	2.50E-08	1.9	2.65E-07	5.76E-07	2.2
Uranium-238 ^c	6.20E-11	1.97E-10	3.2	1.24E-08	2.37E-08	1.9	6.57E-08	1.19E-07	1.8

^aCOCs for surface and subsurface soil are from Table 2.2 of the *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/01-2229&D3).

^bInhalation CSF is converted from the inhalation unit risk assuming a 70-kg adult and an inhalation rate of 20 m³/day.

^cCSFs from the *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1641&D2) include daughter products. The RI and 2020 +D CSFs are used for comparison.

Note: The U.S. Environmental Protection Agency’s current methods assume an 80-kg adult body weight and no longer use the inhalation rate; rather, the methods use inhalation unit risk and inhalation reference concentration values that do not require the use of an inhalation rate.

Bold values indicate changes where the new CSF suggests the COC is more potent than previously considered (e.g., the CSF ratio > 1).

-- = No value available.

COC = contaminant of concern

CSF = cancer slope factor

PCB = polychlorinated biphenyl

RI = remedial investigation

UEFPC = Upper East Fork Poplar Creek

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Table B.5. Comparison of VOC concentrations in soil to RSL

CHEMICAL_NAME	UNITS	RESULTS	RSLTQUAL	VALIDATION	LM_DETECT_LIMIT	RSL for composite worker	Concentration exceeds RSL?
1,1,1-Trichloroethane	µg/kg	1.67	J	J	0.291	81,600,000	No
1,1-Dichloroethane	µg/kg	58.9	J	J	30.5	286,000	No
cis-1,2-Dichloroethene	µg/kg	177	EJ	J	0.291	653,000	No
Ethylbenzene	µg/kg	4.16	J	J	0.291	183,000	No
Tetrachloroethene	µg/kg	452	--	=	30.5	653,000	No
Toluene	µg/kg	7.61	J	J	0.291	81,600,000	No
Total xylene	µg/kg	13.4	J	J	0.291	251,000	No
trans-1,2-Dichloroethene	µg/kg	4.57	J	J	0.291	653,000	No
Trichloroethene	µg/kg	55.9	J	J	33.5	32,600	No
Vinyl chloride	µg/kg	171	--	=	30.5	104,000	No

-- = No result qualifier.

EJ = concentration exceeds the calibration range of the instrument

J = analyte detected; estimated value

RSL = regional screening level

VOC = volatile organic compound

'=' = validated result, detected and unqualified

B.3.4. East End Volatile Organic Compound Plume

B.3.4.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

The performance goal of the treatment system discharge, as described in the *Removal Action Report for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee* (DOE/OR/01-2297&D1), is to meet AWQC recreational (organism only) criteria. The AWQC (organism only) standard for carbon tetrachloride to be maintained downstream of the treatment unit discharge point was updated in 2004 from 44 µg/L to 16 µg/L (Table B.6). The standard remains the same for the current FYR.

Table B.6. Changes in chemical-specific ARARs, UEFPC EEVOC Plume

Contaminant	Medium	Remediation level	Standard		Percent change	Citation and year for updated values
			1999	2019 ^a		
Carbon tetrachloride	SW	AWQC HH	44 µg/L	16 µg/L	-67%	TDEC 2019 ^b

^aFrom Tennessee Department of Environment and Conservation (TDEC) Chapter 0400-40-03, "General Water Quality Criteria" (TDEC 2019). Values in the table are fish and aquatic/HH recreation, organisms only. TDEC AWQC were updated in 2004, 2008, 2013, 2015, and 2019; new AWQC will be used to measure compliance.

^bTDEC 2019: <https://publications.tnsosfiles.com/rules/0400/0400-40/0400-40-03.20190911.pdf>. The file indicates AWQC values have a date of September 2019 (revised).

ARAR = applicable or relevant and appropriate requirement

AWQC = ambient water quality criteria

EEVOC = East End Volatile Organic Compound

HH = human health

SW = surface water

UEFPC =Upper East Fork Poplar Creek

B.3.4.2. Changes in Risk Assessment Assumptions

Risk-based performance standards are not specified in the *Action Memorandum for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee* (DOE/OR/01-1819&D2; East End Volatile Organic Compound [EEVOC] Plume AM).

EPA published the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)* (EPA 2002; VI Draft Guidance) after the EEVOC Plume AM was approved. In 2015, EPA published the *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (EPA 2015; VI Technical Guidance), along with an online tool for calculating VISLs (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>). The pathway for VOC vapors to intrude into buildings at the site would be volatilization of chemicals from the groundwater table or capillary fringe above the water table into air in soil pores with subsequent diffusion upward to the shallow subsurface beneath an occupied building. VOC concentrations detected in the off-site portion of the EEVOC Plume (wells GW-169/GW-170) included in the Union Valley Interim ROD do not exceed the VI screening concentrations that would indicate potential for unacceptable exposure to building occupants in that area.

The plume passes south of the New Hope Center and travels east under 701 Scarboro Road. Groundwater wells GW-169 and GW-170 are east of the building, and well GW-722-33 is west of the building inside the perimeter of the Y-12 plant. Thus, the range of potential groundwater concentrations is bounded by these wells. The default values in the VISL calculator were used to derive screening levels. Data for VOCs detected at least once in each well between 2021 and 2023 were compared against screening levels for residential and commercial receptors (Table B.7). VISL modeling for residential and industrial exposures is also protective of visitors because their exposure time and frequency are much less than the receptors modeled. No VOCs detected in off-site wells exceed their respective commercial screening level; therefore, the remedy is protective of off-site workers. Table B.7 shows the summary statistics and comparison to default VISLs for these wells.

Table B.7. VI screening, EEVOC Plume

Monitoring well	Depth to water (ft)	Analyte	Frequency of detection	MDC (µg/L)	Default residential VISL		Default commercial/ industrial VISL	
					VISL (µg/L)	MDC > VISL?	VISL (µg/L)	MDC > VISL?
GW-169	29.7	cis-1,2-Dichloroethene	1 / 6	0.24 J	25	No	105	No
		Tetrachloroethene	6 / 6	1.6	5.76	No	24.2	No
		Trichloroethene	3 / 6	0.46 J	0.518	No	2.18	No
GW-722-33	81	Benzene	1 / 8	0.2 J	1.59	No	6.93	No
		Carbon disulfide	1 / 8	0.19 J	124	No	521	No
		Chloroform	3 / 8	0.69 J	0.814	No	3.55	No
GW-170	104	Benzene	12 / 12	0.87 J	1.59	No	6.93	No
		Carbon tetrachloride	10 / 12	1.2 J	0.814	Yes	1.81	No
		Chloroform	10 / 12	0.62 J	0.814	No	3.55	No
		Tetrachloroethene	7 / 12	0.53 J	5.76	No	24.2	No
		Trichloroethene	10 / 12	0.72 J	0.518	Yes	2.18	No

Note: None of the measured groundwater concentrations exceed the commercial/industrial VISLs (at a target risk of 1E-06 or a target hazard index of 0.1), indicating VI is not a potentially complete pathway for the current and anticipated future commercial/industrial land uses. Groundwater monitoring will continue at the EEVOC Plume to evaluate contaminant trends and effectiveness of the plume containment action. A new Visitor Center has been constructed at the east end of the Y-12 National Security Complex. This facility (New Hope Center) was constructed with a vapor barrier, as this is germane to the VI concern expressed by the U.S. Environmental Protection Agency. However, the EEVOC Plume does not pass beneath this facility. The U.S. Department of Energy will consider the potential presence of volatile organic compounds in soil in future site development plans in the plume-affected areas.

EEVOC = East End Volatile Organic Compound

J = analyte detected; estimated value

MDC = maximum detected concentration

VI = vapor intrusion

VISL = vapor intrusion screening level. At a target risk of 1E-06 or target hazard quotient of 0.1, calculated using default exposure parameters in the U.S. Environmental Protection Agency VISL calculator (at <https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>)

Although it is likely future building construction would be designed to reduce intrusion of vapors from the surrounding soils, to provide a level of conservatism in the evaluation, these protective design measures are assumed to not be implemented.

B.4. CHESTNUT RIDGE ADMINISTRATIVE WATERSHED

B.4.1. United Nuclear Corporation Disposal Area

B.4.1.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

The performance standards are based on the MCL for nitrate and the MCL-derived concentration for Sr-90, which are unchanged from the time of the *Record of Decision, United Nuclear Corporation Disposal Site Declaration, Y-12 Plant, Oak Ridge, Tennessee* (DOE 1991; United Nuclear Corporation [UNC] ROD). No other ARARs were specified in the UNC ROD.

B.4.1.2. Changes in Risk Assessment Assumptions

The toxicity values (i.e., CSFs) for Sr-90, both oral and inhalation, have changed slightly since the UNC ROD was approved (Table B.8). Noncancer toxicity values for nitrate have not changed since they were adopted in 1991. The cap and access controls make the exposure pathways incomplete; therefore, these changes have no impact to the risk originally estimated for this site. Also, the prescribed performance standard for Sr-90 is not established using the CERCLA risk range of 10⁻⁴ to 10⁻⁶; rather, the performance

Table B.8. Changes in toxicity factors since the UNC ROD

COC	CAS number	CSFs					
		ROD oral CSF (risk/pCi)	2024 oral CSF (risk/pCi)	Ratio ^a oral CSF (today/1997)	ROD inhal. CSF ^b (risk/pCi)	2024 inhal. CSF ^a (risk/pCi)	Ratio inhal. CSF (today/1997)
Sr-90 (+D) ^b (water)	10098-97-2	5.59E-11	1.35E-10	2.4	6.93E-11	4.33E-10	6.2

^aRatio is the factor by which the risk/hazards would change today. A value < 1 indicates a decrease in risk/hazard; a value > 1 indicates the multiplier for which the risk/hazard would increase using today's toxicity. A ratio of 1 indicates no change in the toxicity value.

^bSelected radionuclides and radioactive decay chain products are designated with the suffix +D to indicate cancer risk and dose effectiveness estimates for these radionuclides include the contributions from their short-lived decay products, assuming equal activity concentrations (i.e., secular equilibrium) with the principal or parent nuclide in the environment.

CAS = Chemical Abstracts Service

COC = contaminant of concern

CSF = cancer slope factor

inhal. = inhalation

ROD = Record of Decision

UNC = United Nuclear Corporation

standard is based on a dose-based MCL and, therefore, the protectiveness of the remedy is not affected by the change in toxicity factors. In fiscal years (FYs) 2021–2023, nitrate and Sr-90 were detected at low concentrations in downgradient monitoring well samples and the downgradient surface water spring location (UNC SW-1); however, the change in the in Sr-90 CSF does not have any impact on potential risk due to the low detected concentrations.

B.4.2. Kerr Hollow Quarry

All assumptions made at the time of the remedy, as described in the *Record of Decision for Kerr Hollow Quarry at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/02-1398&D2; Kerr Hollow Quarry [KHQ] ROD), are still valid. No changes in land use have occurred since the KHQ ROD. No changes in physical site conditions were noted during FYs 2021–2023 inspections, and no significant repairs or upgrades to the infrastructure at KHQ were conducted. The CERCLA decision was no further action (NFA), with monitoring to continue under the Resource Conservation and Recovery Act of 1976 (RCRA) post-closure permit. Beginning in February 2019, all substantive RCRA requirements for the Chestnut Ridge administrative watershed were incorporated into CERCLA.

B.4.3. Filled Coal Ash Pond

Numerical performance standards were not specified in the *Record of Decision for Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond and Vicinity), Oak Ridge, Tennessee* (DOE/OR/02-1410&D3; Filled Coal Ash Pond [FCAP] ROD), and no chemical-specific ARARs were identified by the FCAP ROD.

A comparison of toxicity values for the human health COC (i.e., Th-228 and its daughters) since the risk assessment in the *Remedial Investigation Report on Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond/Upper McCoy Branch) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1268&D2; FCAP RI) (Table B.9) suggests the risk to human health would increase slightly as compared to that originally determined. However, controls in place prevent access to the site, thus making the exposure pathways associated with the ash incomplete.

Table B.9. Changes in toxicity factors for FCAP radionuclides of concern since the FCAP RI

COC		CSFs								
		Oral (risk/pCi)			Inhalation (risk/pCi)			External exposure (risk/year)/(pCi/g)		
		RI ^a	2024	2024/RI	RI ^a	2024	2024/RI	RI ^a	2024	2024/RI
Th-228	(soil)	2.31E-10	2.43E-10	1.1	9.68E-08	1.32E-07	1.4	9.94E-07	5.64E-09	0.0009

^aThe Remedial Investigation Report on Chestnut Ridge Operable Unit 2 (Filled Coal Ash Pond/Upper McCoy Branch) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee (DOE/OR/01-1268&D2) used the CSF designated with the suffix +D to indicate cancer risk and dose effectiveness estimates include the contributions from short-lived decay products, assuming equal activity concentrations (i.e., secular equilibrium) with the principle or parent radionuclide in the environment. Inclusion of these daughter products is no longer considered appropriate for Th-228.

Bold values indicate changes where the new CSF suggests the COC is more potent than previously considered (e.g., the CSF ratio > 1).

COC = contaminant of concern
CSF = cancer slope factor
FCAP = Filled Coal Ash Pond
RI = remedial investigation

B.5. OTHER SITES

B.5.1. Oak Ridge Associated Universities South Campus Facility

B.5.1.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

Because the original remedy in the *Record of Decision for Oak Ridge Associated Universities South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1383&D3; Oak Ridge Associated Universities [ORAU] South Campus Facility [SCF] ROD) was NFA, there were no ARARs included in the decision documents. However, under monitored natural attenuation (MNA) protocol, it is likely MCLs would have been identified as ARARs and a MNA monitoring protocol would have been identified in the *Remedial Action Report for Post-Record of Decision Monitoring at Oak Ridge Associated Universities South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1474&D2). Potential changes in assumptions used for the decision process at ORAU SCF were reviewed for this FYR. No new chemical-specific standards for trichloroethene (TCE) have become available since the ORAU SCF ROD was signed. Specifically, the standard for terminating monitoring in the ORAU SCF ROD—an “acceptable level of TCE” (MCL = 5 µg/L)—has not changed.

B.5.1.2. Changes in Risk Assessment Assumptions

The land use/receptor/exposure pathway assumptions included in the ORAU SCF ROD have not changed, and the land remains under strict DOE control. The most-important changes in toxicity values since the risk assessment was performed for the *Remedial Investigation/Feasibility Study South Campus Facility, Oak Ridge, Tennessee* (DOE/OR/02-1274/V1&D2; ORAU SCF RI/Feasibility Study [FS]) were those for trichloroethene (TCE), which is the primary COC discussed in the ORAU SCF ROD (Table B.10). Changes in the TCE toxicity value result in higher risk than estimated in the ORAU SCF RI/FS. However, because the acceptable level for TCE is its MCL, and because groundwater is not currently being used or expected to be used in the future, this change does not impact the remedy selected in the ORAU SCF ROD.

Table B.10. Changes in toxicity factors since the ORAU SCF RI

COC	CSFs						
	Oral (kg-day/mg)				Inhalation (kg-day/mg)		
	CAS number	RI	2024	2024/RI	RI	2024 ^a	2024/RI
TCE	79-01-6	1.10E-02	4.60E-02	4.2	6.00E-03	1.44E-02	2.4
COC	Chronic RfDs						
	Oral (mg/kg-day)				Inhalation (mg/kg-day)		
	CAS number	RI	2024	2024/RI	RI	2024 ^a	2024/RI
TCE	79-01-6	--	5.00E-04	--	--	5.71E-04	--

^aInhalation CSF and RfD converted from unit risk and reference concentration assuming a 70-kg adult and an inhalation rate of 20 m³/day.

Note: The U.S. Environmental Protection Agency’s current methods assume an 80-kg adult body weight and no longer use the inhalation rate; rather, the methods use inhalation unit risk and inhalation reference concentration values that do not require the use of an inhalation rate.

Bold values indicate changes where the new CSF suggests the COC is more potent than previously considered (e.g., the CSF ratio > 1).

-- = No value available.

CAS = Chemical Abstracts Service

COC = contaminant of concern

CSF = cancer slope factor

ORAU = Oak Ridge Associated Universities

RfD = reference dose

RI = remedial investigation

SCF = South Campus Facility

TCE = trichloroethene

There is increasing commercial development in the area near ORAU SCF; however, this development has not led to increased exposure to contaminated groundwater because there is no use of the groundwater. Potential exposure contact with contaminated groundwater at a wet-weather seep is no longer possible because the seep was covered during site construction, and no new exposure pathways have developed at ORAU SCF.

EPA published the VI Draft Guidance after the ORAU SCF ROD was approved. In 2015, EPA published the VI Technical Guidance, along with an online tool (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>) for calculating VISLs. The pathway for VOC vapors to intrude into buildings at the site would be volatilization of the chemicals from the groundwater table, or capillary fringe above the water table into air in soil pores with subsequent diffusion upward to the shallow subsurface beneath an occupied building. In this 2024 FYR, VISL was run for a commercial receptor for ORAU SCF groundwater, using default parameters for commercial exposures. Between FYs 2021–2023, the maximum TCE concentrations in wells GW-841 and GW-842 were 6.6 µg/L and 2.3 µg/L, respectively. The analytical results for TCE in both wells exceed the default commercial VISL of 2.18 µg/L at an HI of 1 or ILCR of 1E-06. However, there are no exceedances at an HI of 1 or an ILCR of 1E-05. The results of the VISL screening are presented in Table B.11. Groundwater monitoring will continue at ORAU SCF. DOE will consider the potential presence of VOCs in soil in future site development plans.

Table B.11. VI screening for ORAU SCF

Monitoring well	Depth to water (ft)	Analyte	Frequency of detection	MDC (µg/L)	Default residential VISL		Default commercial/industrial VISL	
					VISL (µg/L)	MDC > VISL?	VISL (µg/L)	MDC > VISL?
GW-841	--	Chloroform	1 / 3	0.25	0.814	No	3.55	No
		cis-1,2-Dichloroethene	3 / 3	15	25.0	No	1050	No
		Trichloroethene	3 / 3	6.6	0.518	Yes	2.18	Yes
GW-842	0.92	cis-1,2-Dichloroethene	2 / 2	1	25	No	105	No
		Trichloroethene	2 / 2	2.3	0.518	Yes	2.18	Yes

-- = No value available.

MDC = maximum detected concentration

ORAU = Oak Ridge Associated Universities

SCF = South Campus Facility

VI = vapor intrusion

VISL = vapor intrusion screening level; at a target risk of 1E-06 or target hazard quotient of 0.1, calculated using default exposure parameters in the U.S. Environmental Protection Agency VISL calculator (<https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>)

B.6. OFFSITE

B.6.1. Lower East Fork Poplar Creek

B.6.1.1. Changes in Chemical-Specific Applicable or Relevant and Appropriate Requirements

No chemical-specific ARARs were identified in the *Record of Decision for Lower East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/02-1370&D2; Lower East Fork Poplar Creek [LEFPC] ROD). All location- and action-specific ARARs/TBC criteria cited in the LEFPC ROD were met during ROD implementation. There have been no substantive changes in the ARARs in the LEFPC ROD that would affect protectiveness of the remedy.

B.6.1.2. Changes in Risk Assessment Assumptions

Changes in land use

Changes in land use since the time of the LEFPC ROD have occurred in close proximity to the floodplain, although not in the areas in which RA occurred. Section 5.1.1.3 of the 2024 FYR summarizes land use changes. The greatest number of changes occurred between the 2001–2006 FYRs, when several large residential developments (Wiltshire Drive, Jackson Crossing, and Southwood Subdivisions) were built in the area of the LEFPC floodplain. The other significant change in land use since the time of the *East Fork Poplar Creek-Sewer Line Beltway Remedial Investigation* (DOE/OR/02-1119&D2; East Fork Poplar Creek [EFPC] RI) was the April 29, 2003, transfer of Parcel ED-1 from DOE to the Community Reuse Organization of East Tennessee. The implications of these changes were addressed in detail in the *2006 Remediation Effectiveness Report/Second Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/OR/01-2289&D3; 2006 FYR). No issues were identified stemming from that analysis. Since the 2006 FYR, there have been minor changes in land use. Development in a new subdivision (Forest Creek Village Subdivision), as noted in the *2021 Fifth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2895&D2), continues on the far west end of Oak Ridge. Approximately 30 of the 91 parcels in the Forest Creek Village development are located adjacent to the floodplain, as documented in Section 5.1.1.3 of the 2024 FYR. The original cleanup goals identified in the LEFPC ROD are still protective for the current land uses.

Changes in exposure factors

Although no gardens were observed in the FY 2023 review of land use in the LEFPC floodplain, EPA requested an evaluation of mercury uptake into homegrown vegetables through their comments on the *2020 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2844&D2). The mercury uptake evaluation was completed as part of this 2024 FYR.

Preliminary remediation goals (PRGs) for the consumption of fruits and vegetables were calculated using the Oak Ridge National Laboratory Risk Assessment Information System PRG calculator, using a combination of default and site-specific parameters (see Attachment B.1). PRGs for mercuric sulfide ranged from 162 mg/kg for consumption of a limited number of fruit and vegetable types at a fraction ingested (FI) of 25% to 900 mg/kg for a limited number of vegetables at an FI of 17%. While the mercuric sulfide PRG of 162 mg/kg is less than the original cleanup goal of 400-mg/kg mercury, it is unlikely an individual family would ingest both 25% of their fruit intake and 17% of their vegetable intake from a residential plot year-round for 26 years. The mercuric sulfide PRG for a more likely intake of 17% fruits and vegetables is 500 mg/kg. Additionally, the mercuric sulfide PRG of 162 mg/kg is less than the 95% upper confidence level of the measured concentrations of mercury in each LEFPC floodplain soil segment, which ranges from 9 mg/kg to 121 mg/kg (Attachment B.1, Table 1), indicating the concentration of mercury in LEFPC floodplain soil does not pose an unacceptable risk for the limited consumption of fruits and vegetables.

Changes in toxicity factors

Table B.12 compares the RfDs used in the risk assessment for the EFPC RI) to the most current RfDs. This comparison is indicated as the ratio in the table. Ratios < 1 indicate the current RfD is more potent than the RfD at the time of the LEFPC ROD. For the LEFPC ROD, the oral and inhalation RfDs for mercury have not changed. This RfD value was used in conjunction with a bioavailability factor to develop the final RL in the LEFPC ROD.

Table B.12. Changes in toxicity factors since the EFPC RI, 1994

COC	Chronic RfDs					
	RI	2024	Ratio	RI	2024 ^a	Ratio
	oral RfD (mg/kg-day)	oral RfD (mg/kg-day)	oral RfD (2024/RI)	inhal. RfD (mg/kg-day)	inhal. RfD (mg/kg-day)	inhal. RfD (2024/RI)
Mercury (as mercuric chloride)	3.00E-04	3.00E-04	1.00	8.60E-05	8.57E-05	1.00

^aInhalation RfD is converted from the inhalation reference concentration assuming a 70-kg adult and an inhalation rate of 20 m³/day.

Note: The U.S. Environmental Protection Agency's current methods assume an 80-kg adult body weight and no longer use the inhalation rate; rather, the methods use inhalation unit risk and inhalation reference concentration values that do not require the use of an inhalation rate.

COC = contaminant of concern

EFPC = East Fork Poplar Creek

inhal. = inhalation

RfD = reference dose

RI = remedial investigation

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ATTACHMENT B.1.
EVALUATION OF LOWER EAST FORK POPLAR CREEK FLOODPLAIN SOIL FOR
CONSUMPTION OF FRUITS AND VEGETABLES

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This attachment documents the evaluation of Lower East Fork Poplar Creek (LEFPC) floodplain soil for protection of human health via ingestion of homegrown fruits and vegetables. Protection of human health was evaluated under three scenarios: (1) a farmer consuming mercury-contaminated fruits and vegetables; (2) industrial, residential, and recreational receptors potentially exposed to mercury in soils via ingestion and dermal contact; and (3) a child inadvertently ingesting contaminated soils.

The remedial goal options (RGOs) were derived for the farmer ingesting contaminated fruits and vegetables. RGOs for the industrial, residential, and recreational receptors were from the *Feasibility Study for the East Fork Poplar Creek – Sewer Line Beltway, Oak Ridge, Tennessee*, 1994, U.S. Department of Energy (DOE/OR/02-1185&D2). The child inadvertently ingesting soil RGO was from the *Record of Decision for Lower East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE/OR/02-1370&D2; LEFPC Record of Decision [ROD]). Mercury concentrations in floodplain soils were compared to the RGOs presented in the LEFPC ROD.

All soil data from the LEFPC floodplain were obtained from the Oak Ridge Environmental Information System. The dataset consisted of samples collected from the *East Fork Poplar Creek-Sewer Line Beltway Remedial Investigation, Oak Ridge, Tennessee* (DOE/OR/02-1119&D2; EFPC Remedial Investigation [RI]) and the *Confirmatory Sampling and Analysis Plan for the Lower East Fork Poplar Creek Operable Unit, Oak Ridge, Tennessee* (LMES 1996). The data were then sorted, and duplicate samples were evaluated as follows:

- The sample with the highest detected value for samples with a start depth less than 2 ft was retained.
- As part of the LEFPC RI, a vertical integration study was performed where duplicate cores were collected and subdivided into 1-in. samples. These samples were not used in the statistical evaluation; rather, the 0 to 1.3-ft core data were used for consistency with all other retained samples.

Consistent with the exposure assessment in the LEFPC RI, the data were further subdivided by the floodplain segments (Figure B.1.1) for statistical evaluation and comparison to the RGOs for industrial, residential, and recreational exposures as appropriate for the land use of the segment. A graph of the 95% upper confidence level (UCL₉₅) mercury concentrations in each floodplain segment is presented in Figure B.1.2. Note that some segments have multiple land uses. Individual segment maps are presented in Attachment B.1.1.

Summary statistics for mercury were calculated using ProUCL Version 5.2 and are presented in Table B.1.1. The ProUCL output file is presented in Attachment B.1.2. Samples on the creek bank or in very close proximity to the creek bank were removed from the dataset.

Mercuric sulfide preliminary remediation goals (PRGs)/residential screening levels (RSLs) were calculated for the consumption of fruits and vegetables grown in floodplain soil in residential use segments. Calculations were completed using the Oak Ridge National Laboratory Risk Assessment Information System PRG calculator because the U.S. Environmental Protection Agency (EPA) RSL calculator does not have inputs for consumption of fruits and vegetables. Mercuric sulfide was determined to be the predominant form of mercury in floodplain soils as part of the LEFPC RI and determination of RGOs.

The mercury RGO presented in the LEFPC ROD for child residential receptors of 400 mg/kg was based on the 85th percentile of calculated RGO values for mercuric sulfide. The adjusted mercury RGOs for commercial, U.S. Department of Energy-owned, and other land uses presented in the LEFPC FS are 938 mg/kg for children and 1252 mg/kg for adults. As shown in Figure B.1.2, the UCL₉₅ mercury concentrations in each LEFPC floodplain segment are all less than the 400-mg/kg RGO for the protection of child residential receptors and are, therefore, protective of industrial and recreational receptors.

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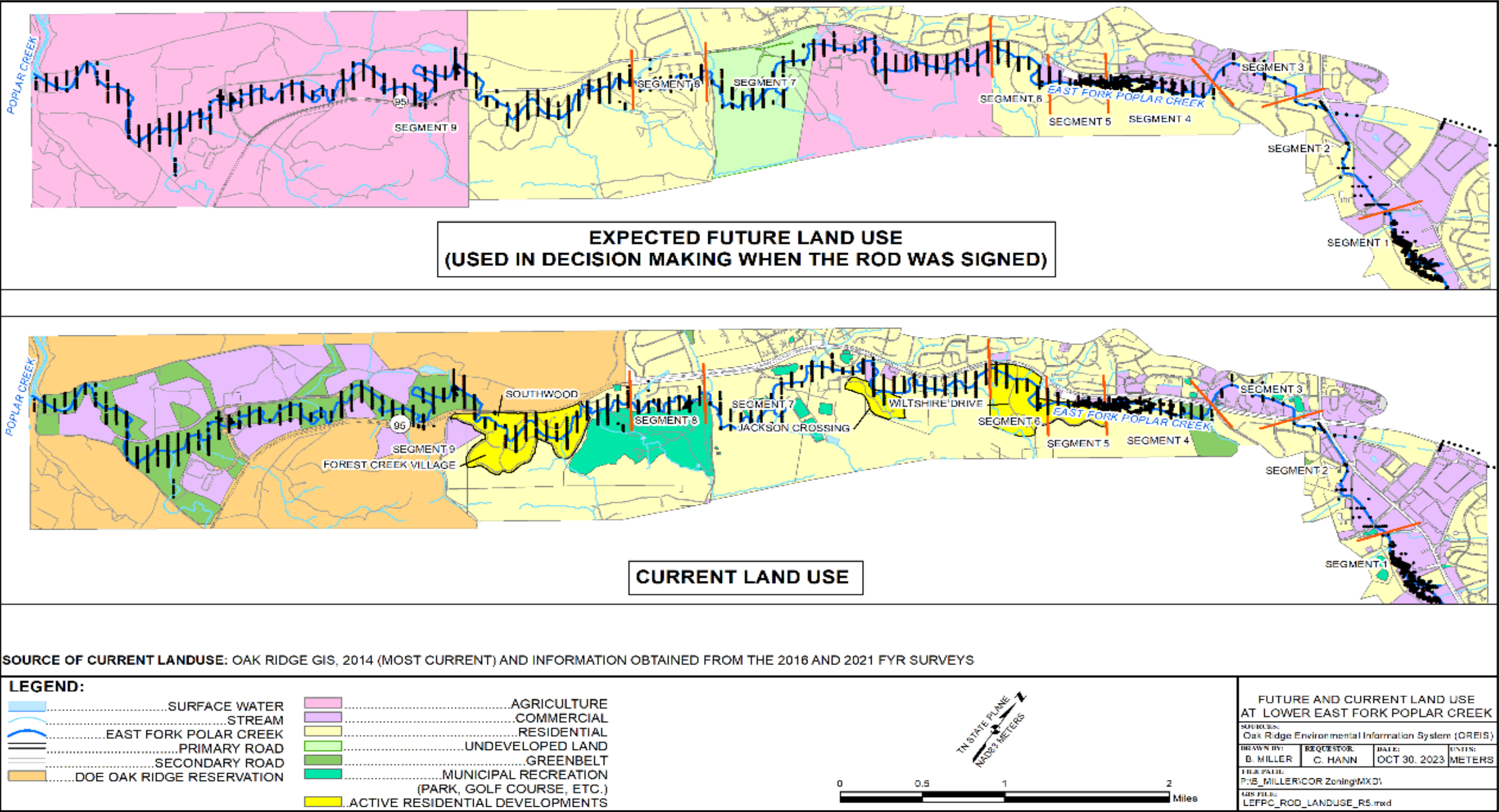


Figure B.1.1. LEFPC sample locations and land use.

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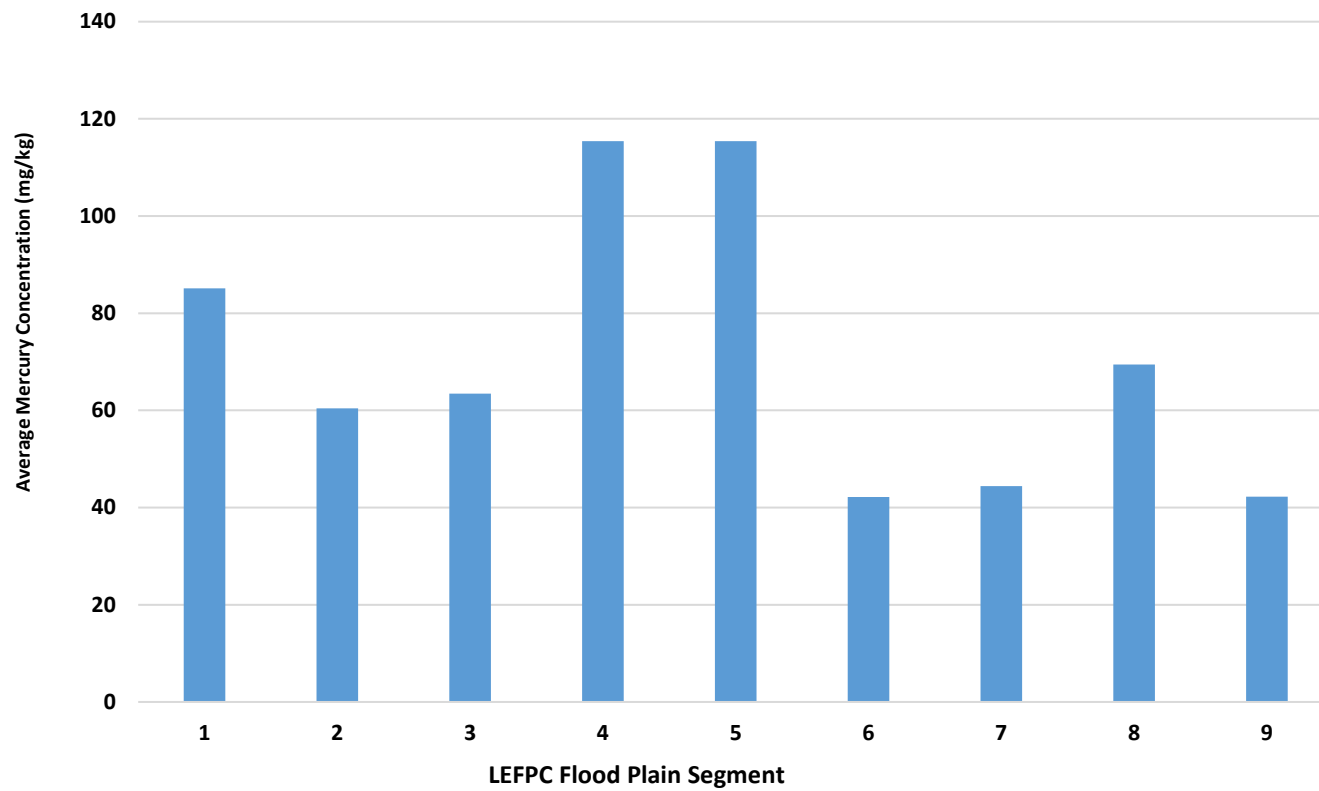


Figure B.1.2. UCL₉₅ mercury concentrations by LEFPC segment.

Table B.1.1. Summary statistics for mercury in LEFPC floodplain soils by segment

Segment	Number of samples	Number of detections	Minimum detected value (mg/kg)	Maximum detected value (mg/kg)	Mean detected value (mg/kg)	UCL ₉₅ (mg/kg)	UCL ₉₅ basis
1	522	464	0.03	1300	85.14	83.98	95% KM approximate gamma UCL
2	93	32	3.6	443	60.44	36.57	95% KM approximate gamma UCL
3	37	13	4.5	150	63.45	35.4	95% KM (t) UCL
4	383	342	0.6	777.6	115.4	112.1	95% KM (t) UCL
5	150	126	0.5	432	116.2	120.6	95% GROS approximate gamma UCL
6	75	29	0.22	117	36.4	21.52	95% KM approximate gamma UCL
7	320	81	1.5	278	44.44	9.005	KM H-UCL
8	83	43	7.35	417	69.47	57.41	95% GROS approximate gamma UCL
9	768	212	2.73	216	42.27	14.15	95% KM approximate gamma UCL

KM = Kaplan Meir

LEFPC = Lower East Fork Poplar Creek

UCL = upper confidence level

UCL₉₅ = 95% upper confidence level

PRGs/RSLs and their associated input parameters for the consumption of homegrown fruits and vegetables are presented in Attachment B.1.3. The default PRGs/RSLs for consumption of fruits and vegetables use a single ingestion rate and mass loading factor. Subsistence-level agriculture is not practiced in the LEFPC floodplain; therefore, to reduce conservatism in the consumption of fruits and vegetables PRG, Fred Dolislager of the Oak Ridge National Laboratory Risk Assessment Information System (personal communication Dolislager 2023) agreed it was appropriate to average the adult and child fruit and vegetable intake rates and mass loading factors from the EPA PRG calculator for radionuclides as input parameters for the PRG calculator (Tables B.1.2 and B.1.3). Two fraction ingested (FI) parameters based on residential lot size and proximity to LEFPC were used—25% (i.e., a 10-ft × 15-ft residential garden) and 17% (i.e., a 10-ft × 10-ft residential garden) based on the minimum garden size of 600 ft² (i.e., a 20-ft × 30-ft residential garden) to feed a family of four year-round (Old Farmer's Almanac at almanac.com). Input parameters for the consumption of fruits and vegetables ranged from a limited number of fruit and vegetable types to consumption of a limited number of vegetables only. The selection of the types of fruits and vegetables represent tree, shrub, and herbaceous fruits as well as both root and above-ground vegetables.

PRGs for mercuric sulfide ranged from 162 mg/kg for consumption of a limited number of fruit and vegetable types at an FI of 25% to 900 mg/kg for a limited number of vegetables at an FI of 17%. PRGs for mercuric sulfide ranged from 162 mg/kg for consumption of a limited number of fruit and vegetable types at an FI of 25% to 900 mg/kg for a limited number of vegetables at an FI of 17%. While the mercuric sulfide PRG of 162 mg/kg is less than the original cleanup goal of 400-mg/kg mercury, it is unlikely an individual family would ingest both 25% of their fruit intake and 17% of their vegetable intake from a residential plot year-round for 26 years. The mercuric sulfide PRG for a more likely intake of 17% fruits and vegetables is 500 mg/kg. Additionally, the mercuric sulfide PRG of 162 mg/kg is less than the UCL₉₅ of the measured concentrations of mercury in each LEFPC floodplain soil segment, which ranges from 9 mg/kg to 121 mg/kg (Table B.1.1), indicating the concentration of mercury in LEFPC floodplain soil does not pose an unacceptable risk for the limited consumption of fruits and vegetables.

REFERENCES

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Table B.1.2. Input parameters for consumption of a limited number of fruit and vegetable types

Variable	Value	Average (g)	Average (mg)
IRAPfar-a (apple ingestion rate - farmer adult) g/day	84.8		
IRBEfar-a (berry ingestion rate - farmer adult) g/day	35.2		
IRSTfar-a (strawberry ingestion rate - farmer adult) g/day	40.6	53.5333333	53533.3333
IRASfar-a (asparagus ingestion rate - farmer adult) g/day	40.1		
IRCRfar-a (carrot ingestion rate - farmer adult) g/day	24.4		
IRCUfar-a (cucumber ingestion rate - farmer adult) g/day	54.9		
IROKfar-a (okra ingestion rate - farmer adult) g/day	30.4		
IRONfar-a (onion ingestion rate - farmer adult) g/day	27.3		
IRPPfar-a (pepper ingestion rate - farmer adult) g/day	23.9		
IRSNfar-a (snap bean ingestion rate - farmer adult) g/day	54.5		
IRTOfar-a (tomato ingestion rate - farmer adult) g/day	94	43.6875	43687.5
IRAPfar-c (apple ingestion rate - farmer child) g/day	82.7		
IRBEfar-c (berry ingestion rate - farmer child) g/day	24.2		
IRSTfar-c (strawberry ingestion rate - farmer child) g/day	27.5	44.8	44800
IRASfar-c (asparagus ingestion rate - farmer child) g/day	11.9		
IRCRfar-c (carrot ingestion rate - farmer child) g/day	13.1		
IRCUfar-c (cucumber ingestion rate - farmer child) g/day	16.3		
IROKfar-c (okra ingestion rate - farmer child) g/day	9.4		
IRONfar-c (onion ingestion rate - farmer child) g/day	7.5		
IRPPfar-c (pepper ingestion rate - farmer child) g/day	7.4		
IRSNfar-c (snap bean ingestion rate - farmer child) g/day	28.7		
IRTOfar-c (tomato ingestion rate - farmer child) g/day	42.2	17.0625	17062.5
MLFapple (apple mass loading factor) unitless	0.00016		
MLFberry (berry mass loading factor) unitless	0.000166		
MLFstrawberry (strawberry mass loading factor) unitless	0.00008	0.00013533	

Table B.1.2. Input parameters for consumption of a limited number of fruit and vegetable types (cont.)

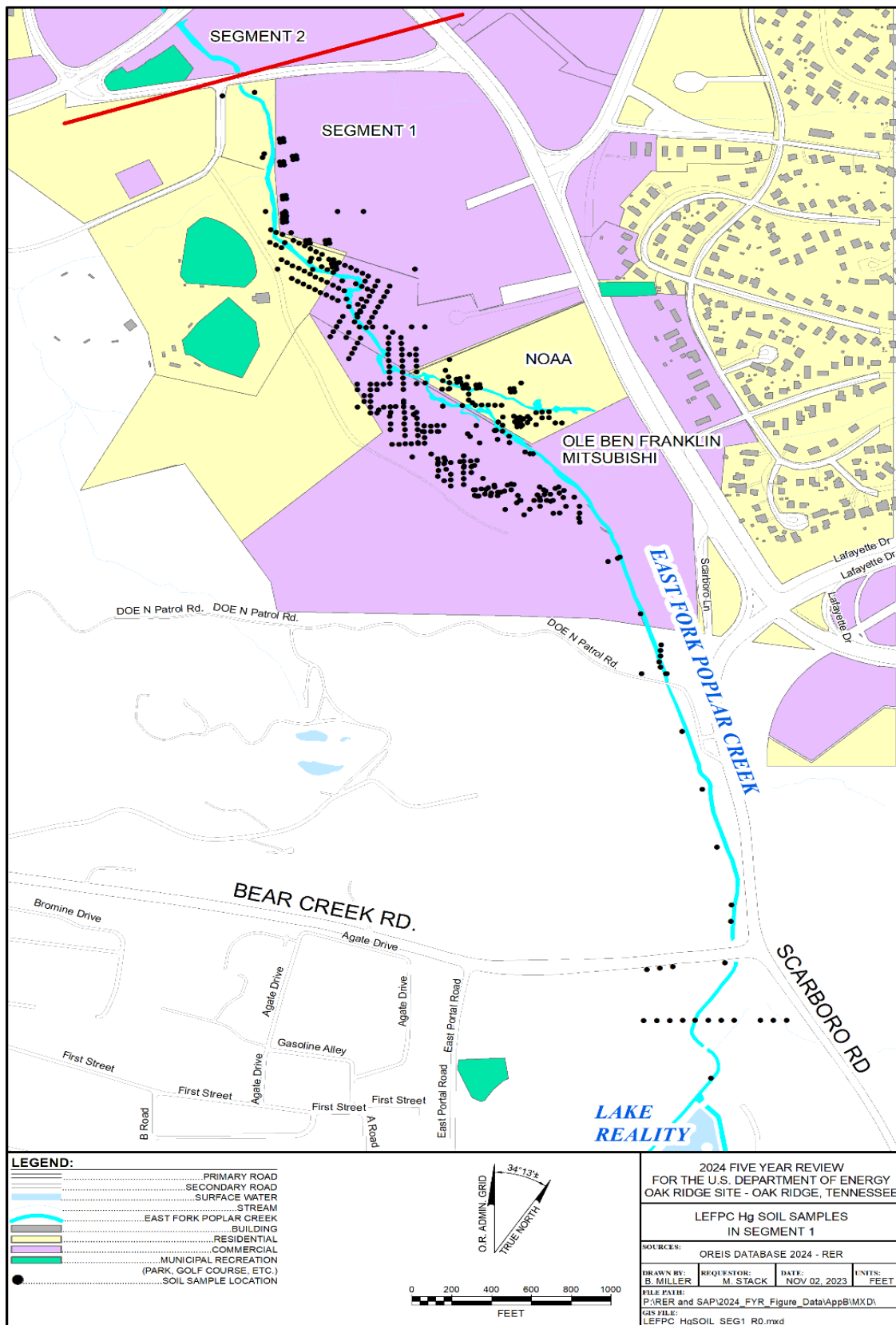
Variable	Value	Average (g)	Average (mg)
MLFasparagus (asparagus mass loading factor) unitless	0.000079		
MLFcarrot (carrot mass loading factor) unitless	0.000097		
MLFcucumber (cucumber mass loading factor) unitless	0.00004		
MLFokra (okra mass loading factor) unitless	0.00008		
MLFonion (onion mass loading factor) unitless	0.000097		
MLFpepper (pepper mass loading factor) unitless	0.00222		
MLFsnap bean (snap bean mass loading factor) unitless	0.005		
MLFtomato (tomato mass loading factor) unitless	0.00177	0.00117288	
Average of Fruit and Vegetable MLFs		0.00088991	

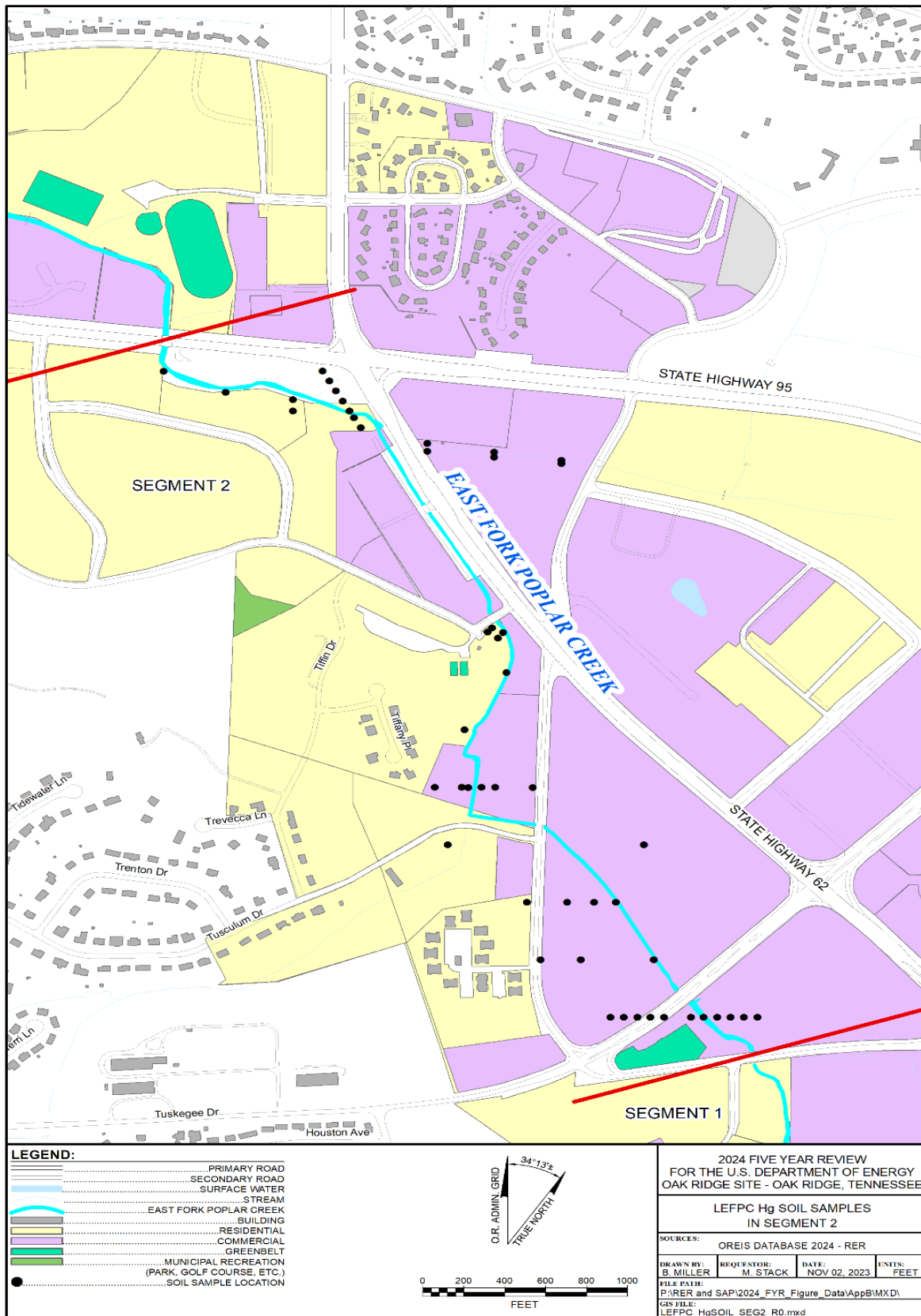
Table B.1.3. Input parameters for consumption of a limited number of vegetable types

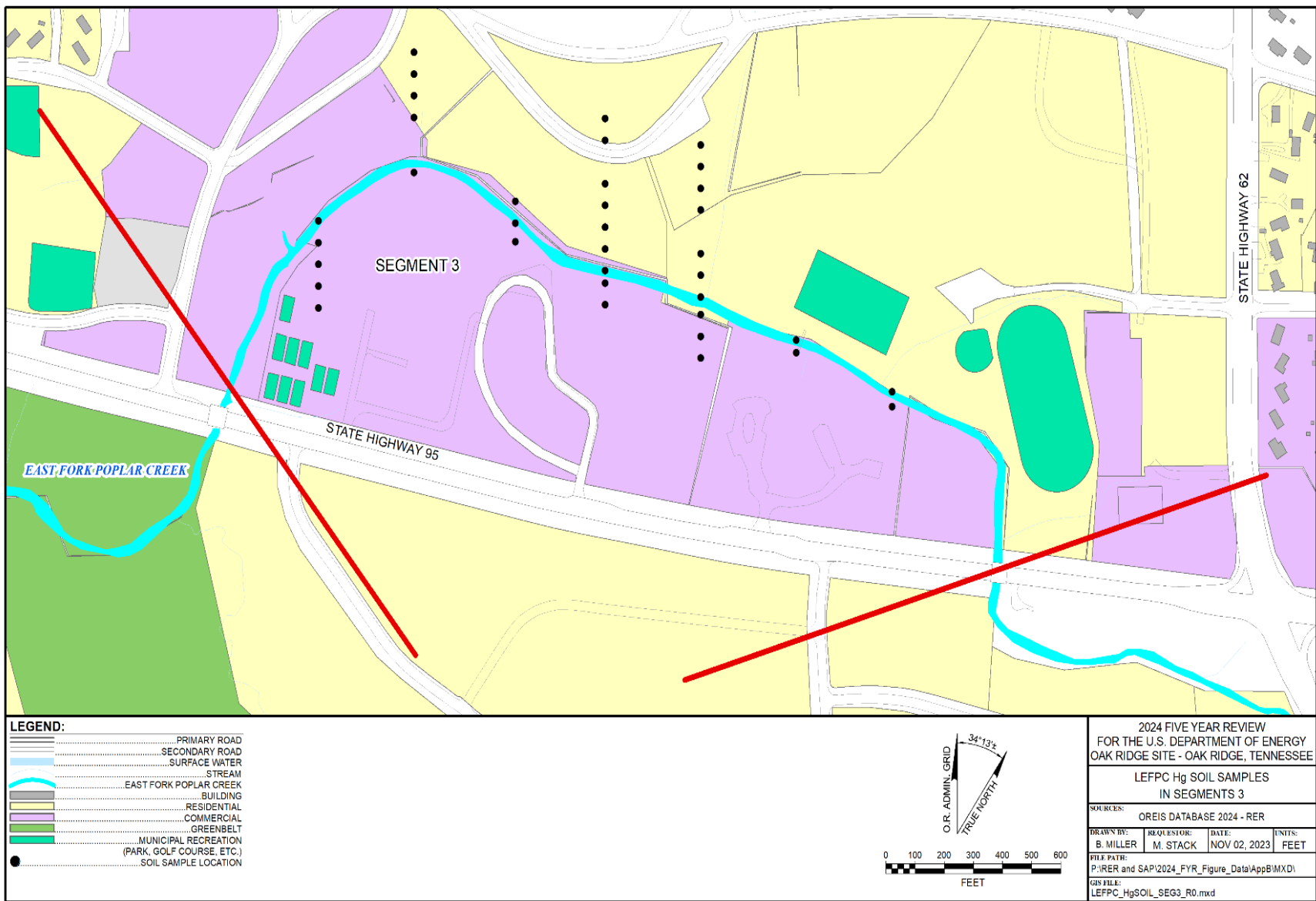
Variable	Value	Average (g)	Average (mg)
IRCR _{far-a} (carrot ingestion rate - farmer adult) g/day	24.4		
IRCU _{far-a} (cucumber ingestion rate - farmer adult) g/day	54.9		
IROK _{far-a} (okra ingestion rate - farmer adult) g/day	30.4		
IRSN _{far-a} (snap bean ingestion rate - farmer adult) g/day	54.5		
IRTO _{far-a} (tomato ingestion rate - farmer adult) g/day	94	51.64	51640
IRCR _{far-c} (carrot ingestion rate - farmer child) g/day	13.1		
IRCU _{far-c} (cucumber ingestion rate - farmer child) g/day	16.3		
IROK _{far-c} (okra ingestion rate - farmer child) g/day	9.4		
IRSN _{far-c} (snap bean ingestion rate - farmer child) g/day	28.7		
IRTO _{far-c} (tomato ingestion rate - farmer child) g/day	42.2	21.94	21940
MLF _{carrot} (carrot mass loading factor) unitless	0.000097		
MLF _{cucumber} (cucumber mass loading factor) unitless	0.00004		
MLF _{okra} (okra mass loading factor) unitless	0.00008		
MLF _{snap bean} (snap bean mass loading factor) unitless	0.005		
MLF _{tomato} (tomato mass loading factor) unitless	0.00177	0.0013974	

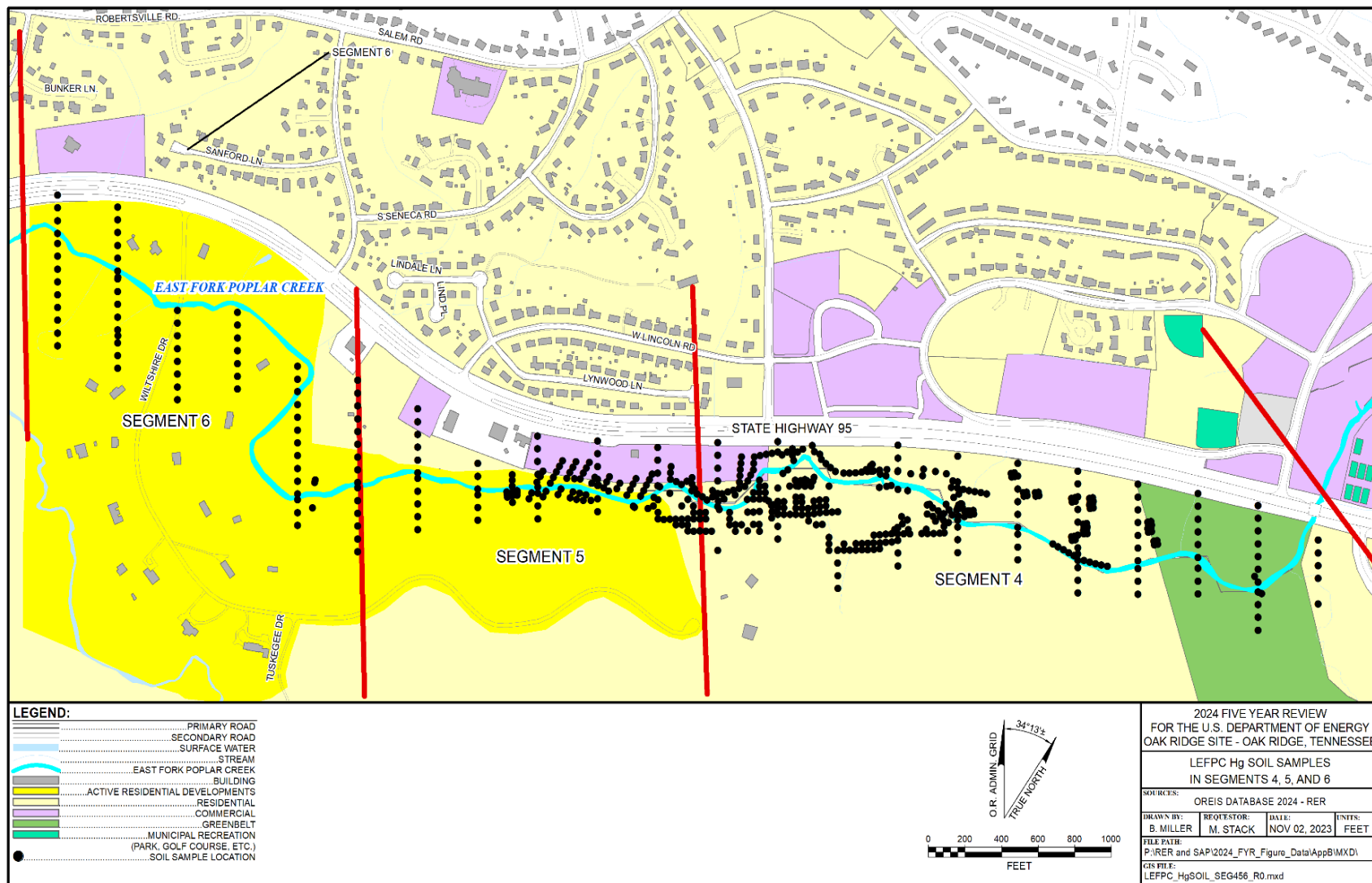
Attachment B.1.1.
Lower East Fork Poplar Creek Floodplain Segment Maps

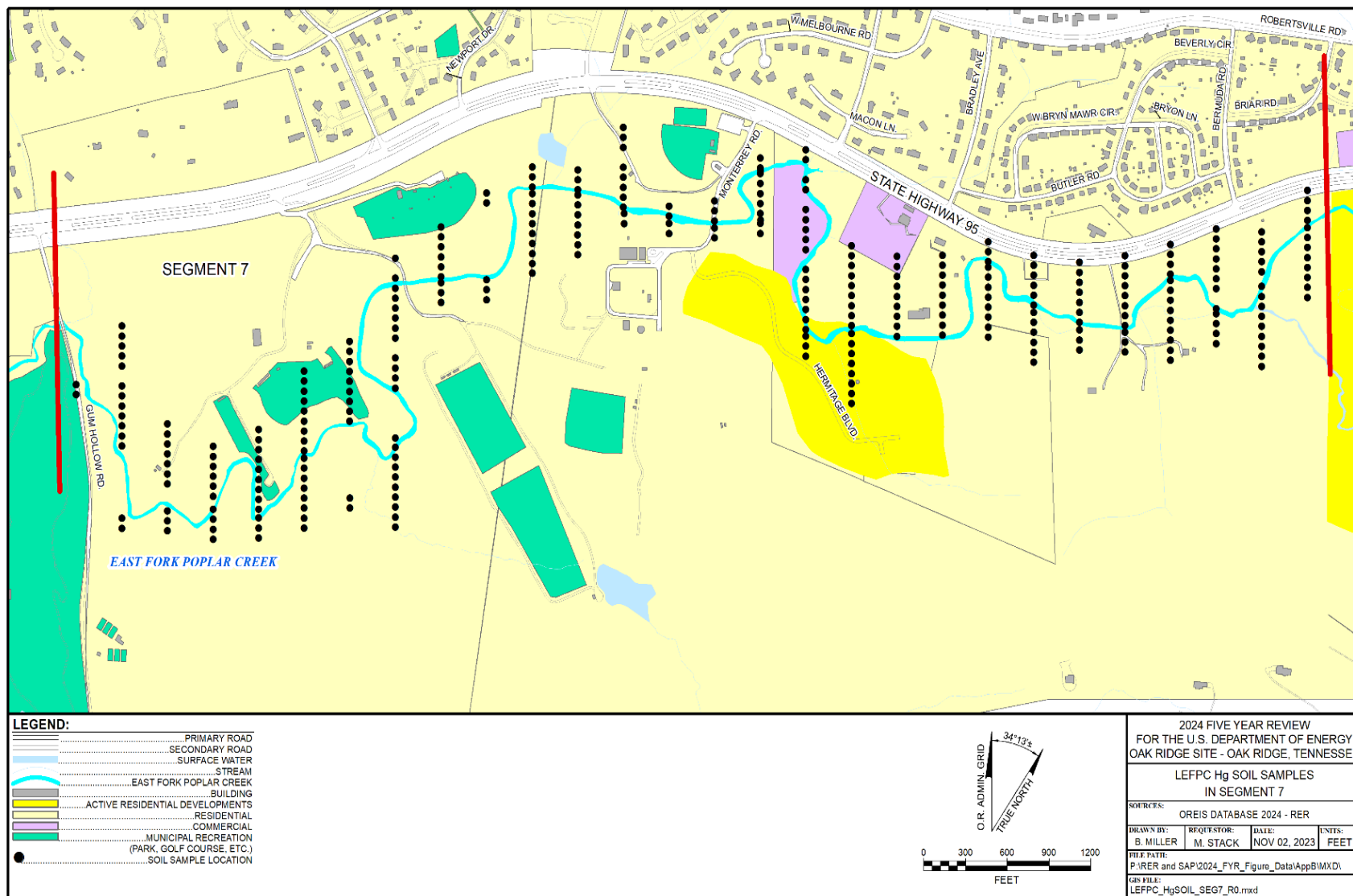
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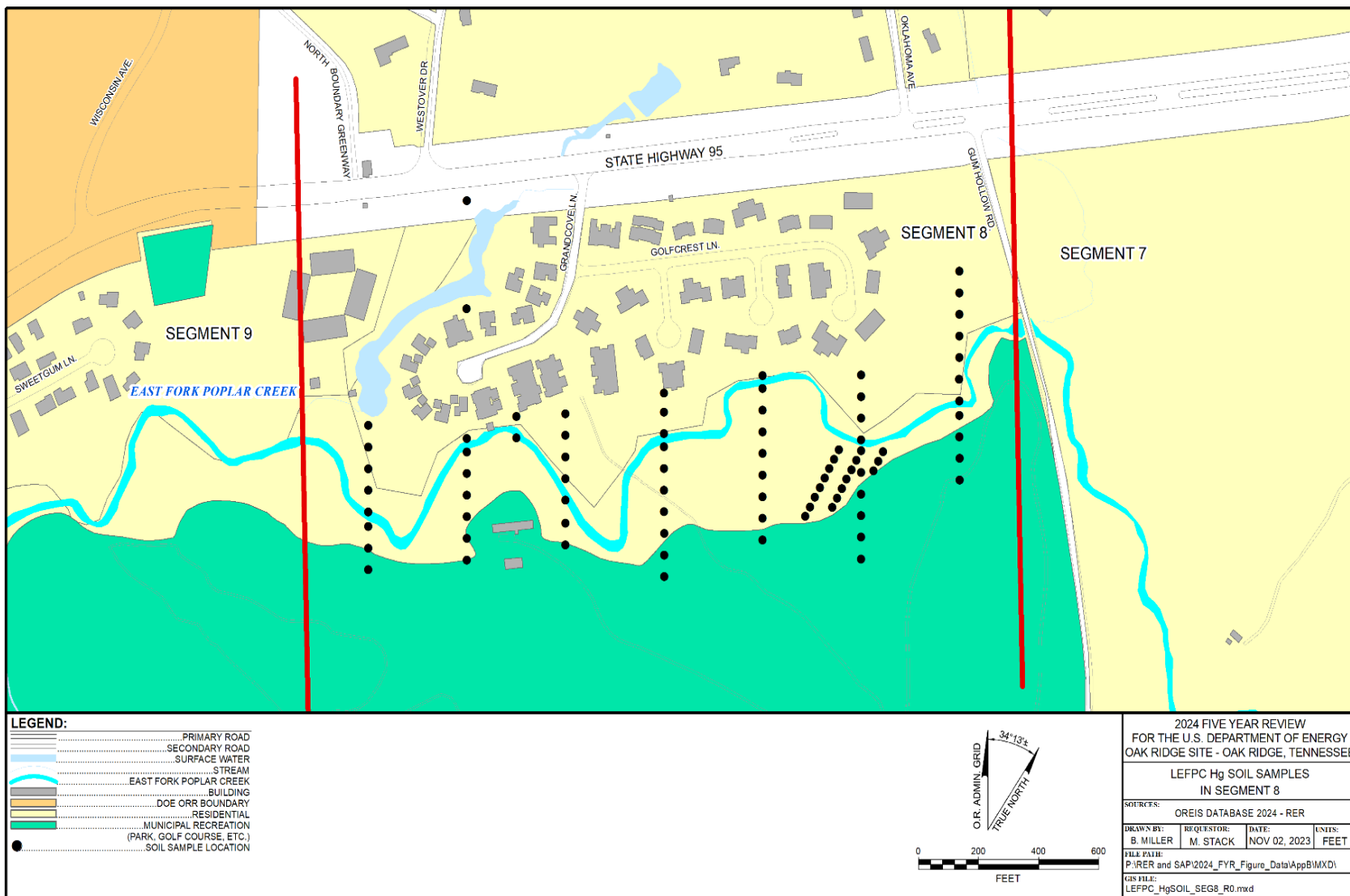


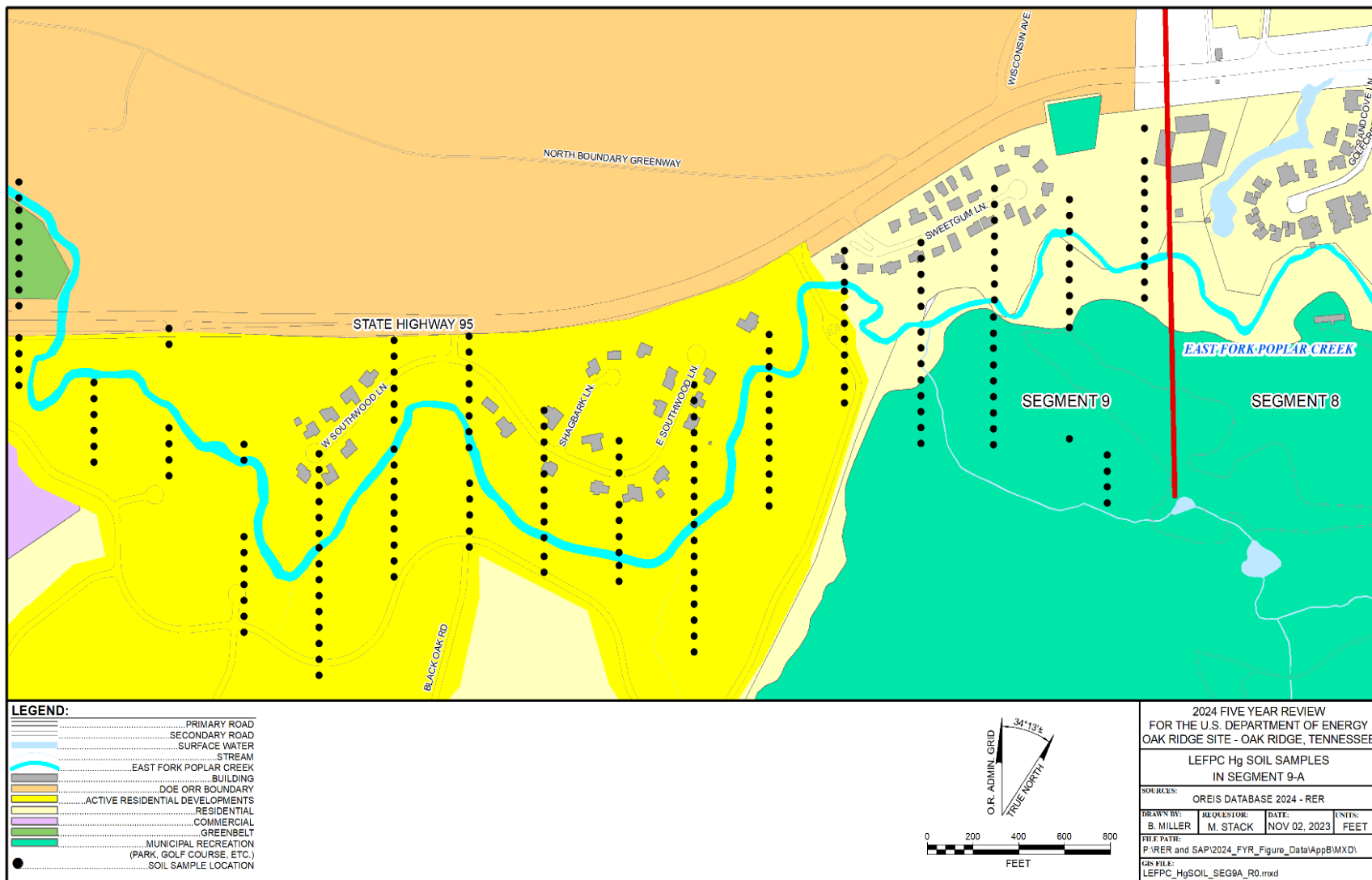


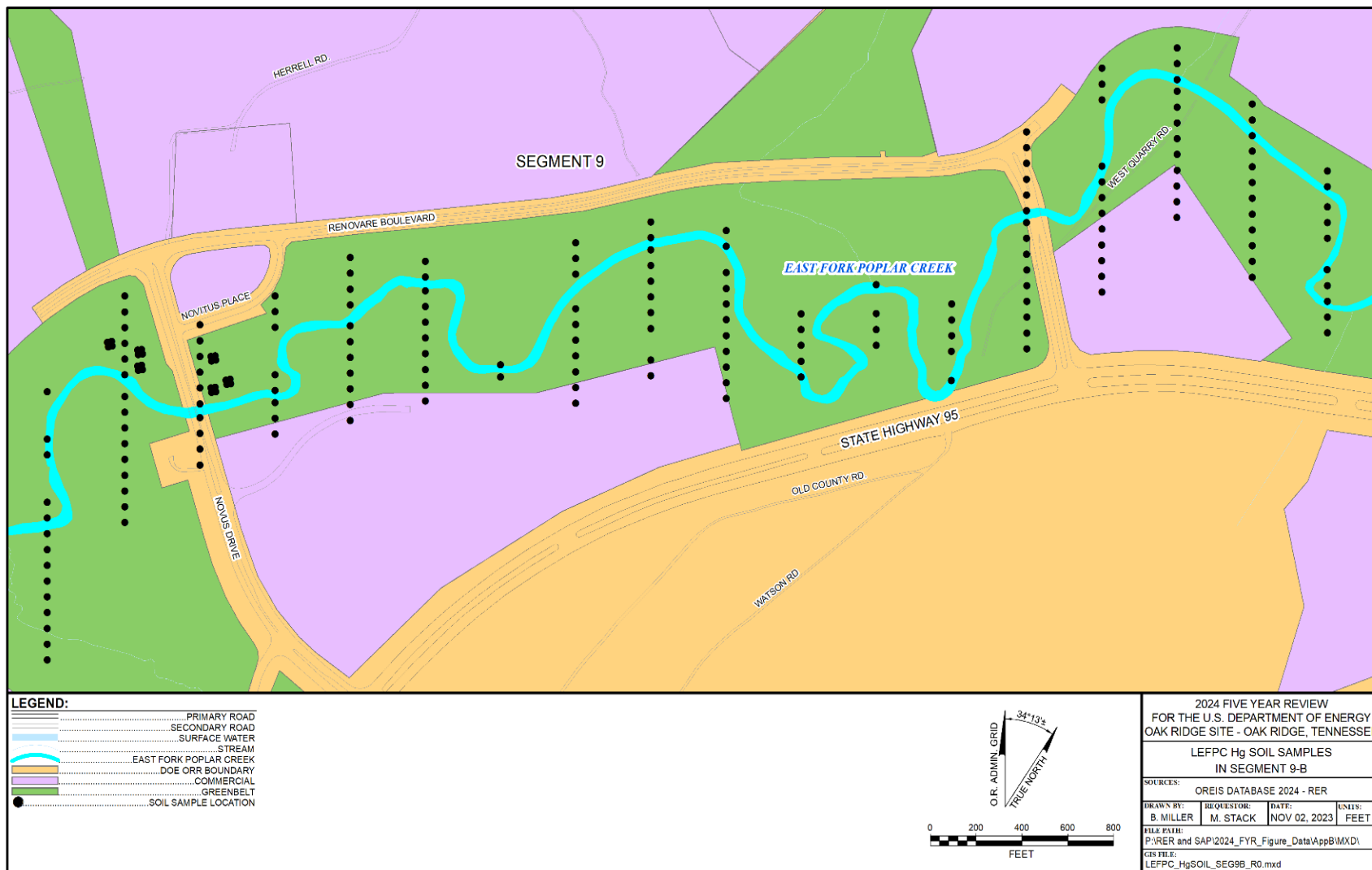












Attachment B.1.2.
ProUCL Output

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UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation	ProUCL 5.2 11/28/2023 11:10:18 AM
From File	ProUCL Input Expanded Data Set less likely excavated samples in NOAA and Bruner.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Seg 1 Hg

General Statistics

Total Number of Observations	522	Number of Distinct Observations	465
Number of Detects	464	Number of Non-Detects	58
Number of Distinct Detects	443	Number of Distinct Non-Detects	35
Minimum Detect	0.03	Minimum Non-Detect	0.48
Maximum Detect	1300	Maximum Non-Detect	7.6
Variance Detects	11462	Percent Non-Detects	11.11%
Mean Detects	85.14	SD Detects	107.1
Median Detects	50.5	CV Detects	1.257
Skewness Detects	4.063	Kurtosis Detects	35.95
Mean of Logged Detects	3.576	SD of Logged Detects	1.618

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.727
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.213
1% Lilliefors Critical Value	0.048

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	75.83	KM Standard Error of Mean	4.566
90KM SD	104.2	95% KM (BCA) UCL	83.15
95% KM (t) UCL	83.35	95% KM (Percentile Bootstrap) UCL	83.37
95% KM (z) UCL	83.34	95% KM Bootstrap t UCL	84.36
90% KM Chebyshev UCL	89.53	95% KM Chebyshev UCL	95.73
97.5% KM Chebyshev UCL	104.3	99% KM Chebyshev UCL	121.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.998
5% A-D Critical Value	0.803
K-S Test Statistic	0.0401
5% K-S Critical Value	0.044

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.696	k star (bias corrected MLE)	0.693
Theta hat (MLE)	122.3	Theta star (bias corrected MLE)	122.8
nu hat (MLE)	646.3	nu star (bias corrected)	643.4
Mean (detects)	85.14		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	75.68
Maximum	1300	Median	40.74
SD	104.4	CV	1.38
k hat (MLE)	0.397	k star (bias corrected MLE)	0.396
Theta hat (MLE)	190.6	Theta star (bias corrected MLE)	191.1
nu hat (MLE)	414.4	nu star (bias corrected)	413.4
Adjusted Level of Significance (β)	0.0495		
Approximate Chi Square Value (413.40, α)	367.3	Adjusted Chi Square Value (413.40, β)	367.1
95% Gamma Approximate UCL	85.19	95% Gamma Adjusted UCL	85.21

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	75.83	SD (KM)	104.2
Variance (KM)	10860	SE of Mean (KM)	4.566
k hat (KM)	0.529	k star (KM)	0.528
nu hat (KM)	552.8	nu star (KM)	550.9
theta hat (KM)	143.2	theta star (KM)	143.7
80% gamma percentile (KM)	124.8	90% gamma percentile (KM)	202.8
95% gamma percentile (KM)	285.7	99% gamma percentile (KM)	488.6

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (550.93, α)	497.5	Adjusted Chi Square Value (550.93, β)	497.4
95% KM Approximate Gamma UCL	83.98	95% KM Adjusted Gamma UCL	84

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.939
10% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.0964
10% Lilliefors Critical Value	0.038

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	75.93	Mean in Log Scale	3.261
SD in Original Scale	104.2	SD in Log Scale	1.772
95% t UCL (assumes normality of ROS data)	83.45	95% Percentile Bootstrap UCL	83.55
95% BCA Bootstrap UCL	83.9	95% Bootstrap t UCL	84.25
95% H-UCL (Log ROS)	156.3		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.146	KM Geo Mean	23.25
KM SD (logged)	1.994	95% Critical H Value (KM-Log)	3.071
KM Standard Error of Mean (logged)	0.0914	95% H-UCL (KM -Log)	221.9
KM SD (logged)	1.994	95% Critical H Value (KM-Log)	3.071
KM Standard Error of Mean (logged)	0.0914		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	75.87
SD in Original Scale	104.3
95% t UCL (Assumes normality)	83.39

DL/2 Log-Transformed

Mean in Log Scale	3.229
SD in Log Scale	1.82
95% H-Stat UCL	166.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 83.98

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

**When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 2 Hg

General Statistics

Total Number of Observations	93	Number of Distinct Observations	64
Number of Detects	32	Number of Non-Detects	61
Number of Distinct Detects	31	Number of Distinct Non-Detects	34
Minimum Detect	3.6	Minimum Non-Detect	1.1
Maximum Detect	443	Maximum Non-Detect	6.2
Variance Detects	7929	Percent Non-Detects	65.59%
Mean Detects	60.44	SD Detects	89.05
Median Detects	32.5	CV Detects	1.473
Skewness Detects	3.014	Kurtosis Detects	10.78
Mean of Logged Detects	3.373	SD of Logged Detects	1.205

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.632	Shapiro Wilk GOF Test
1% Shapiro Wilk Critical Value	0.904	Detected Data Not Normal at 1% Significance Level
Lilliefors Test Statistic	0.262	Lilliefors GOF Test
1% Lilliefors Critical Value	0.18	Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	21.53	KM Standard Error of Mean	6.177
90KM SD	58.63	95% KM (BCA) UCL	33.05
95% KM (t) UCL	31.8	95% KM (Percentile Bootstrap) UCL	33.05
95% KM (z) UCL	31.69	95% KM Bootstrap t UCL	40.38
90% KM Chebyshev UCL	40.06	95% KM Chebyshev UCL	48.46
97.5% KM Chebyshev UCL	60.11	99% KM Chebyshev UCL	82.99

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.077	Anderson-Darling GOF Test
5% A-D Critical Value	0.785	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.161	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.813	k star (bias corrected MLE)	0.758
Theta hat (MLE)	74.35	Theta star (bias corrected MLE)	79.78
nu hat (MLE)	52.03	nu star (bias corrected)	48.48
Mean (detects)	60.44		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	20.8
Maximum	443	Median	0.01
SD	59.2	CV	2.846
k hat (MLE)	0.156	k star (bias corrected MLE)	0.158
Theta hat (MLE)	133.3	Theta star (bias corrected MLE)	131.5
nu hat (MLE)	29.03	nu star (bias corrected)	29.43
Adjusted Level of Significance (β)	0.0474		
Approximate Chi Square Value (29.43, α)	18.05	Adjusted Chi Square Value (29.43, β)	17.91
95% Gamma Approximate UCL	33.93	95% Gamma Adjusted UCL	34.19

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	21.53	SD (KM)	58.63
Variance (KM)	3437	SE of Mean (KM)	6.177
k hat (KM)	0.135	k star (KM)	0.138
nu hat (KM)	25.1	nu star (KM)	25.62
theta hat (KM)	159.6	theta star (KM)	156.3
80% gamma percentile (KM)	21.76	90% gamma percentile (KM)	62.98
95% gamma percentile (KM)	120.4	99% gamma percentile (KM)	290

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (25.62, α)	15.09	Adjusted Chi Square Value (25.62, β)	14.96
95% KM Approximate Gamma UCL	36.57	95% KM Adjusted Gamma UCL	36.88

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.958	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.941	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.135	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.142	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	21.43	Mean in Log Scale	0.959
SD in Original Scale	58.98	SD in Log Scale	1.997
95% t UCL (assumes normality of ROS data)	31.59	95% Percentile Bootstrap UCL	32.01
95% BCA Bootstrap UCL	34.85	95% Bootstrap t UCL	36.93
95% H-UCL (Log ROS)	38.82		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.231	KM Geo Mean	3.425
KM SD (logged)	1.703	95% Critical H Value (KM-Log)	3.027
KM Standard Error of Mean (logged)	0.18	95% H-UCL (KM -Log)	25

KM SD (logged)	1.703	95% Critical H Value (KM-Log)	3.027
KM Standard Error of Mean (logged)	0.18		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	21.91	Mean in Log Scale	1.463
SD in Original Scale	58.81	SD in Log Scale	1.59
95% t UCL (Assumes normality)	32.04	95% H-Stat UCL	24.67

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 36.57

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

**When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 3 Hg

General Statistics

Total Number of Observations	37	Number of Distinct Observations	28
Number of Detects	13	Number of Non-Detects	24
Number of Distinct Detects	13	Number of Distinct Non-Detects	15
Minimum Detect	4.5	Minimum Non-Detect	2.5
Maximum Detect	150	Maximum Non-Detect	5.4
Variance Detects	2256	Percent Non-Detects	64.86%
Mean Detects	63.45	SD Detects	47.5
Median Detects	55	CV Detects	0.749
Skewness Detects	0.721	Kurtosis Detects	-0.71
Mean of Logged Detects	3.808	SD of Logged Detects	0.976

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.907
1% Shapiro Wilk Critical Value	0.814
Lilliefors Test Statistic	0.178
1% Lilliefors Critical Value	0.271

Shapiro Wilk GOF Test

Detected Data appear Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data appear Normal at 1% Significance Level

Detected Data appear Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	23.92	KM Standard Error of Mean	6.798
90KM SD	39.73	95% KM (BCA) UCL	34.26
95% KM (t) UCL	35.4	95% KM (Percentile Bootstrap) UCL	35.13
95% KM (z) UCL	35.1	95% KM Bootstrap t UCL	38.38
90% KM Chebyshev UCL	44.31	95% KM Chebyshev UCL	53.55
97.5% KM Chebyshev UCL	66.37	99% KM Chebyshev UCL	91.56

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.218
5% A-D Critical Value	0.749
K-S Test Statistic	0.109
5% K-S Critical Value	0.241

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.607	k star (bias corrected MLE)	1.288
Theta hat (MLE)	39.48	Theta star (bias corrected MLE)	49.27
nu hat (MLE)	41.79	nu star (bias corrected)	33.48
Mean (detects)	63.45		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	22.3
Maximum	150	Median	0.01
SD	41.17	CV	1.846
k hat (MLE)	0.16	k star (bias corrected MLE)	0.165
Theta hat (MLE)	139.3	Theta star (bias corrected MLE)	135
nu hat (MLE)	11.85	nu star (bias corrected)	12.22
Adjusted Level of Significance (β)	0.0431		
Approximate Chi Square Value (12.22, α)	5.374	Adjusted Chi Square Value (12.22, β)	5.177
95% Gamma Approximate UCL	50.72	95% Gamma Adjusted UCL	52.65

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	23.92	SD (KM)	39.73
Variance (KM)	1578	SE of Mean (KM)	6.798
k hat (KM)	0.363	k star (KM)	0.351
nu hat (KM)	26.83	nu star (KM)	25.99
theta hat (KM)	65.98	theta star (KM)	68.12
80% gamma percentile (KM)	37.9	90% gamma percentile (KM)	69.04
95% gamma percentile (KM)	103.9	99% gamma percentile (KM)	192.8

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (25.99, α)	15.37	Adjusted Chi Square Value (25.99, β)	15.01
95% KM Approximate Gamma UCL	40.45	95% KM Adjusted Gamma UCL	41.4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.927	Shapiro Wilk GOF Test
10% Shapiro Wilk Critical Value	0.889	Detected Data appear Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.133	Lilliefors GOF Test
10% Lilliefors Critical Value	0.215	Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	24.22	Mean in Log Scale	1.952
SD in Original Scale	40.13	SD in Log Scale	1.562
95% t UCL (assumes normality of ROS data)	35.36	95% Percentile Bootstrap UCL	35.19
95% BCA Bootstrap UCL	36.73	95% Bootstrap t UCL	39.33
95% H-UCL (Log ROS)	53.49		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.934	KM Geo Mean	6.915
KM SD (logged)	1.488	95% Critical H Value (KM-Log)	3.001
KM Standard Error of Mean (logged)	0.255	95% H-UCL (KM -Log)	44.01
KM SD (logged)	1.488	95% Critical H Value (KM-Log)	3.001
KM Standard Error of Mean (logged)	0.255		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	23.46	Mean in Log Scale	1.703
SD in Original Scale	40.53	SD in Log Scale	1.676
95% t UCL (Assumes normality)	34.71	95% H-Stat UCL	55.69

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL 35.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 4 Hg

General Statistics

Total Number of Observations	383	Number of Distinct Observations	349
Number of Detects	342	Number of Non-Detects	41
Number of Distinct Detects	324	Number of Distinct Non-Detects	26
Minimum Detect	0.6	Minimum Non-Detect	0.17
Maximum Detect	777.6	Maximum Non-Detect	7
Variance Detects	11113	Percent Non-Detects	10.70%
Mean Detects	115.4	SD Detects	105.4
Median Detects	83.47	CV Detects	0.913
Skewness Detects	1.839	Kurtosis Detects	5.344
Mean of Logged Detects	4.253	SD of Logged Detects	1.183

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.843
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.144
1% Lilliefors Critical Value	0.0559

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	103.2	KM Standard Error of Mean	5.399
90KM SD	105.5	95% KM (BCA) UCL	112.5
95% KM (t) UCL	112.1	95% KM (Percentile Bootstrap) UCL	112.6
95% KM (z) UCL	112.1	95% KM Bootstrap t UCL	112.7
90% KM Chebyshev UCL	119.4	95% KM Chebyshev UCL	126.8
97.5% KM Chebyshev UCL	136.9	99% KM Chebyshev UCL	156.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.125
5% A-D Critical Value	0.781
K-S Test Statistic	0.0629
5% K-S Critical Value	0.0505

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.147	k star (bias corrected MLE)	1.139
Theta hat (MLE)	100.6	Theta star (bias corrected MLE)	101.3
nu hat (MLE)	784.6	nu star (bias corrected)	779.1
Mean (detects)	115.4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	103.1
Maximum	777.6	Median	71.88
SD	105.8	CV	1.026
k hat (MLE)	0.517	k star (bias corrected MLE)	0.514
Theta hat (MLE)	199.6	Theta star (bias corrected MLE)	200.4
nu hat (MLE)	395.7	nu star (bias corrected)	393.9
Adjusted Level of Significance (β)	0.0494		
Approximate Chi Square Value (393.92, α)	348.9	Adjusted Chi Square Value (393.92, β)	348.8
95% Gamma Approximate UCL	116.4	95% Gamma Adjusted UCL	116.4

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	103.2	SD (KM)	105.5
Variance (KM)	11131	SE of Mean (KM)	5.399
k hat (KM)	0.957	k star (KM)	0.952
nu hat (KM)	733.3	nu star (KM)	728.9
theta hat (KM)	107.8	theta star (KM)	108.5
80% gamma percentile (KM)	166.8	90% gamma percentile (KM)	240.6
95% gamma percentile (KM)	314.7	99% gamma percentile (KM)	487.5

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (728.86, α)	667.2	Adjusted Chi Square Value (728.86, β)	667
95% KM Approximate Gamma UCL	112.8	95% KM Adjusted Gamma UCL	112.8

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.921
10% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.12
10% Lilliefors Critical Value	0.0442

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	103.8	Mean in Log Scale	4.004
SD in Original Scale	105.1	SD in Log Scale	1.332
95% t UCL (assumes normality of ROS data)	112.7	95% Percentile Bootstrap UCL	112.9
95% BCA Bootstrap UCL	113.1	95% Bootstrap t UCL	113.2
95% H-UCL (Log ROS)	157		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	3.816	KM Geo Mean	45.43
KM SD (logged)	1.714	95% Critical H Value (KM-Log)	2.806
KM Standard Error of Mean (logged)	0.0948	95% H-UCL (KM -Log)	252.4
KM SD (logged)	1.714	95% Critical H Value (KM-Log)	2.806
KM Standard Error of Mean (logged)	0.0948		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	103.3	Mean in Log Scale	3.855
SD in Original Scale	105.6	SD in Log Scale	1.615
95% t UCL (Assumes normality)	112.1	95% H-Stat UCL	217.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution

Suggested UCL to Use

95% KM (t) UCL 112.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 5 Hg

General Statistics

Total Number of Observations	150	Number of Distinct Observations	140
Number of Detects	126	Number of Non-Detects	24
Number of Distinct Detects	124	Number of Distinct Non-Detects	16
Minimum Detect	0.5	Minimum Non-Detect	2.6
Maximum Detect	432	Maximum Non-Detect	6
Variance Detects	10391	Percent Non-Detects	16%
Mean Detects	116.2	SD Detects	101.9
Median Detects	88.5	CV Detects	0.877
Skewness Detects	1.181	Kurtosis Detects	0.695

Mean of Logged Detects 4.223

SD of Logged Detects 1.266

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.861

1% Shapiro Wilk P Value 0

Lilliefors Test Statistic 0.175

1% Lilliefors Critical Value 0.0917

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean 97.78

90KM SD 102.2

95% KM (t) UCL 111.6

95% KM (z) UCL 111.6

90% KM Chebyshev UCL 122.9

97.5% KM Chebyshev UCL 150.1

KM Standard Error of Mean 8.374

95% KM (BCA) UCL 113.3

95% KM (Percentile Bootstrap) UCL 113.1

95% KM Bootstrap t UCL 113.2

95% KM Chebyshev UCL 134.3

99% KM Chebyshev UCL 181.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 0.749

5% A-D Critical Value 0.781

K-S Test Statistic 0.0988

5% K-S Critical Value 0.0851

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE) 1.076

Theta hat (MLE) 108

nu hat (MLE) 271.2

Mean (detects) 116.2

k star (bias corrected MLE) 1.056

Theta star (bias corrected MLE) 110

nu star (bias corrected) 266.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum 0.01

Maximum 432

SD 102.5

k hat (MLE) 0.466

Theta hat (MLE) 210

nu hat (MLE) 139.7

Adjusted Level of Significance (β) 0.0484

Mean 97.78

Median 73.22

CV 1.048

k star (bias corrected MLE) 0.461

Theta star (bias corrected MLE) 212.2

nu star (bias corrected) 138.2

Approximate Chi Square Value (138.25, α) 112.1
 95% Gamma Approximate UCL 120.6

Adjusted Chi Square Value (138.25, β) 111.9
 95% Gamma Adjusted UCL 120.9

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	97.78	SD (KM)	102.2
Variance (KM)	10435	SE of Mean (KM)	8.374
k hat (KM)	0.916	k star (KM)	0.902
nu hat (KM)	274.9	nu star (KM)	270.7
theta hat (KM)	106.7	theta star (KM)	108.4
80% gamma percentile (KM)	158.6	90% gamma percentile (KM)	230.9
95% gamma percentile (KM)	303.8	99% gamma percentile (KM)	474.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (270.72, α) 233.6
 95% KM Approximate Gamma UCL 113.3

Adjusted Chi Square Value (270.72, β) 233.3
 95% KM Adjusted Gamma UCL 113.5

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic 0.908
 10% Shapiro Wilk P Value 1.57E-10
 Lilliefors Test Statistic 0.165
 10% Lilliefors Critical Value 0.0725

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale 98.59
 SD in Original Scale 101.7
 95% t UCL (assumes normality of ROS data) 112.3
 95% BCA Bootstrap UCL 113.8
 95% H-UCL (Log ROS) 187.1

Mean in Log Scale 3.836
 SD in Log Scale 1.466
 95% Percentile Bootstrap UCL 113
 95% Bootstrap t UCL 113.9

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged) 3.541
 KM SD (logged) 1.961
 KM Standard Error of Mean (logged) 0.171
 KM SD (logged) 1.961
 KM Standard Error of Mean (logged) 0.171

KM Geo Mean 34.52
 95% Critical H Value (KM-Log) 3.247
 95% H-UCL (KM -Log) 397.8
 95% Critical H Value (KM-Log) 3.247

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 97.89
 SD in Original Scale 102.4
 95% t UCL (Assumes normality) 111.7

DL/2 Log-Transformed

Mean in Log Scale 3.645
 SD in Log Scale 1.768
 95% H-Stat UCL 282.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 113.3

95% GROS Approximate Gamma UCL 120.6

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 6 Hg

General Statistics

Total Number of Observations	75	Number of Distinct Observations	51
Number of Detects	29	Number of Non-Detects	46
Number of Distinct Detects	26	Number of Distinct Non-Detects	28
Minimum Detect	0.22	Minimum Non-Detect	0.81
Maximum Detect	117	Maximum Non-Detect	6.4
Variance Detects	1187	Percent Non-Detects	61.33%
Mean Detects	36.4	SD Detects	34.45
Median Detects	25	CV Detects	0.946
Skewness Detects	0.928	Kurtosis Detects	-0.264
Mean of Logged Detects	2.9	SD of Logged Detects	1.51

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.869
1% Shapiro Wilk Critical Value	0.898
Lilliefors Test Statistic	0.194
1% Lilliefors Critical Value	0.189

Shapiro Wilk GOF Test

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	14.31	KM Standard Error of Mean	3.221
90KM SD	27.4	95% KM (BCA) UCL	19.89
95% KM (t) UCL	19.68	95% KM (Percentile Bootstrap) UCL	19.71
95% KM (z) UCL	19.61	95% KM Bootstrap t UCL	21.31
90% KM Chebyshev UCL	23.97	95% KM Chebyshev UCL	28.35
97.5% KM Chebyshev UCL	34.43	99% KM Chebyshev UCL	46.36

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.261	Anderson-Darling GOF Test
5% A-D Critical Value	0.78	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0985	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.848	k star (bias corrected MLE)	0.783
Theta hat (MLE)	42.94	Theta star (bias corrected MLE)	46.49
nu hat (MLE)	49.17	nu star (bias corrected)	45.42
Mean (detects)	36.4		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	14.08
Maximum	117	Median	0.01
SD	27.7	CV	1.967
k hat (MLE)	0.173	k star (bias corrected MLE)	0.175
Theta hat (MLE)	81.38	Theta star (bias corrected MLE)	80.46
nu hat (MLE)	25.96	nu star (bias corrected)	26.25
Adjusted Level of Significance (β)	0.0468		
Approximate Chi Square Value (26.25, α)	15.57	Adjusted Chi Square Value (26.25, β)	15.41
95% Gamma Approximate UCL	23.74	95% Gamma Adjusted UCL	23.99

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	14.31	SD (KM)	27.4
Variance (KM)	750.9	SE of Mean (KM)	3.221
k hat (KM)	0.273	k star (KM)	0.271
nu hat (KM)	40.91	nu star (KM)	40.61
theta hat (KM)	52.47	theta star (KM)	52.86
80% gamma percentile (KM)	21.34	90% gamma percentile (KM)	42.68
95% gamma percentile (KM)	67.62	99% gamma percentile (KM)	133.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (40.61, α)	27.01	Adjusted Chi Square Value (40.61, β)	26.79
95% KM Approximate Gamma UCL	21.52	95% KM Adjusted Gamma UCL	21.69

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic 0.909
 10% Shapiro Wilk Critical Value 0.937
 Lilliefors Test Statistic 0.135
 10% Lilliefors Critical Value 0.148

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Approximate Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	14.51	Mean in Log Scale	0.754
SD in Original Scale	27.49	SD in Log Scale	2.035
95% t UCL (assumes normality of ROS data)	19.79	95% Percentile Bootstrap UCL	19.86
95% BCA Bootstrap UCL	20.74	95% Bootstrap t UCL	20.82
95% H-UCL (Log ROS)	38.26		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.315	KM Geo Mean	1.37
KM SD (logged)	2.303	95% Critical H Value (KM-Log)	3.816
KM Standard Error of Mean (logged)	0.283	95% H-UCL (KM -Log)	53.95
KM SD (logged)	2.303	95% Critical H Value (KM-Log)	3.816
KM Standard Error of Mean (logged)	0.283		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 14.94
 SD in Original Scale 27.27
 95% t UCL (Assumes normality) 20.18

DL/2 Log-Transformed

Mean in Log Scale 1.214
 SD in Log Scale 1.715
 95% H-Stat UCL 27

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL 21.52

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 7 Hg

General Statistics

Total Number of Observations	320	Number of Distinct Observations	109
Number of Detects	81	Number of Non-Detects	239
Number of Distinct Detects	62	Number of Distinct Non-Detects	51

Minimum Detect	1.5	Minimum Non-Detect	0.85
Maximum Detect	278	Maximum Non-Detect	6.3
Variance Detects	2737	Percent Non-Detects	74.69%
Mean Detects	44.44	SD Detects	52.32
Median Detects	23	CV Detects	1.177
Skewness Detects	2.48	Kurtosis Detects	6.96
Mean of Logged Detects	3.276	SD of Logged Detects	1.026

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.707
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.221
1% Lilliefors Critical Value	0.114

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	11.9	KM Standard Error of Mean	1.817
90KM SD	32.3	95% KM (BCA) UCL	15.08
95% KM (t) UCL	14.9	95% KM (Percentile Bootstrap) UCL	15.12
95% KM (z) UCL	14.89	95% KM Bootstrap t UCL	15.7
90% KM Chebyshev UCL	17.35	95% KM Chebyshev UCL	19.82
97.5% KM Chebyshev UCL	23.25	99% KM Chebyshev UCL	29.98

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.621
5% A-D Critical Value	0.78
K-S Test Statistic	0.142
5% K-S Critical Value	0.102

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.102	k star (bias corrected MLE)	1.069
Theta hat (MLE)	40.33	Theta star (bias corrected MLE)	41.56
nu hat (MLE)	178.5	nu star (bias corrected)	173.2
Mean (detects)	44.44		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	11.26
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Maximum	278	Median	0.01
SD	32.57	CV	2.893
k hat (MLE)	0.152	k star (bias corrected MLE)	0.153
Theta hat (MLE)	73.85	Theta star (bias corrected MLE)	73.54
nu hat (MLE)	97.54	nu star (bias corrected)	97.96
Adjusted Level of Significance (β)	0.0493		
Approximate Chi Square Value (97.96, α)	76.13	Adjusted Chi Square Value (97.96, β)	76.04
95% Gamma Approximate UCL	14.48	95% Gamma Adjusted UCL	14.5

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	11.9	SD (KM)	32.3
Variance (KM)	1043	SE of Mean (KM)	1.817
k hat (KM)	0.136	k star (KM)	0.137
nu hat (KM)	86.94	nu star (KM)	87.46
theta hat (KM)	87.62	theta star (KM)	87.11
80% gamma percentile (KM)	11.94	90% gamma percentile (KM)	34.76
95% gamma percentile (KM)	66.63	99% gamma percentile (KM)	161

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (87.46, α)	66.9	Adjusted Chi Square Value (87.46, β)	66.82
95% KM Approximate Gamma UCL	15.56	95% KM Adjusted Gamma UCL	15.58

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.984
10% Shapiro Wilk P Value	0.763
Lilliefors Test Statistic	0.0778
10% Lilliefors Critical Value	0.0902

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 10% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 10% Significance Level

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	12.33	Mean in Log Scale	0.718
SD in Original Scale	32.22	SD in Log Scale	1.852
95% t UCL (assumes normality of ROS data)	15.3	95% Percentile Bootstrap UCL	15.53
95% BCA Bootstrap UCL	15.78	95% Bootstrap t UCL	15.93
95% H-UCL (Log ROS)	15.45		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.724	KM Geo Mean	2.063
KM SD (logged)	1.575	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.09	95% H-UCL (KM -Log)	9.005
KM SD (logged)	1.575	95% Critical H Value (KM-Log)	2.645
KM Standard Error of Mean (logged)	0.09		

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.38	Mean in Log Scale	1.085
SD in Original Scale	32.19	SD in Log Scale	1.42
95% t UCL (Assumes normality)	15.35	95% H-Stat UCL	9.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 10% Significance Level

Suggested UCL to Use

KM H-UCL 9.005

The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.

**If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 8 Hg

General Statistics

Total Number of Observations	83	Number of Distinct Observations	63
Number of Detects	43	Number of Non-Detects	40
Number of Distinct Detects	41	Number of Distinct Non-Detects	22
Minimum Detect	7.35	Minimum Non-Detect	1.9
Maximum Detect	417	Maximum Non-Detect	5.7
Variance Detects	7011	Percent Non-Detects	48.19%
Mean Detects	69.47	SD Detects	83.73
Median Detects	41.59	CV Detects	1.205
Skewness Detects	2.716	Kurtosis Detects	8.448
Mean of Logged Detects	3.725	SD of Logged Detects	1.02

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.686
1% Shapiro Wilk Critical Value	0.923
Lilliefors Test Statistic	0.229
1% Lilliefors Critical Value	0.156

Shapiro Wilk GOF Test

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	36.91	KM Standard Error of Mean	7.604
90KM SD	68.47	95% KM (BCA) UCL	49.98
95% KM (t) UCL	49.56	95% KM (Percentile Bootstrap) UCL	49.97
95% KM (z) UCL	49.42	95% KM Bootstrap t UCL	56.43
90% KM Chebyshev UCL	59.72	95% KM Chebyshev UCL	70.05
97.5% KM Chebyshev UCL	84.39	99% KM Chebyshev UCL	112.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.778	Anderson-Darling GOF Test
5% A-D Critical Value	0.775	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.112	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.139	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.106	k star (bias corrected MLE)	1.044
Theta hat (MLE)	62.82	Theta star (bias corrected MLE)	66.53
nu hat (MLE)	95.1	nu star (bias corrected)	89.8
Mean (detects)	69.47		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	36
Maximum	417	Median	8.1
SD	69.36	CV	1.927
k hat (MLE)	0.191	k star (bias corrected MLE)	0.192
Theta hat (MLE)	188.1	Theta star (bias corrected MLE)	187.1
nu hat (MLE)	31.76	nu star (bias corrected)	31.95
Adjusted Level of Significance (β)	0.0471		
Approximate Chi Square Value (31.95, α)	20.03	Adjusted Chi Square Value (31.95, β)	19.86
95% Gamma Approximate UCL	57.41	95% Gamma Adjusted UCL	57.9

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	36.91	SD (KM)	68.47
Variance (KM)	4688	SE of Mean (KM)	7.604
k hat (KM)	0.291	k star (KM)	0.288
nu hat (KM)	48.24	nu star (KM)	47.83

theta hat (KM)	127	theta star (KM)	128.1
80% gamma percentile (KM)	56.02	90% gamma percentile (KM)	109.4
95% gamma percentile (KM)	171	99% gamma percentile (KM)	332.1

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (47.83, α)	32.96	Adjusted Chi Square Value (47.83, β)	32.74
95% KM Approximate Gamma UCL	53.56	95% KM Adjusted Gamma UCL	53.92

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.969	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.951	Detected Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.0903	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.123	Detected Data appear Lognormal at 10% Significance Level	

Detected Data appear Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	37.66	Mean in Log Scale	2.473
SD in Original Scale	68.51	SD in Log Scale	1.536
95% t UCL (assumes normality of ROS data)	50.17	95% Percentile Bootstrap UCL	50.22
95% BCA Bootstrap UCL	51.83	95% Bootstrap t UCL	55.25
95% H-UCL (Log ROS)	62.03		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.239	KM Geo Mean	9.385
KM SD (logged)	1.703	95% Critical H Value (KM-Log)	3.001
KM Standard Error of Mean (logged)	0.189	95% H-UCL (KM -Log)	70.35
KM SD (logged)	1.703	95% Critical H Value (KM-Log)	3.001
KM Standard Error of Mean (logged)	0.189		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	36.84	Mean in Log Scale	2.187
SD in Original Scale	68.92	SD in Log Scale	1.773
95% t UCL (Assumes normality)	49.43	95% H-Stat UCL	78.48

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	53.56	95% GROS Approximate Gamma UCL	57.41
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The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.

Please verify the data were collected from random locations.
If the data were collected using judgmental or other non-random methods,
then contact a statistician to correctly calculate UCLs.

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Seg 9 Hg

General Statistics

Total Number of Observations	768	Number of Distinct Observations	212
Number of Detects	212	Number of Non-Detects	556
Number of Distinct Detects	159	Number of Distinct Non-Detects	61
Minimum Detect	2.73	Minimum Non-Detect	0.8
Maximum Detect	216	Maximum Non-Detect	7.9
Variance Detects	1652	Percent Non-Detects	72.40%
Mean Detects	42.27	SD Detects	40.64
Median Detects	31.49	CV Detects	0.962
Skewness Detects	2.137	Kurtosis Detects	5.201
Mean of Logged Detects	3.341	SD of Logged Detects	0.936

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.769
1% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.165
1% Lilliefors Critical Value	0.0709

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 1% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 1% Significance Level

Detected Data Not Normal at 1% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	12.27	KM Standard Error of Mean	1.021
90KM SD	28.23	95% KM (BCA) UCL	14.08
95% KM (t) UCL	13.96	95% KM (Percentile Bootstrap) UCL	13.94
95% KM (z) UCL	13.95	95% KM Bootstrap t UCL	14.08
90% KM Chebyshev UCL	15.34	95% KM Chebyshev UCL	16.73
97.5% KM Chebyshev UCL	18.65	99% KM Chebyshev UCL	22.43

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.1
5% A-D Critical Value	0.774

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.0561	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.0636	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.384	k star (bias corrected MLE)	1.368
Theta hat (MLE)	30.53	Theta star (bias corrected MLE)	30.9
nu hat (MLE)	586.9	nu star (bias corrected)	580
Mean (detects)	42.27		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
 GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
 For such situations, GROS method may yield incorrect values of UCLs and BTVs
 This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	11.67
Maximum	216	Median	0.01
SD	28.49	CV	2.44
k hat (MLE)	0.157	k star (bias corrected MLE)	0.157
Theta hat (MLE)	74.44	Theta star (bias corrected MLE)	74.32
nu hat (MLE)	240.9	nu star (bias corrected)	241.3
Adjusted Level of Significance (β)	0.0497		
Approximate Chi Square Value (241.28, α)	206.3	Adjusted Chi Square Value (241.28, β)	206.3
95% Gamma Approximate UCL	13.65	95% Gamma Adjusted UCL	13.66

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	12.27	SD (KM)	28.23
Variance (KM)	796.9	SE of Mean (KM)	1.021
k hat (KM)	0.189	k star (KM)	0.189
nu hat (KM)	290.4	nu star (KM)	290.6
theta hat (KM)	64.92	theta star (KM)	64.88
80% gamma percentile (KM)	15.69	90% gamma percentile (KM)	37.09
95% gamma percentile (KM)	64.15	99% gamma percentile (KM)	139.3

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (290.59, α)	252.1	Adjusted Chi Square Value (290.59, β)	252
95% KM Approximate Gamma UCL	14.15	95% KM Adjusted Gamma UCL	14.15

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.97	Shapiro Wilk GOF Test
10% Shapiro Wilk P Value	0.0128	Detected Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.0627	Lilliefors GOF Test

10% Lilliefors Critical Value 0.0561

Detected Data Not Lognormal at 10% Significance Level

Detected Data Not Lognormal at 10% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	13.43	Mean in Log Scale	1.237
SD in Original Scale	27.84	SD in Log Scale	1.658
95% t UCL (assumes normality of ROS data)	15.09	95% Percentile Bootstrap UCL	15.15
95% BCA Bootstrap UCL	15.22	95% Bootstrap t UCL	15.21
95% H-UCL (Log ROS)	15.97		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.776	KM Geo Mean	2.174
KM SD (logged)	1.665	95% Critical H Value (KM-Log)	2.685
KM Standard Error of Mean (logged)	0.0609	95% H-UCL (KM -Log)	10.21
KM SD (logged)	1.665	95% Critical H Value (KM-Log)	2.685
KM Standard Error of Mean (logged)	0.0609		

Note: KM UCLs may be biased low with this dataset. Other substitution method recommended

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	12.98	Mean in Log Scale	1.312
SD in Original Scale	27.97	SD in Log Scale	1.379
95% t UCL (Assumes normality)	14.64	95% H-Stat UCL	10.83

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Approximate Gamma UCL	14.15	95% GROS Approximate Gamma UCL	13.65
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**When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL**

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Attachment B.1.3.
Preliminary Remediation Goal Input Parameters and Results

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PRG Input Parameters for Ingestion of a Fruits and Vegetables FI=25%	
Variable	Site-Specific Value
BW _{far-a} (body weight - adult) kg	80
BW _{far-c} (body weight - child) kg	15
CF _{far-produce} (contaminated intake fraction) unitless	0.25
ED _{far-a} (exposure duration - adult) yr	34
ED _{far-c} (exposure duration - child) yr	6
EF _{far-a} (exposure frequency - adult) day/yr	350
EF _{far-c} (exposure frequency - child) day/yr	350
THQ (target hazard quotient) unitless	1
IFF _{far-adj} (age-adjusted fruit intake rate) mg-year/kg-day	18365725
IFV _{far-adj} (age-adjusted vegetable intake rate) mg-year/kg-day	10223232.8
IRF _{far-a} (fruit intake rate - adult) mg/day	64700
IRF _{far-c} (fruit intake rate - child) mg/day	62440
IRV _{far-a} (vegetable intake rate - adult) mg/day	52613.33
IRV _{far-c} (vegetable intake rate - child) mg/day	17121.4286
LT (lifetime - resident) yr	70
MLF _{produce} (produce plant mass loading factor) unitless	0.00145385
TR (target cancer risk) unitless	0.000001

PRG Input Parameters for Ingestion of Vegetables Only FI=25%	
Variable	Site-Specific Value
BW _{far-a} (body weight - adult) kg	80
BW _{far-c} (body weight - child) kg	15
CF _{far-produce} (contaminated intake fraction) unitless	0.25
ED _{far-a} (exposure duration - adult) yr	34
ED _{far-c} (exposure duration - child) yr	6
EF _{far-a} (exposure frequency - adult) day/yr	350
EF _{far-c} (exposure frequency - child) day/yr	350
THQ (target hazard quotient) unitless	1
IFF _{far-adj} (age-adjusted fruit intake rate) mg-year/kg-day	0
IFV _{far-adj} (age-adjusted vegetable intake rate) mg-year/kg-day	10753050
IRF _{far-a} (fruit intake rate - adult) mg/day	0
IRF _{far-c} (fruit intake rate - child) mg/day	0
IRV _{far-a} (vegetable intake rate - adult) mg/day	51640
IRV _{far-c} (vegetable intake rate - child) mg/day	21940
LT (lifetime - resident) yr	70
MLF _{produce} (produce plant mass loading factor) unitless	0.0013974
TR (target cancer risk) unitless	0.000001

PRG Input Parameters for Ingestion of a Fruits and Vegetables FI=17%	
Variable	Site-Specific Value
BW _{far-a} (body weight - adult) kg	80
BW _{far-c} (body weight - child) kg	15
CF _{far-produce} (contaminated intake fraction) unitless	0.17
ED _{far-a} (exposure duration - adult) yr	34
ED _{far-c} (exposure duration - child) yr	6
EF _{far-a} (exposure frequency - adult) day/yr	350
EF _{far-c} (exposure frequency - child) day/yr	350
THQ (target hazard quotient) unitless	1
IFF _{far-adj} (age-adjusted fruit intake rate) mg-year/kg-day	35833000
IFV _{far-adj} (age-adjusted vegetable intake rate) mg-year/kg-day	24535875
IRF _{far-a} (fruit intake rate - adult) mg/day	53533.33
IRF _{far-c} (fruit intake rate - child) mg/day	44800
IRV _{far-a} (vegetable intake rate - adult) mg/day	43687.5
IRV _{far-c} (vegetable intake rate - child) mg/day	17062.5
LT (lifetime - resident) yr	70
MLF _{produce} (produce plant mass loading factor) unitless	0.00088991
TR (target cancer risk) unitless	0.000001

PRG Input Parameters for Ingestion of Vegetables Only FI=17%	
Variable	Site-Specific Value
BW _{far-a} (body weight - adult) kg	80
BW _{far-c} (body weight - child) kg	15
CF _{far-produce} (contaminated intake fraction) unitless	0.17
ED _{far-a} (exposure duration - adult) yr	34
ED _{far-c} (exposure duration - child) yr	6
EF _{far-a} (exposure frequency - adult) day/yr	350
EF _{far-c} (exposure frequency - child) day/yr	350
THQ (target hazard quotient) unitless	1
IFF _{far-adj} (age-adjusted fruit intake rate) mg-year/kg-day	35833000
IFV _{far-adj} (age-adjusted vegetable intake rate) mg-year/kg-day	24535875
IRF _{far-a} (fruit intake rate - adult) mg/day	0
IRF _{far-c} (fruit intake rate - child) mg/day	0
IRV _{far-a} (vegetable intake rate - adult) mg/day	51640
IRV _{far-c} (vegetable intake rate - child) mg/day	21940
LT (lifetime - resident) yr	70
MLF _{produce} (produce plant mass loading factor) unitless	0.0013974
TR (target cancer risk) unitless	0.000001

PRGs/RSLs for Ingestion of Fruits and Vegetables FI = 25%

Site-Specific

Farmer PRGs for Contaminated Soil

Chemical	CAS Number	Mutagen?	VOC?	RfD (mg/kg-day)	RfD Ref	Soil-to-Plant Transfer Factor (kg-dry soil per kg-fresh plant)	Soil-to-Plant Transfer Factor (kg-dry soil per kg-dry plant)	Produce Ingestion PRG HQ=1 (mg/kg)
Mercuric Chloride	7487-94-7	No	No	3.00E-04	IC	1.03E+01	5.16E+01	2.28E-02
Mercuric Sulfide	1344-48-5	No	No	3.00E-04	S	-	-	1.62E+02
Mercury (elemental)	7439-97-6	No	Yes	1.60E-04	C	2.25E-01	9.00E-01	5.56E-01
Mercury, Inorganic Salts	NA	No	No	3.00E-04	S	2.25E-01	9.00E-01	1.04E+00

PRGs/RSLs for Ingestion of Vegetables only FI = 25%

Site-Specific

Farmer PRGs for Contaminated Soil

Chemical	CAS Number	Mutagen?	VOC?	RfD (mg/kg-day)	RfD Ref	Soil-to-Plant Transfer Factor (kg-dry soil per kg-fresh plant)	Soil-to-Plant Transfer Factor (kg-dry soil per kg-dry plant)	Produce Ingestion PRG HQ=1 (mg/kg)
Mercuric Chloride	7487-94-7	No	No	3.00E-04	IC	1.03E+01	5.16E+01	8.28E-02
Mercuric Sulfide	1344-48-5	No	No	3.00E-04	S	-	-	6.12E+02
Mercury (elemental)	7439-97-6	No	Yes	1.60E-04	C	2.25E-01	9.00E-01	2.02E+00
Mercury, Inorganic Salts	NA	No	No	3.00E-04	S	2.25E-01	9.00E-01	3.78E+00

PRGs/RSLs for Ingestion of Fruits and Vegetables FI = 17%

Site-Specific

Farmer PRGs for Contaminated Soil

Chemical	CAS Number	Mutagen?	VOC?	RfD (mg/kg-day)	RfD Ref	Soil-to-Plant Transfer Factor (kg-dry soil per kg-fresh plant)	Soil-to-Plant Transfer Factor (kg-dry soil per kg-dry plant)	Produce Ingestion PRG HQ=1 (mg/kg)
Mercuric Chloride	7487-94-7	No	No	3.00E-04	IC	1.03E+01	5.16E+01	4.32E-02
Mercuric Sulfide	1344-48-5	No	No	3.00E-04	S	-	-	5.01E+02
Mercury (elemental)	7439-97-6	No	Yes	1.60E-04	C	2.25E-01	9.00E-01	1.05E+00
Mercury, Inorganic Salts	NA	No	No	3.00E-04	S	2.25E-01	9.00E-01	1.98E+00

PRGs/RSLs for Ingestion of Vegetables only FI = 17%

Site-Specific
Farmer PRGs for Contaminated Soil

Chemical	CAS Number	Mutagen?	VOC?	RfD (mg/kg-day)	RfD Ref	Soil-to-Plant Transfer Factor (kg-dry soil per kg-fresh plant)	Soil-to-Plant Transfer Factor (kg-dry soil per kg-dry plant)	Produce Ingestion PRG HQ=1 (mg/kg)
Mercuric Chloride	7487-94-7	No	No	3.00E-04	IC	1.03E+01	5.16E+01	4.32E-02
Mercuric Sulfide	1344-48-5	No	No	3.00E-04	S	-	-	5.01E+02
Mercury (elemental)	7439-97-6	No	Yes	1.60E-04	C	2.25E-01	9.00E-01	1.05E+00
Mercury, Inorganic Salts	NA	No	No	3.00E-04	S	2.25E-01	9.00E-01	1.98E+00

**APPENDIX C.
PROPERTY TRANSFERS FOR UPPER EAST FORK POPLAR CREEK
WATERSHED**

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FIGURE

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TABLE

Table C.1. Current transferred properties at Y-12 and their use	C-11
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ACRONYMS

bgs	below ground surface
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
LUC	land use control
ROD	Record of Decision
UEFPC	Upper East Fork Poplar Creek
Y-12	Y-12 National Security Complex

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Y-12 NATIONAL SECURITY COMPLEX

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LAND USE CONTROLS CAPTURED IN PROPERTY TRANSFER PROCESS AT THE Y-12 NATIONAL SECURITY COMPLEX

In accordance with the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3; Upper East Fork Poplar Creek [UEFPC] Phase I Interim Record of Decision [ROD]) and the *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014), title transfers will comply with the requirements of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 120(h). Because all title transfers at the Y-12 National Security Complex (Y-12) in the UEFPC characterization areas have taken place before cleanup has been completed, the titles were transferred under Section (h)(3)(c), Covenant Deferral, allowing for cleanup to be finished after the transfer. This type of transfer is documented in a Covenant Deferral Request (CDR). Y-12 CDRs to date are shown on Figure C.1.

Covenant deferrals under CERCLA Section 120(h) require the following provisions be included in the quitclaim deed:

- Provide any necessary restrictions on property use to ensure protection of human health and the environment.
- Provide that there will be restrictions on use necessary to ensure required remedial investigations, response actions, and oversight activities will not be disrupted.

Specifics on the provisions for use restrictions and continued maintenance of land use controls (LUCs) are included in the UEFPC Phase I Interim ROD. These are included as part of the CERCLA Section 120(h) covenant deferral details in the CDR documents and quitclaim deed for each transferred property. The restrictions specific to the transferred properties at Y-12 include:

- **Groundwater use restrictions:** Prohibit the transferee(s), and any successor grantee, from extracting and using groundwater without prior testing and regulatory approvals.
- **Land use restrictions:** (Note these include industrial use in the area of the transfers.) Prohibit use of the property for residential housing, elementary or secondary schools, a childcare facility or children's playground, recreational use, or any other activity inconsistent with industrial use.
- **Excavation/Penetration restrictions:** (Note the CDR approved a restriction of 22.5 ft below ground surface [bgs] within Site A and 18.5 ft bgs within Site B.) Prohibit any excavation, use, or disturbance of any portion of the property located more than 22.5 ft bgs within Site A or more than 18.5 ft bgs within Site B, without prior written approval from the Grantor, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation. The Grantee covenants and agrees any excavation on adjacent property is prohibited without prior written approval from the Grantor. The Grantee covenants and agrees any facilities constructed on the property will not have basements.

Plumes of volatile organic compound contamination have been found in groundwater underlying some portions of Y-12; therefore, the National Nuclear Security Administration also required footprint parcel transferee(s) to design and construct future buildings in accordance with relevant federal government guidance to minimize worker exposure to contaminant vapors.

The UEFPC Phase I Interim ROD LUC requirements were verified and are included in the CDRs and quitclaim deeds for all currently transferred property at Y-12. To date, there have been two parcel transfers at Y-12 that required a CDR with LUCs. These transferred properties at Y-12 and their use are shown in Table C.1.

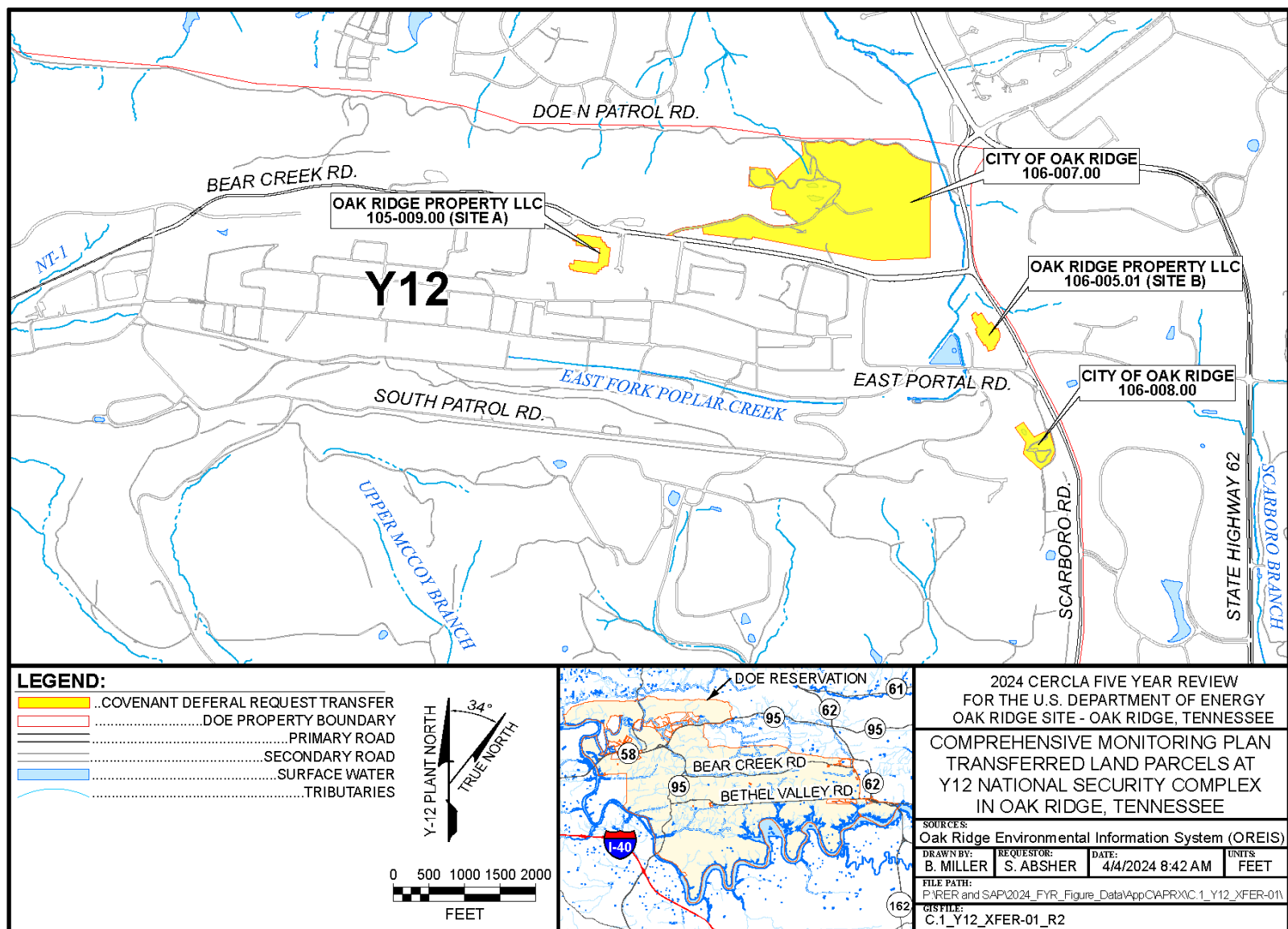


Figure C.1. Parcel transfers at Y-12.

Table C.1. Current transferred properties at Y-12 and their use

Transferred properties^a	Covenant Deferral Request reference	Quitclaim deed reference	2023 use
Site A (8.26 acres in the north-central part of Y-12); Oak Ridge Property LLC 105-009.00	<i>Covenant Deferral Request, Y-12 National Security Complex Sites A and B, Oak Ridge, Tennessee (Y/TS-1948); November 2004 (Tetra Tech 2004).</i>	Deed Book 1411, pages 1386–1401 (December 15, 2005)	Jack Case Center
Site B (8.91 acres in the eastern part of Y-12); Oak Ridge Property LLC 106-005.01	<i>Covenant Deferral Request, Y-12 National Security Complex Sites A and B, Oak Ridge, Tennessee (Y/TS-1948); November 2004 (Tetra Tech 2004).</i>	Deed Book 1411, pages 1386–1401 (December 15, 2005)	New Hope Center

^aCity of Oak Ridge parcels 106-008 and 106-007 are included on Figure C.1 to be all inclusive of transferred properties at Y-12; however, they are not within the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE/OR/01-1951&D3) boundary and are, therefore, not included in this table.

Y-12 = Y-12 National Security Complex

REFERENCES

DOE/OR-1014. *Federal Facility Agreement for the Oak Ridge Reservation*, 1992, U.S. Department of Energy, U.S. Environmental Protection Agency Region 4, and Tennessee Department of Environment and Conservation, Washington, D.C. URL: <https://ucor.com/regulatory-agreements-for-the-oak-ridge-reservation/>. Last accessed February 2024.

DOE/OR/01-1951&D3. *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, 2002, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

Tetra Tech 2004. *Covenant Deferral Request, Y-12 National Security Complex Sites A and B, Oak Ridge, Tennessee*, Y/TS-1948, Oak Ridge, TN. DOEIC Number: F.0608.090.0331. URL: <https://doeic.science.energy.gov/uploads/F.0608.090.0331.pdf>.

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APPENDIX D.
CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION FOR
FISCAL YEAR 2023

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CERTIFICATION OF LAND USE CONTROL IMPLEMENTATION FOR FISCAL YEAR 2023

This certification is provided for fiscal year 2023, comprising the period October 1, 2022, through September 30, 2023.

Monitoring and field inspections have been conducted during this period to determine whether the current land use controls (LUCs) implemented for Melton Valley (MV), Bethel Valley (BV), Bear Creek Valley (BCV), Upper East Fork Poplar Creek (UEFPC), the East Tennessee Technology Park (ETTP), and Chestnut Ridge (ChR), including the Oak Ridge Associated Universities (ORAU) South Campus Facility (SCF), remain protective and consistent with all remedial action objectives. I, therefore, certify, based on the provided information and belief formed after reasonable inquiry, that the approved, implemented LUCs for MV, BV, BCV, UEFPC, ETTP, and ChR single actions (including the ORAU SCF) remain in effect and are protective for the intended land use.

John A. Mullis II, Manager
Oak Ridge Office of Environmental Management

Date

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APPENDIX E.
FISCAL YEAR 2022 UNC ENGINEERING EVALUATION REPORT

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Engineering Document Cover Page

Project Title:	United Nuclear Corporation Landfill		
Area:	Y-12, Chestnut Ridge		
Discipline:	Civil	Document Number: RPC-9Y1200-H967	
Subject:	Engineering Inspection and Evaluation of United Nuclear Corporation (UNC) Landfill, Chestnut Ridge, Y-12 Plant.		
Purpose of Document:			
This report presents a record of the inspection of the UNC landfill and an engineering assessment of the facility that was constructed 30 years ago. The evaluation includes an assessment of landfill settlement based on site observations, review of the construction records including type of waste located within the facility, a review of the compacted clay cap and a literature review of the expected performance of the PVC membrane utilized in the facility cap.			

Revision Number	Page Numbers	Originator	Checker	Nuclear Safety Review ¹	Approver	Approval Date
0	17			NA		07-06-2022

¹ Nuclear Safety review required for only calculations as described in PROC-DE-0704 unless waived by Chief Engineer. N/A Nuclear Safety review for other Engineering Documents.

Summary of Revision	
Revision 0	Initial Issue
Revision 1	

Engineering Inspection and Evaluation of United Nuclear Corporation (UNC) Landfill, Chestnut Ridge, Y-12 Plant.

INTRODUCTION

Scope of Report

This report presents a record of the inspection of the UNC landfill and an engineering assessment of the facility that was constructed 1992 (30 years ago). This document is specifically in support of the 2024 Five Year Review (FYR). The report supports the answer to Five Year Review Question A (Ref. 13):

- *Is the remedy functioning as intended by decision documents?*
- *Are there problems with the remedy that could ultimately lead to remedy not being protective or suggest protectiveness is at risk?*
- *Do maintenance activities, as implemented, maintain the effectiveness of the response actions?*

Accordingly, this evaluation includes an assessment of landfill settlement based on site observations, review of the construction records including type of waste located within the facility, a review of the compacted clay cap and a literature review of the expected performance of the PVC membrane utilized in the facility cap. To date groundwater monitoring wells downgradient of the facility are not indicating any movement of chemicals of concern from the facility to the monitoring locations. The original design life of the facility was not found in the reviewed documents, but the post closure monitoring period was to be 30 years. The facility has now reached that limit and the path forward needs definition.

Background (from Ref 3)

The United Nuclear Corporation (UNC) Disposal Site consists of a 1.3-acre excavation cut into the crest of Chestnut Ridge, in the southern portion of the Oak Ridge Y-12 Plant, in Oak Ridge, Tennessee (Figure 1). The UNC excavation depth ranged from 25 to 30 ft on the northern side to less than 5 ft on the southern side. Between June 1982 and November 1984, the UNC Site received waste from the decommissioning of a UNC uranium recovery facility in Wood River Junction, Rhode Island. This waste included 11,000 55-gal drums of sludge fixed in cement, 18,000 drums of contaminated soil, and 288 wooden boxes of contaminated building and process demolition materials. The drums were generally stacked ten high, following the contour of the excavation and tapering to the limits of the excavation. The wooden boxes were placed near the southern perimeter of the pit.

During 1985, extraction procedure toxicity testing on the drummed sludges and soils indicated the waste to be nonhazardous as defined by the Resource Conservation and Recovery Act (RCRA). However, ⁹⁰Sr and nitrates both tested above Safe Drinking Water Act (SDWA) maximum contaminant level (MCL) (see Ref 3). (Under CERCLA, SDWA was the only chemical-specific applicable or relevant and appropriate requirement for the UNC Site.)

Soil samples obtained in 1986 in the vicinity of the disposal site indicated that the wastes at the site had not leached significantly into the subsurface soil. Groundwater monitoring (1986-1990) also did not indicate leakage of contaminants into the groundwater. However, based on the deteriorated condition of the waste containers, the estimated source inventory, and mobility of waste constituents present, the UNC Disposal Site was deemed a potential risk to human health and the environment. Accordingly, the major goal of the UNC Site response action was to prevent or minimize the contamination of shallow groundwater beneath and downgradient of the UNC disposal site (Ref. 3).

In 1991, Elza gate soil and concrete and asbestos debris was added to the waste in the facility, and by August of 1992, the waste had been covered with manufactured sand, general fill, contouring fill, a 2 ft thick compact clay cap, a 30 mil PVC geomembrane, a drainage layer and 18 inches of protective cover soil and seeded. Figure 2 shows a profile of the facility (from Ref. 3), although the 29,000 drums in the landfill were only stacked to 10 high.

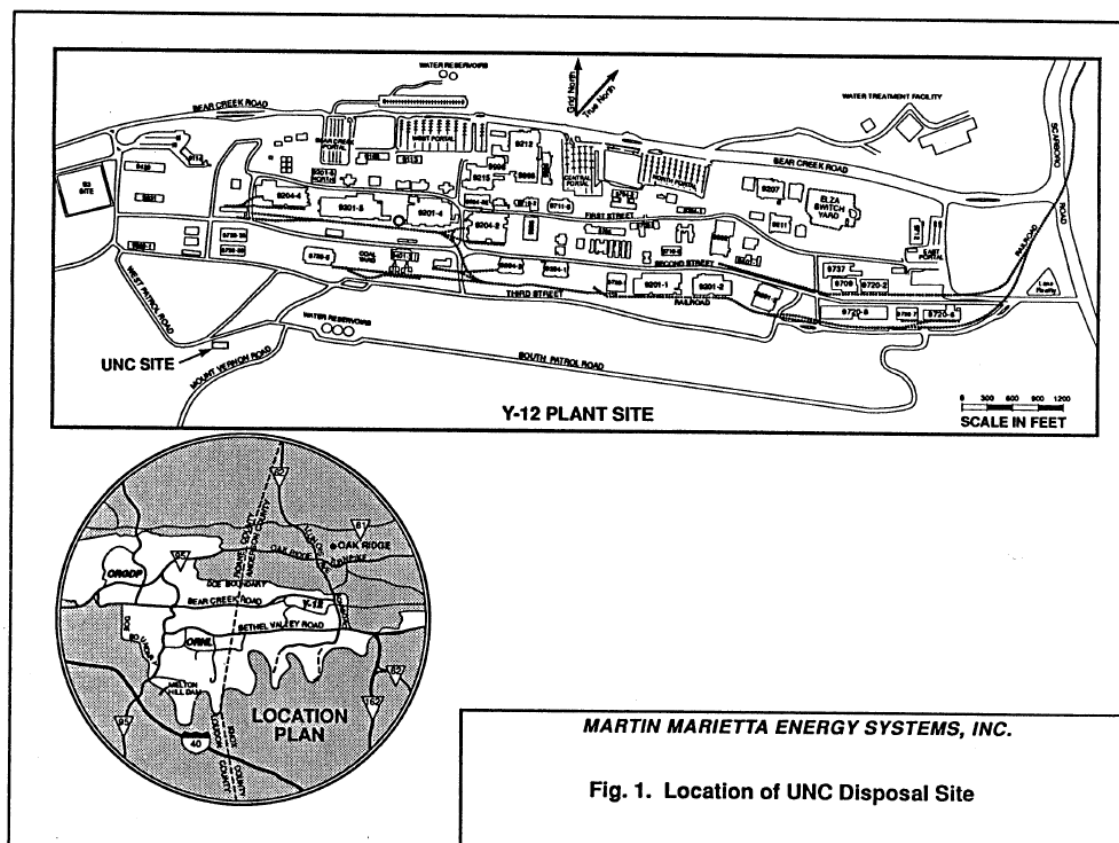


Fig. 1. Location of United Nuclear Corporation disposal site.

Variations to Design

Documented variations to the original design found during review of historical records of the facility indicted two notable changes:

- 1) The drums were only stacked 10 high (laid horizontally) rather than the 20 or so high shown schematically in Figure 2 and in the design drawings.
- 2) The cap was constructed with a slope that essentially matched the surrounding contours rather than the broken slope shown on the drawings. This is confirmed in the later planned contours for the facility.

These changes were made after preparation of Figure 2 (from design phase) below.

The finish design elevation topography of the cap is shown in Figure 3, overlying the 2015 LIDAR hillshade background.

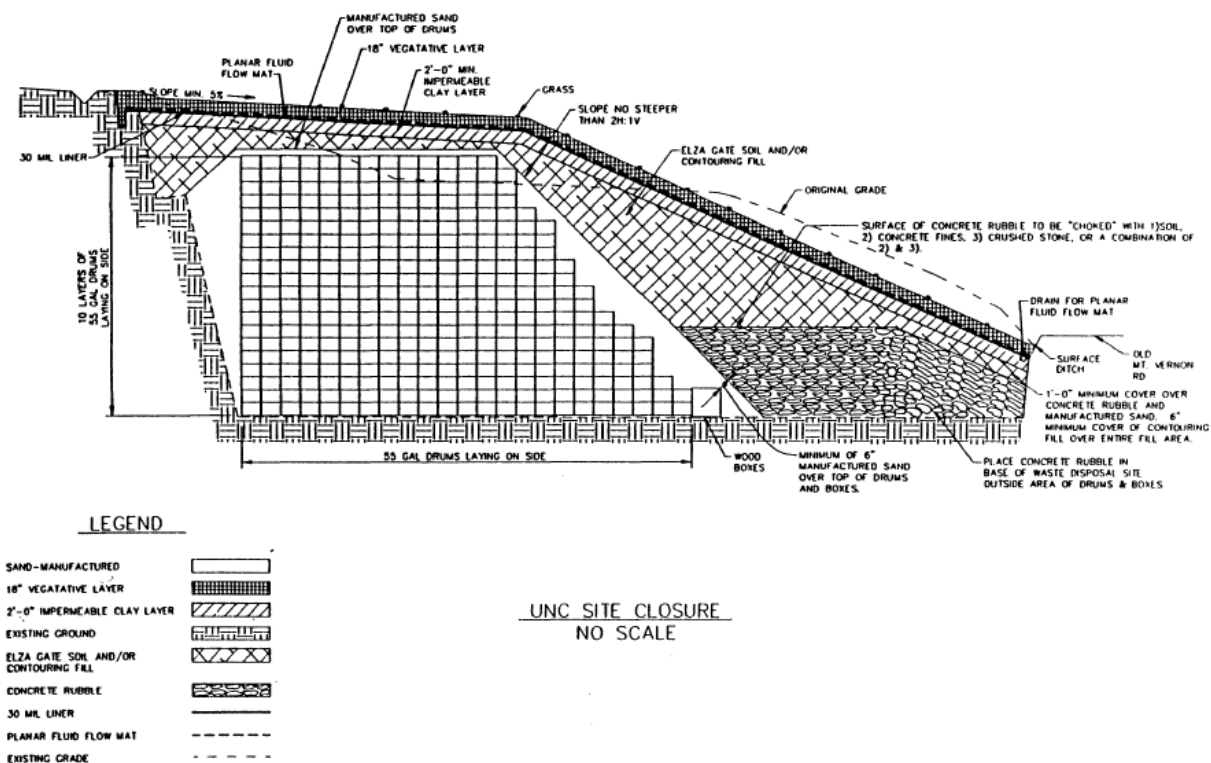


Figure 2. Typical cross section of United Nuclear Corporation disposal facility (from Ref. 3).

SITE OBSERVATIONS

Field Observations

A site-walkdown was performed on March 24, 2022, to inspect the facility for general condition, grass cover, and signs of any settlement or change in configuration of the UNC facility. No site photographs were taken in accordance with Y-12 restrictions.

The area was found to sustain a thick grass growth with good coverage. A few corners showed signs of scalping by mowers, but in general the vegetative cover was rated as excellent. There were no visible signs of soil cracking (desiccation) or other detrimental local features.

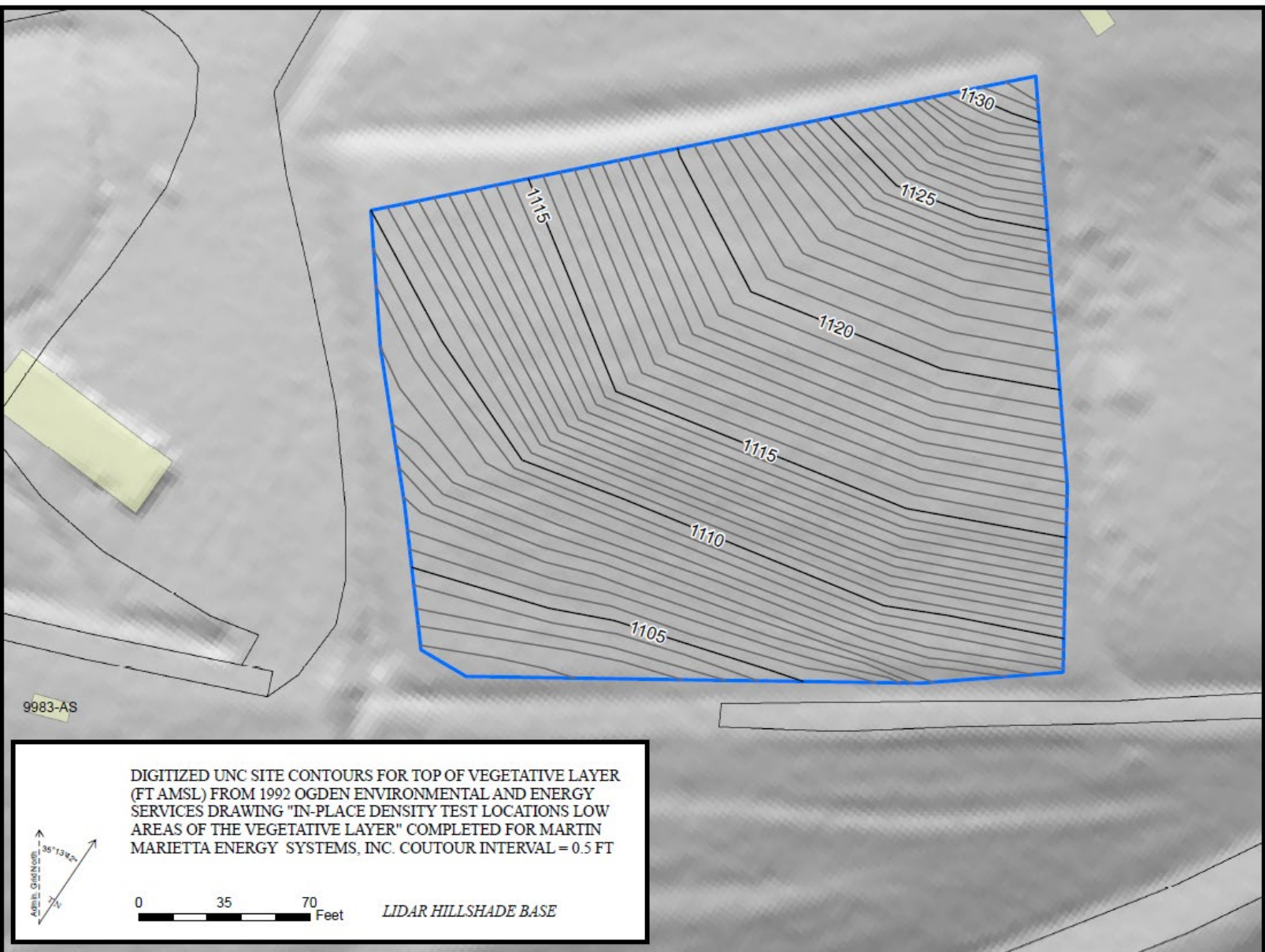


Figure 3 – Final design cap contours (0.5' interval) overlying 2015 LIDAR hillshade of the UNC cap.

Document Path: C:\Oak Ridge\Y-12\20220525 - UNC Site Cap Drawings\20220526 - UNC Site Cap Drawing Veg Layer Topo.mxd

The site is shown in Figure 4 with hillshade LIDAR from the 2015 state lidar survey, with notes subjectively added from the March inspection. In general, the site is one continuous planar surface with a slight break in slope at about the location indicated. There were also 3 areas which could be noted to have differential rise or depressions as noted, but these were subjectively mapped and were not measured for location of actual topographic difference. All areas had sufficient slope to drain to the southwest. The noted depressions and bumps were very gradual in nature, with no sharp slope changes or offsets found. There were no distinct drainage paths or gullies on the cap.

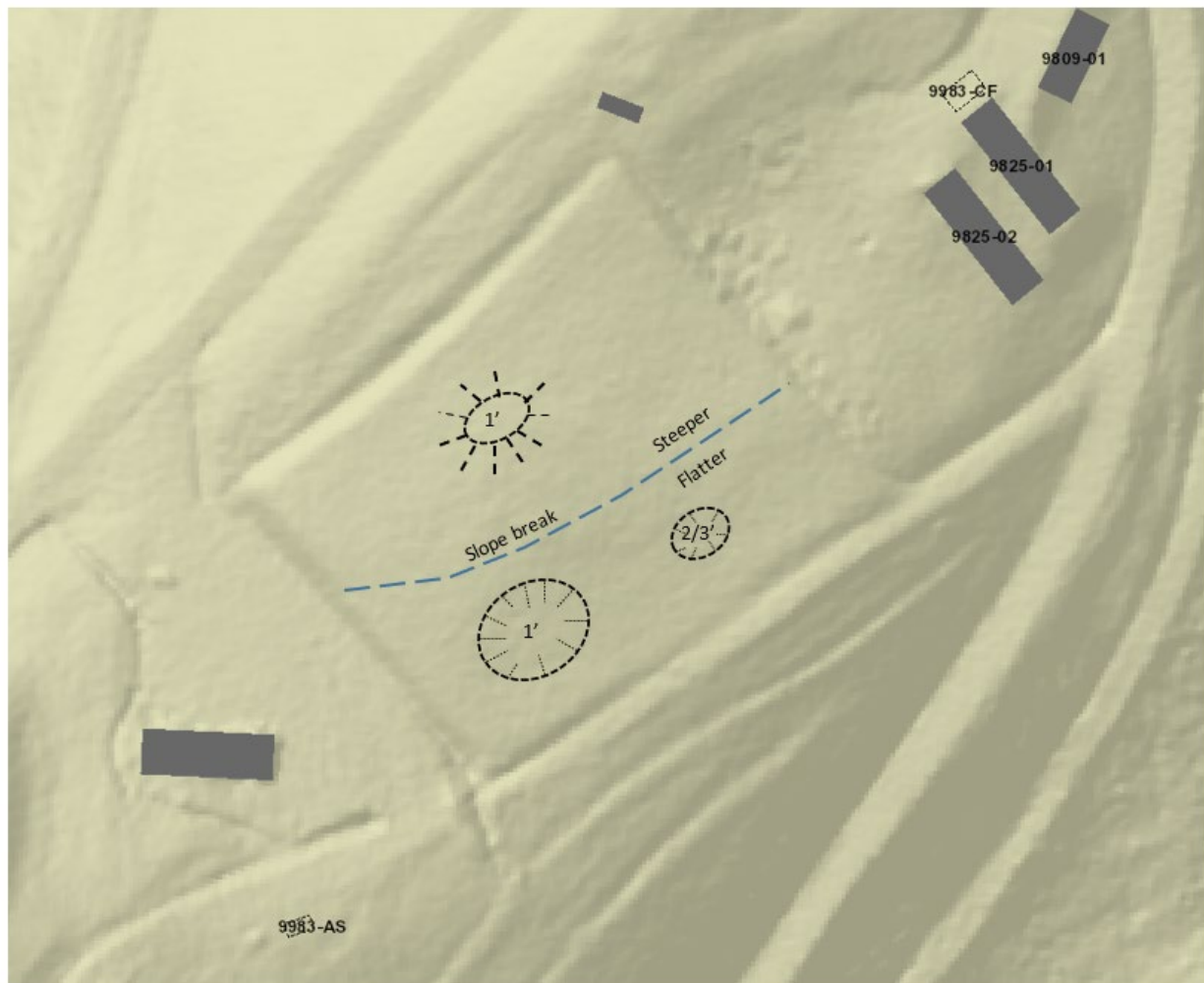


Figure 4 - 2022 Topographic Rises and Depressions Subjectively Observed in the Field.

Historical Comparison

Shown in Figure 5 is the mapped waste locations at the time of construction (from Ref. 3). One of the observed “depression areas” appears to be over the wooden box areas indicated on Figure 5 but is very gradual in nature. There also appears to be a gentle break in slope roughly correlates to the southern edge of the drummed waste (which corresponds to the details of Figure 2 also).

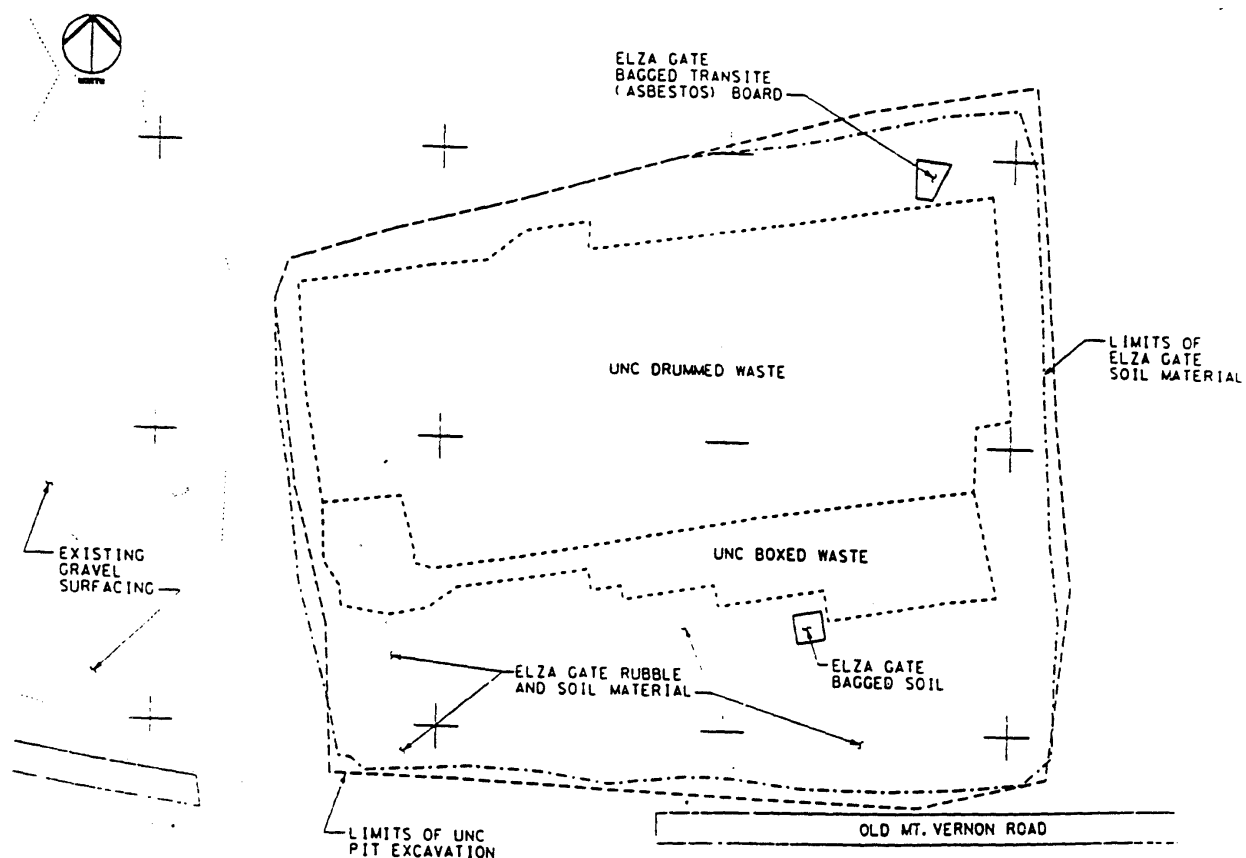


Figure 5 – Plan view of waste locations within UNC landfill (from Ref. 3) (no scale)

By overlaying the 2015 LIDAR map and the 1992 as-built clay cap topography (as shown on Figure 3) and comparing the design top of vegetative cover and the LIDAR surveyed elevations, an isopach map of settlement can be developed, as shown in Figure 6. This figure shows the interpreted change in elevation of the cap between 1992 and 2015, with an inherent accuracy of no better than ± 6 inches (0.5 ft). Negative elevation changes indicate probable settlement, whereas positive changes probably indicate no settlement and thickened cover soils (or raised membrane elevations). Overall, the map shows that there is minimal perceptible settlement over the 23-year period monitored in this comparison. The observed features from the 2022 site visit are not indicated on Figure 6. These observations were only qualitative in nature and may be due to changes that have occurred since 2015.

Groundwater Monitoring

The Post-Construction Report, (Ref 3) specifies implementing a groundwater monitoring program. Although analytes are not mandated by the report, groundwater is monitored for chemicals of concern (nitrate and ^{90}Sr) for input into the performance assessment. Groundwater around the UNC site is monitored by four (4) monitoring wells which indicate groundwater levels are approximately 80 feet below the cap elevation and 60 feet below the base of the waste in the facility.

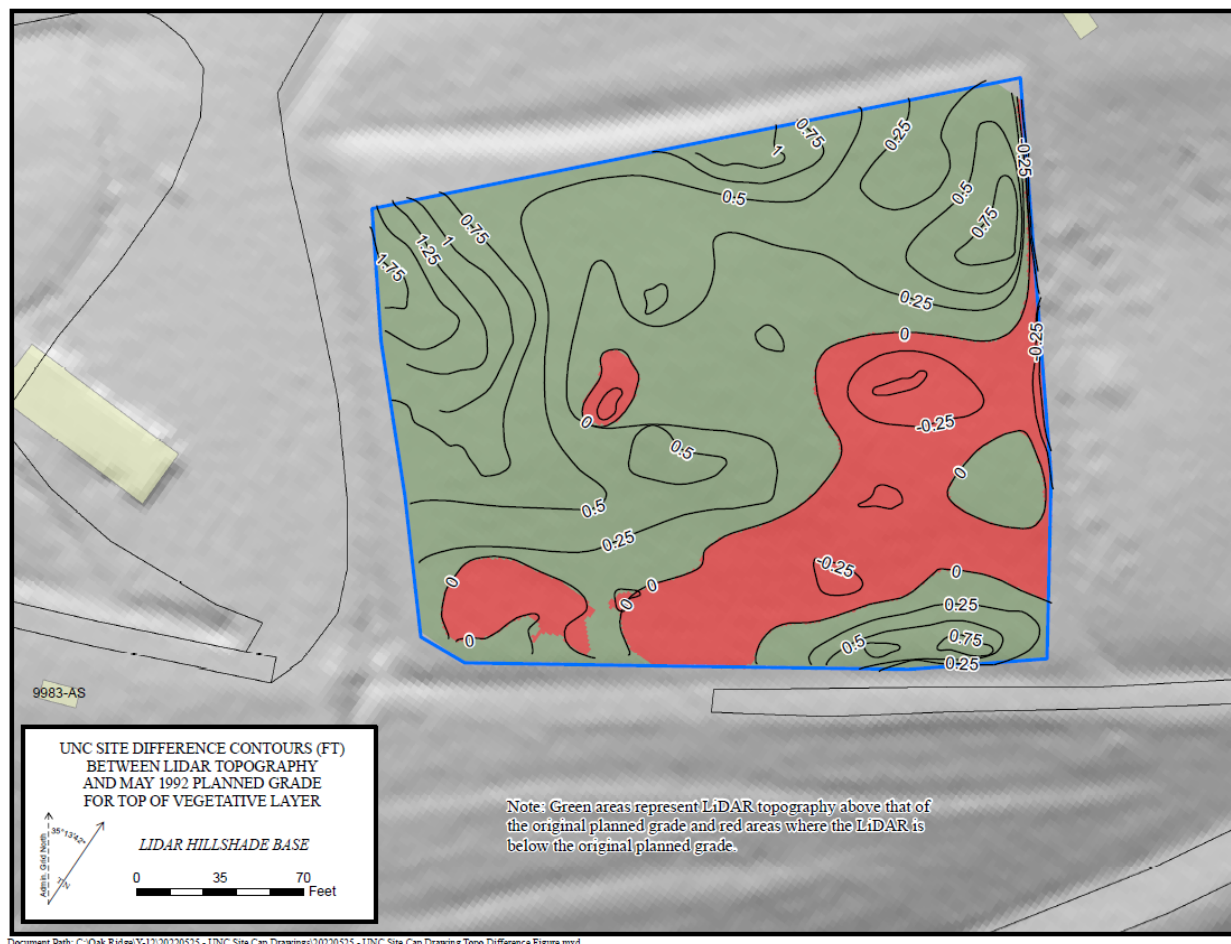


Figure 6 – Isopach Map of Cap Elevation Changes Between 1992 and 2015 (neg= settlement)

Monitoring at the UNC Disposal Site consists of semiannual sampling at one upgradient well (GW 1090), three downgradient wells (GW-203, GW-205, and GW-221), and one downgradient surface water location (UNC SW-1), shown on Figure 7. Figure 7 also shows approximate piezometric surface contours for the UNC Disposal Site as well as the inferred groundwater flow direction based on the potentiometric surface gradient. The FY 2021 average groundwater elevations (based on two measurements at the time of sampling) at each sampled well are also shown on the figure below the well number. Although MW 1090 is designated as an upgradient monitoring location based on groundwater elevations in the area, percolating groundwater beneath the waste could affect any of the nearby wells, as indicated by the base of the buried waste within the unlined UNC waste disposal unit being elevated much higher than the groundwater elevations. Samples were analyzed for field parameters, metals, nitrate, gross alpha and beta activity, and ^{90}Sr . Additional isotopic analyses (^{40}K) were conducted on samples collected from GW-205 and UNC SW-1. The pH levels measured at the UNC Disposal Site are typical of shallow groundwater at the ORR.

The major goal of the remedial action in the UNC Disposal Site Record of Decision (ROD) is to “ensure that mobile contaminants in the UNC waste, principally nitrate and ^{90}Sr , are not being leached to groundwater at a rate that would result in concentrations of these

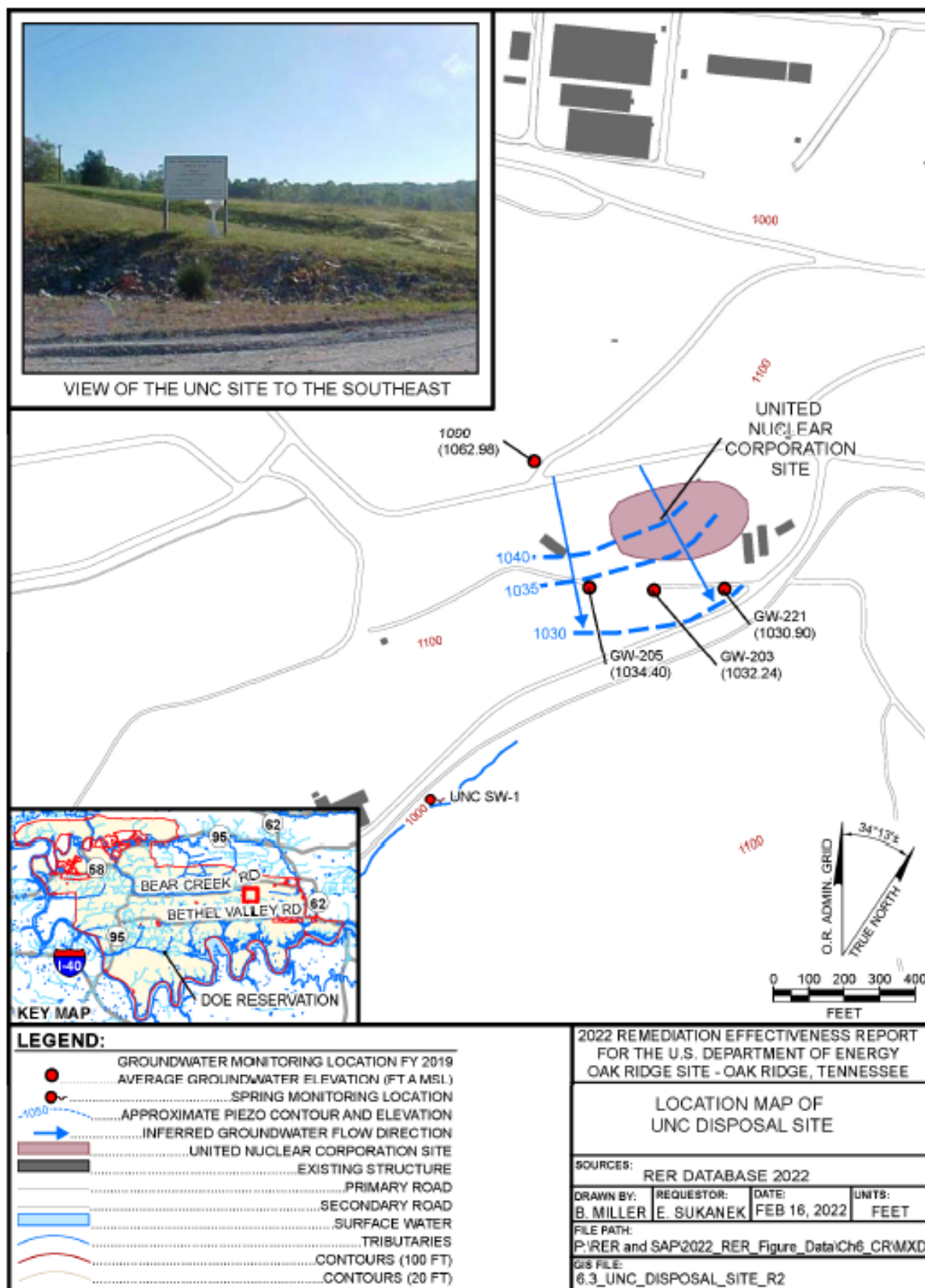


Figure 7 - Ground and surface water monitoring locations around UNC, from Ref. 4.

contaminants above safe drinking water standards.” The Feasibility Study for the United Nuclear Corporation Disposal Site, (Ref. 5) included results of contaminant transport modeling, indicating possible impacts to groundwater of nitrate concentrations of as much as 193 mg/L and ^{90}Sr concentrations as great as about 50 pCi/L. The expected remedy performance in the UNC Disposal Site ROD is to control contaminant migration so that nitrate is less than the MCL of 10 mg/L and no more than 2 pCi/L of ^{90}Sr will occur in groundwater. These concentrations are within the CERCLA requirements: Excess Lifetime Cancer Risk (ELCR) risk range of 10^{-4} to 10^{-6} . Further, the groundwater concentration “is not expected to exceed 8 mg/L for nitrate.” As reported in the annual remediation effectiveness report (Ref. 4), monitoring data showed the UNC Disposal Site met its expected performance goals during FY 2021.

DISCUSSION

The existing UNC facility has been in-place for 30 years, and while there is no specified “design life” in the design documents reviewed, the monitoring period was to be 30 years implying any required actions would occur at or prior to that time. There are presently no plans for permanent remediation of the facility, and so this report presents a reassessment of the facility with recommendations for future actions as appropriate.

In review of the design of the facility and the present age, the following key factors are judged to be the main items of concern for the facility:

- 1) Degradation of waste containment.
- 2) Leaching of the waste and leakage from the facility.
- 3) Settlement of the waste and the overlying materials affecting the integrity and performance of:
 - a. the clay cap,
 - b. the PVC geomembrane.
- 4) Drainage of surface water and infiltrated water above the membrane.
- 5) Cover soils and erosion control.

Each are discussed in more detail in the following sections.

Degradation of the Waste and Containers

As described above, the waste includes cemented sludge in drums, soil in drums, boxed waste and unbound waste. Each of these containers and waste will degrade to one degree or another at various rates based on the conditions within the facility. That rate is essentially not controllable and could not realistically be accounted for in the design. Degradation would manifest itself externally as settlement of the facility cap, but there have been no measurements of settlement since completion. It is prudent to assume at least a portion of the ultimate degradation expected has occurred to date. The maps in Figures 4 and 6 are a first pass at such an assessment, but the accuracy of each is not well defined. However, it is also apparent that there has not been significant differential settlement of the facility which could lead to stressing of the cap materials. Predictions of future localized behavior are not reliable, and thus continued monitoring is recommended.

Leaching and Leakage

The UNC landfill is not lined, and the waste was placed directly upon the prepared excavated subgrade. The clay and membrane layers of the cap fully cover the waste but do not extend as far as the perimeter drainage ditches, so perimeter infiltration through the protective cover soil is possible (see Fig 2). Thus, potential sources of water into the waste include:

- Leakage through the cap PVC membrane and the clay layer.
- Lateral seepage into the waste from adjacent areas.

Leakage through the cap is discussed below and is judged unlikely.

Lateral seepage into the facility is possible and expected but is also expected to be very minimal due to the placement of the facility nearly on the crest of Chestnut Ridge and the depth of the groundwater table well below the facility. Only the areas to the north and east of the facility are upslope of the bottom of waste.

Any water that enters the facility will eventually leave again as groundwater, as the cap precludes evapotranspiration. Groundwater monitoring performed both upgradient and downgradient of the facility has shown no attributable transport of contaminants from the facility.

Thus, it does not appear that leaching, or leakage are occurring on an observable or measurable scale.

Performance of the Clay Cap

The cap of the facility includes a 2-foot-thick clay cap overlain by a PVC geomembrane in intimate contact. Together these layers work complementarily to be more impermeable than either individual layer, as a defect in one layer will very rarely line up with a defect in the other layer.

The clay cap was constructed of specifically selected material compacted to specific criteria to provide a barrier with a permeability of less than 10^{-7} cm/sec. However, localized deformation from below (differential settlement) can cause cracking of the clay such that integrity of the layer can be compromised. Generally, a strain of 0.8% is considered the maximum strain that the clay can safely undergo without loss of performance (Ref 6). This means that the clay can stretch by no more than 0.8%, which corresponds to a local differential settlement of 1.25 feet over a distance of 10 feet. Such a feature, if present in 2016 would be very obvious on Figure 4. In the 2022 inspection, some surface features were noted with uneven grades, but none were as severe as required for cracking of the clay cap, and so it may be concluded that the clay cap is intact and performing as designed. The life of the clay cap, without significant differential settlement and protection from drying shrinkage, roots and animal burrowing, is essentially unlimited.

Performance of the PVC Membrane Layer

Overlying the clay cap is a 30 mil PVC-P (polyvinyl chloride - plasticized) membrane, which is now 30 yrs. old. The membrane has been buried under the soil cover for the entire

period. It has not been inspected or tested to determine its condition as part of this assessment. Instead, a literature review of testing by others on buried PVC was performed.

A literature search of PVC membranes shows that the formulation of the original material is key to the durability of the material. The amount and type of plasticizer, filler and antioxidants all play a part in the longevity and durability of the material. PVC itself (hard plastic) is very stable, but membranes contain plasticizer to provide flexibility. In general, it is found that PVC membranes age rapidly at the beginning, but then reach a more equilibrated state and change much more slowly with time - see Figure 8 (Ref. 11). Volatility is the measurement of the removal of plasticizers from the membrane over time and affects many other key membrane properties including strength and modulus (stretchability). Loss of plasticizers is generally more prevalent in membranes immersed in water or other liquids (Ref. 12). Thicker membranes are also less susceptible to plasticizer loss due to self-protection.

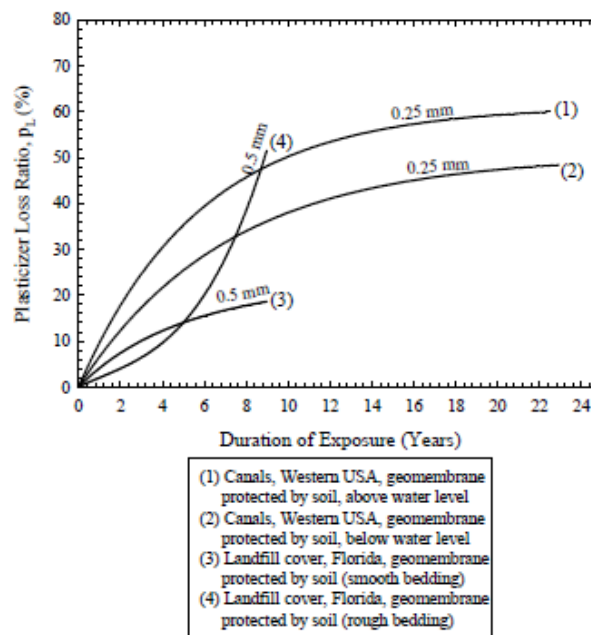


Figure 8 – Relationship between plasticizer loss ratio versus duration of exposure (Ref. 11)

The project manufacturer's data (Ref. 10) indicates the plasticizer used in the UNC membrane was diisodecyl phthalate (DIDP), which is a high molecular material (favorable), and per literature, is one of the most volatile-resistant plasticizers for PVC formulation (See Figure 9 below, from Ref. 2). The percentage of plasticizer used in the UNC PVC membrane is not clear, but the PVC membrane volatile percentage is listed as 0.3%. (Ref. 10)

A study of 30 yr. old, buried PVC membrane (Ref. 12) found that the materials evaluated did not change enough in material performance to fall below the original material specification requirements. However, in that study the original material properties were not known, so the change in properties over the 30 yr. span could not be quantified.

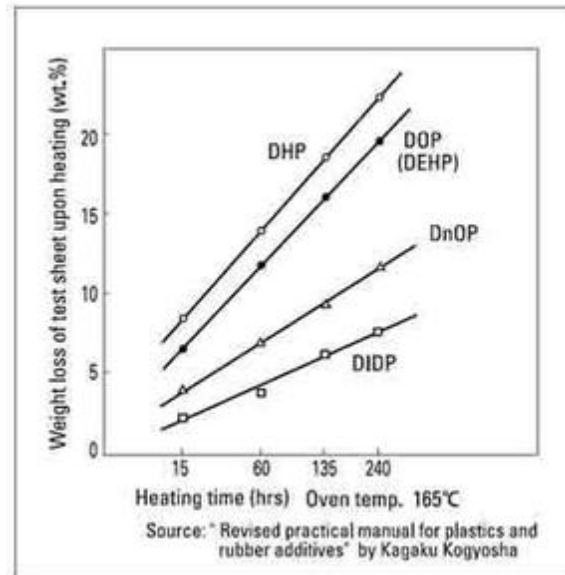


Figure 9 -The loss of weight is a result of volatilization of the plasticizer (Ref. 2).

In Table 1 below, is the QC testing performed on the original UNC materials (from Ref. 10) and the properties relative to the specified requirements (i.e., the basis of the design). Also listed are the standard ASTM requirements for PVC membrane at the time (Ref. 1). Clearly the installed membrane met or exceeded the design material properties and the industry minimums (ASTM). While it is not certain that those same properties still exist in the cap 30 years later, trends noted in the literature based on testing indicate exceedance of the specified material properties is still expected to exist. As the plasticizer in the PVC ages, it causes hardening of the material, which increases the strength and the modulus, while decreasing the elongation. The QC test results (Table 1) show the original material had elongation available well above the specified values (180%) and it is doubtful the required performance criteria will not still be met after hardening. On the other hand, the test data shows the original strength and modulus are only moderately above criteria, but ageing will increase these values further. Therefore, the changes in properties due to aging are not expected to adversely affect the properties of the membrane to the extent that it does not meet the project performance criteria after 30 years of service.

Koerner (Ref. 8) performed some studies of the longevity of buried geomembranes of various types, including PVC, but came to no specific conclusions for any materials except HDPE, as that is presently the predominant material utilized in landfill liners and caps. For exposed PVC membranes produced in the US, a half-life of 18 yrs. was determined, but protection from UV and other exposure conditions greatly increases the life of the membrane.

The ultimate service life of the UNC membrane is not predicted for this cap, but based on the literature review as discussed above, it is judged that the UNC PVC membrane has sufficient properties to continue to meet the project design criteria. Discussion of the PVC membrane in combination with the compacted clay cap is discussed below.

	1991 Requirements				UNC PVC membrane, Delivered product, 1992										Typical Change in Property Over Time
Property	Specified Properties Required at Manufacture	Industry stnd at time of manufacture **	Spec'd stnd ASTM	Tested stnd ASTM	Roll 7		Roll 14		Roll 21		Roll 28		Average	Relative to Spec	
					MD	TD	MD	TD	MD	TD	MD	TD			
Break (Tensile) strength (psi)	2300 (69 ppi)	60 ppi	D 882, Method A	D 882	85.4	91.5	86.8	86	83.3	82.3	88.4	83.6	85.9	125%	increases
Elongation at break (%)	300	250	D 882 (A)	D 682*	566	549	501	561	506	557	539	551	541	180%	decreases
Modulus at 100% strain (psi)	1000 (30 ppi)	30 ppi	D 882	D 382*	32.2	33.8	35	32.8	33.4	31.6	34.1	31.7	33.1	110%	increases (hardening)
Tear resistance (lbs)	8	9	D 1004	D1004	9.3	9.2	9.6	9.4	9.1	9	9.8	9.6	9.4	117%	
Thickness, min (mil). smooth	28.5	27.9	D 374/D 1593	D 1593	31.4		31.2		30.6		30.8		31	109%	minor reduction
Specific Gravity	1.24-1.30		D 792 A-1	D 792									1.24	Pass	
Dimensional stability (% change, max)	±5	±5	D 1204 (100C, 0.25 hr)	D 1204	-0.4	0.4	-0.6	0.7	-0.8	0.4	-1.2	0.9	-0.1	Pass	
Water extraction (% change)	<0.25	<0.35	D 3083 /D 1239	D 1239									0.23	Pass	
Volatile loss (% loss)	.70 max	1	D 1203		Not tested								not tested		
Low temperature brittleness at -20F, percent passing	No requirement listed	80	D 1790	D 1790	90		90		100		100		95	Pass	decreases
Seam tests					Factory 1 to 2	Factory 2 to 5	Factory 3 to 2	Factory 4 to 5	Field Destruct 1-2	Field Destruct 2-3	Field Destruct 3-4				
Bonded seam shear strength (ppi)	55.2	48	D 3083 / D 882	D 751	72.5	76.72	68.44	68.46	69.6	73.9	60.1		70.0	127%	Related to strength
Peel Adhesion (ppi)	FTB or 10		D 413	D 413	39.5	39.18	32.56	34.34	17.3	24	22.9		30.0	300%	
* clearly a typo, should be D 882															
** From ASTM D3083 -1989															

Table 1 - UNC PVC 30 mil membrane requirements, standards and properties (Refs. 10 and 1)

Joint performance of the PVC membrane and compacted clay

The PVC membrane is intended to be the primary water barrier layer, but the service life of the membrane may not be as long as the protection ultimately required for the underlying waste materials. On the other hand, the 2 feet thick compacted clay cap will be in service for a long time provided it is protected from drying (leading to shrinkage cracking), excessive deformation, and penetration by roots or burrows. The PVC membrane can easily initially accommodate stretching of up to 300% although this stretchability can decrease with aging. The clay will outlast the PVC but can only accommodate tensile strain of about 0.8% (Ref. 6) before impermeability is compromised. Thus, only minor differential settlement can be accommodated by the clay layer alone as noted above.

So while the PVC can accommodate high differential settlement for its service life, the clay can provide a longer-term barrier provided there is not high differential settlement. Together, to date, the 2 barriers have satisfactorily met the performance criteria for the facility.

Drainage of surface and infiltrated water above the membrane

Drainage features from the cap and down the perimeter ditches appear to be performing well. There are no surface gullies or appreciable erosion features on the cap and the grass growth is excellent. Mowing is performed routinely to prevent growth of trees and shrubs and to minimize activity by burrowing animals.

Water which infiltrates the vegetated protective soil cover is to be collected by the drainage netting overlying the membrane. The condition of this netting is not known but may be clogged with roots. Clogging may cause development of a water head (pressure) on the membrane, but no adverse effects have been noted and cap stability appears acceptable. The netting also forms a barrier to burrowing animals.

Monitoring well data is not indicating any seepage through the waste and into the groundwater regime.

Cover soils and erosion control

There are no signs of obvious surface erosion over the landfill. Constructed drainage patterns for the landfill and the establishment of a well-maintained grass cover have effectively minimized erosion across the site. The actual thickness of the vegetative cover has not been determined, but it is clearly sufficient to grow grass needed for protection. The grass is protecting against erosion except in a few localized spots around the edges where scalloping by mowers is occurring.

CONCLUSIONS

The facility is judged acceptable at present and no detrimental trends have been observed. It may be concluded that:

- 1) The excellent grass growth has protected the cap from erosion.
- 2) Apparent settlement of the cap has been minimal.
- 3) Differential settlement (if occurring) is well within tolerable limits.
- 4) Ongoing groundwater monitoring is not indicating detrimental infiltration of contaminants to the groundwater.
- 5) The clay cap should continue to perform adequately provided it is protected from surface erosion, burrowing animals, roots and desiccation.
- 6) Based on a review of literature and the quality of the installed PVC membrane, it is expected that the membrane has retained its quality to at least the properties required in the initial specification.

However, the life of the cap is dependent upon acceptable levels of differential settlement, and this phenomenon is unpredictable given the nature of buried drums. Therefore, the following actions are recommended to insure timely detection of unfavorable conditions:

- 1) Continue semi-annual inspections of the facility cap with an emphasis on surface erosion and differential settlement of the cap.
- 2) In the interest of long-term accurate monitoring, a LIDAR survey of the facility (along with other landfill facilities in the area) is recommended at a frequency of about 5 years. Comparison of LIDAR surveys will readily identify differential settlement which may be of concern and provide an accurate measurement of cap subsidence, erosion or other damage.

FUTURE MONITORING AND RE-EVALUATION

Continue semi-annual monitoring of UNC facility and cap for erosion, settlement, (total and differential) and other detrimental characteristics.

Unless there is excessive settlement, the present cap is expected to continue to meet design performance criteria, and sampling and integrity testing of the PVC membrane may be deferred.

A complete re-evaluation of the cap, including PVC membrane sampling and integrity testing should be performed in preparation of the future Chestnut Ridge ROD in 2038 (FFA Appendix J date 2038: Remedial Action Report 2041).

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- 1) ASTM, ASTM D3083 - Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining, 1989, ASTM International.
- 2) "Bleeding and Evaporation of Plasticizers, from the European Council of Vinyl", Belgium. 2021, from <https://pvc.org/about-pvc/pvc/physical-properties/bleeding-and-evaporation-of-plasticizers/>, June 2022
- 3) DOE/OR/01-1128&DI Y/ER-51&DI, "Postconstruction Report for the United Nuclear Corporation Disposal Site at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee" prepared by Engineering organization Martin Marietta Energy Systems, Inc., June 1993.
- 4) DOE/OR/01-2916&D1 "2022 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee, Data and Evaluations", March 2022.
- 5) ES/ER-15&D, "Feasibility Study for the United Nuclear Corporation Disposal Site at the Oak Ridge Y-12 Plant", Oak Ridge, Tennessee, Feb 1, 1991.
- 6) Golder Associates, letter to Duratek Federal Service's regarding: "Tensile Strain in Cover Clay Layer and Soil Material Consolidation Calculations, EMWMF, Oak Ridge Tennessee", dated 5/12/2005.
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- 8) Koerner, R. M., Koerner, G. and Hsuan, Y.G., "Geomembrane Lifetime Prediction: Unexposed and Exposed Conditions", GRI White Paper #6, 2011.
- 9) Ogden Environmental, "Closure of United Nuclear Corporation (UNC) Waste Disposal Site-Phase II Summary Report of Laboratory and Field Test Data" July 31, 1992.
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- 11) Stark T. D., H. Choi, and P. W. Diebel, "Plasticizer Retention in PVC Geomembranes", presented at Geo-Frontiers 2005, Austin Tx

- 12) Stark, Timothy D. and E. J. Newman, "Thirty Year Durability of a 20 Mil PVC Geomembrane" ANTEC 2015 - Proceedings of the Annual Technical Conference and Exhibition of the Society of Plastics Engineers, 2015, p. 2958-2965
- 13) EPA (U.S. Environmental Protection Agency) 2001. Comprehensive Five-Year Review Guidance, Office of Solid Waste and Emergency Response (OSWER) No. 9355.7-03B-P. U.S. Environmental Protection Agency, Washington, D.C.

Comment Resolution Form

Document Number: DOE/OR/01-2962&D1	Document Title: <i>2024 Five-Year Review for the Upper East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds and the Lower East Fork Poplar Creek and Oak Ridge Associated Universities South Campus Facility Operable Units on the U.S. Department of Energy Oak Ridge Site, Oak Ridge Tennessee</i>	
Name of Reviewer: NA	Organization: U.S. Environmental Protection Agency	Date Comments Transmitted: NA

Comment No.	Sect/Page	Comment	Response	Responsible Person
Comments on the D1 2024 FYR were due November 13, 2024. EPA did not request a 30-day extension and comments were not received by the date of the Comment Response meeting (January 16, 2025).				

Comment Resolution Form

Comment No.	Sect/Page	Comment	Response	Responsible Person

Comment Resolution Form

Document Number: DOE/OR/01-2962&D1	Document Title: 2024 Five-Year Review for the Upper East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds and the Lower East Fork Poplar Creek and Oak Ridge Associated Universities South Campus Facility Operable Units on the U.S. Department of Energy Oak Ridge Site, Oak Ridge Tennessee	
Name of Reviewer: Randy C. Young	Organization: Tennessee Department of Environment and Conservation	Date Comments Transmitted: November 8, 2024

Comment No.	Sect/Page	Comment	Response
Section 1.0 Oak Ridge Site Five-Year Review (FYR)			
1	Page 1-6, Figure 1.2	Please confirm if the Chestnut Ridge Record of Decision (ROD) should also include groundwater.	Agree. Groundwater will be considered in the future ChR ROD and will be added to this figure for future documents.
2	Page 1-13, Table 1.2	Soil should also be listed under the future follow-up action for the Phase II Interim RA for Contaminated Soils and Scrapyard. It appears not all contaminants of concern (COCs) were addressed for protection of the industrial worker; therefore, additional soil characterization and remediation may be necessary for exposure units already addressed under the Interim ROD (IROD).	Clarification. Table 1.2 footnote 'a' refers to Figure 1.2. Figure 1.2 clarifies that soil in UEFPC is included in a future final ROD. The UEFPC Phase II Interim ROD specified remediation levels protective of the site-specific risk scenario that met the RAOs (Table 2.3 of the UEFPC Phase II Interim ROD). The UEFPC Phase II Interim ROD did not include COCs that were less than the target risk levels (1×10^{-5} ELCR or HI of 1) or had low frequencies of detections above these levels. The protection of human health and associated COCs for soils will be revisited in the final ROD.
Section 2.0 Upper East Fork Poplar Creek (UEFPC) Watershed			
3	Page 2-19, Table 2.4	The property record notices only list the Roane County Register of Deeds office under the implementation and frequency column. Please revise to include Anderson County Register of Deeds or explain why only Roane County is listed.	Agree. This will be reflected in an upcoming revision to the EFPC and ChR RAR CMP.
4	Page 2-50, Section 2.2.2.1, second paragraph	This paragraph states that the UEFPC Phase II IROD does not include actions to address inaccessible soil. There is significant discussion of implementing the selected remedy as soil becomes accessible, both within the text of the IROD, and within DOE's responses within the IROD responsiveness summary section. Revise this paragraph to reflect that the Phase II IROD does include	Clarification. Project Team discussions on inaccessible soil are proceeding as noted in the comment. The 2029 FYR of UEFPC will include the results of these ongoing discussions.

Comment No.	Sect/Page	Comment	Response
		actions to address inaccessible soil as it becomes accessible (e.g., EU-5) or further explain what is meant by this statement.	
5	Page 2-50, Section 2.2.2.2, first bullet	This bullet suggests that not all human health soil COCs identified during the baseline human health risk assessment (BHHRA) are addressed under the Phase II IROD, but rather characterization and remediation is limited to what is considered the <i>primary</i> COCs. TDEC has concerns that the Phase II IROD does not characterize and evaluate risk to the industrial worker for all known COCs, and the no further action determination for protection of the industrial worker may not be appropriate. Furthermore, a non-comprehensive COC list may necessitate additional land use controls (LUCs) such as implementing the excavation/penetration permit program (EPPP) for any subsurface work (0 ft). TDEC requests that DOE schedule a meeting with the tri-parties to further discuss this concern.	Clarification. See response to Comment #2. Any “no further action” determination for soils addressed under the UEFPC Phase II Interim ROD is an interim determination. Relevant information from ongoing Project Team discussions will be included in the 2029 FYR for UEFPC. Inclusion of the issue in an upcoming Project Team agenda may be requested
6	Page 2-57, Section 2.2.5.2.2	The vapor exposure evaluation was limited to the Old Salvage Yard (OSY) site in EU-11 and EU-13. Due to the presence of a large volatile organic carbon (VOC) plume within the UEFPC watershed and the lack of milestones and forward progression in implementing the soil remedy in exposure units (EUs) over the VOC plume(s), a vapor intrusion (VI) screening should be conducted for all EUs to evaluate if VI is an issue that needs to be addressed while the soil remedy is implemented. Conduct a VI screening for all EUs overlying the VOC plume(s) or explain why a comprehensive VI screening has not been conducted.	Original response: Clarification. Soil actions are designed to protect human health from exposure to contaminants in soil and prevent migration of contaminants to groundwater above agreed upon limits. The final UEFPC ROD will evaluate VI, as applicable. Revised response per 01/16/2025 comment response meeting: Clarification. Soil actions are designed to protect human health from exposure to contaminants in soil and prevent migration of contaminants to groundwater above agreed upon limits. The final UEFPC ROD will evaluate VI, as applicable. Discussions with the Project Team will continue as EUs are completed to determine how VI requirements may be documented.
7	Page 2-57, Section 2.2.5.2.2, last paragraph	This paragraph discusses that regional screening levels (RSLs) were used to perform the vapor exposure evaluation for the OSY site in EU-11 and EU-13. Are there groundwater monitoring wells in the vicinity of OSY to conduct a VI screening using vapor intrusion screening levels (VISL)?	Original Response: Clarification. The groundwater plume emanating from the S-3 Ponds area underflows the OSY area, therefore, any wells at the OSY would not give a positive identification of the OSY as a potential groundwater contamination source. Groundwater in this area will be addressed under a future ROD.

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			Revised response per 01/16/2025 comment response meeting: Clarification. While several groundwater wells are located near the periphery of the OSY, there are no wells in the OSY area. The groundwater plume emanating from the S-3 Ponds area underflows the OSY area; therefore, any wells at the OSY would not give a positive identification of the OSY as a potential groundwater contamination source. Groundwater in this area will be addressed under a future ROD.
8	Page 2-81, Table 2.28	Has the East End VOC (EEVOC) Action Memorandum (AM) been updated to reflect the change in the carbon tetrachloride ambient water quality criteria (AWQC)? If not, the assumption used at the time of the remedy selection may not be valid and the AM should be revised to reflect the more stringent/protective AWQC.	Clarification. In March of 2013 DOE issued an NSC to the EEVOC AM codifying both the monitoring station LRBP-1 as the EEVOC effluent monitoring POC for the carbon tetrachloride AWQC and the revised 16 ug/L AWQC ARAR (Tennessee recreational [human health organisms only] water quality standard). Note that there were no exceedances of the 16-µg/L AWQC for carbon tetrachloride at LRBP-1 during FYs 2021–2023, with maximum concentrations of 1.4 µg/L in FY 2021, 1.3 µg/L in FY 2022, and 1.5 J µg/L in FY 2023.
Section 3.0 Chestnut Ridge			
9	Page 3-34, Section 3.3.4.2.2	There is detailed discussion of fish tissue trends for selenium and mercury for largemouth bass samples, but there is only minimal discussion of the arsenic fish tissue trend. The text states that arsenic tissue concentrations remain low and comparable to recent years; however, the data shown in Figure 3.8 suggests an increasing trend of arsenic in largemouth bass tissue in recent years. The arsenic tissue concentrations appear to be approaching 3x higher than the concentrations recorded in the last 3-5 years, with the last comparable measurements recorded in 2006. The Filled Coal Ash Pond (FCAP) ROD does not include Rogers Quarry, but the quarry does receive inputs from the FCAP, and the FCAP ROD addresses threats to plants, animals, and humans. Please provide additional discussion of these increasing arsenic tissue trends. How do these concentrations compare to AWQC	Original response: Clarification. As stated in Section 3.3.4.2.2: <i>Biological monitoring is not specified in the FCAP ROD. Biological monitoring at FCAP and downgradient Rogers Quarry is conducted to monitor trends for the future ChR ROD, and those data are summarized in the annual RERs.</i> Note that arsenic concentrations have been below detection limits when reported to ½ the MDL; this reporting limit was not used for 2023 data. When the 2023 data are reported to ½ the MDL, all concentrations are again below detection limits as presented in recent RERs (there was no significant detectable increase in arsenic concentrations). The figure from the 2024 RER is attached to the end of this CRT. Additionally, arsenic from coal ash is not restricted to transport via Upper McCoy Branch (UMB) into Rogers Quarry. UMB and Rogers Quarry received coal ash slurry for over 20 years. As

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		or other risk based levels for fish tissue? Has something changed in recent years that would promote increased accumulation of arsenic in fish tissue?	stated in the FCAP RI, <i>in 1967 and 1968, UMB was diverted into Rogers Quarry. Ash continued to flow through the FCAP and UMB to the quarry until 1989, when a bypass pipe was constructed to carry it directly from the steam plant to Rogers Quarry.</i> As stated in Section 3.3.4.2.2 of the 2024 FYR, a future ChR ROD will evaluate and address inputs to Rogers Quarry, as applicable. Note that AWQC are not performance criteria for the FCAP ROD and are used for comparative purposes only. Revised response per 01/16/2025 comment response meeting: Clarification. As stated in Section 3.3.4.2.2: <i>Biological monitoring is not specified in the FCAP ROD. Biological monitoring at FCAP and downgradient Rogers Quarry is conducted to monitor trends for the future ChR ROD, and those data are summarized in the annual RERs.</i> Note that arsenic concentrations have been below detection limits when reported to ½ the MDL; this reporting limit was not used for 2023 data. When the 2023 data are reported to ½ the MDL, all concentrations are again below detection limits as presented in recent RERs (there was no significant detectable increase in arsenic concentrations). The figure from the 2024 RER is attached to the end of this CRT. The arsenic results in FY 2022 and FY 2023 were non-detects, so the appearance of a slight upward trend is due to higher reported detection limits from the laboratory for these years. Additionally, arsenic from coal ash is not restricted to transport via Upper McCoy Branch (UMB) into Rogers Quarry. UMB and Rogers Quarry received coal ash slurry for over 20 years. As stated in the FCAP RI, <i>in 1967 and 1968, UMB was diverted into Rogers Quarry. Ash continued to flow through the FCAP and UMB to the quarry until 1989, when a bypass pipe was constructed to carry it directly from the steam plant to Rogers Quarry.</i> As stated in Section 3.3.4.2.2 of the 2024 FYR, a future ChR ROD will evaluate and address inputs to Rogers Quarry, as applicable. Note that AWQC are not performance criteria for the FCAP ROD and are used for comparative purposes only.

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10	Page 3-35, second paragraph	The statement that mercury concentrations in forage fish are well below the AWQC seems contradictory to the statement in the previous paragraph (“...elevated selenium and mercury concentrations in fish from Rogers Quarry suggest continuing low-level inputs from FCAP.”) Additionally, the AWQC is listed as 1.5 µg/g dry weight when the standard U.S. Environmental Protection Agency (EPA) AWQC for mercury is 0.3 mg/kg in wet weight. Explain the difference in AWQC limits used, and further elaborate how modifications to the passive treatment system (PTS) have decreased exposure to ash-associated contaminants when there are still elevated selenium and mercury concentrations in fish.	Clarification. Note that AWQC are not performance criteria per the FCAP ROD. Information on biological monitoring is provided for use in future decisions. Note also that because there is a selenium tissue criterion for whole body fish, the whole body contaminant concentrations are presented on a dry weight basis using the percent moisture of the samples (80% moisture) in order to compare to the selenium tissue criterion which is on a dry weight basis. There is no criterion for mercury in whole body fish; it is true that the tissue criterion for mercury in fish fillets is 0.3 ug/g wet weight. Because the whole body concentrations are presented on a dry weight basis, the tissue criterion was converted to a dry weight basis. The mercury concentrations are not elevated in these fish.
11	Page 3-37, Section 3.3.5.1, Question A	Were the additional maintenance activities on erosion controls measures standard maintenance, or was this maintenance in response to an observation or event? Is it possible that stormwater represented an ash transport pathway that bypassed the wetland/PTS, representing migration of ash contamination into McCoy Branch and Rogers Quarry that may not have been captured by the PTS effluent monitoring?	Clarification. Erosion control measures are deployed in the channel upstream of the spillway as a routine maintenance BMP intended to reduce the transport of solid materials during stormwater events. Bypass of the PTS occurs when precipitation events have the intensity to generate runoff from the FCAP to the spillway, particularly during the wet season. The results of the FCAP Action Plan were presented in the <i>2019 Remediation Effectiveness Report for the U.S. Department of Energy, Oak Ridge Site, Oak Ridge Tennessee (2019 RER; DOE/OR/01-2787&D2)</i> and included an evaluation of sediment transport from the unit.
12	Page 3-39, Table 3.19	The listed response to Question C in the table is contradictory to the measured contaminants levels in fish tissue. The response states “...there is no evidence the health of fish populations is affected by exposure to ash.” Adverse effects to fish have been measured in literature to occur between 0.2 – 1.0 µg/g mercury in fish. While adverse effects may not be physically evident, these levels of concentrations can affect reproductive success and behavior in fish which can be destructive. Adjust the language in the Question C response to reflect current literature on the effects of elevated contaminant levels (particularly mercury) in fish communities.	Clarification. Fish health metrics have been measured in Rogers Quarry fish for the past 8 years. These metrics included 20 meristic measurements, condition factors, population surveys, and blood chemistry measures (e.g. Brooks et al., 2023). The response to Question C pertains to the FCAP RA. The scope of the FCAP action was source control of the ash to reduce releases from the ash to the environment. The goal of the remedy, as stated in the FCAP ROD, was solely to <i>reduce or eliminate contaminant entry into the Upper McCoy Branch surface waters... and the monitoring was to verify that the passive treatment system reduces contaminant levels in water entering Upper McCoy Branch at least as well as the existing</i>

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			<i>wetlands</i>. As stated previously in the section, additional evaluations, including potential actions, will be addressed in a future ChR ROD. Brooks, SC, Mathews, TJ, Jett, RT, Matson, PG, Jones, MW, Fortner, AM, Lowe, KA, Jones, NJ. 2023. Rogers Quarry Special Studies Report 2003. ORNL/SPR-2023/3058
Section 4.0 Oak Ridge Associated Universities South Campus Facility (ORAU)			
13	Page 4-11, Section 4.1.5.2.2	The VI screening concluded that groundwater concentrations exceed the commercial VISLs. These exceedances suggests that there is a potential for VI to occur and the current remedy may not be protective to the indoor worker in adjacent buildings. Please explain why the results of the VI screening do not impact the protectiveness determination.	Clarification. The concentrations exceed the VISL at a 1E-06 cancer risk or HI of 0.1 but does not exceed at the 1E-05 cancer risk or HI of 1. Therefore, the potential risk via inhalation of vapors is within EPA's Risk Management Range of 1E-06 – 1E-04. Additionally, the exceedances of the VISL are from single detected concentrations in each well (GW-841 and GW-842) with the remaining results being non-detects or less than the screening level. Groundwater monitoring will continue at the South Campus Facility Site.
Section 5.0 Lower East Fork Poplar Creek (LEFPC)			
14	Page 5-14, Section 5.1.4.2.2, second paragraph	While sunfish tissue mercury concentrations decrease below the EPA threshold in the Clinch River a few kilometers downstream of the confluence with Poplar Creek, TDEC DoR-OR has collected largemouth bass fish tissue in the stretch of the Clinch River immediately adjacent to the Poplar Creek input and measured concentrations well-above the EPA threshold for mercury. Largemouth bass feed higher in the food chain than sunfish and are not necessarily directly comparable, but they do represent a target recreational fish species in this area. While these data are sparse at this time, this area of the Clinch River has also been demonstrated in recent years to attract attention from recreational fishers, as documented through the TDEC DoR-OR-led Roving Creel Survey. Please address the potential for recreational exposures immediately adjacent and downstream of ORR discharges.	Original response: Comment noted. The LEFPC ROD only included soil in the 100-year floodplain along LEFPC and the Sewer Line Beltway, terrestrial biota, and groundwater. It did not include CR or PC, nor did it include surface water and aquatic biota in LEFPC. Recreational exposures are outside the scope of the LEFPC ROD. Revised response per 01/16/2025 comment response meeting: Comment noted. The LEFPC ROD only included soil in the 100-year floodplain along LEFPC and the Sewer Line Beltway, terrestrial biota, and groundwater. It did not include CR or PC, nor did it include surface water and aquatic biota in LEFPC. Recreational exposures are outside the scope of the LEFPC ROD. The EFPC Surface Water ROD (FFA Appendix J date FY 2035) will include surface water, creek bank and bed sediments, aquatic biota, and LUCs.

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15	Page 5-14, Section 5.1.4.2.2, fifth paragraph	While methylmercury has decreased in some biota over the last 13 years, that does not appear to be true of all measured biota. Several groups appear to have remained consistent in methylmercury concentrations depending on the site at which they are measured. Update the text to discuss and reflect this variation in trends.	Original response: Comment noted. The information in this section provides a baseline for the future EFPC ROD. This section is not meant to be inclusive of all information. Biota discussed in this section is provided for informational purposes and are not within the scope of the LEFPC ROD. However, temporal trends suggest total, and methylmercury concentrations have remained the same or decreased in biota over the past 13 years, and these decreases were also seen at the Hinds Creek reference site. Revised response per 01/16/2025 comment response meeting: Comment noted. The information in this section provides a baseline for the future EFPC ROD. This section is not meant to be inclusive of all information. Biota discussion in this section is provided for informational purposes and is not within the scope of the LEFPC ROD. Aquatic biota will be included in the EFPC Surface Water ROD (FFA Appendix J date FY 2035). However, temporal trends suggest total, and methylmercury concentrations have remained the same or decreased in biota over the past 13 years, and these decreases were also seen at the Hinds Creek reference site.
16	Page 5-17, Section 5.1.5, Question B (Table 5.6)	There continue to be homeless encampments regularly encountered by TDEC DoR-OR within the LEFPC floodplain and in known mercury hotspots associated with the Bruner site. How is human health risk to these populations being evaluated in this FYR?	Original response: Clarification. As stated in the response to a comment from TDEC on the 2023 RER, the baseline risk assessment included in the LEFPC ROD evaluated potential exposures of children, teens, and adults under residential, agricultural, industrial, and open land use (i.e., recreational) scenarios. These exposure scenarios account for longer exposure durations than would be expected for transient homeless individuals who might camp in the floodplain; therefore, the scenarios included in the LEFPC ROD are more conservative and protective of transient homeless individuals. Revised response per 01/16/2025 comment response meeting: Clarification. As stated in the response to a comment from TDEC on the 2023 RER, the baseline risk assessment included in the LEFPC ROD evaluated potential exposures of

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			children, teens, and adults under residential, agricultural, industrial, and open land use (i.e., recreational) scenarios. These exposure scenarios account for longer exposure durations than would be expected for transient homeless individuals who might camp in the floodplain; therefore, the scenarios included in the LEFPC ROD are more conservative and protective of transient homeless individuals. The residential scenario risk calculation is much more conservative than a trespasser, e.g. the residential scenario assumed 26 years of exposure for 365 days a year, while the recreational scenario assumed four years of exposure for 75 days a year.
17	Page 5-18	Response to Question C in the table states that the remedial action objectives (RAOs) remain protective of ecological receptors. Several biota receptors have measured mercury bioaccumulation concentrations above the EPA AWQC for fish (0.3 mg/kg). Elevated levels of methylmercury in biota have been shown to have various adverse effects on those communities (e.g., reproduction, reproductive success, behavior, etc.). Explain how these RAOs are protective despite elevated levels of mercury and methylmercury in biota communities.	Comment noted. The LEFPC ROD scope does not include fish; the stated studies are for terrestrial receptors associated with the floodplain. As stated in the section extensive studies were conducted for terrestrial receptors and are included in the 2016 and 2021 FYRs.
18	Page 5-21, Section 5.1.5.2.2, first paragraph	Areas within the LEFPC floodplain continue to be used for homeless encampments in recent years. TDEC DoR-OR continues to observe both members of the homeless community as well as their campsites during routine monitoring activities in these areas. Please address this risk pathway associated with the change in land use here, in addition to continued standard residential development.	Comment noted. Please see response to Comment 16, above.
19	Page 5-21, Section 5.1.5.2.2, last sentence	Please edit the final sentence to include a very high-level conclusion regarding the concern for overbank sediment deposition and recontamination of the remediated floodplain soils. Details can be reviewed in the 2021 FYR document, but it would be helpful to address the conclusions of the study of the potential for	Clarification. Appendix E.4 of the 2021 FYR provided an assessment of the LEFPC floodplain remediated areas and the potential recontamination through overbank sediment deposition. This assessment concluded that "LEFPC recontamination with total mercury at concentrations greater than the 400-ppm

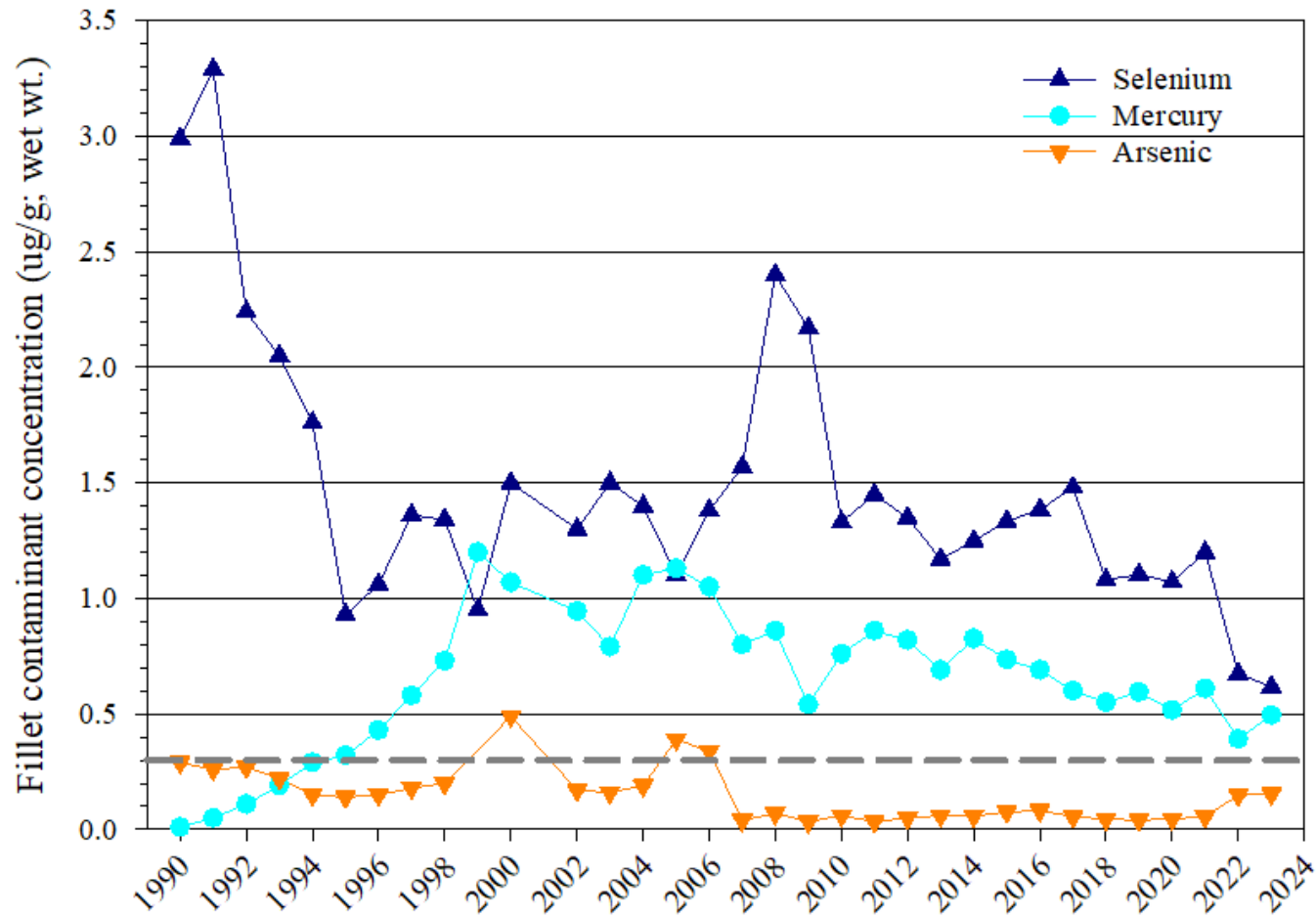
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		recontamination in full here to complete the answer/discussion addressing Question B.	cleanup level is very unlikely to occur under current conditions, as evidenced by: • Estimation of the mercury concentration in suspended sediment transport at Station 17. • Review of streambed and streambank sediment mercury concentrations." To confirm this conclusion, FY 2023 flow-paced composite data from Station 17 was evaluated to calculate the concentration of mercury associated with the solids collected in the autosampler. The average mercury concentration associated with the solid materials was approximately 30 ppm (median of about 26 ppm). A box plot of the 51 composite samples is provided at the end of this CRF. This concentration of solids is less than the East Fork stream bank mercury concentrations in EFK reaches EFK 16 - 20 and EFK 20- 23 (ORNL/TM-2016/134 Table 15) and is within the lower ranges of floodplain surface mercury concentrations (ORNL/TM-2016/134, Table 16). Although transport of the solids from UEFPC to LEFPC is significant as bedload and suspended load (the Station 17 autosampler intake is positioned just above the streambed), the potential for significant additional mercury deposition as overbank deposition is small relative to existing LEFPC mercury associated with streambanks and the floodplain surface. Reference: <i>ORNL/TM-2016/134 Evaluation of Lower East Fork Poplar Creek Mercury Sources March 2016, Watson et al.</i>
20	Page 5-22, Section 5.1.7	EPA has disagreed with the protectiveness statement of "protective of human health and the environment" for the last couple of FYRs. The protectiveness statement remains the same in this current FYR, but there has been little to no discussion of how EPA's concerns have been resolved regarding the changes in the food chain and risk assessment modeling implemented during the 2021 FYR. Please provide some additional information on how this disagreement on protectiveness has been addressed to support this protectiveness statement for LEFPC.	Original response: Comment noted. DOE responded to EPA's concerns about LEFPC. DOE's summarization in response to prior EPA comments are in prior FYRs. Please refer to FYR guidance on differing protectiveness statements between the lead agency and EPA. Revised response per 01/16/2025 comment response meeting: Comment noted. This decision was a risk-management decision led by citizens of Oak Ridge, who advocated increasing the clean-up level to 400 ppm for ecological as well as human receptors. This risk management decision and public

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			participation process resulted in less soil removal, less harm to the environment, and significant cost savings, and was lauded by DOE, EPA, and the public. The additional site-specific investigations and thorough statistical evaluation performed following EPA's deferred protectiveness statement for LEFPC in the 2011 FYR and subsequently presented in the 2016 and 2021 FYRs demonstrate that the assumptions at the time of the remedy and at present remain within the risk range decided in the ROD. Please refer to FYR guidance on differing protectiveness statements between the lead agency and EPA.
Appendix A: Site Visits			
No comments.			
Appendix B: Applicable Relevant and Appropriate Requirement (ARAR) and Human Health Risk Updates			
21	Page B-20, Section B.3.4.2	The updated VI screening for the EEVOC plume appears to be limited to groundwater wells located on the distal edge of the plume. Groundwater concentrations are much higher near the source area and the potential for VI is much greater in that area. Please explain why the screening was not conducted across the footprint of the plume and revise the VI screening to address the entire plume area.	Clarification. The VI evaluation was limited to the portion of the plume extending outside of the plant boundary where members of the public could be exposed. There are currently no buildings within the Y-12 Plant over the EEVOC Plume.
Appendix C: Property Transfers for UEFPC Watersheds			
No comments.			
Appendix D: Certificate of LUC Implementation for Fiscal Year 2023			
No comments.			
Appendix E: Fiscal Year 2022 UNC Engineering Evaluation Report			
No comments.			

TDEC Comment 9. Figure 6.7 from 2024 RER showing the average FY 2023 arsenic concentration reported correctly to one half the MDL:



Dashed gray line indicates federal-recommended AWQC for mercury in fish fillets (0.3 µg/g). Note these are screening criteria.

Figure 6.1. Mean concentrations of selenium, mercury, and arsenic in fillets of largemouth bass from Rogers Quarry, 1990–2023 (n = 6 fish/year).

TDEC Comment 19. Box plot showing the average mercury concentration associated with the solid materials was approximately 30 ppm (median of about 26 ppm):

