DOE/OR/01-2949&D2

Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee

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E.0525.031.0109

DOE/OR/01-2949&D2

Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee

Date Issued—April 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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PREFACE

This *Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (Main Plant Area [MPA] Interim Record of Decision [IROD]) has been prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, to present the public with the selected interim remedy for groundwater remediation at the East Tennessee Technology Park. This MPA IROD documents the selected remedy agreed on by the U.S. Department of Energy, U.S. Environmental Protection Agency, and Tennessee Department of Environment and Conservation and contains the Responsiveness Summary addressing public comments received during the Proposed Plan review period. This decision is based on the contents of the Administrative Record file for this project and relies on information from the *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2) and the *Proposed Plan for an Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2921&D2/R1).

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ACRONYMS

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CMP	Comprehensive Monitoring Plan
COC	contaminant of concern
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
CWTS	Chromium Water Treatment System
DCA	dichloroethane
DCE	dichloroethene
DNAPL	dense, non-aqueous-phase liquid
DOE	U.S. Department of Energy
EISB	enhanced in situ bioremediation
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
EVO	emulsified vegetable oil
FFA	Federal Facility Agreement
FFS	focused feasibility study
FLUTe™	Flexible Liner Underground Technologies, LLC™
FS	feasibility study
FYR	Five-Year Review
GAC	granular activated carbon
gpm	gallons per minute
HEU	highly enriched uranium
HI	hazard index
IROD	Interim Record of Decision
ISSM	in situ soil mixing
ISTT	in situ thermal treatment
LEU	low enriched uranium
LGAC	liquid-phase granular activated carbon
LUC	land use control
LUCIP	Land Use Control Implementation Plan
MCL	maximum contaminant level
MPA	Main Plant Area
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act of 1969
NPL	National Priorities List
O&M	operation and maintenance
OREM	Oak Ridge Office of Environmental Management
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
PCE	tetrachloroethene
PDI	pre-design investigation
RAR	Remedial Action Report

RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act of 1976
RD	remedial design
RDR	Remedial Design Report
RDWP	Remedial Design Work Plan
RER	Remediation Effectiveness Report
RI	remedial investigation
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act of 1974
SSL	soil screening level
TCA	trichloroethane
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
UU/UE	unlimited use/unrestricted exposure
VC	vinyl chloride
VGAC	vapor-phase granular activated carbon
WP	Work Plan
WRRP	Water Resources Restoration Program
Y-12	Y-12 National Security Complex
ZVI	zero-valent iron

PART 1. DECLARATION

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1.1 SITE NAME AND LOCATION

East Tennessee Technology Park (ETTP) Main Plant Area (MPA) Groundwater
Oak Ridge Reservation (ORR) (U.S. Department of Energy [DOE]) National Priorities List (NPL) Site
Oak Ridge, Tennessee
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Information System Identification TN1890090003

1.2 STATEMENT OF BASIS AND PURPOSE

This *Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (MPA Interim Record of Decision [ROD] [IROD]) presents the selected interim remedial action for six chlorinated volatile organic compound (CVOC) plumes in ETTP MPA groundwater in Oak Ridge, Tennessee. This interim action is chosen in accordance with CERCLA (as amended by the Superfund Amendments and Reauthorization Act of 1986 [SARA]) and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the site. The interim remedy is intended to reduce the mass of contaminants in the most concentrated parts of the plumes that may serve as a source for associated dissolved-phase contamination. This interim action addresses some of the highest concentrations of CVOCs, primarily trichloroethene (TCE), in MPA groundwater. Other contaminants of concern (COCs) have been identified in the MPA and will be addressed as part of ongoing efforts to identify final remedial actions for the site.

This document is issued by DOE, as the lead agency. The U.S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC) are support agencies as parties of the Federal Facility Agreement (FFA) for this response action. DOE and EPA have jointly selected the remedy for the site. TDEC concurs with the selected remedy.

Implementing this interim action will (1) help further define the extent of the six plumes, (2) reduce the concentration of CVOCs in the high-concentration areas of each plume, and (3) provide technology performance information that will be used in selecting final actions for these and other plumes at the site. Treating the high-concentrations plume source areas will not return the groundwater to unrestricted use. The selected remedy is an interim remedy, and land use restrictions will be required until groundwater contamination concentrations are below federal and state maximum contaminant levels (MCLs) and Tennessee groundwater quality criteria and the remedy is protective for all uses. The interim land use controls (LUCs) that are already in place at the site and selected in this MPA IROD will continue in effect and remain enforceable as part of the selected CERCLA remedy until such time as they may be changed by a future CERCLA decision. DOE has developed a *Land Use Control Assurance Plan for the Oak Ridge Reservation* (DOE/OR/01-1824&D0) to help ensure land use restrictions are maintained and periodically verified. DOE has also developed the *East Tennessee Technology Park Administrative Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2477&D4; ETTP Remedial Action Report [RAR] Comprehensive Monitoring Plan [CMP]) that documents and tracks all interim LUCs. Compliance with these requirements is tracked annually in the ORR Remediation Effectiveness Report (RER) and in Five-Year Reviews (FYRs). DOE will maintain LUCs until concentrations of hazardous substances in the soil and groundwater are at such levels to allow for unlimited use/unrestricted exposure (UU/UE) or goals set forth in a final remedy are achieved. DOE is responsible for maintaining, monitoring, and enforcing such LUCs, including in the case these procedural responsibilities are assigned to another party by contract, property transfer agreement, or through other means. In these instances, DOE shall retain ultimate responsibility for remedy integrity.

Activities identified in this MPA IROD will be implemented and funded in accordance with the *Federal Facility Agreement for the Oak Ridge Reservation* (DOE/OR-1014; ORR FFA). The public will be

informed and involved in a timely manner in the CERCLA decision-making processes, consistent with requirements of CERCLA, the NCP, the ORR FFA, and the *Public Involvement Plan for CERCLA Activities at the U.S. Department of Energy Oak Ridge Site* (OREM-22-7619). Information supporting the selected remedy is contained in the Administrative Record file found at the Office of Scientific and Technical Information, 1 Science.gov 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. This information is also available online. (Note the link will be provided in the Final IROD.) Documents pertaining to implementing and performing the interim remedial actions, including the annual ORR RER and FYRs, will be placed in a post-ROD file, which will be available to the public.

1.3 ASSESSMENT OF SITE

ETTP (formerly referred to as the Oak Ridge K-25 Site or the Oak Ridge Gaseous Diffusion Plant [ORGDP]) is located on the DOE ORR in Oak Ridge, Tennessee (Figure 1.1). The MPA is that portion of ETTP that generally coincides with the original 1945 footprint of the K-25 Site and includes most of the major facilities associated with the uranium enrichment process, chemical processing, and operational support activities. The MPA at ETTP is shown in Figure 1.2.

This MPA IROD addresses six CVOC source areas that are generally named for former buildings in the area of the plumes: Mitchell Branch Comingled Plume/K-1407-B, K-1401, K-25/K-1024, K-1035, K-27/K-1232, and K-1239, as shown in Figure 1.3. Additional areas of groundwater contamination are also shown on the figure and discussed in Chapter 2. Exposure unit numbers are associated with the *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2; Zone 2 Soil ROD) and are included on the figure to facilitate cross-referencing the plume nomenclature with the exposure unit numbers when cited in the document.

Releases of hazardous substances from the CVOC groundwater sources addressed by this MPA IROD present an endangerment to public health, welfare, or the environment. If land use restrictions that prevent access to or use of groundwater are maintained as directed by the MPA IROD, then on-site exposure to the public is minimized. If, however, contaminants leaching from these sources migrate toward off-site locations, additional remedial action may be warranted. A final remedial action will be taken in the future, if warranted, to address any unacceptable risk remaining at the conclusion of this interim action.

1.4 DESCRIPTION OF SELECTED REMEDY

The selected remedy for this MPA IROD is active treatment using enhanced in situ bioremediation (EISB) at the six CVOC groundwater plumes. Bioremediation is an engineered technology that modifies environmental conditions to encourage microorganisms to destroy or detoxify organic contaminants in the environment. The selected remedy includes continuation of LUCs that are currently in place at ETTP, specifically deed restrictions preventing groundwater use. This selected remedy is based on current information and satisfies the requirement to incorporate public comment.

Soil excavation projects implemented as required by the Zone 2 Soil ROD are addressing the principal threat(s) posed by soil sources that have contributed to the groundwater plumes. This MPA IROD further addresses principal threats posed by the contaminant sources that remain below the water table and/or within bedrock at the six CVOC groundwater plumes. Additional areas of concern will be identified and evaluated as part of the future MPA groundwater investigations.

Components of the interim remedy include the following:

- Additional data collection activities as part of a pre-design investigation (PDI) designed to help delineate the areas of contamination > 1000 µg/L of individual CVOCs or 400 µg/L of vinyl chloride (VC). This work will be scoped and performed under a Remedial Design (RD) Work Plan (WP) (RDWP).

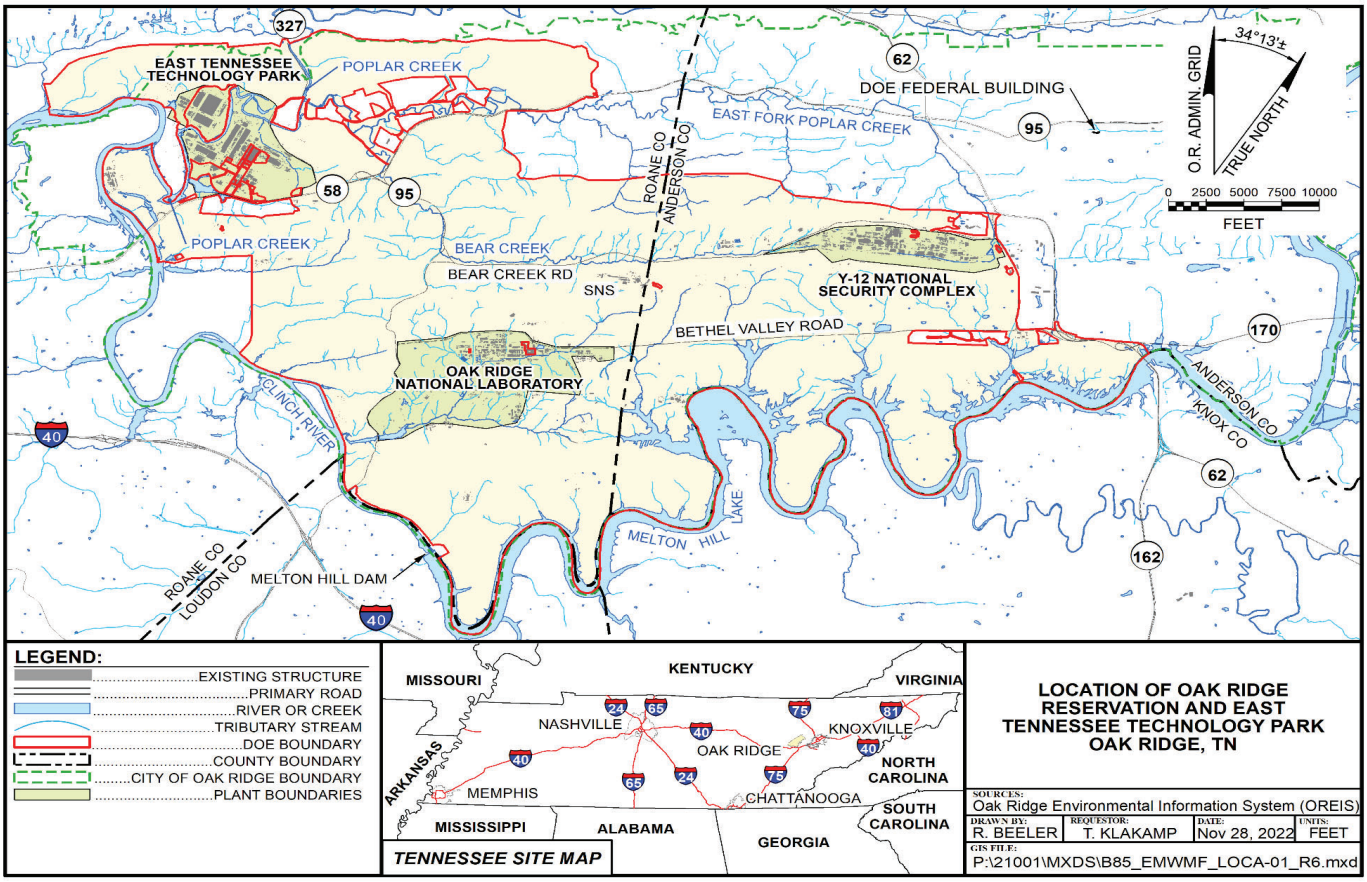

Figure 1.1. DOE ORR.

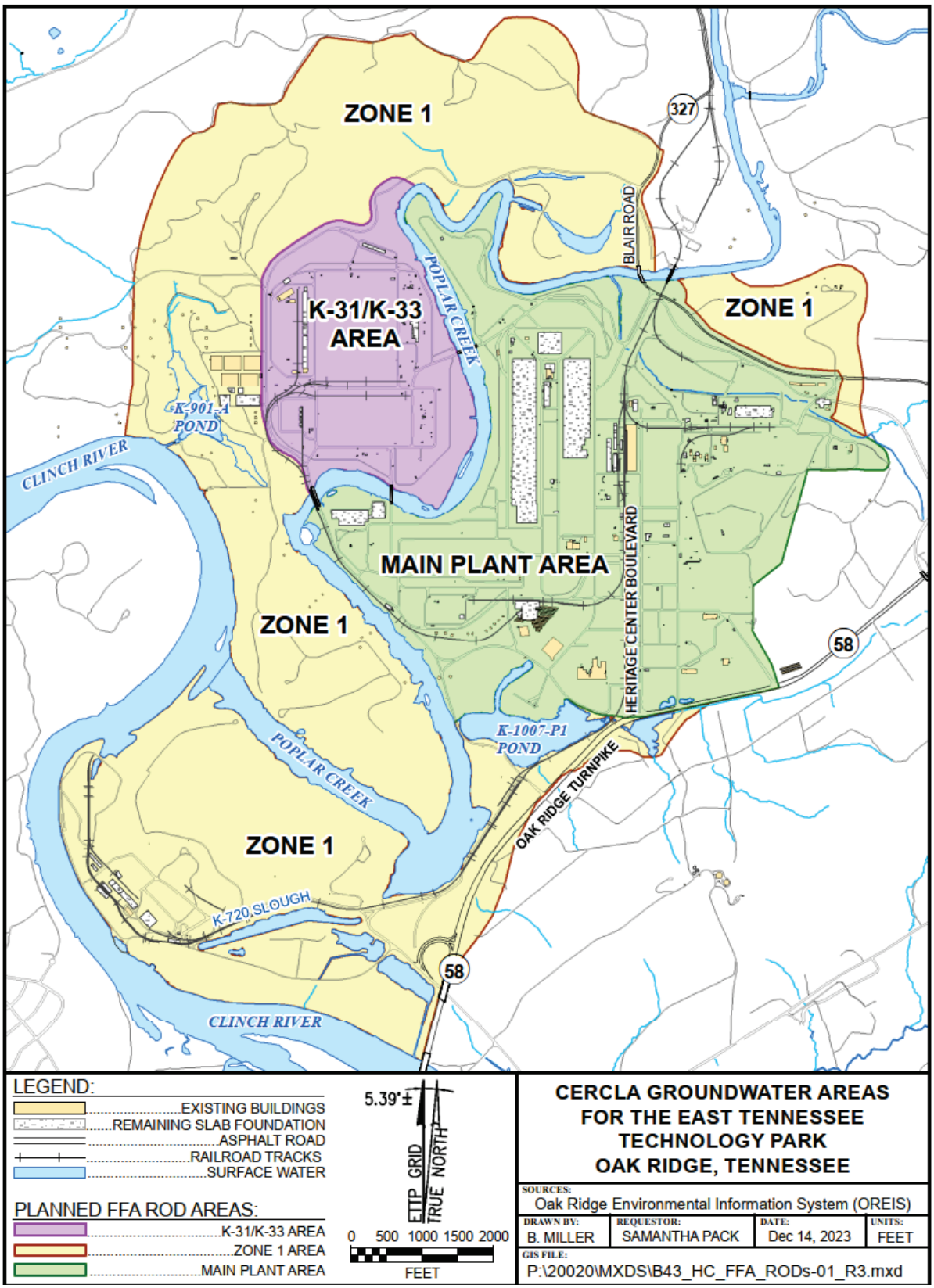

Figure 1.2. Location of MPA at ETTP.

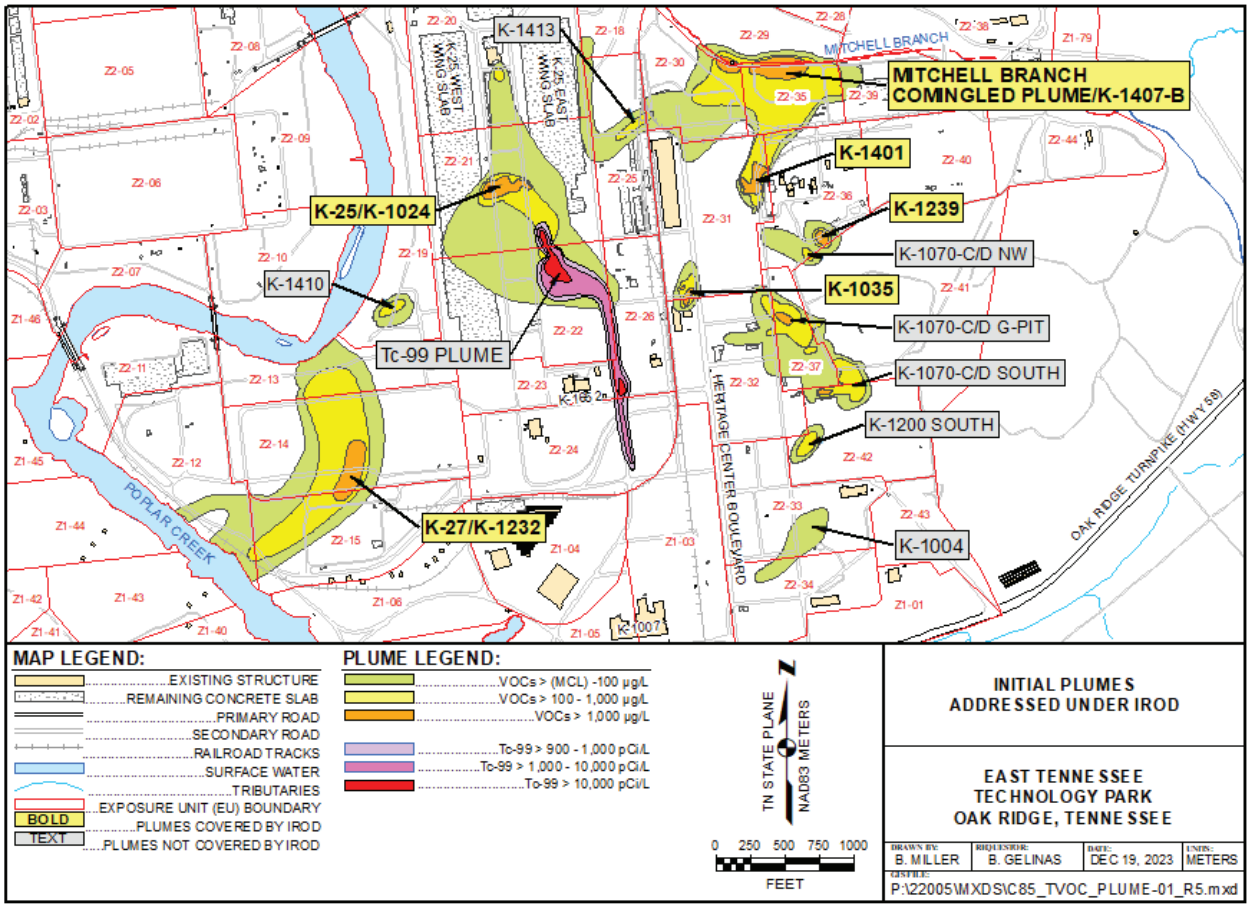

Figure 1.3. Groundwater source areas addressed in this MPA IROD based on data available for the MPA FFS, with exposure unit boundaries.

- As part of the PDI, groundwater wells and piezometers will be installed in the unconsolidated zone and bedrock to bound the horizontal and vertical extents of the plumes to design the EISB injection network. The PDI work will also involve sampling and analysis of geochemical and microbial parameters to assess the amendment substrate types that will be used.
- The PDI results, remedial action design, and remedial action implementation plan will be documented in an RD Report (RDR)/Remedial Action WP (RAWP).
- The RDR/RAWP will identify the injection well network well depths and screen intervals, carbon substrate that will be used, and injection rates of the substrate.
- The substrate used for injections is assumed to be commercially available, food-grade emulsified vegetable oil (EVO). Other substrates could also be used (e.g., EVO with zero-valent iron [ZVI]), and/or the EVO might be amended with other organics (e.g., lactate) plus buffers and bioaugmentation cultures.
- Remedial action fieldwork implementation includes drilling the injection wells and any additional associated performance monitoring wells and establishing the substrate delivery system.
- Operation and maintenance (O&M) activities include injections and follow-on groundwater monitoring. Due to the size and number of contaminant source areas addressed under this MPA IROD, activities will start with one plume source and move from site to site. Injections are not anticipated to occur simultaneously at more than one source area. For cost-estimating purposes, a second round of injections was assumed to begin at year 2 or 3, after all source areas have received the initial injections. The second round of injections will be followed by a 3-year period of post-injection monitoring.
- Post-injection monitoring will occur on a routine basis, with a focus on TCE and its breakdown products, as well as additional CVOCs and bioremediation metrics, as defined and approved by the FFA parties in an RDR/RAWP.
- As operations progress, optimizations of the injections may be carried out based on monitoring data. These optimizations would be designed to target treatment reagent distribution, reagent concentration, and resulting changes in microbial populations and geochemistry; optimization could include additional injections and changing the substrate mixture to optimize delivery to more challenging intervals within the formation.
- Annual reporting will occur either as part of the annual ORR RER or in a stand-alone document to be determined.
- This interim remedy is assumed to be evaluated for a 5-year period, starting from completion of the last injection area.

This interim decision was supported by the *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2; MPA Focused Feasibility Study [FS] [FFS]) that evaluated a limited set of alternatives for which there have been considerable implementation experiences for similar site conditions and similar contaminants. As work progresses on this interim action, DOE simultaneously will be performing the steps required under CERCLA to identify the final actions for the MPA, as further discussed in Part 2 of this MPA IROD. This interim response action fits into the overall groundwater remediation strategy for the MPA by initiating groundwater restoration via interim action while additional data are collected and evaluated for the MPA. ETTP is the first site on the ORR to implement full-scale groundwater remediation under an IROD.

1.5 STATUTORY DETERMINATIONS

The selected interim remedy for this MPA IROD is protective of human health and the environment. This interim remedy is cost effective and satisfies the statutory preference for permanent solutions through treatment.

The interim remedy is consistent with any eventual final remedy, which, per the NCP, will restore groundwater to its beneficial use unless a waiver is invoked consistent with 40 Code of Federal Regulations (CFR) 300.430(f)(1)(ii)(C).

During the IROD period, protectiveness is achieved through a combination of ongoing LUCs and monitoring to ensure there are no exposures to unacceptable contaminant levels in groundwater. The action also removes contamination mass to address potential longer-term exposures.

The selected interim remedy is not intended to meet chemical-specific requirements of the Safe Drinking Water Act of 1974 (SDWA)[1] or Tennessee numeric or narrative groundwater quality criteria[2]. Under the NCP at 40 CFR 300.430(f)(1)(ii)(C)(1), an alternative that does not meet an applicable or relevant and appropriate requirement (ARAR) may be selected when the alternative is an interim measure and the ARAR will be attained or waived as part of a total (i.e., final) remedial action. Thus, a waiver under CERCLA 121(d)(4)(A) is being invoked as part of this remedy because the MCLs under the SDWA and Tennessee groundwater quality criteria will not be met; however, the remedy will meet all applicable or relevant and appropriate action-specific and location-specific requirements. A final ROD (or RODs) for the MPA will demonstrate compliance with all federal and state requirements that are identified as ARARs, including any potential ARAR waivers.

Because this selected remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE, a statutory review will be conducted within 5 years after initiation and at least every 5 years to ensure the remedy is protective of human health and the environment, as long as hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE remain. DOE will submit the results of these FYRs in accordance with the requirements of CERCLA, the NCP, and the ORR FFA for the Oak Ridge NPL Site.

1.6 INTERIM RECORD OF DECISION CERTIFICATION CHECKLIST

The following information is included in Part 2 of this MPA IROD:

- COCs and their respective concentrations (Section 2.5).
- Baseline risk represented by the COCs (Section 2.7). Because this is an IROD, a final MPA groundwater baseline risk assessment will need to be performed as part of a final ROD (or RODs) for the MPA, using the additional characterization data proposed to be collected as part of this MPA IROD.
- Target performance treatment levels established for COCs and the basis for the levels (Section 2.8).
- Current and future land and groundwater use assumptions used in the baseline risk assessment and IROD (Section 2.6) and land use restrictions that will remain in place during IROD implementation (Section 2.9).
- Decisive factor(s) that led to selecting the remedy (Section 2.12).

[1]Federal SDWA MCLs listed in 40 CFR 141.61(a) and 40 CFR 141.62(b), and Tennessee SDWA MCLs listed in TDEC 0400-45-01-.06 and TDEC 0400-45-01-.25.
[2]Tennessee groundwater quality criteria listed in TDEC 0400-40-03-.03.

- Estimated capital, O&M, and total present-worth costs; discount rate; number of years over which the remedy cost estimates are projected; and non-discounted, constant-dollar alternative comparison if appropriate (Section 2.12).

- Manner in which any source material constituting principal threat is addressed (Section 2.13).

Additional information regarding ETTP, ORR, and the MPA can be found in the Administrative Record generated and approved by the three FFA parties for this MPA IROD.

APPROVALS

Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee DOE/OR/01-2949&D2 April 2024

JOHN MULLIS Digitally signed by JOHN MULLIS Date: 2024.04.18 11:26:00 -04'00'

John A. Mullis II, Manager — Date
Oak Ridge Office of Environmental Management
U.S. Department of Energy

Greg Young, Deputy Commissioner — Date
Bureau of Environment
Tennessee Department of Environment and Conservation

Caroline Freeman, Director — Date
Superfund and Emergency Management Division
U.S. Environmental Protection Agency, Region 4

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PART 2. DECISION SUMMARY

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2.1 SITE NAME, LOCATION, AND DESCRIPTION

ETTP MPA Groundwater
ORR (DOE) NPL Site
Oak Ridge, Tennessee
CERCLA Information System Identification TN1890090003

The 32,465-acre, DOE-owned ORR is located within the city limits of Oak Ridge, Tennessee, which is approximately 12.5 miles west-northwest of Knoxville, Tennessee, in Roane and Anderson Counties (Figure 1.1). The ORR is bounded to the south and west by the Clinch River and to the east and north by the developed residential/business portion of the city of Oak Ridge. There are three major federal research and production installations at the ORR that are managed by DOE. The three installations were originally constructed on the ORR as part of the World War II-era Manhattan Project and include the Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12), and ETTP (formerly referred to as the Oak Ridge K-25 Site or the ORGDP). Historic operations at all three installations resulted in waste disposal areas as well as soil, surface water, sediment, groundwater, and buildings contamination. Consequently, the ORR was placed on the CERCLA NPL in 1989.

DOE is the lead agency for this action and is responsible for environmental restoration activities on the ORR (DOE) NPL Site under its Office of Environmental Management Program at the national level, and locally under the Oak Ridge Office of Environmental Management (OREM) Program. The OREM Program is responsible for eliminating any significant hazards to human health and the environment associated with contamination. Environmental restoration activities on the ORR (DOE) NPL Site are performed in accordance with CERCLA and the NCP.

OREM cleanup efforts have recently focused on cleaning up ETTP. ETTP's principal mission was uranium enrichment, which occurred from 1945–1987. In 2020, demolition of all buildings covered under CERCLA was completed. Environmental media remaining at ETTP, including soil, groundwater, surface water, sediment, and biota, currently are being cleaned up to allow for beneficial reuse. This interim action focuses on six specific sources of groundwater plumes in the MPA of the ETTP site (Mitchell Branch Comingled Plume/K-1407-B, K-1401, K-25/K-1024, K-1035, K-27/K-1232, and K-1239). The MPA is that portion of ETTP that generally coincides with the original 1945 footprint of the K-25 Site and includes most of the major facilities associated with uranium enrichment, chemical processing, and operational support activities. The MPA at ETTP is shown in Figure 1.2.

DOE has completed numerous CERCLA documents to support information presented in this MPA IROD and has submitted those documents to EPA and TDEC for review. With the exception of the *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1778&D1; 1999 Remedial Investigation [RI]); the *Final Sitewide Remedial Investigation and Feasibility Study for East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2279&D3; 2007 Sitewide RI); and the *East Tennessee Technology Park Main Plant Groundwater Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2835&D1; MPA FS), all other CERCLA documents cited in this MPA IROD have been approved by EPA and TDEC. Any use of information from those unapproved documents in this MPA IROD is considered appropriate and accurate.

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

ETTP occupies approximately 5000 acres of the ORR. Areas potentially impacted by site activities account for roughly 2200 of the 5000 acres. ETTP's original mission was to supply enriched uranium material for nuclear weapons. From 1945–1964, gaseous diffusion technology was used to enrich uranium for use in nuclear weapons. There were five primary process buildings (K-25, K-27, K-29, K-31, and K-33) where

highly enriched uranium (HEU) and low-enriched uranium (LEU) were produced. In 1964, HEU production was discontinued and the K-25 and K-27 process buildings were shut down.

Over the next 20 years, ETTP's primary mission was LEU production for fabrication into fuel elements for commercial and research nuclear reactors. Secondary missions in the mid-1980s included research on new technologies for uranium enrichment (e.g., gas centrifuge and laser isotope separation). In 1985, because of a decline in the demand for enriched uranium, DOE placed ETTP in standby mode. ETTP was shut down permanently in 1987. Currently, DOE activities at ETTP include environmental cleanup and reindustrialization efforts. Portions of ETTP are used for non-DOE industrial activities.

ETTP operations resulted in a legacy of inactive and contaminated facilities, waste disposal areas, and contaminated media, including the following:

- buildings
- buried wastes
- buried tanks
- underground waste lines
- scrap and debris
- surface and subsurface soils
- groundwater
- surface water and sediment

Early investigations of hazardous releases from contaminant source areas at ETTP were initiated to meet the requirements of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984, and CERCLA. Early remedial actions addressed a variety of sites that were identified as having ongoing releases to the environment. A listing of these actions is available in the annual ORR RER and the *2021 Fifth CERCLA Five-Year Review of the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee* (DOE/OR/01-2895&D1). All the buildings at ETTP under CERCLA removal authority have been demolished. The early actions and facility demolition are complete.

Another set of key decisions at ETTP addressed soil, buried waste, and subsurface structures. For the purposes of these decisions, ETTP was divided into two geographical areas (Figure 2.1)—Zone 1, consisting of approximately 1400 acres outside the original fence line of the main processing/industrial area, and Zone 2, the processing/industrial area inside the original fence line. Historically, Zone 1 was mostly undeveloped, but portions were used for industrial purposes in the former Powerhouse area and for waste disposal. Zone 2 is the main plant production area associated with heavy industrial use as well as waste treatment and disposal. For the purpose of groundwater decisions, the Zone 2 area has been divided into the Main Plant and K-31/K-33 Areas.

Characterization and remedial actions for soil, buried waste, and subsurface structures in Zone 1 were implemented under the *Record of Decision for Interim Actions in Zone 1, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1997&D2; Zone 1 Soil IROD), as amended. The approved *Amendment to the Record of Decision for Interim Actions in Zone 1 for Final Soil Actions, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2817&D3) added protection of ecological receptors in the terrestrial environment, given that much of Zone 1 is undeveloped and is viable ecological habitat. The Zone 1 Soil IROD remedial actions are complete. DOE is in the process of finalizing the Final Zone 1 Soil ROD for no further action for Zone 1 soil.

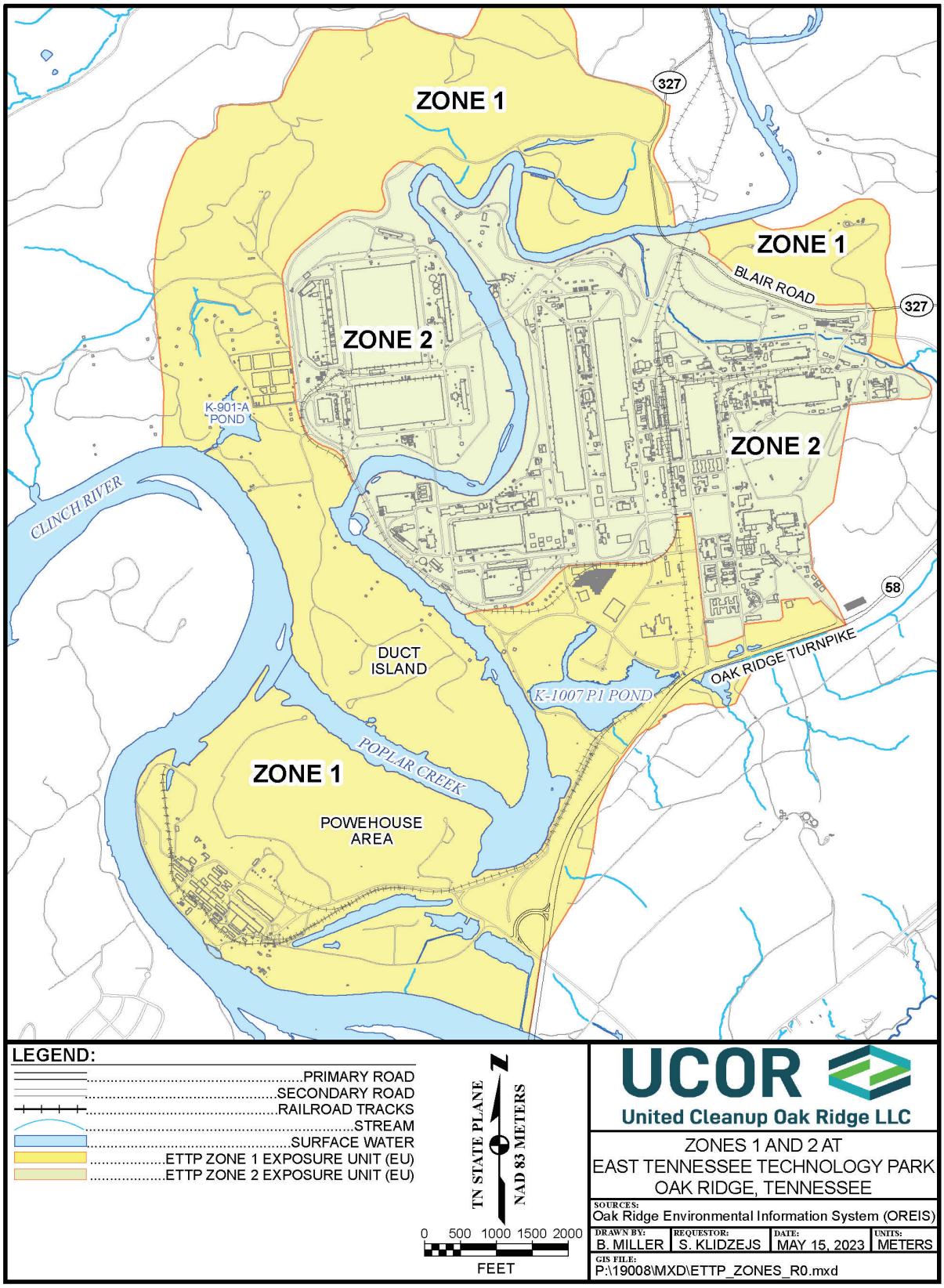

Figure 2.1. Zone 1 and Zone 2 areas at ETTP.

Remedial actions in Zone 2 are in progress, and all required soil excavations are anticipated to be completed by September 2025. Actions under both the Zone 2 Soil ROD and the Zone 1 Soil IROD are based on protecting both human health and the environment, including requirements to remove soil that poses an unacceptable risk to industrial workers or is determined to be a source to groundwater contamination. Neither ROD includes actions that extend below the water table (or below the top of bedrock). An ETTP sitewide surface water/sediment/remaining ecology investigation is currently being conducted under the EPA- and TDEC-approved *Remedial Investigation Work Plan for Remaining Ecology/Surface Water/Sediment at East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2912&D2). Any required remedial actions will be completed under a ROD that follows this work.

As described above, remaining CERCLA decisions at ETTP will address contamination in saturated soil; below the water table and in bedrock groundwater; soil vapor; surface water; and sediment in the ponds, wetlands, and perennial streams.

DOE, EPA, and TDEC understand and agree the interim remedy reflected herein is dependent, in part, on DOE's implementation of specific LUCs. The ETTP RAR CMP outlines institutional controls on groundwater usage that will remain in place through deed restrictions filed in the transfer deeds. The ETTP RAR CMP states, "In the event of property transfer, DOE will ensure that DOE's property disposal agent incorporates the Land Use Control (LUC) objectives into restrictive covenant languages in the deeds transferring the property… The deeds will contain appropriate provisions to ensure the restrictions continue to run with the land and are enforceable by DOE." Refer to Table 6.24 (Section 6.24) in the ETTP RAR CMP for LUC requirements for transferred properties.

In accordance with DOE policy, to the extent practicable, National Environmental Policy Act of 1969 (NEPA) values have been incorporated throughout the CERCLA process, culminating in this MPA IROD. Separate NEPA documentation will not be issued.

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

DOE has participated in public engagement activities while selecting this interim action. DOE has met with the Oak Ridge Site-Specific Advisory Board, a community-based advisory organization established to provide recommendations to DOE on remediation decisions on the ORR (DOE) NPL Site.

As required in CERCLA Section 117(a), 42 United States Code 9617(a), and the NCP at 40 CFR 300.430(f)(3)(i), DOE published a public notice of availability for the *Proposed Plan for an Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2921&D2/R1; MPA Proposed Plan) in *The Oak Ridger*, *Knoxville News-Sentinel*, *Loudon County News-Harriman Record*, *Rockwood Times*, and other local newspapers within the region. The public notice established a public comment period from April 5, 2023, to May 19, 2023. A formal public meeting was held on April 25, 2023, to present the preferred alternative described in the Proposed Plan and solicit public input. All comments on the Proposed Plan are presented as received; the comments and their responses are included in Part 3 of this MPA IROD.

This interim remedy was chosen in accordance with CERCLA, as amended by SARA and the NCP. This decision was based on the Administrative Record prepared for this project. The principal documents supporting this MPA IROD include the following:

- The MPA FFS.
- The MPA Proposed Plan.

Two previous CERCLA RI efforts also played a role in identifying the areas and contaminants covered by this MPA IROD—the 1999 RI and the 2007 Sitewide RI. All these documents and other information supporting selection of this remedy can be found at the DOE Information Center, at the Office of Scientific and Technical Information, 1 Science.gov Way, Oak Ridge, Tennessee, 37830, (865) 241-4780.

2.4 SCOPE AND ROLE OF REMEDIAL ACTION

The strategy for cleaning up legacy contamination at ETTP has been implemented in phases:

- The initial cleanup effort focused on areas of known releases to stop ongoing releases to the environment.
- An accelerated closure project was implemented under removal authority to remove all contaminated buildings.
- As buildings were demolished, soil remedial actions began, including soil excavation of groundwater plume sources.

Once all primary soil source materials have been excavated down to the water table or bedrock, whichever is encountered first, this MPA IROD will begin remediating the plume contaminant source material that still resides below the water table or in bedrock. The scope covered by the proposed interim action is six specific areas of groundwater contamination (i.e., groundwater plumes) located below the water table in the saturated zone in the unconsolidated weathered soil/rock and in the bedrock.

The specific six areas are CVOC groundwater plume areas where contaminant concentrations exceed 1000 µg/L of individual CVOCs or 400 µg/L of VC. These plumes generally are named for former buildings in the area of the contamination and include (Figure 1.3):

- Mitchell Branch Comingled Plume/K-1407-B
- K-1401
- K-25/K-1024
- K-1035
- K-27/K-1232
- K-1239

For the six sites covered by this MPA IROD, the primary soil sources associated with the groundwater plumes have been or are being excavated above the water table under the Zone 2 Soil ROD, as shown in Table 2.1. Completion of the soil work sets the stage for the next phase of work below the water table.

The area and mass of contamination that fall within the scope of this MPA IROD in each of the six areas currently are defined by the data available for the MPA FFS (data collected prior to September 2019). Prior to implementing EISB, DOE will perform PDIs to further delineate the final areas for injections system design purpose. The current understanding of the conceptual site models (CSMs) for the six areas is provided later in this section. When the PDI is developed, it will consider all data collected since documentation of the CSM, described below, in the MPA FFS.

Table 2.1. Zone 2 soil source actions related to MPA plumes

Groundwater area of contamination	Zone 2 source action	Excavation volume (yd^3)
Mitchell Branch Comingled Plume/K-1407-B	Exposure Unit Z2-35 Area 2 (PCE)	850
	K-1407-B Holding Pond	1000
K-1401	Degreasers, acid baths and dip tanks, and other degreasing infrastructure removed during demolition of K-1401	--
K-25/K-1024	Exposure Unit Z2-21	70,000[a]
K-1035	Pits, drain lines, and soil removed (2009)	2540
K-27/K-1232	K-631 north TCE	19,000[a]
	K-131 north TCE	
	Tank Farm Area TCE	
	K-413 southeast TCE	
K-1239	No CVOCs identified in Zone 2 soils	--

[a]Estimated total volume. Work is in progress at the time of this MPA Interim Record of Decision.

CVOC = chlorinated volatile organic compound
MPA = Main Plant Area
TCE = trichloroethene
PCE = tetrachloroethene

There are additional groundwater plumes at ETTP as well as surface water, sediment, and ecological media that will need to be addressed under CERCLA concurrent with implementing the scope of this interim action. This MPA IROD does not address those additional resources. Separate RODs are planned to address the remaining scope, including:

- Remaining contaminants in the MPA
- K-31/K-33 Area groundwater
- Areas of concern in Zone 1 groundwater
- Remaining surface water, sediment, and ecological receptors at ETTP (e.g., remaining media)

The MPA FS was a precursor to the MPA FFS and identified the additional areas of groundwater contamination in the MPA. Simultaneous to implementing the MPA IROD remedy, DOE will begin the CERCLA efforts to address these additional areas, including but not limited to:

- low-concentration plumes surrounding the CVOC source areas covered in this MPA IROD
- Tc-99 plume
- K-1004 plume
- K-1413 plume
- K-1410 plume
- K-1420
- K-25/UNW-137
- K-1064 Peninsula
- K-1070-C/D Burial Ground (K-1200 North, K-1200 South, K-1070-C/D Northwest, and G-Pit)
- well TDEC-01 area (BRW-140 and UNW-161)

DOE will initiate the CERCLA work on these additional areas through a data quality objectives session that identifies additional data needs to develop an RI/FS and subsequent CERCLA decision document. DOE anticipates this effort to be dynamic as more information becomes available through both implementation of the IROD work and additional data characterization work. Therefore, DOE plans to use an adaptive management approach to complete the groundwater restoration work at ETTP. The adaptive management process was presented in the approved MPA FFS. DOE will follow the adaptive management process consistent with EPA Office of Land and Emergency Management Directives 9200.3-120 and 9200.3-123.

Once decisions are in place for this remaining scope at ETTP, and remedial actions are complete, CERCLA activities will transition to long-term stewardship, maintenance, and monitoring, including FYRs.

2.5 SUMMARY OF SITE CHARACTERISTICS

2.5.1 Main Plant Area General Conceptual Site Model

ETTP, formerly known as the K-25 Site, is an approximately 1000-acre industrial facility located approximately 25 miles northwest of Knoxville, Tennessee, on the DOE ORR. The ETTP site, shown in Figure 1.1, is located within East Fork Valley between Pine Ridge to the southeast, McKinney Ridge to the northeast, and Black Oak Ridge to the northwest. The site is further bounded by the Clinch River and a large, first-order tributary to the Clinch River, Poplar Creek. Poplar Creek meanders through the site and provides the western border of the MPA. The primary components of the MPA CSM include the complex geology and associated hydrogeology, in concert with the fluctuating surface water and a variety of source release mechanisms. These components are described below.

2.5.1.1 Geology

The geology within the MPA is complex, reflecting lithologic diversity (carbonate and clastics) and structural complexity at different scales, all of which have been overprinted by karst solution processes to varying degrees. The ETTP site is situated on the trailing edge of the Kingston thrust sheet adjacent to the Whiteoak Mountain Fault and is underlain by bedrock that can be broadly classed as either carbonate (Cambro-Ordovician Knox Group and Ordovician Chickamauga Supergroup) or clastic (Cambrian Rome Formation and Silurian Rockwood Formation). Within the MPA, bedrock is largely mantled by a veneer of unconsolidated overburden ranging up to 70 ft thick in the western portion near Poplar Creek. Saprolite, produced from the in-place weathering of bedrock, may be included in the unconsolidated overburden materials. Cut and fill performed during construction led to buried channels and relict sinkholes and removal of elevated areas to produce the relatively flat topography of the MPA. Although bedrock is exposed along much of the shoreline and bottom of the Clinch River, sediment accumulations are quite thick (up to several meters) along some stretches of Poplar Creek. However, bedrock is exposed in outcrops along much of the Poplar Creek shoreline.

Chickamauga Supergroup carbonates underlie the majority of the MPA, including the K-27/K-29 Area, K-25 Area, K-1064 Area, and K-1004 laboratory area. The eastern portion of the MPA, including a portion of the K-1401 Area, the K-1407-B Area, and the K-1420 Area, is underlain by clastics of the Rockwood Formation (Figure 2.2). The Cambrian Rome Formation clastics underlie Pine Ridge on the hanging wall of the Whiteoak Mountain Fault, south of the MPA, and clastics of the Silurian Rockwood Formation underlie the hanging wall of the K-25 Fault. The Rockwood Formation consists of brown to gray, fine- to medium-grained shale and siltstones, with occasional sandstone and limestone.

The Knox Group carbonates underlie the northernmost portion of the MPA, and also Black Oak Ridge, located to the north of the MPA. The contact between the Chickamauga Supergroup and the underlying Knox Group carbonates is marked by a regional unconformity. The Knox Group carbonates consist of

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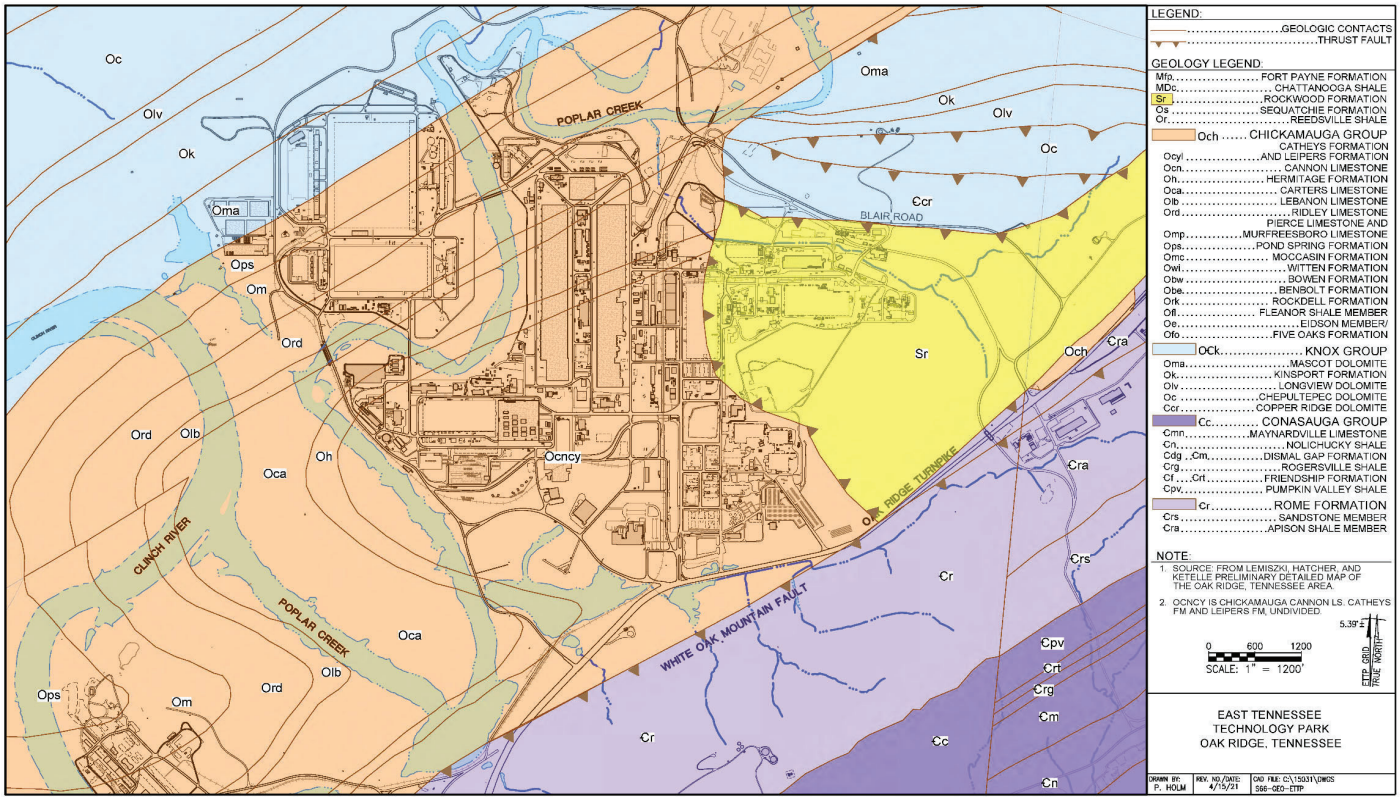

Figure 2.2. Geology underlying ETTP.

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stacks of fractured and solutioned, thick to massively bedded dolostone that is highly siliceous. The Chickamauga Supergroup, on the other hand, which underlies the majority of the MPA, is composed primarily of limestone, although there are also distinct calcareous shale beds, mud-rich limestones, and thin mud seams and stringers within the Chickamauga Supergroup.

The structural geology within the MPA includes macroscopic folds and faults as well as mesoscopic fractures, folds, and faults. Major faults in the study area (shown on Figure 2.2) include the aforementioned Whiteoak Mountain Fault and the K-25 Fault.

The K-25 Fault, which dips to the northeast, places differing rock types in proximity in the northeastern portion of the MPA and cuts across the northeast-trending bedrock to the west of the fault (Lemiszki 1995).

The top of bedrock surface, based on the depth of bedrock encountered in drilling for wells and drive point locations, is shown in Figure 2.2. This map illustrates that an undulating bedrock surface underlies ETTP.

Although many of the fractures observed in outcrop are healed or calcite filled, Lemiszki (1995) observed that bedding-strike parallel fractures sets appear to reflect a higher percentage of open fractures. The preferential weathering of this set suggests its importance in controlling groundwater flow paths parallel to the valley and ridge topography.

It is important to note both Poplar Creek and the Clinch River transect bedding strike and, consequently, intersect countless shallow, bedding-strike parallel flow paths—including fractures, solutionally widened fractures and cavities, and potential stratabound flow intervals—providing avenues for groundwater discharge to Poplar Creek and the Clinch River.

2.5.1.2 Surface water hydrology

The MPA is bounded by Poplar Creek. At high-pool stage, Poplar Creek ranges up to 220 ft wide, with water depths ranging up to 22 ft, although most of the time, it is less than 15 ft deep. During low-pool stage, the creek is 100 to 130 ft wide, largely restricted to the pre-impoundment channel. Periodic upstream flow reversals have been observed, where instead of the flow in Poplar Creek being toward the Clinch River, the flow in Poplar Creek is from the Clinch River in the direction toward the headwaters of Poplar Creek. These reversals have been observed to extend from the mouth of Poplar Creek upstream to above the Black Oak Ridge water gap, although the magnitude of the flow reversals decreases progressively upstream. Groundwater and surface water at the ETTP site interact in a complex manner, with surface water conditions dramatically influencing groundwater flow and discharge.

Patterns of stage fluctuations in Poplar Creek are observed at three scales—seasonal, diurnal, and storm-related—resulting in extremely transient and variable boundary conditions. Tennessee Valley Authority maintains Watts Bar at a low-pool stage elevation of approximately 735 ft above mean sea level (amsl) during the winter months (from early December through early April), and a high-pool stage (approximately 741 ft amsl) during the summer months (from late April through November). The diurnal fluctuations consist of 1- to 1.5-ft increases, which may last for a few hours twice daily. These fluctuations are the result of discharge at Melton Hill Dam. Finally, high-intensity, or long-duration, winter storms have been observed to cause short-term (lasting several days to a week) increases of up to 8 ft, which are superimposed on the normal reservoir operation fluctuations. These complex fluctuations in surface water levels result in an equally complex interaction with groundwater. Changes in surface water levels have a significant impact on the rate of groundwater flow towards these zones of groundwater discharge.

2.5.1.3 Groundwater hydrogeology

The water table in the MPA occurs at depths ranging from approximately 2 to 50 ft below ground surface (bgs) and typically within the unconsolidated zone above the underlying bedrock. In some areas of the MPA, as in the southern portion, bedrock is shallow enough so that the water table lies completely within

bedrock. Figure 2.3 shows the average potentiometric surface for the MPA based on both unconsolidated zone and bedrock well data. The data used to develop this map include water levels from the permanent wells and from the Zone 2 soils investigations. In general, the shallow potentiometric surface reflects surface topography, indicating flow from the higher elevation areas toward the Clinch River and Poplar Creek. In the northern portion of the MPA, shallow groundwater flow is toward Mitchell Branch, which transects the northern portion of the MPA.

2.5.1.4 COCs

The six areas addressed in this MPA IROD are groundwater plume areas where contaminant concentrations exceed 1000 µg/L of individual CVOCs or 400 µg/L of VC and, thus, CVOCs are the intended target of the EISB treatment. However, the additional COCs are anticipated to be reduced by the treatment technology. The primary COCs in the six areas of groundwater contamination addressed in this MPA IROD are indicated in Table 2.2. The data included in the screening summarized in Table 2.2, and used to prepare the MPA FFS, cover the 10-year period from 2009 to September 2019.

Table 2.2. ETTP MPA groundwater priority COC screening results summary, 2009–2019

Area	Primary COCs exceeding MCL, 2009–2019
Mitchell Branch Comingled Plume/K-1407-B	1,1-DCE; PCE; TCE; VC; and cis-1,2-DCE
K-1401	1,1-DCE; PCE; TCE; VC; and cis-1,2-DCE
K-1024	PCE; TCE; and cis-1,2-DCE
K-1035	1,1-DCE; PCE; and TCE
K-27/K-1232	Carbon tetrachloride and TCE
K-1239	cis-1,2-DCE and TCE

COC = contaminant of concern
DCE = dichloroethene
ETTP = East Tennessee Technology Park
MCL = maximum contaminant level
MPA = Main Plant Area
PCE = tetrachloroethene
TCE = trichloroethene
VC = vinyl chloride

There are also additional COCs including, but not limited to, metals, radionuclides, and inorganics, that are not being directly addressed by this interim action. These additional chemicals will be identified and addressed prior to obtaining a final ROD (or RODs) for the MPA.

The following sections describe each of the six CVOC source areas covered by this MPA IROD. The approximate areas representing CVOCs > 1000 µg/L (or 400 µg/L for VC) are shown on Figure 1.3; however, additional sampling planned for the PDI stage of this project will further refine the areas targeted for EISB injection wells.

2.5.2 Mitchell Branch Comingled Plume/K-1407-B Conceptual Site Model

As shown in Figure 1.3, there is an area in the northeast portion of the MPA where plumes from several different sources comingle near the Mitchell Branch creek. This area is hydrologically downgradient of several source areas, including the K-1407-B Holding Pond, K-1401 operations, K-1070-C/D Burial Ground, K-1239, and areas to the east, including K-1413. The precise shape of the convergence of plumes is not fully understood; however, three of the source areas that are the focus of this MPA IROD have been identified. The K-1407-B source is covered in this section and K-1401 and K-1239 are covered separately.

The K-1407-B Holding Pond was an unlined surface impoundment located immediately south of Mitchell Branch and west of Building K-1420. Constructed in 1943, it was used as a settling basin for metal hydroxide sludges that were precipitated after neutralization in the K-1407-A Neutralization Pit. Other wastes

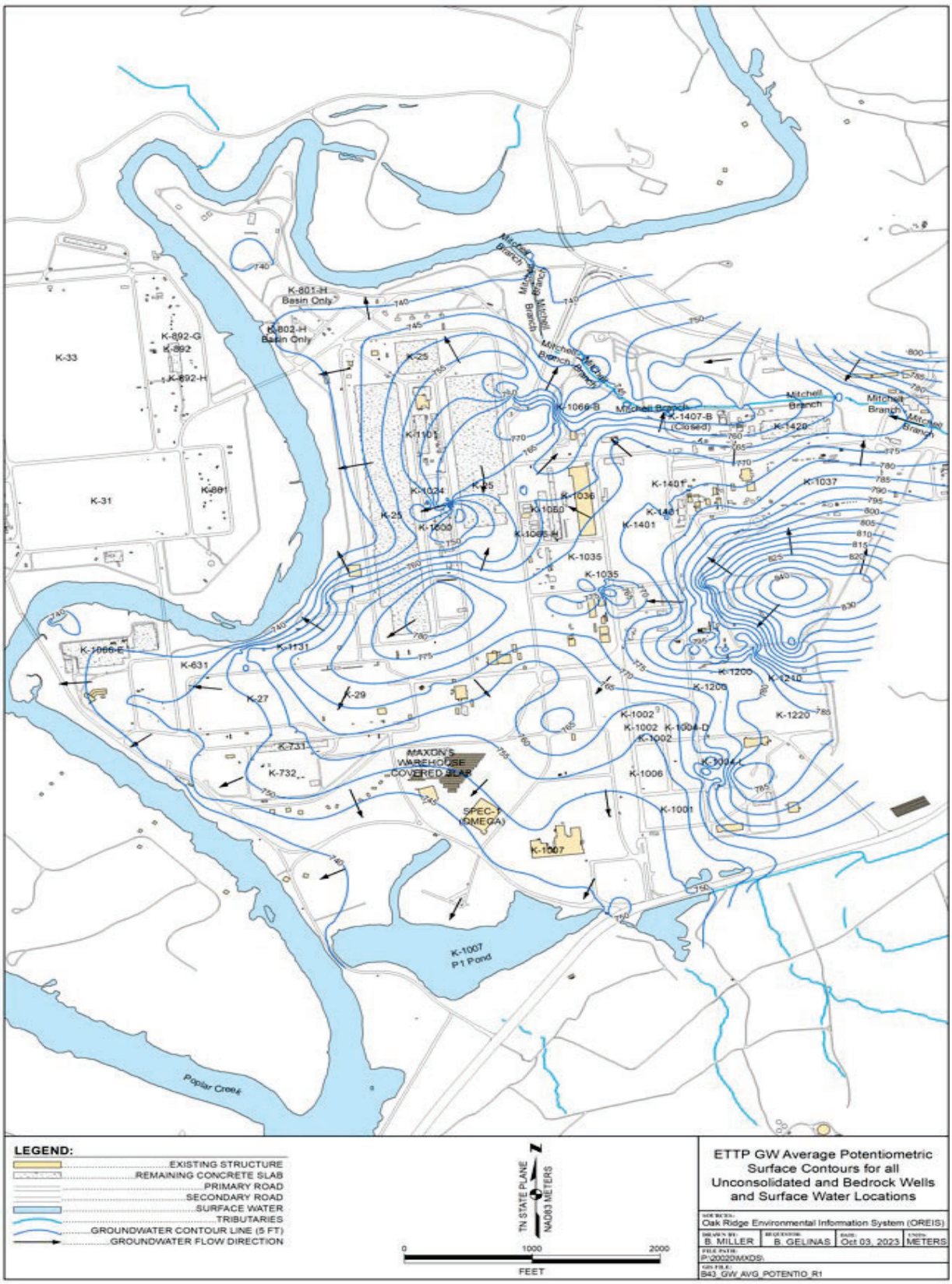

Figure 2.3. Average potentiometric surface for MPA of ETTP (average of all data between 1985 and 2023).

discharged to the K-1407-B Holding Pond included waste water from the K-1401 Acid Line, K-1413 laboratory solutions, K-1420 plating operations, Building K-1303 (nitric acid and rinse waters), Building K-1302 (recirculating cooling water supply), K-1503 Neutralization Pit, K-1421 Incinerator drain, Building K-1420 (plating facility rinse water, mercury recovery operations, decontamination spray booth rinse water, and various cleaning solutions), and purge cascade laboratory solutions. A valve allowed wastes to bypass the pit and discharge directly into the K-1407-B Holding Pond; no records of frequency of use of this valve exist. The discharge of wastes into the K-1407-B Holding Pond ceased in 1988. After terminating discharges to the pond, waste sediment/sludges were excavated as part of the RCRA closure action. Sampling of the underlying soils after removing the sediment and sludge identified a variety of radiological contaminants in excess of the Zone 2 Soil ROD soil screening levels (SSLs) for protection of groundwater, including Tc-99 and uranium isotopes. Elevated metals concentrations and low levels of CVOCs were also detected in confirmatory soil samples. The pond was filled with riprap, concrete debris, and soil; covered with clean soil; capped with a layer of topsoil; and revegetated.

The primary thrust fault, the K-25 Fault, is located just west of the K-1407-B Holding Pond, which sits on the hanging wall of the fault, and is underlain by rocks of the Rockwood Formation. The Rockwood Formation consists of brown to gray, fine- to medium-grained shale and siltstones, with occasional sandstone and limestone. The water table occurs at depths ranging from less than 1 ft near Mitchell Branch to as much as 25 ft south of the former pond. The water table occurs within overburden over much of this area, with saturated overburden ranging up to 20 ft thick. Mitchell Branch, which was relocated during construction of ETTP, is the primary receiving point for groundwater and surface water flow in this portion of ETTP. The stream segment opposite the K-1407-B Holding Pond was also equipped with a liner for installation of the Mitchell Branch groundwater collection system in 1995. Operation of the collection system was terminated in 2005.

Groundwater data from monitoring wells in the vicinity of the K-1407-B Holding Pond indicate the long-term presence of a CVOC plume in this area. This plume is located adjacent to Mitchell Branch. The CVOCs in this plume include 1,1-dichloroethane (DCA); 1,1-dichloroethene (DCE); 1,2-DCA; cis-1,2-DCE; methylene chloride; tetrachloroethene (PCE); TCE; trans-1,2-DCE; and VC. Alpha activity has also been detected above the groundwater MCL in some K-1407-B Holding Pond monitoring wells. Most of the highest CVOC concentrations occur directly beneath the northern boundary of the former pond and adjacent to Mitchell Branch.

The highest historical concentrations of TCE were in bedrock well BRW-108; a concentration of 76,000 µg/L was detected during well installation activities completed in February 2005. During the last 10 years, TCE concentrations have fluctuated from 12,500 to 53,000 µg/L. TCE has also been detected at significant concentrations in BRW-007, adjacent to BRW-108. The September 2019 result for TCE at BRW-007 was 16,000 µg/L. Relatively high concentrations of CVOCs are also present in the unconsolidated zone wells near Mitchell Branch. Figures 2.4 and 2.5 show the distribution of TCE in the unconsolidated zone and bedrock, respectively. Although TCE represents the CVOC with the highest concentrations in the Mitchell Branch area, PCE has also been measured occasionally at concentrations exceeding 1000 µg/L. The highest historical concentration of PCE (3850 µg/L) was reported at well BRW-007 in March 2009. The highest historical concentration of VC (5900 µg/L) was reported at OW-01 in April 2018.

The observed CVOC contamination is predominantly associated with fractured bedrock in the vicinity of the K-1407-B Area. CVOCs are undergoing a variable degree of degradation from parent compounds (e.g., TCE, PCE, and trichloroethane [TCA]) to secondary daughter products. Dense, non-aqueous-phase liquids (DNAPLs) are considered likely present adjacent to the K-1407-B Holding Pond. The suspected DNAPL would provide a continuing source of contamination to the K-1407-B Area as it diffuses from the bedrock matrix into groundwater.

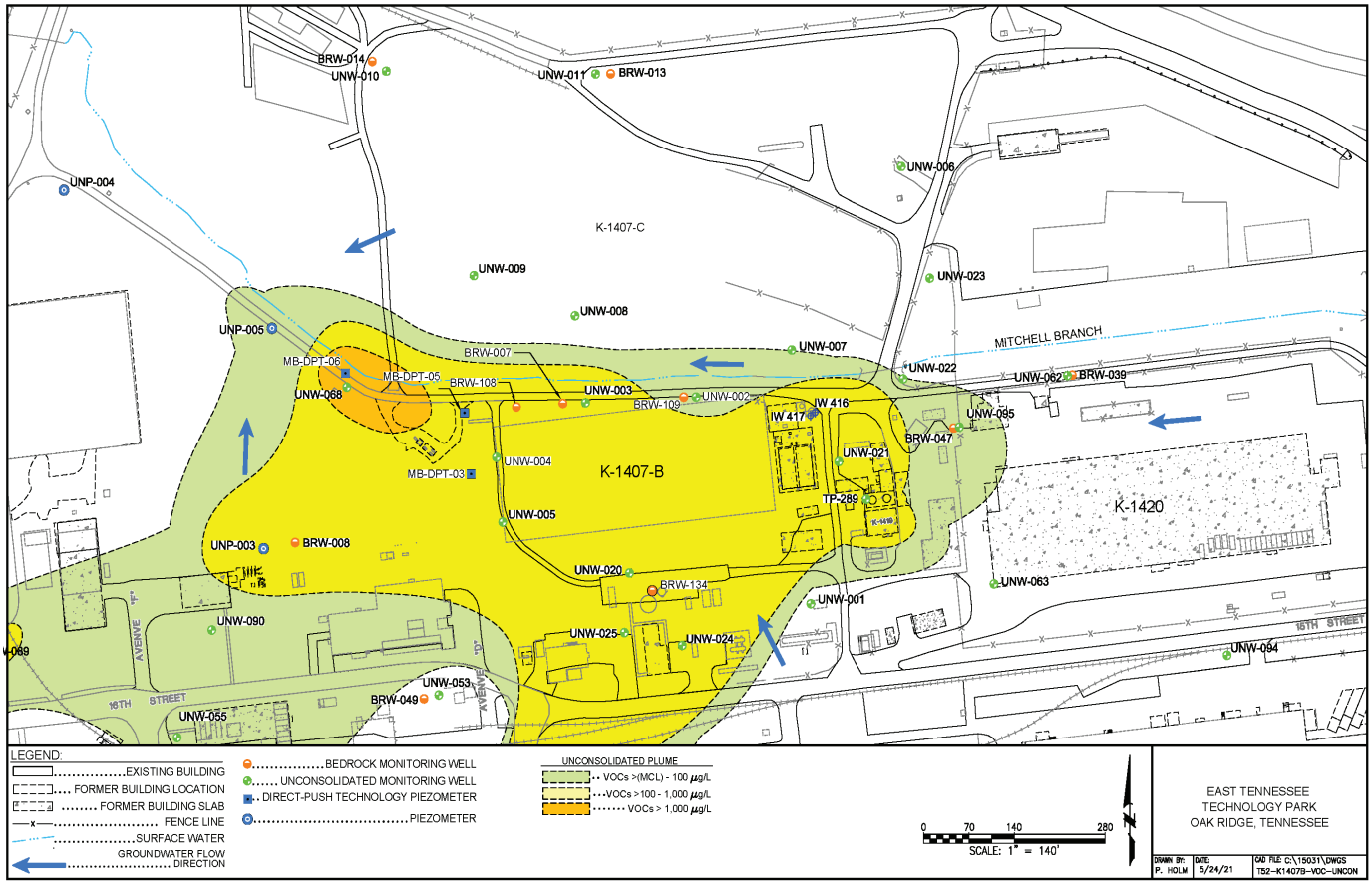

Figure 2.4. Distribution of CVOCs in unconsolidated zone in K-1407-B Area.

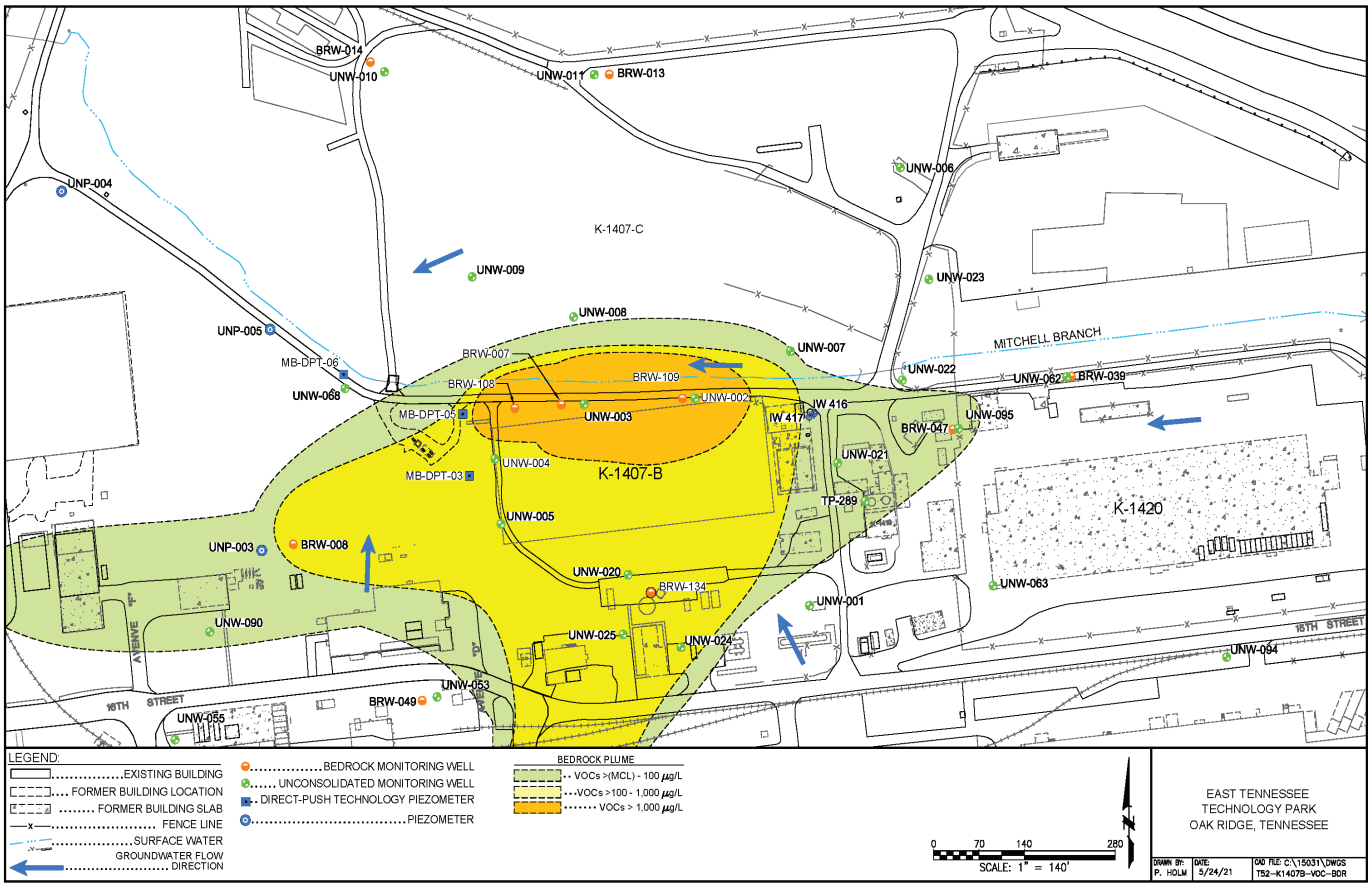

Figure 2.5. Distribution of CVOCs in bedrock in K-1407-B Area.

Additional soil source removal from the K-1407-B Holding Pond Area is expected to reduce groundwater concentrations, at least in the unconsolidated zone, and may result in a change in the plume extent. The PDI will assess the impacts of the source removal on groundwater concentrations and further delineate the current extent of concentrations > 1000 µg/L of individual CVOCs or 400 µg/L of VC µg/L at this site.

2.5.3 K-1401 Conceptual Site Model

Beginning in 1944, degreasers were used in K-1401 to clean pipes and other equipment associated with the uranium enrichment process. TCE was the common degreaser from the 1940s through the 1960s but was replaced by TCA in the 1970s and 1980s. Carbon tetrachloride and Freon were also used in the early years. Records indicate TCE usage was at a rate of about six 55-gal drums per day in the 1940s through the 1960s. The K-1401 degreaser cleaning tanks were located along the east wall of Building K-1401. Spent cleaning solutions were drained onto the floor and collected in an acid-brick-lined floor trench surrounding the cleaning tanks. The floor trench emptied into a small, acid-brick-lined sump at the exterior wall. From the sump, the effluent entered the exterior acid drain line through a pipe opening through the sump wall. The acid drain line was approximately 1500 ft long and was buried 4 to 15 ft below grade. The acid drain line flowed north along the east side of the building. Between 1944–1987, the line was used to transfer corrosive solutions from Building K-1401 to the K-1407-A Neutralization Pit at the Central Neutralization Facility.

The discovery of leaks in the line resulted in the entire pipeline being slip-lined with a 10-in. high-density polyethylene sleeve. However, the drain line was taken out of service in 1987 when it was found that the line in the vicinity of K-1401 continued to leak at a rate too rapid to accurately measure (estimated at 4 to 100 gallons per minute [gpm]).

The K-1401 Area is underlain by the Silurian-age Rockwood Formation that contains highly fractured and folded silty shales and siltstones. The K-25 Fault was intersected in three boundary boreholes (BR-01 [134.3 ft bgs], BR-02 [169.0 ft bgs], and BR-06 [186.6 ft bgs]). Chickamauga limestones occupy the subsurface below the fault. Bedrock is highly fractured and structurally distorted due to the proximity of the K-25 Fault. Fracture apertures identified from geophysical logging of boreholes decrease in size with depth.

The horizontal hydraulic gradient is generally to the north, with lower heads to the north and higher heads to the south-southeast. Vertical gradients are predominantly upward, with highest heads occurring at depth to the south and the lowest heads along the northern area of the site. Hydraulic conductivity from slug tests of wells shows a decrease in hydraulic conductivity with depth, consistent with decreasing fracture apertures. Pump tests have indicated anisotropy in the aquifer, with higher hydraulic conductivity generally in the east-west direction.

Characterization work conducted for the *Design Characterization Completion Report for the Sitewide Groundwater Treatability Study at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2768&D1; K-1401 Groundwater Treatability Study) completed in 2018 delineated a source area that encompasses contaminated soil and confirmed the presence of DNAPL in the bedrock at depths greater than 100 ft bgs. This source area is present below the water table and is believed to be the major source of the dissolved-phase K-1401 plume. TCE concentrations exceeding the MCL (5 µg/L) are present to depths of 145 ft.

The plume at K-1401 is present in both the unconsolidated zone and bedrock (Figure 2.6) and has migrated northward in response to the hydraulic gradient in the area. Flow within the bedrock is controlled by the complex fracturing and structural deformation associated with the K-25 Fault that passes in the vicinity of the K-1401 building. Farther north, the plume merges into the Mitchell Branch Comingled Plumes area. K-1401 Area monitoring wells with long-term monitoring records available from as far back as the 1980s indicate TCE concentrations have remained relatively stable since monitoring began.

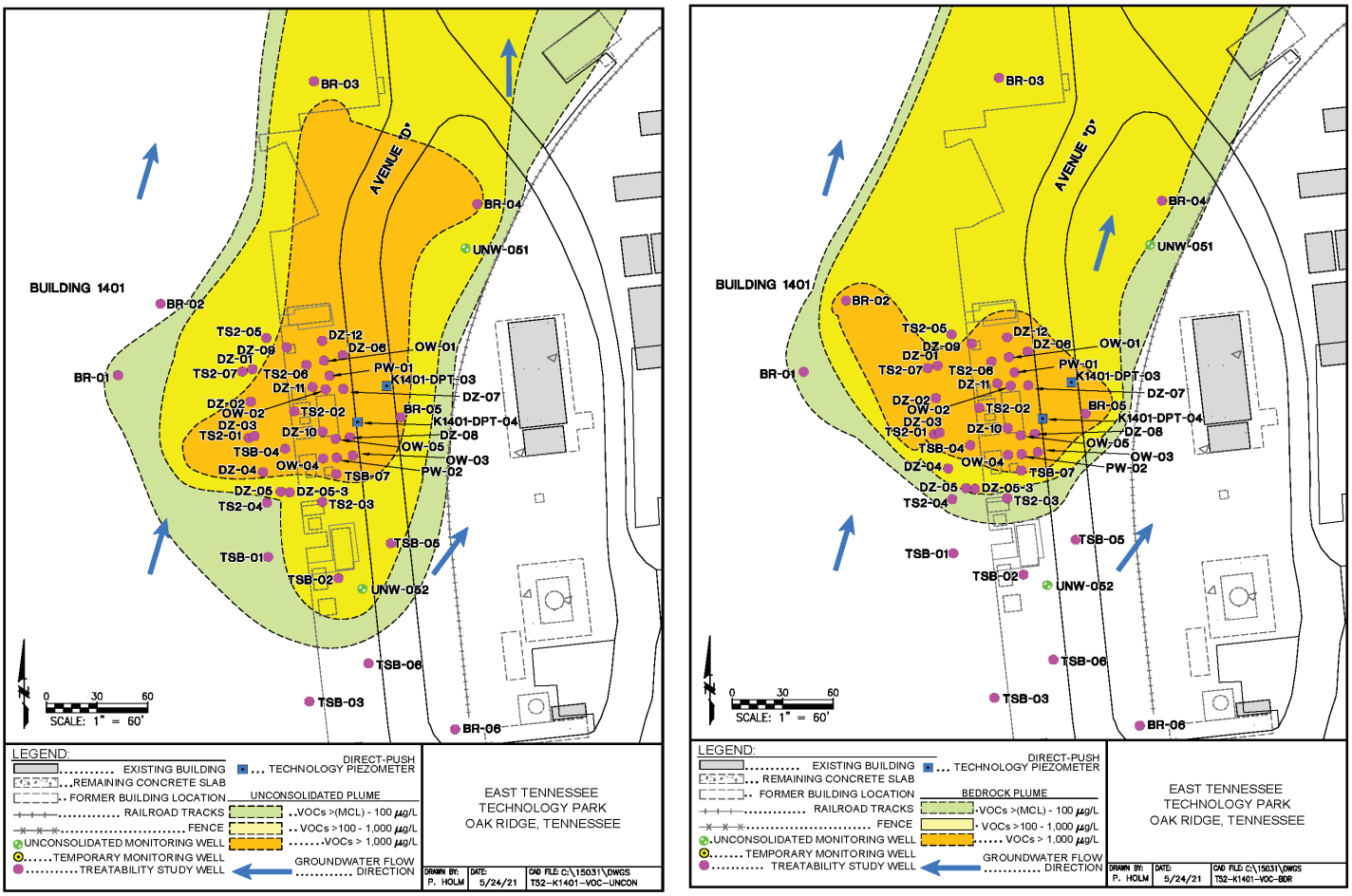

Figure 2.6. Total priority CVOC concentrations in groundwater in unconsolidated zone (left) and in bedrock (right) in K-1401 Area.

The K-1401 Groundwater Treatability Study estimated the TCE mass in soil/rock at 536 lb, and the estimated TCE mass in groundwater, including DNAPL, at 10,500 lb. Based on estimates of TCE mass, approximately 50% of the mass resides in the top 25 ft bgs in the core area of contamination. The bulk of the remaining mass below 25 ft is found in the 25- to 45-ft bgs interval. TCE concentrations in soil/rock were as high as 4,200,000 µg/kg and TCE concentrations in groundwater were as high as 420,000 µg/L in the June 2018 sampling event. The CVOCs identified as primary COCs include 1,1,1-TCA; 1,1,2-TCA; 1,1-DCA; 1,1-DCE; cis-1,2-DCE; Freon-113; methylene chloride; PCE; TCE; trans-1,2-DCE; and VC. The highest concentrations in the plume occur in the vicinity of the former degreaser pits, and the plume generally extends northward (downgradient) roughly parallel with the former acid line.

2.5.4 K-25/K-1024 Conceptual Site Model

Building K-1024, constructed in 1944, was located within the central portion of the U-shaped K-25 building, immediately north of Building K-1600. The K-1024 facility was used to repair and calibrate instruments in the control and operation of the Building K-25 uranium-enrichment cascade. In 1963, an acid cleaning area was installed in the west wing of Building K-1024. Instrument repair operations at Building K-1024 involved extensive use of mercury, acids, and chlorinated solvents, including TCE. Acid wastewater was discharged from Building K-1024 into a neutralization pit that flowed directly into the storm drain system, which conveyed stormwater northward toward Mitchell Branch. Building K-1024 was demolished in 2008; the slab was removed in 2020. Comparing current topography with pre-construction topography shows substantial cut and fill of the pre-construction topography was conducted to construct Building K-25. Boring logs from the soil investigations, which confirm results of the pre- and post-construction topographic evaluation, show the depth to native soil typically occurs at about 15 ft bgs in the K-1024 Area. The bedrock underlying the K-25/K-1024 Area consists of limestones with interbedded calcareous shales and siltstones of the Chickamauga Group. The presence of groundwater in boreholes installed in 2017 at K-1024 indicated the depth to groundwater ranges from 27.36 to 57.7 ft bgs. Groundwater flow is generally to the west and southwest (Figure 2.3).

During the initial Zone 2 soil characterization in 2005, TCE was detected at 11,000 µg/kg at a depth of 8.5 ft from a soil sample located on the south side of Building K-1024. Further sampling indicated the Zone 2 groundwater SSL was exceeded in six samples from three sample locations located adjacent to and southeast of the footprint of the former K-1024 facility. The exceedances of the TCE groundwater SSL discovered in 2005 led to an extensive investigation of the magnitude and extent of TCE in soil and groundwater. During subsequent investigations and confirmation sampling during the actual Zone 2 soil excavation project, additional soil samples were found to have TCE concentrations exceeding the TCE groundwater SSL.

The Zone 2 remedial action to address this CVOC soil source area will remove an estimated 16,000 yd^3 of soil from the area immediately south of, and partially including, the southern portion of the former K-1024 building footprint. The target depth of excavation varies from 20 to 35 ft bgs.

In support of the MPA FS, five new wells (BRW-125, BRW-126, BRW-127, BRW-139, and UNW-159) and one Flexible Liner Underground Technologies, LLC™ (FLUTe™)-only location (Borehole-09) were installed in the K-1024 Area in the spring of 2019. There were no indications of DNAPL from the FLUTe™ liner; however, the occurrence of DNAPL cannot be ruled out. Analytical results from the K-1024 Area indicate the presence of 1,1-DCE; cis-1,2-DCE; PCE; and TCE at concentrations above their MCLs. The highest concentration of TCE (28,700 µg/L) was detected at BRW-125, which is completed to a depth of 70 ft and is the bedrock well located nearest to the known soil source. The concentrations of TCE at additional bedrock wells were much lower, ranging from 21 to 34 µg/L. The distribution of CVOCs in the unconsolidated zone and bedrock is illustrated in Figure 2.7.

The PDI work will assess the impacts of the source removal on groundwater concentrations and further delineate the current extent of concentrations > 1000 µg/L of individual CVOCs or 400 µg/L of VC at this site.

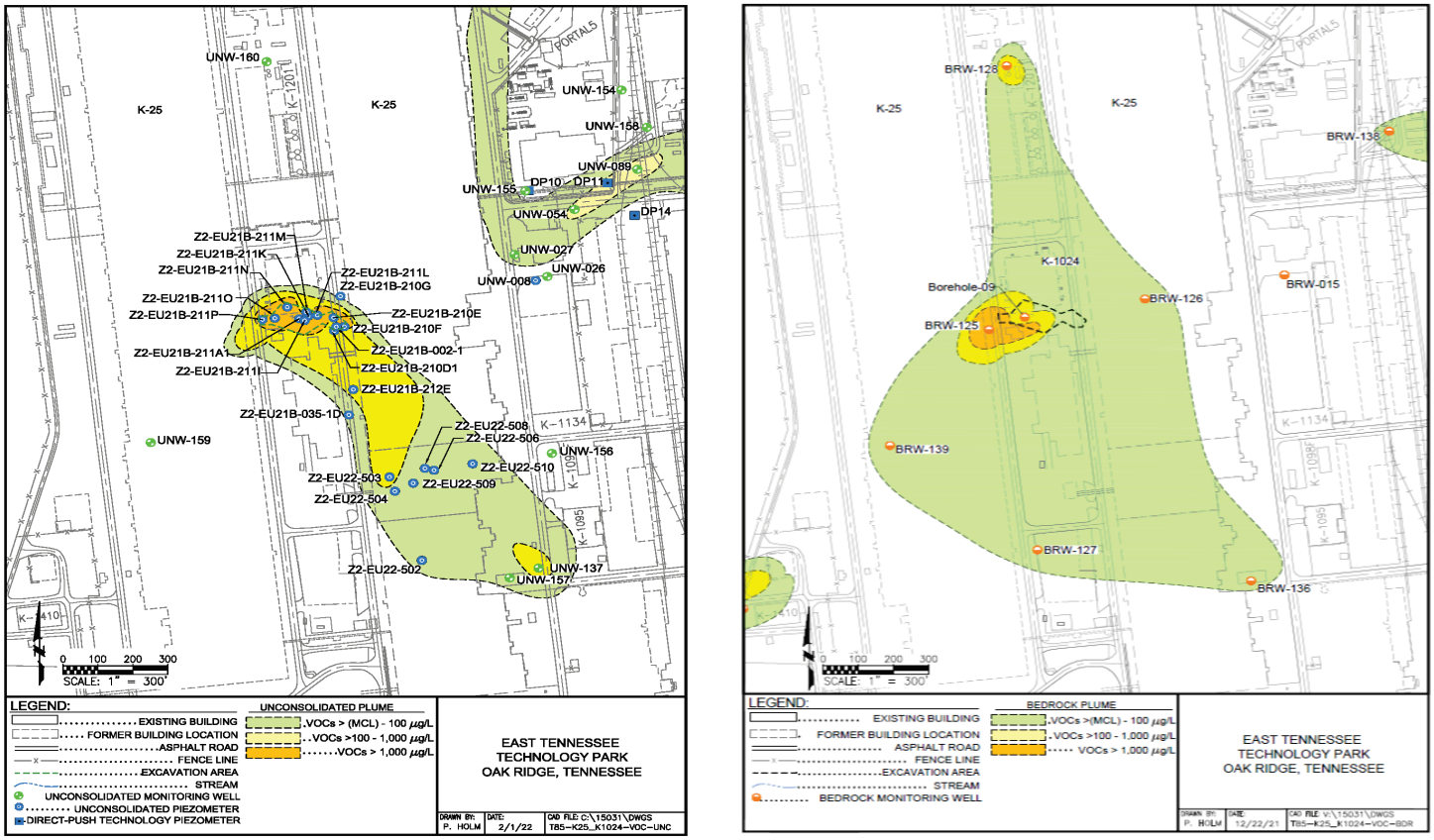

Figure 2.7. Distribution of CVOCs at K-1024 in unconsolidated zone (left) and bedrock (right).

2.5.5 K-1035 Conceptual Site Model

Building K-1035 is located in the north-central part of the industrialized portion of ETTP, immediately south of Building K-1036 and to the west of former Building K-1401. Building K-1035 housed the printed circuit board fabrication shop and an acid cleaning area consisting of two below-grade cylindrical pits, an acid pit and a neutralization pit, and associated drain lines located near the south end of the building. Both pits were essentially inverted reinforced concrete pipes filled with a limestone gravel bed to neutralize acid wastes. It is unknown if the base of the pits was concrete or soil. Drain lines connected floor drains and sinks inside K-1035 to the pits and then diverted waste to a single catch basin that was part of the storm drain system. The catch basin liquids were diluted with stormwater prior to flowing out the SD-190 storm drain system, which ultimately discharges to Mitchell Branch. The pits received acid wastes and chlorinated organics from electroplating and etching activities from the early 1960s until 1976–1977 and from decontamination activities that continued until 1985. Approximately 100 gal/week of acid/chlorinated organic wastes was discharged in batches to the pits.

Operational records indicate a variety of CVOCs and acids were used for cleaning purposes, including TCE; Freon-113; PCE; 1,1,1-TCA; methylene chloride; methyl ethyl ketone; carbon tetrachloride; and nitric, hydrofluoric, hydrochloric, and chromic acids. Disposal records indicated, in 1978–1980, wastes were transferred to the K-1070-C/D G-Pit for disposal. After March 1980, wastes were drummed and shipped offsite for commercial disposal. The pits and some of the associated drain lines and soil were removed during demolition of the K-1035 slab in 2009. The footprint of K-1035 is now a gravel-covered (temporary) parking area.

An evaluation of potential groundwater contamination sources under the Zone 2 Soil ROD was recently completed and determined no source material remains in the unsaturated zone at K-1035 (*Fiscal Year 2010 Phased Construction Completion Report for EU Z2-31 in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* [DOE/OR/01-2443&D2]). Vertical migration of contaminants from the historical releases at K-1035 has resulted in the remaining contamination located within the saturated zone. The resulting plume (Figure 2.8) occurs in the unconsolidated zone and bedrock but appears to be limited in areal extent. Although bedrock concentrations of contaminants are lower than concentrations found in the unconsolidated zone, the full vertical extent of contamination remains uncertain.

Soil and groundwater data indicate releases of PCE have occurred in this area, most likely via leaks from the base of the pits. Historical records also indicate, on at least one occasion, 50 gal of TCE product was inadvertently spilled into the storm drain system at K-1035. From the base of the pits, CVOCs have spread radially and predominantly toward the northeast. Results of a particle tracking simulation conducted in the 2007 Sitewide RI indicated particles released into the unconsolidated zone at Building K-1035 traveled northward, first through the unconsolidated zone, then into bedrock. The particles continued northward, moving deeper into bedrock before discharging to Poplar Creek.

The K-1035 Area is located on the footwall of the K-25 Fault. This fault lies immediately east of K-1035, but its exact location on the east side of K-1035 is uncertain due to the cut and fill activities during site construction. K-1035 is underlain by carbonates of the Chickamauga Group and lies in a region of relatively flat water table gradient. Prior to removing Buildings K-1035 and K-1401 in 2009, much of the land surface was covered by pavement (roadways and parking areas) and buildings. The footprints of these two former buildings are now open, relatively flat, grass- or gravel-covered areas that likely are associated with much greater recharge to groundwater than occurred prior to removing the building slabs and other paved areas.

Figure 2.8. Distribution of CVOCs at K-1035 in unconsolidated zone (left) and bedrock (right).

The potentiometric surface in the unconsolidated zone and bedrock shows a predominant flow gradient to the northwest. However, during operations at ETTP, a sump in the northwest corner of the adjacent K-1401 building produced a significant drawdown in the water table to the northeast of K-1035, which likely influenced groundwater movement while the sump was in operation. Results of dye tracer testing during the 2007 Sitewide RI were not entirely consistent with the anticipated groundwater flow path. At the K-1035 plume, tracer was injected into a well installed at location K1035-DPT-006 that contained high concentrations of PCE and TCE. Tracer was detected on the ninth day after injection at K1035-DPT-001, approximately 100 ft to the southeast of the injection location. The seepage velocity indicated by the tracer was approximately 11 ft/day. The inferred piezometric gradient in this area is to the northeast; however, dye was detected southeast of the injection point. A video survey of the storm drain system at ETTP conducted in 1994–1995 indicated inflow into the SD-190 storm drain system through a joint in the pipe at a point approximately 50 ft east-southeast of the K1035-DPT-001 location where the dye was detected. It is uncertain if the occurrence of dye and contaminants to the south of the K-1035 pits is a reflection of the natural flow system in this area or if the lower head provided by the storm drain serves to direct a portion of flow in the south-southeasterly direction. Additional data collected during implementation of the PDI phase will be evaluated to refine the understanding of the flow system at K-1035.

Constituents detected in groundwater at concentrations above MCLs in the vicinity of Building K-1035 include the CVOCs 1,1,2-TCA; 1,1-DCE; PCE; and TCE. The maximum concentrations of PCE (6370 µg/L); TCE (42,600 µg/L); and 1,1-DCE (3210 µg/L) were from K-1035-DPT-006 in March 2009. This well was located adjacent to the neutralization pit, at the south end of the building, and was removed in 2009 during decontamination and decommissioning of the building. High concentrations of TCE were also detected in K1035-DPT-007, located east of the former acid pit, with a concentration of 4400 µg/L in March 2010 and 540 µg/L in August 2020.

The vertical extent of contamination remains uncertain. Concentrations of the degradation products 1,1-DCA; 1,1-DCE; and cis-1,2-DCE indicate some degradation of the parent CVOCs is occurring. Few, sporadic exceedances of metal MCLs have been detected in recent years. The occurrence of high concentrations of CVOCs in groundwater in a relatively small area in the vicinity of Building K-1035 suggests the pits and associated piping were the historical sources of these contaminants.

The PDI step of this MPA IROD will address the remaining data needed to complete the RD. Data gaps for the unconsolidated zone include plume delineation to the northwest and south. With only one bedrock well at K-1035, screened from 50 to 60 ft bgs, additional wells will be necessary to define the extent of the plume in bedrock.

2.5.6 K-27/K-1232 Conceptual Site Model

The K-27/K-1232 Area lies in the western portion of the MPA. It is bounded by Poplar Creek to the north, west, and southwest and by the former K-25 process building to the east. The K-27 and Poplar Creek facilities area was a highly industrialized portion of ETTP that contained numerous facilities associated with uranium enrichment and other processes that used TCE and other solvents. There is a CVOC plume that underlies this area, with TCE as the primary constituent. Several groundwater investigations attempted to find the source or sources of this plume, but it was not until the Zone 2 soil investigations that potential sources have become apparent. These Zone 2 investigations were completed after the MPA FFS was developed.

In the K-27 Area, TCE was used as a coolant for the condensation of the process gas to collect assay samples and recover product and tails from the cascade process. Dry ice/TCE cold traps, known as slush baths, were used to freeze out uranium hexafluoride process gas in the line recorders. The Poplar Creek buildings area contained a number of chemical processing facilities, a uranium hexafluoride feed production facility, and various support facilities. The K-1232 Complex included a chemical recovery facility that treated

RCRA-listed waste, a tank farm, and a wastewater treatment basin. Other Poplar Creek facilities included K-631, K-131, and K-1131, which supported uranium hexafluoride production. TCE and other solvents were widely used in these facilities and historically discharged into floor drains, dilution pits, neutralization pits, and the storm drain network.

Soil sampling in the K-27 Area conducted under the Zone 2 Soil ROD did not identify a clear soil source of TCE in the K-27 building footprint. However, soil sampling in the Poplar Creek buildings area since the time of the MPA FFS has identified potential sources of the TCE plume, which has resulted in an updated CSM since the time of the MPA FFS. Figure 2.9 shows the plumes configuration based on data available at the time of the MPA FFS (using data collected through June 2019). Figure 2.10 shows the Poplar Creek facilities areas where Zone 2 2021 data collection efforts identified soils with exceedances of TCE screening levels used to identify potential sources to groundwater.

The K-27/K-1232 Area overlies undifferentiated limestones of the Catheys-Cannon Formations of the Chickamauga Supergroup and is near the axis of the syncline shown in Figure 2.2. Bedrock in this area of the site is overlain by 20 to 60 ft of overburden materials but is exposed in and along Poplar Creek, highlighting that potential flow paths in the unconsolidated zone generally terminate at, and discharge to, Poplar Creek.

The pre-construction topography in this area includes several features that appear to be influencing migration of the TCE plume, including large drainage swales and possible karst features. The original topography was considerably reworked to yield the relatively flat present-day surface. The pre-construction topographic maps show there was a prominent ravine that extended from the southeast corner of the K-27 building south through the K-731 Switchyard, to join a former embayment off of the east side of Poplar Creek. The fill in these two features is estimated to range up to a 30-ft thickness.

Another important aspect of this area is the presence of an east-west-trending groundwater flow divide that transects the area. Groundwater north of the divide flows northward, toward the deeply incised Poplar Creek channel, and groundwater south of the divide flows southward toward Poplar Creek following the former embayment off of Poplar Creek. Although this groundwater divide appears to be more prominent in the unconsolidated zone, water level elevations in the K-27/K-1232 Area indicate this divide also occurs in bedrock.

The water table occurs in the unconsolidated zone over most of the K-27/K-1232 Area, with saturated overburden thickness ranging from 15 to 35 ft. The average potentiometric surface for the unconsolidated zone and bedrock based on the permanent monitoring well network is shown in Figure 2.11. Vertical gradients observed at well pair BRW-069/UNW-037 located on the south side of the K-27 building generally show upward gradients from the bedrock to the unconsolidated zone, although a downward gradient has been observed on at least one occasion. Downward vertical hydraulic gradients present at well pairs UNW-029/BRW-041 and UNW-037/BRW-067 located in the interior of the plume are replaced by upward gradients at Poplar Creek, suggesting groundwater discharge into the creek.

Contamination is migrating through both the bedrock and overburden but, in general, the higher concentrations are found within the bedrock. TCE was detected at bedrock well BRW-122 (8170 µg/L), located in the former K-27 building footprint. This well also contained carbon tetrachloride and cis-1,2-DCE above MCLs. Bedrock well BRW-133, located north of the former K-27 building, contains TCE at a concentration of 806 µg/L. With the exception of BRW-122, the TCE degradation products cis-1,2-DCE and VC are only present in low concentrations below MCLs and generally are not detected at most wells. The groundwater plumes in Figure 2.9 illustrate the contamination has migrated southward from the Poplar Creek area and K-27 and then takes a significant shift to the southwest, likely following the relict pre-construction features. Additional data collection during the PDI phase of this MPA IROD will be incorporated into the CSM for the K-27/K-1232 Area.

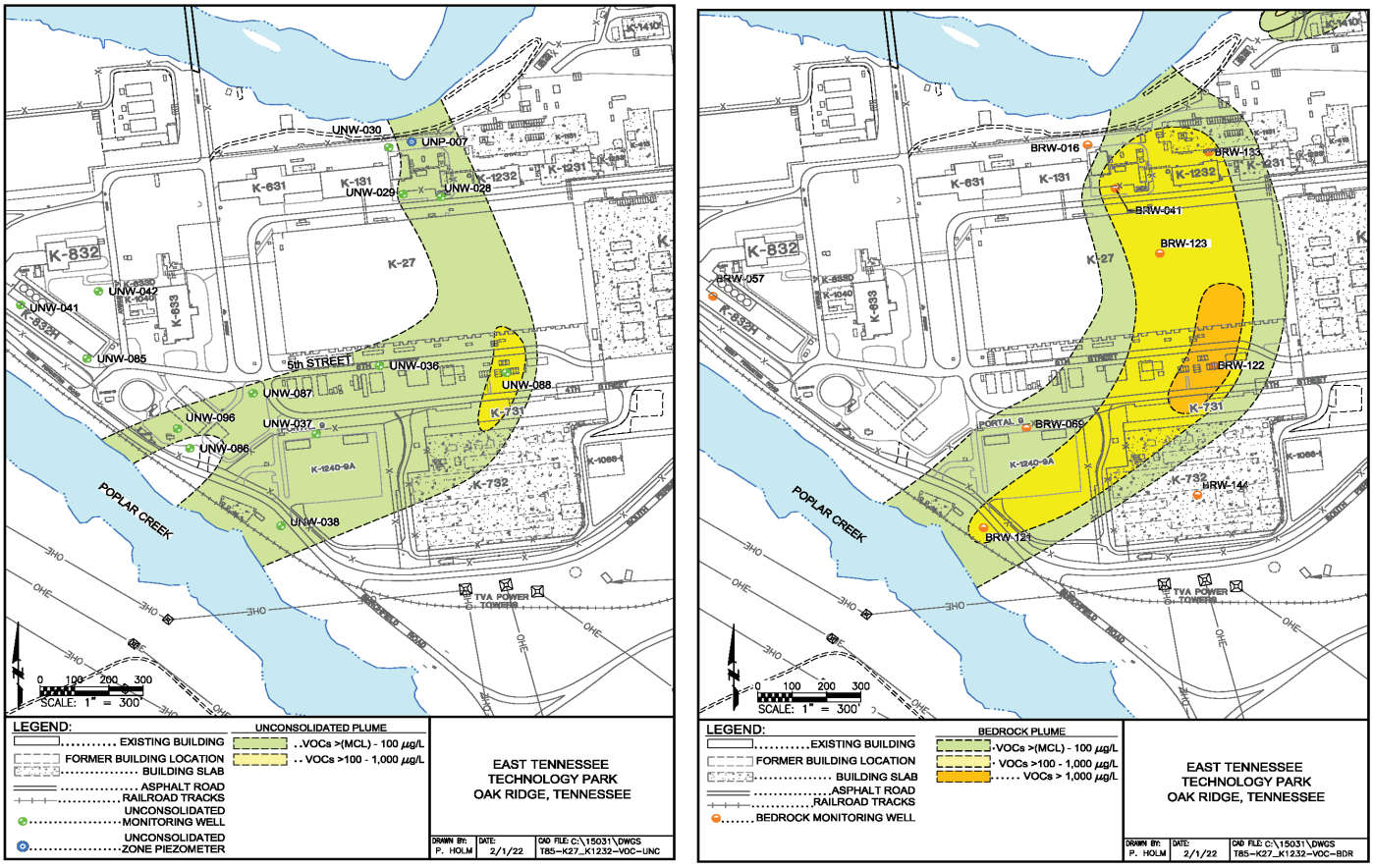

Figure 2.9. Distribution of CVOCs at K-27/K-1232 in unconsolidated zone (left) and bedrock (right).

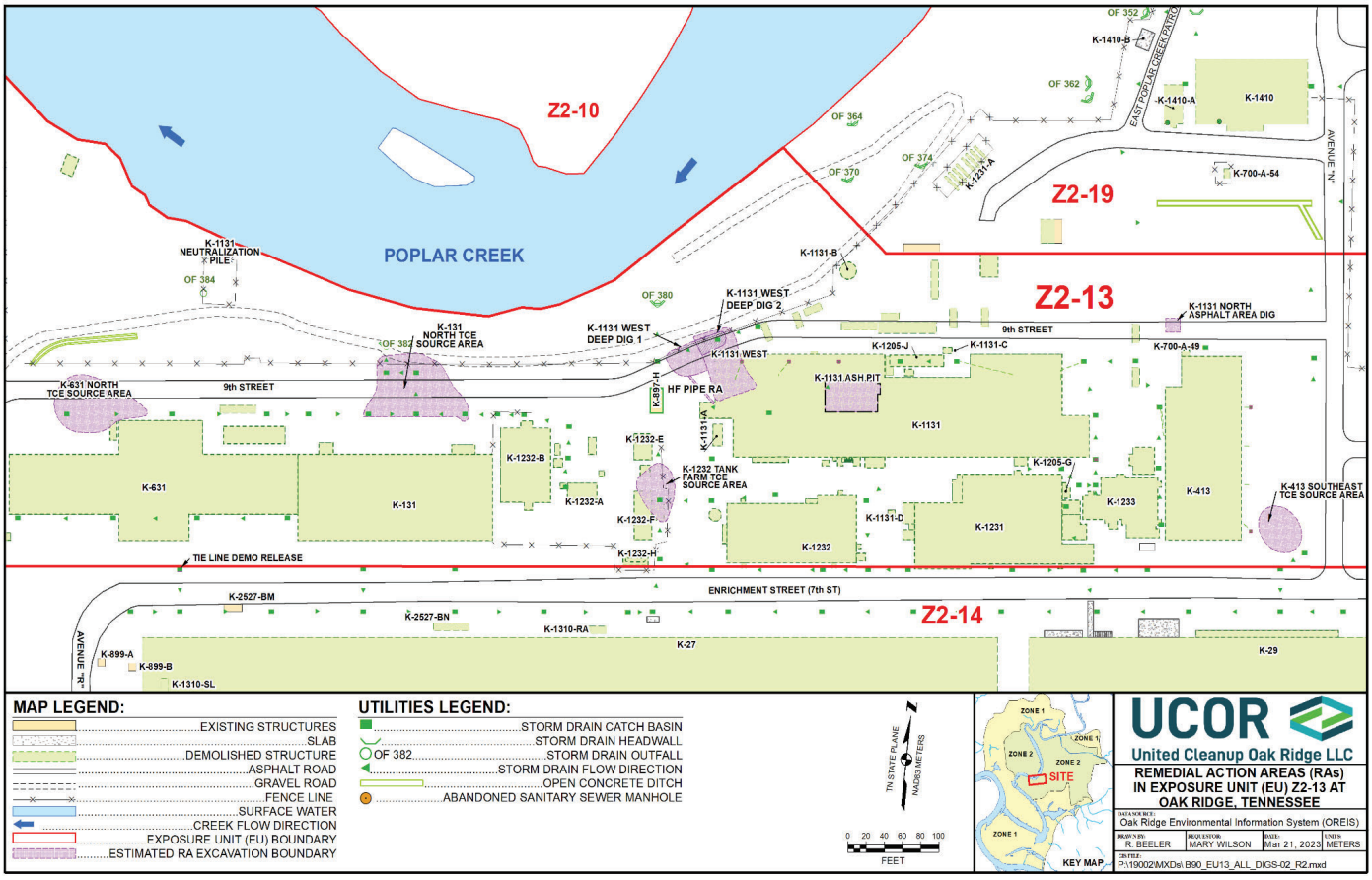

Figure 2.10. Excavation areas exceeding groundwater SSLs in Poplar Creek facilities area.

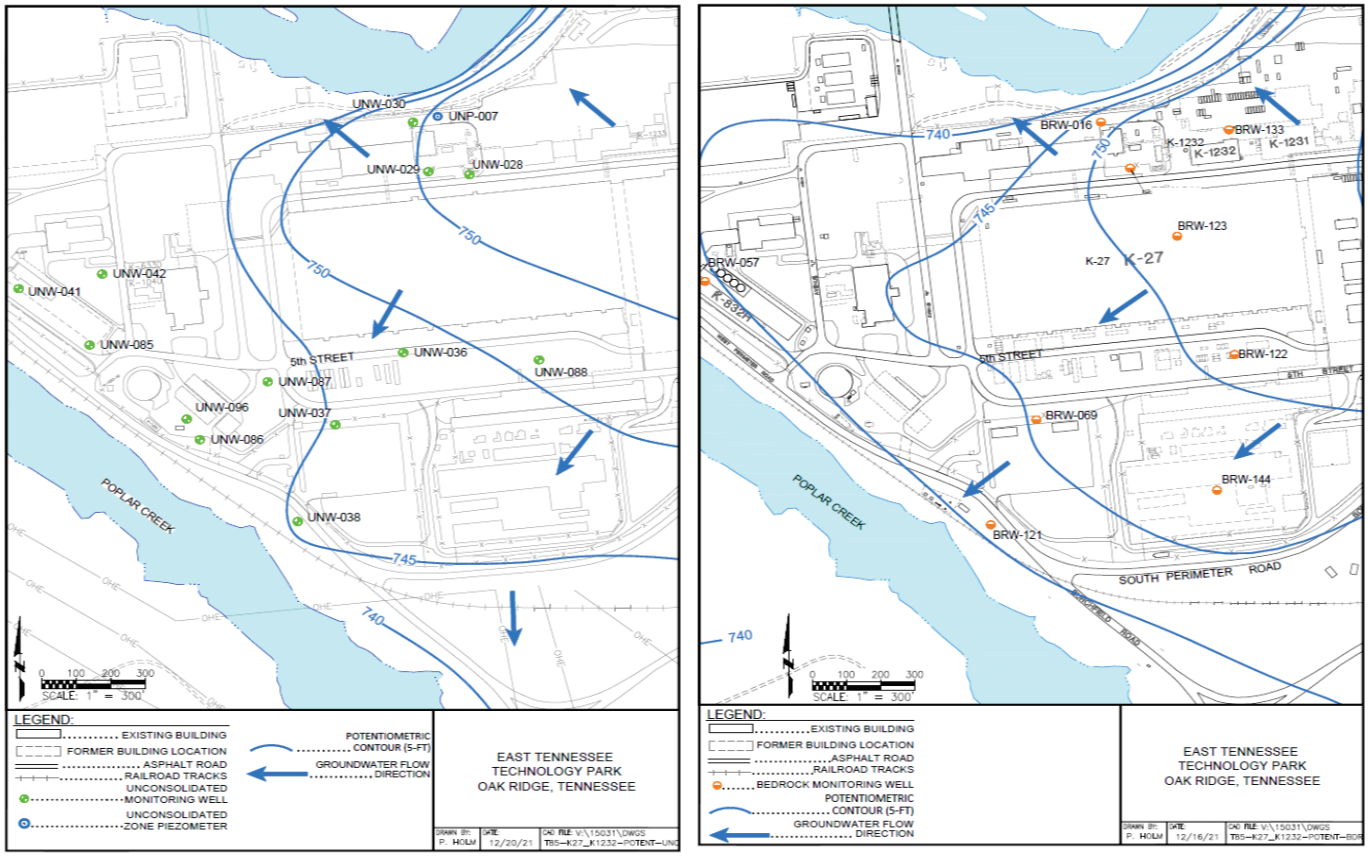

Figure 2.11. Average potentiometric surface for unconsolidated zone (left) and bedrock (right) in K-27/K-1232 Area.

Uncertainties in the unconsolidated zone plume exist at the K-27/K-1232 Area. The data gaps include the extent of the unconsolidated zone CVOC plume to the north, east, and south of well UNW-088. There are numerous wells that provide good data coverage west of UNW-088, and several wells, located over 750 ft north of UNW-088, delineate the northern extent of the > 1000-µg/L CVOC plume. However, the northern extent of the 1000-µg/L CVOC (or 400 µg/L for VC) plume where UNW-088 is located is a data gap. Additional data gaps are associated with the southern and eastern extents of the > 1000 µg/L of individual CVOCs or 400 µg/L of VC plume from UNW-088. Additional data from the Poplar Creek facilities soil removal for the Zone 2 Soil ROD will be useful for PDI planning.

Uncertainty in the bedrock CVOC plume exists at K-27/K-1232. Data gaps include the lateral extent of the 1000 µg/L of individual CVOCs or 400 µg/L of VC plume to the north, east, south, and west from well BRW-122; this well is completed to a depth of 60 ft bgs and contains TCE concentrations of 8170 µg/L. The vertical extent of the > 1000 µg/L of individual CVOCs or 400 µg/L of VC plume is also a data gap for the K-27/K-1232 Area.

The RDWP will present the additional investigations to address data gaps under the PDIs.

2.5.7 K-1239 Conceptual Site Model

The K-1239 Disposal Pit was located approximately 50 ft north of East Patrol Road along the north side of the K-1070-C/D Burial Ground (Figure 2.12). The pit was used to dispose of waste liquids from at least 1946 until 1976. Records indicate the pit was abandoned in 1976 and removed in 1977.

The approximate dimensions of the K-1239 Disposal Pit were 20.5 ft × 15.5 ft with a depth of 11.5 ft, which corresponds to a liquid capacity of approximately 27,000 gal. The pit walls and top slab were constructed of concrete, and the pit bottom (as-built elevation of 812.84 ft amsl) was open to the underlying soil. There are no disposal records of the wastes disposed of in the pit; however, it is surmised from the design of the pit that it was to be used for disposal of liquid wastes. Liquid wastes poured into the pit were allowed to infiltrate into the underlying soils and likely would have continued to move downward into the underlying bedrock, which was present approximately 7 ft below the base of the pit. Construction of the South Coal Yard, completed in 1977, called for the complete removal of the pit and approximately 5 ft of the underlying soils in the grading plan for the coal yard. The current ground elevation at the former location of the K-1239 Disposal Pit is 807 ft amsl, which is more than 5 ft below the elevation of the pit at the time of its construction. Any wastes that were present in the pit at the time of its removal were likely removed along with the surrounding (and underlying) soil.

The K-1239 Disposal Pit is located on the hanging wall of the K-25 thrust fault and is underlain by rocks of the Rockwood Formation. Drilling logs for well BRW-129 indicate siltstones were encountered at a depth of 2 ft bgs and interbedded siltstone and shale were encountered to the total depth of the borehole, which was drilled to 60 ft bgs. Well BRW-129 is screened from 30 to 40 ft bgs.

The depth to water at BRW-129 was approximately 5.5 ft bgs in May 2019. The water level in UNP-001 has ranged from 12 to 22 ft bgs. Groundwater flow in the unconsolidated zone at K-1239 is expected to follow mapped potentiometric gradients, which indicate flow to the northwest. In the fractured Rockwood Formation, flow is controlled by discrete fracture openings in the rock, which are likely to be relatively convoluted due to the high degree of structural deformation in this area due to thrust faulting.

Bedrock well BRW-129 was installed adjacent to the former location of the pit (Figure 2.12). The well was completed in bedrock, with a screened interval of 30 to 40 ft bgs. The analysis of a sample from the well, collected in March 2019, measured 59,800 µg/L of TCE, which is one of the highest concentrations of TCE detected in ETTP groundwater.

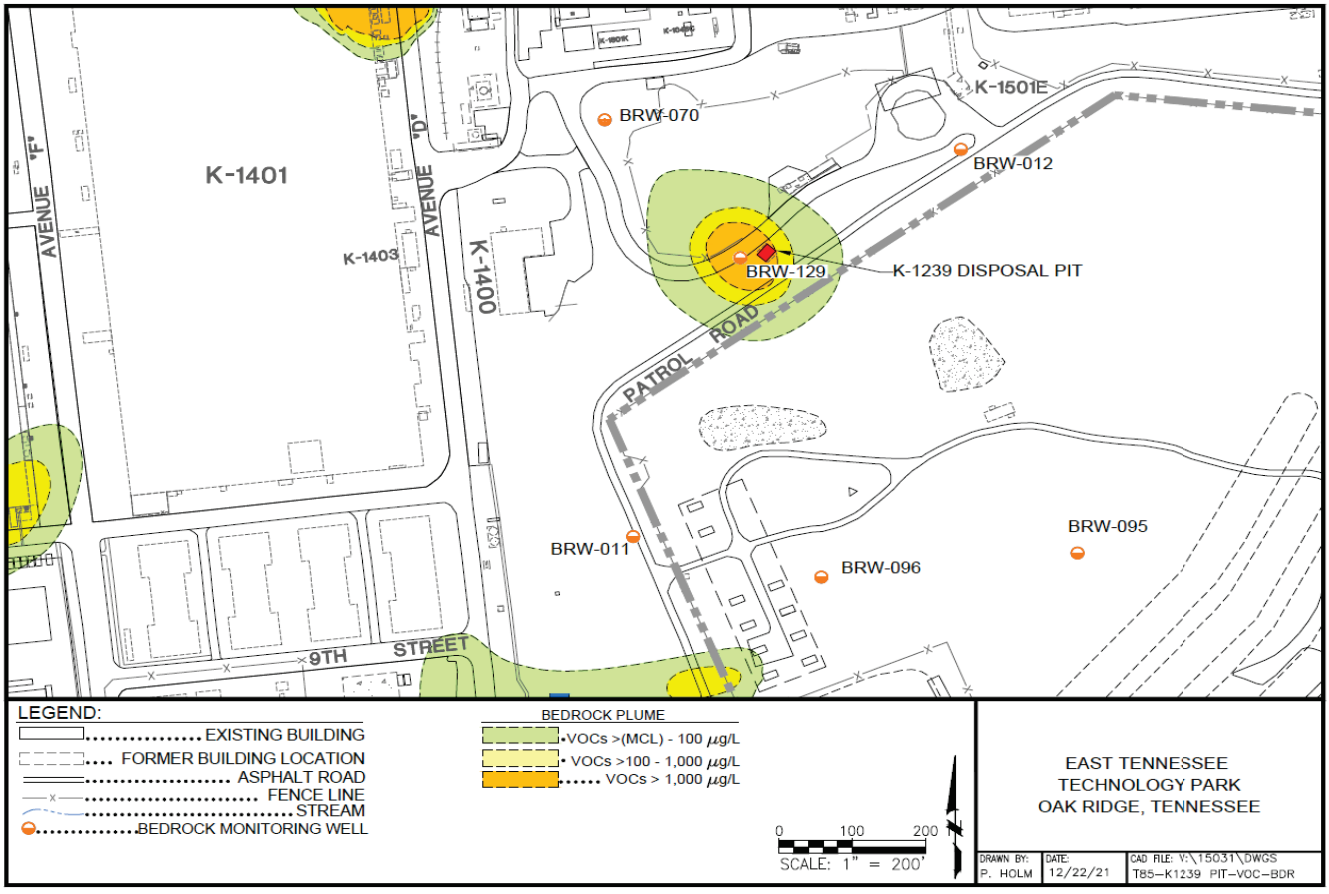

Figure 2.12. Distribution of CVOCs in K-1239 Area bedrock.

The presence of TCE at a concentration exceeding 1% of its solubility (TCE solubility in water is 11,000 µg/L) suggests there is a strong probability that DNAPL is present in the bedrock at this location. Additional data collected during the PDI phase of the MPA IROD will be evaluated to improve the understanding of site conditions at the K-1239 Disposal Pit.

Based on the description of the K-1239 Disposal Pit removal, changes to the area of K-1239 for construction of the coal pile, and the shallow depth to bedrock from boreholes in the area, it is suspected any significant CVOC contamination is limited to the bedrock. However, there is uncertainty in the CSM in this regard, as no unconsolidated zone groundwater samples have been collected in the K-1239 Area.

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

In the mid-1990s, DOE, EPA, and TDEC recognized the need for an overall strategy for making remedial decisions that was tied to the anticipated end use of the area being addressed. They agreed to make remedial decisions at an ORR site and watershed scale (e.g., Y-12 Bear Creek Valley) using consensus end-state land uses developed by the citizen stakeholders. DOE commissioned the End Use Working Group Stewardship Committee to recommend end uses for each watershed. ETTP was considered a single watershed in this end-state planning. The committee published the *Stakeholder Report on Stewardship* in 1998 that made such recommendations. The end-state recommendations have been used to make remedial action objectives for the existing RODs consistent with the proposed future end-state land uses.

The MPA lies within Zone 2 of ETTP. For the Zone 2 Soil ROD, "unrestricted industrial land use" served as the basis for the remedial action objectives and remediation goals. This reasonably anticipated future land use for Zone 2 of unrestricted industrial is further defined as industrial use (2000 hr/year for 25 years) to 10 ft bgs. Based on input from the three FFA parties and from the public, 10 ft was selected to allow for most industrial uses, including activities necessary to build basements and to repair or install utilities. An industrial land use is a logical extension of those areas of ETTP used in the past for industrial purposes because of the availability of standard utility and transportation infrastructure to support industrial activities and the relative ease of conversion to reuse for industrial purposes. Note the final land use restrictions for Zone 2 will be developed as part of the Zone 2 Soil RAR.

The End Use Working Group did not establish end states for groundwater; rather, it was deferred to future decisions. The State of Tennessee designates groundwater at ETTP as general use, per State of Tennessee Water Quality Criteria General Use Ground Water (0400-40-03-.07(4)(b)) requirements. Because of groundwater use restrictions, no current direct exposure risk exists to industrial workers via use of potable water.

The Zone 2 Soil ROD identified the remedial action objective for groundwater resources as, "Protect groundwater to levels at or below MCLs," indicating a goal of full restoration consistent with the State's designation. The goal will remain in place until groundwater is restored to meet state and federal numerical criteria or until such time in the future that an ARAR waiver is granted.

Portions of the ETTP MPA have been or will be leased or transferred for reindustrialization. In all cases, the transfer deeds transfer the property but prevent groundwater use at the site and require actions to ensure indirect exposures via vapor intrusion are mitigated.

Vapor intrusion LUC implementation is outlined in the specific property transfer deed covenants.

The transfer status of the sites addressed in this MPA IROD is listed below:

- The K-1407-B Area has not been transferred.
- The K-1401 and K-1035 groundwater plumes areas are located in parcel areas ED-11, which transferred in May 2014.

- The K-1024 Area will be retained by the federal government as part of the K-25 National Historic Preservation/National Park Service footprint.
- Most of the K-27/K-1232 Area has not been transferred, but the southern portion is in a pending transfer area.
- The K-1239 groundwater plume lies within parcel ED-10, which transferred in February 2012, but additional PDIs could show it may encroach on other areas.

Despite having transferred the land for reuse at the MPA, the transfer deeds all contain language that ensures the United States retains access to the groundwater plumes at ETTP for the purpose of investigations, remedial action, and monitoring sites to implement the selected remedy. Coordination with existing tenants may need to be accounted for in planning and implementing work.

In addition to the on-site uses of the land and groundwater resources, off-site land and groundwater uses are considered since groundwater flows to off-site locations. Residents currently are located offsite to the north and west of ETTP. DOE conducted the *Offsite Groundwater Assessment Remedial Site Evaluation* (DOE/OR/01-2715&D2) from fiscal years 2014–2016 to investigate groundwater quality and potential off-site migration of contaminants from the ORR. The study included sampling 15 residential wells and springs downgradient of ETTP. The study did not identify any contamination issues or other impacts at these 15 wells and springs sampled during the fiscal years 2014–2016 time period. Continued sampling in accordance with Phase 2 of the Offsite Groundwater Remedial Site Evaluation at a subset of five downgradient monitoring locations in fiscal years 2019–2021 has documented the absence of off-site contamination issues in those five residential wells.

2.7 SUMMARY OF SITE RISKS

Although a comprehensive RI/baseline risk assessment has not been completed for the MPA, several past studies have estimated the risks associated with the MPA groundwater plumes. These studies provide the basis for taking an interim action prior to completing a full human health and ecological baseline risk assessment as part of a final ROD (or RODs) for the MPA. Although there are no current complete on-site human exposure pathways (i.e., residential land use does not occur in the MPA and no workers are currently exposed to unacceptable high groundwater contaminant concentrations and risk due to deed restrictions on groundwater use), these studies identified potential future uses of the groundwater resource could result in unacceptable risk. DOE will ensure any unacceptable risks due to vapor intrusion are addressed through enforcement of deed restrictions and as part of a final ROD (or RODs) for the MPA.

2.7.1 Human Health Risks

In 2007, a Sitewide RI was performed at ETTP and included a human health risk assessment on groundwater. EPA and TDEC withheld approval of the RI/FS pending completion of additional work. Regardless, the study found groundwater underlying ETTP is contaminated with CVOCs that could result in unacceptable human health risks if used as a potable water source. The predominant CVOC present in groundwater is TCE, with 1,1,1-TCA and PCE being less widespread throughout the area. Degradation products of these parent compounds, primarily cis-1,2-DCE; 1,1-DCE; and VC, are also present in substantial concentrations in some areas.

The 2007 Sitewide RI study evaluated risks from exposure to groundwater by hypothetical future industrial workers and future residents for the source areas listed in Table 2.3.

At the time the 2007 Sitewide RI study was performed, no assessment for K-25/K-1024 and K-1239 plume source areas was included since these areas of contamination had not yet been identified. However, TCE concentrations in these two areas are similar to the concentrations measured in the other four source areas.

Table 2.3. Summary of risk characterization results for hypothetical industrial and residential receptor

Source area evaluated in 2007 assessment	Industrial receptor		Residential receptor		CERCLA acceptable upper bound on risk[a]	
	ILCR	HI	ILCR	HI	ILCR	HI
K-1407-B	3.0E-03	25	3.5E-02	200	1E-04	1.0
K-1401	5.7E-03	42	6.6E-02	340	--	--
K-1035	4.4E-03	39	6.2E-02	320	--	--
K-27/K-29	3.5E-05	1.5	7.5E-04	12	--	--

[a]*Role of Baseline Risk Assessment in Superfund Remedy Selection Decisions*, Directive 9355.0-30, Office of Solid Waste and Emergency response, 1991.

-- Indicates acceptable risk values are the same for all source assessments.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
HI = hazard index
ILCR = individual lifetime cancer risk

For each source area evaluated in the 2007 Sitewide RI study, estimated human health risks exceeded the CERCLA risk goal of 1.0E-04 to 1.0E-06. In several cases, the risk significantly exceeded this goal, which provides the driver for this proposed interim action.

2.7.2 Environmental Risks

In general, with some exceptions, ecological risks are not a primary driver for early groundwater actions. Exceptions are sites with significant groundwater contaminant release to surface water where surface water concentrations exceed ecological screening values.

An evaluation of ecological impacts in Poplar Creek was conducted as part of the 1997 *Record of Decision for the Clinch River/Poplar Creek Operable Unit, Oak Ridge, Tennessee* (DOE/OR/02-1547&D3). As noted in that ROD, sediment pore water and water above sediments were not found to be toxic, indicating groundwater potentially entering the system as pore water is not contributing to toxicity in Poplar Creek.

An ecological risk assessment to evaluate ecological effects from Mitchell Branch surface water and sediment was included in the 2007 Sitewide RI. Benthic invertebrates in sediment could potentially be exposed to contaminants in groundwater as it moves through sediment pore water to discharge to surface water features. Because of this, possible exposure of benthic invertebrates to groundwater in the vicinity of Mitchell Branch was considered in the ecological risk assessment. This potential risk was examined assuming measured groundwater concentrations represent pore water concentrations to which benthic invertebrates would be exposed. Comparison of groundwater concentrations along Mitchell Branch to surface ambient water quality criteria revealed several metals (copper, iron, and manganese) and CVOCs (primarily TCE) that could pose a risk to benthic invertebrates.

However, groundwater remedial goal options for pore water were not developed because of the extremely conservative nature of the analysis (e.g., assumes exposure to the maximum reported groundwater concentrations with no dilution from groundwater to pore water, the organisms are as sensitive to pore water concentrations as they are to surface water concentrations, and the use of overly protective Tier II secondary chronic values based on limited data).

Groundwater was not identified as an ecological risk concern; therefore, ecological risk is not a driver for this interim action. As part of a final ROD (or RODs) for the MPA, DOE will identify areas where groundwater plumes could have the potential to migrate to nearby surface waters to ensure future proposed remedial actions consider this risk. Ecological receptors within these water bodies are being evaluated as part of the Remaining Media ROD project.

2.8 REMEDIAL ACTION OBJECTIVES

The purpose of the interim action is to initiate remedial actions while additional information is collected to better assess the practicability of aquifer restoration prior to determining final cleanup goals.

In the ETTP MPA, CVOCs present the greatest human health risks in groundwater and exceed MCLs by several orders of magnitude. The MPA groundwater plume areas addressed in this MPA IROD are the areas where the greatest CVOC contaminant mass has been observed. These areas act as sources of continued releases to the associated groundwater plumes. The interim remedial action objective for this MPA IROD is to substantially reduce CVOC contaminant mass in these areas. Reducing groundwater plume source material will facilitate long-term restoration of groundwater at the site.

Interim remedial action objectives have been identified to establish goals for the interim action to determine if the action has been successful at reducing source mass. Interim remedial action objectives are sometimes referred to as functional objectives, performance metrics, or near-term remediation goals. They describe intermediary goals that guide progress towards achieving final remedial action objectives that will be in a final ROD (or RODs) for the MPA. The CVOC treatment areas covered by this MPA IROD were defined on the basis of concentrations > 1000 µg/L for at least one CVOC identified for that source, typically TCE, or 400 µg/L for VC.

These concentrations were used as the target performance metric for developing the remedial alternatives and are identified as the interim remedial action objective for this MPA IROD—to reduce contaminant concentrations to less than or equal to 1000 µg/L for individual CVOCs (or 400 µg/L for VC). This 1000-µg/L (or 400 µg/L for VC) threshold was selected because it is a practical goal to achieve contaminant mass removal and is similar to values selected for several other CERCLA sites for this purpose, including two EPA Region 4 National Aeronautics and Space Administration sites and DOE's Santa Susana site. It also represents a contaminant level that is less than values suggesting the presence of DNAPL, or less than 1% of the solubility of TCE and other priority CVOCs (cis-1,2-DCE; 1,1-DCE; carbon tetrachloride; PCE; and VC). Treatment to these levels contributes to DOE's strategy to substantially reduce further contribution of contaminant mass to the aquifer.

If performance data indicate treatment is capable of reducing contaminant concentrations to levels below the target performance metrics (1000 µg/L for individual CVOCs or 400 µg/L for VC), then active remediation will continue to achieve the greatest practicable reduction in contaminant mass. In this situation, the treatment would continue until performance data indicate additional treatment actions do not accomplish any further practicable reduction in contaminant concentrations.

Decision rules identified in the RDR/RAWP will be used to define the conditions for ceasing active treatment operations for the interim action and in collaboration with TDEC and EPA to determine the next stage of work. The interim remedial action objective for this MPA IROD does not include groundwater restoration to CVOC MCLs; rather, it focuses on plume contaminant mass reduction to identified performance metrics.

This interim action identifies SDWA MCLs as chemical-specific ARARs because they are still well suited to establishing remedial goals for groundwater as well as legally applicable narrative and numeric Tennessee groundwater quality criteria. However, because this is an interim action, DOE is seeking a waiver from these ARARs under CERCLA Section 121(d)(4)A), 42 United States Code Section 9621(d)(4)(A), which allows for remedial actions to be selected that will not attain ARARs, if the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed (commonly called the interim action waiver).

To summarize, the interim remedial action objectives for this MPA IROD are to:

- Reduce contaminant mass that continues to act as sources for groundwater contamination.
- Reduce contaminant concentrations to less than or equal to 1000 µg/L for individual CVOCs or 400 µg/L for VC.
- Achieve the greatest practicable reduction in contaminant mass in the six source zones.

2.9 DESCRIPTION OF ALTERNATIVES

Four alternatives were evaluated in the MPA FFS for the six groundwater plumes:

- Alternative 0 – No action
- Alternative 1 – In situ thermal treatment (ISTT)
- Alternative 2 – EISB treatment
- Alternative 3 – In situ soil mixing (ISSM), along with EISB for deeper zones

Major components of each remedial alternative are summarized in Table 2.4. The remedial alternatives developed were a set of technology combinations that will result in the most promising alternatives to achieve cleanup objectives. These remedial alternatives are described more fully in the MPA FFS. With the exception of the no action alternative, all the remedial alternatives listed in Table 2.4 include common components such as PDIs, performance monitoring, and LUCs.\ The interim remedial action objective for the CVOC groundwater plumes is to reduce CVOC mass. The performance metric for accomplishing this interim remedial action objective is to reduce concentrations of individual chlorinated organics to less than or equal to 1000 µg/L (or 400 µg/L in the case of VC).

Table 2.4. Summary of alternatives for CVOC groundwater plumes

Alternative	Description	Cost/Timeframe
Alternative 0 – No action	No actions	Cost: $0 Timeframe: not applicable
Alternative 1 – ISTT and LUCs	This alternative involves installing heating elements to increase the subsurface temperature, resulting in volatilization of contaminants, with capture of the resulting vapors using a vacuum extraction system. The vapors will be treated before being discharged to the atmosphere. Process water produced as a result of treatment will be treated onsite and discharged to a permitted NPDES outfall	Capital cost: $123.3 million Total present-worth cost: $133.5 million Timeframe: 5 years
Alternative 2 – EISB and LUCs	This alternative involves stimulating existing subsurface bacteria to promote dechlorination and ultimate destruction of the CVOC contaminants. It involves installing injection wells in the unconsolidated zone and bedrock. A carbon substrate, along with other supporting treatment reagents (e.g., supplements and bioaugmentation cultures), will be injected into the wells so they can be distributed in the subsurface. Multiple injections will be completed to recharge the system with treatment reagents	Capital cost: $16.9 million Total present-worth cost: $32.7 million Timeframe: 5 years
Alternative 3 – ISSM, along with EISB for deeper zones, and LUCs	This alternative involves using a soil mixing technology to deliver ZVI and bentonite to the unconsolidated zone. The reagents will treat contaminants and minimize contamination migration from the treatment zone. The soil mixing technology will be completed under a tent with air control to prevent the release of CVOCs to the atmosphere. This alternative also uses EISB treatment in the bedrock	Capital cost: $154.1 million Total present-worth cost: $167.2 million Timeframe: 5 years

CVOC = chlorinated volatile organic compound
EISB = enhanced in situ bioremediation
ISSM = in situ soil mixing
ISTT = in situ thermal treatment
LUC = land use control
NPDES = National Pollutant Discharge Elimination System
ZVI = zero-valent iron

2.9.1 Alternative 0 – No Action

Under this alternative, no remediation or monitoring is planned for groundwater in the MPA. LUCs would continue to be implemented as described in Section 2.11.5. While contaminants would likely attenuate over a long period of time, the pace of attenuation would not be assessed, the nature and extent of contamination in the future would be unknown, and there would be no knowledge of how much attenuation has occurred over time.

2.9.2 Alternative 1 – In Situ Thermal Treatment and Land Use Controls

This alternative actively treats source areas using ISTT, within the unconsolidated zone and bedrock to an assumed depth of 50 ft bgs, using conductive heating. Figure 2.13 illustrates the conceptual design information of how this alternative might be applied, using the K-1401 plume source as an example source area.

Under this alternative, ISTT is assumed to be implemented throughout the entire source area, as defined by individual CVOC concentrations in groundwater > 1000 µg/L (or 400 µg/L for VC). For K-1401, the majority of the TCE source mass is estimated to reside in the top 45-ft-bgs interval so that a target depth of 50 ft bgs was selected for the MPA FFS analysis.

ISTT implementation includes using thermal conductive heating to allow for maximum heat transfer and uniform heating. The heating occurs through a series of heater wells, which have a heating element in them to generate heat that is conducted out from the wells. A minimum treatment temperature of 100°C would be used throughout the area. The heater wells would be installed to 55 ft bgs to achieve heating down to 50 ft bgs (ISTT heaters are typically installed deeper than the target treatment depth). Heated vapors and steam, with some free liquid, would be collected from vertical, multi-phase extraction wells that are located within 3 ft of each heater well. The extracted liquids and vapors would be sent to treatment in aboveground liquid- and gas-phase granular activated carbon (GAC) treatment systems; an air stripper (with vapor-phase GAC [VGAC]) may be used in advance of the liquid-phase GAC (LGAC) treatment to optimize contaminant loading on carbon. The treated extracted liquid, assumed to be generated at a rate of about 1 to 3 gpm over the course of treatment, would be stored in a tank near the ISTT system. As the tank approaches capacity, the liquid content would be pumped from the storage tank to a tanker truck, which will transport the liquid to the Chromium Water Treatment System (CWTS). The CWTS effluent is transported via pipeline to the Clinch River where it is discharged via a diffuser.

To ensure vapor capture during operation, a 6-in.-thick concrete vapor cap would be installed to cover the treatment area. Horizontal vapor recovery lines would be placed under the vapor cap to collect vapors not collected by the fluid/vapor recovery wells. The vapors would be treated with VGAC. The vapor cap, air stripper, and the GAC used to treat vapor and extracted water are standard components of the screened ISTT technology.

For cost-estimating purposes, a unit cost per cubic yard of soil treated was assumed and is inclusive of installation and operation of the ISTT system, including waste management. The duration of operations of the ISTT system is based on input from thermal vendors. Additional time will be provided in planning to allow for unforeseen delays and operational challenges. The total time for active remediation, site cooldown, and decommissioning of aboveground infrastructure is expected to be 1 year. The active time of remediation is expected to be approximately 6 months. Performance monitoring during the cooldown phase of remediation is expected to take an additional 4 years. During operation, detailed subsurface monitoring will be performed using real-time temperature sensing technology to ensure there are no cold spots and the co-boiling point of the water/CVOC mixture is achieved. The monitoring data would also be used to optimize the heating and extraction system to improve overall performance, including capture of vapors. The GAC used to treat vapor/liquid will be managed offsite for disposal and will not be regenerated based on the COCs at the site.

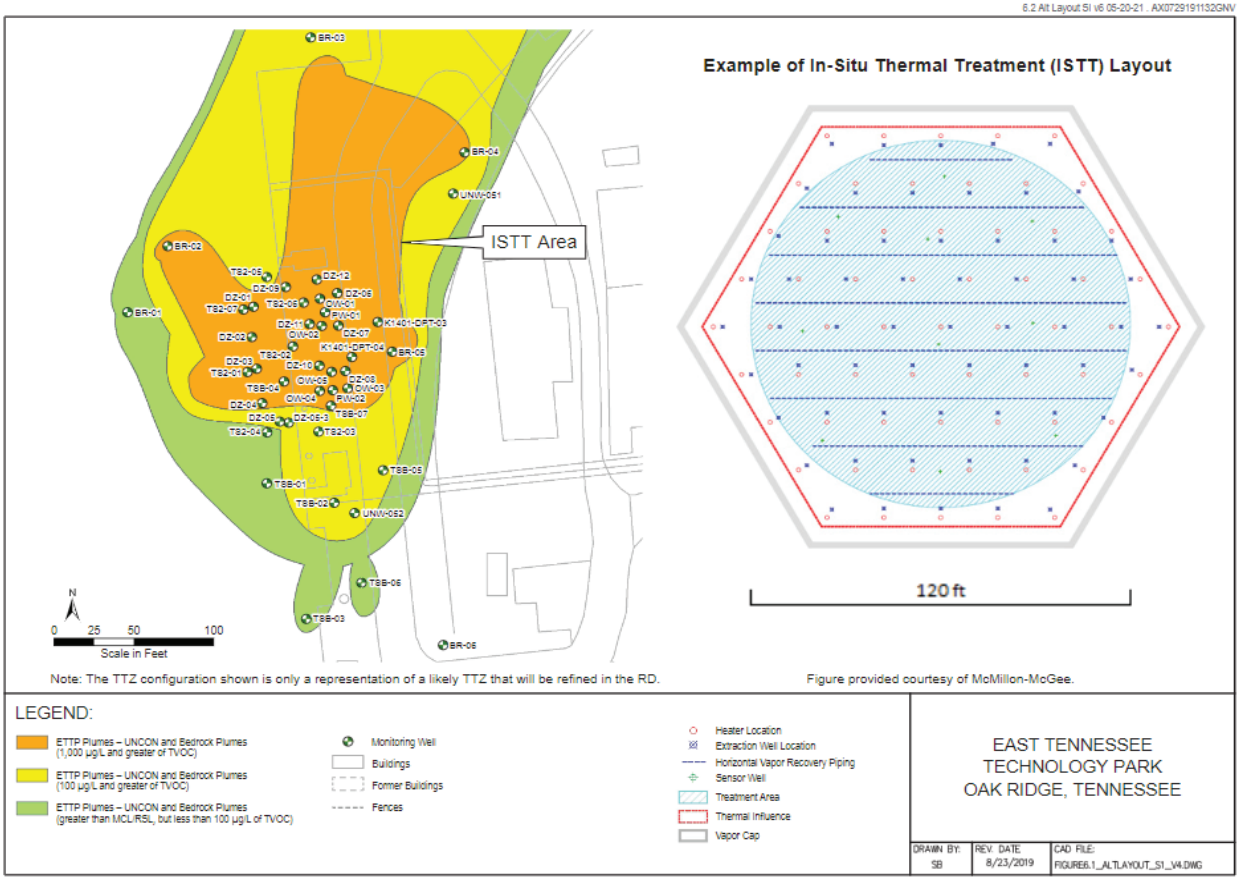

Figure 2.13. Alternative 1 conceptual layout – ISTT and LUCs.

Other waste residuals (e.g., drill cuttings from installing the thermal treatment system, removing the vapor cover) may go to either the Environmental Management Waste Management Facility (EMWMF) or Nevada National Security Site; the final decision on the disposition of the waste cannot be made until the treatment residuals have been profiled. For cost-estimating purposes, the waste residuals are assumed to be transported to the EMWMF for management. The mass of GAC used for vapor and water treatment will be a function of the mass of contaminants present, which cannot be accurately estimated. Also for cost-estimating purposes, 10,000 lb of combined LGAC and VGAC are assumed to require management at the EMWMF. Additional O&M activities associated with this alternative include quarterly inspections and semiannual performance sampling.

Although follow-on management of the site would not be determined until the interim remedy is complete, it is important to note natural reductive dechlorination of the COCs is not expected to be significantly impacted by the ISTT and might even be enhanced. Although the high temperature achieved during ISTT is likely to kill a large fraction of the microbial population naturally present in the subsurface, it is not likely to kill all of the microorganisms. Re-colonization of the subsurface will also occur once the temperature cools to less than about 40ºC. Natural reduction chlorination may be enhanced by the ISTT due to the formation of partially oxidized organics from the COCs and the natural organic material in the subsurface. These partially oxidized organics are more easily biodegraded and serve as electron donor for reductive dechlorination. The enhancement of natural reductive dechlorination after ISTT is a general observation of the industry (Stroo et al. 2012).

LUCs will be addressed under the ETTP RAR CMP.

2.9.3 Alternative 2 – Enhanced In Situ Bioremediation and Land Use Controls

This alternative actively treats source areas using EISB. EISB injection wells would be used to treat groundwater within the unconsolidated zone and shallow bedrock. For the MPA FFS, treatment was assumed to occur to a depth of 50 ft bgs. As indicated in Section 2.14 and based on findings from the PDI work, actual treatment may occur as deep as 100 ft bgs. The EISB injection wells would distribute a carbon substrate to the source area, as shown in Figure 2.14. Other potential additives (e.g., bioaugmentation cultures, nutrients, buffers, and ZVI) could also be injected, if the geochemical and microbial parameters that would be collected during the PDI suggest they are beneficial.

Injections will be carried out through permanent injection wells that are installed in the unconsolidated zone and bedrock. The unconsolidated wells would be clustered with two separate screen intervals: one in the overburden, and one in the weathered bedrock. The substrate used for injections is assumed to be commercially available EVO. Other substrates could also be used (e.g., EVO with ZVI), and/or the EVO might be amended with other organics (e.g., lactate) plus buffers and bioaugmentation cultures. Sampling and analysis of geochemical and microbial parameters will be performed as part of the PDI to help assess the need for other amendments. Successful distribution of the substrate is a key variable in the effectiveness of this alternative. PDI testing (e.g., tracer testing or other strategies) may help to identify placement of injection wells to optimize substrate distribution and monitoring of the remedy.

O&M activities associated with this alternative include initial injections, groundwater monitoring, and follow-up injections. After the initial injection, system optimizations would be designed to target challenges with delivery and could include additional injections, optimization of the substrates mixture, and possibly recirculation of groundwater to optimize delivery to more challenging locations within the formation. For the purposes of this evaluation, a second round of injections was assumed to occur at year 2 and be followed with a 3-year period of post-injection monitoring. Injection well fouling may require routine well maintenance and rehabilitation prior to each injection. The total time for active remediation and performance monitoring for this interim remedy is expected to be 5 years. Additional O&M activities associated with this alternative include quarterly inspections and semiannual performance sampling, which will be carried out during the operating period.

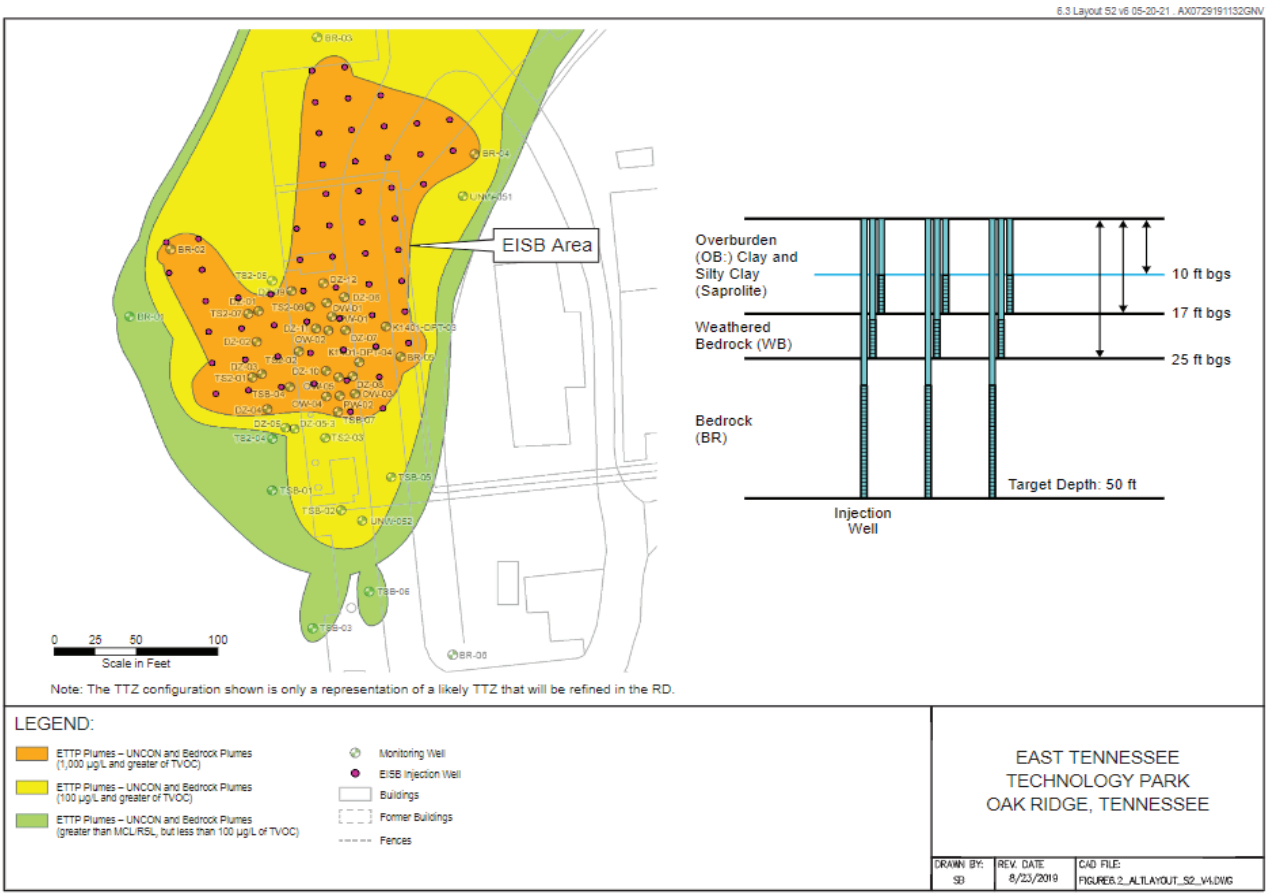

Figure 2.14. Alternative 2 conceptual layout – EISB and LUCs.

A treatability study of EISB titled *Treatability Study for the Bethel Valley 7000 Area Groundwater Plume, Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/01-2566&D1; 7000 Area Treatability Study) was performed at the Bethel Valley 7000 Area at ORNL. Although subsurface conditions at Bethel Valley may not be identical to those at ETTP, the lessons learned from the 7000 Area Treatability Study will be used to support RD, where appropriate. Overall, the findings of the pilot study were positive.

Following interim action completion, decommissioning could be implemented, if the interim remedial action objectives have been achieved and additional use of the injection wells is not likely. Decommissioning would be implemented to return the site to its original condition and, for cost-estimating purposes, includes abandoning on-site wells (injection and monitoring wells not required for long-term monitoring). Decommissioning costs were included in the MPA FFS costs, even though decommissioning might not be performed as part of the interim action.

LUCs will be addressed under the ETTP RAR CMP.

2.9.4 Alternative 3 – In Situ Soil Mixing, Enhanced In Situ Bioremediation for Deeper Zone, and Land Use Controls

This alternative actively treats source areas using a combination of ISSM and EISB (via injection wells). ISSM would be used in the unconsolidated zone while EISB injections would be performed in the bedrock. The ISSM would thoroughly mix the unconsolidated soil and weathered bedrock with reactive material, such as ZVI and bentonite. ZVI abiotically reduces the CVOCs while bentonite lowers the hydraulic conductivity of the material to prevent or minimize recontamination of the area from contaminated groundwater outside the target source areas. EISB would be used in the bedrock where it is not possible to perform soil mixing. Figure 2.15 illustrates the major components of the conceptual design for this alternative.

ISSM would be implemented using earthmoving equipment to mix reagents with contaminated saturated soil/weathered bedrock and groundwater within the source area. Backhoe mixing would likely be used, as large-diameter augers cannot mix the weathered bedrock. The mixing would be performed to the depth of refusal of a backhoe. Clean, unsaturated soil would first be removed to reduce the volume of soil to be mixed and to allow room for swell of the soil. Clean soil would be backfilled across the site as necessary. During ISSM activities, a temporary, high-efficiency, particulate air-ventilated tent is assumed to be needed to prevent emissions of CVOCs. Completing ISSM activities in the tented area will require Level B protection.

Soil mixing results in soft soils immediately after mixing, but they will consolidate somewhat with time. Additional reagents (e.g., cement) might need to be mixed with the soil if higher-strength soil is required for future reuse of the site. Mixing with cement should not be performed until approximately 4 months after mixing, as the high pH conditions created by the cement will reduce the rate of the ZVI reactions.

Beneath the ISSM area, injections of EISB treatment substrates would be implemented to stimulate biological activity within the bedrock, similar to the description for Alternative 2. The injections would be performed after the ISSM is complete and the soil has stabilized to support the drill rig.

There are no O&M activities associated with the ISSM, which is expected to be completed within 1 year. For EISB in the bedrock, O&M activities associated with this alternative include initial injections, groundwater monitoring, and potential follow-up injections. As with Alternative 2, the EISB component of this alternative would be optimized based on monitoring data. For the purposes of this evaluation, the first injections are assumed to occur at year 2, and a second round of injections would occur at year 4 and be followed by post-injection monitoring. Injection well fouling may require routine well maintenance and rehabilitation prior to each injection. The total time for active remediation and performance monitoring for this interim remedy is expected to be 5 years. Additional O&M activities associated with this alternative include quarterly inspections and semiannual performance sampling, which will be carried out during the operating period.

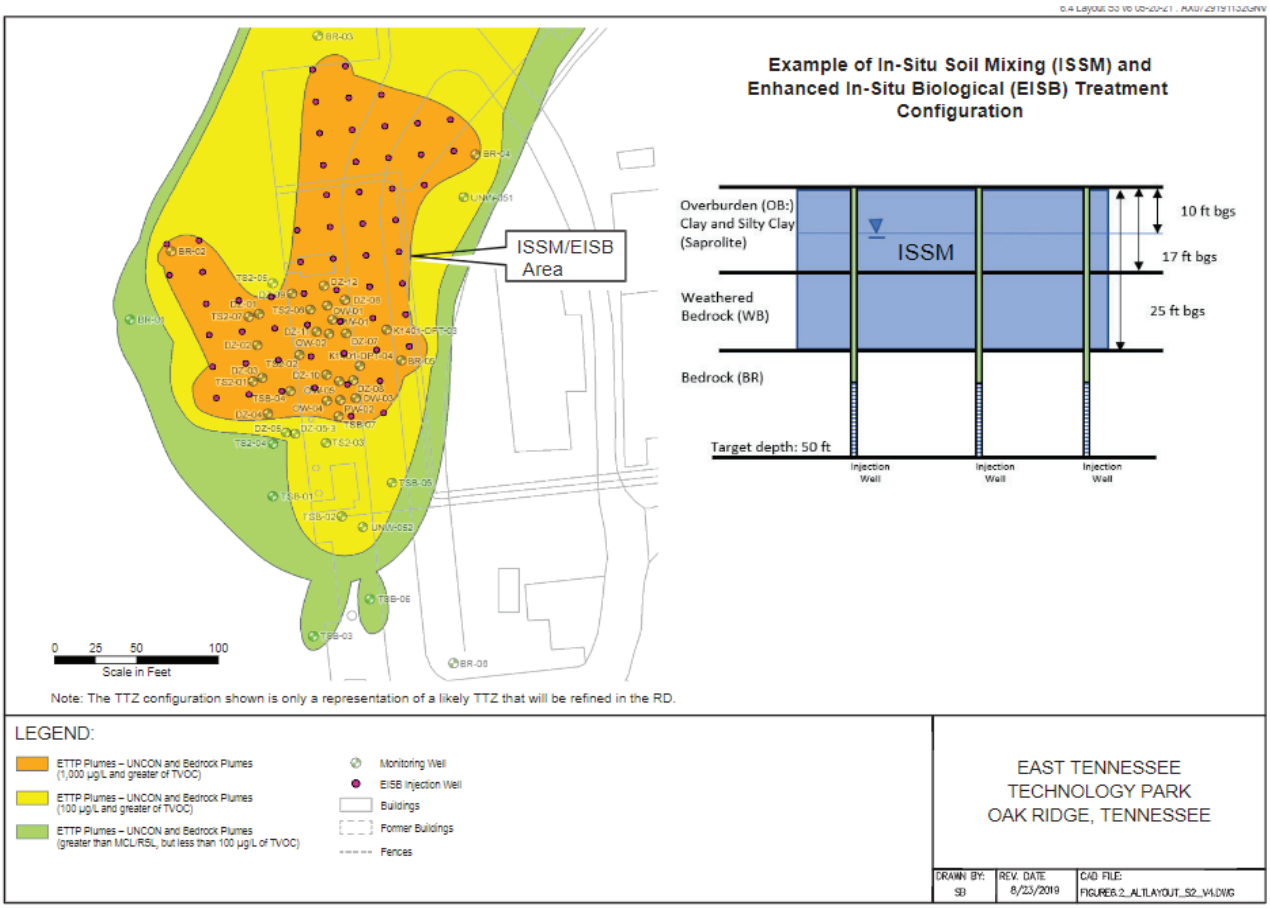

Figure 2.15. Alternative 3 conceptual layout – ISSM, EISB, and LUCs.

Following active treatment, decommissioning would be implemented to return the site to its original condition and, for cost-estimating purposes, includes abandonment of on-site wells (injection and monitoring wells not required for long-term monitoring). LUCs will be addressed under the ETTP RAR CMP.

2.9.5 Common Components of Alternatives

With the exception of the no action alternative, the alternatives described in Table 2.4 have several common components. First, implementing all alternatives will require a PDI as well as performance monitoring. Additionally, LUCs are components of all alternatives. Rather than repeating these details for each detailed description of each alternative, these components are discussed below.

PDIs

Data collected for the MPA FFS were sufficient to evaluate technologies and alternatives for the plume source areas. However, additional data are required to design, install, and operate the remedy.

To simplify the scope of the PDI work, five unconsolidated zone monitoring wells and five bedrock wells were assumed to be installed at each plume source area. For sites where treatment is only in the unconsolidated zone or bedrock, 10 wells total will be installed in a single zone. Some sites may require additional investigation and others may require less investigation. However, as a whole, the total number of 10 wells is considered appropriate for costing and evaluating against MPA FFS criteria.

To develop an MPA FFS cost estimate, the total treatment depth was assumed to be 50 ft. The plume source areas have CVOC concentrations exceeding 1000 µg/L (or 400 µg/L for VC). Additionally, there is confirmed DNAPL at two locations (K-1401 based on visual observation, and K-1024 based on dye tests). It should be noted the presence of DNAPL is difficult to confirm on a repeated basis and, often, resampling at locations with DNAPL observations may not be confirmed. In areas where CVOC concentrations are suspected to be present at concentrations greater than the source treatment thresholds, the PDI will further evaluate the depth of contamination. As a result, the preferred alternative in the MPA Proposed Plan states some PDI wells and some remedial action will occur deeper than 50 ft (see Section 2.14).

The challenge with treating deeper depths is the bedrock is less fractured and less amendable to treatment. However, this condition also results in a reduced chance of contaminant migration in low groundwater flow zones. Implementing these interim remedies will provide valuable data to determine a treatment technology's ability to effectively treat contaminants in the bedrock.

Performance Monitoring

Performance monitoring will be implemented to help assess remedies' effectiveness and determine when the interim action has achieved target performance metrics for each plume source area. Performance metrics for the interim action will be established in the RDR/RAWP. For the purposes of the MPA FFS, the remedies were assumed to be implemented and evaluated for 5 years, which is appropriate for determining if target performance metrics can be achieved in a reasonable period of time. Performance monitoring will include collecting groundwater, the details of which will be developed in the RDR/RAWP. For the conceptual design of each alternative, the following assumptions were made:

- A portion of the new wells installed in the source area as part of the PDIs is located such that they can be used as the performance monitoring wells for each remedy.
- The frequency of monitoring and the target analytes will be defined in the RDR/RAWP. For cost-estimating purposes, frequency is assumed to be semiannual at the 10 performance monitoring wells and the target analytes are assumed to be the same as currently used for the RER wells.

LUCs

A LUC Implementation Plan (LUCIP) for ETTP has been developed in accordance with the LUC Assurance Plan for the ORR that was published with a memorandum of understanding between the FFA parties. The ETTP LUCIP is found in the ETTP RAR CMP. The current ETTP LUCIP is outlined in Chapter 6 of the ETTP RAR CMP and detailed in Appendix D of the ETTP RAR CMP. The ETTP RAR CMP will be updated to incorporate the additional LUCs for this MPA IROD and ensure the appropriate level of detail is included in the ETTP LUCIP. Changes to the ETTP LUCIP will include, but are not limited to, adding MPA groundwater areas addressed by this MPA IROD as a specific subject (i.e., affected area) of the applicable LUCs to clarify these LUCs are separate from the general LUCs for restricting groundwater use at ETTP Zone 2 established by the Zone 2 Soil ROD.

The LUCs established in this MPA IROD have the following objectives:

- Prevent unauthorized access to or use of groundwater.
- Evaluate and mitigate, if necessary, the vapor intrusion pathway on existing and future enclosed building structures.

The LUCs in the following list will apply to the MPA. Table 2.5 lists the purpose, duration, and implementation of the LUCs for the MPA. The property record restrictions for restrictions on groundwater use and vapor intrusion, property record notices, and the excavation/penetration permit program for the existence and location of contaminated groundwater are required by this MPA IROD. Because these LUCs are existing LUCs for ETTP, an in-depth generic description of each one can be found in the ETTP RAR CMP. Site-specific information pertaining to the conditions of use for each LUC has been included in the bullets below. The LUCs are as follows:

- **Property record restrictions.** The purpose is to restrict property use and/or prohibit groundwater use by imposing limitations and mitigating the vapor intrusion pathway on existing and future enclosed building structures as needed. All property use is restricted to industrial use at ETTP Zone 2. All groundwater within the entire MPA IROD area, as shown in Figure 1.3, is restricted for use at least until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved. All current and future buildings in the MPA IROD area, as shown in Figure 1.3, will be mitigated for vapor intrusion if the pathway is found to be complete and exceed acceptable risk standards. Mitigation will continue until volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved.
- **Property record notices.** The purpose is to notify the public about the existence and location of regulated hazardous substances and the location of land that is not appropriate for UU/UE and limitations on the use. A general property record notice that restricts access/use of groundwater has been filed for ETTP
- **Excavation/Penetration permit program.** The purpose is to notify the worker/developer (i.e., permit requestor) on the extent of contamination and prohibit or limit excavation/penetration activity to ensure the excavation/penetration activity is conducted safely. For MPA groundwater, permit requesters will be notified of the presence of contaminated groundwater at applicable depths and the ongoing groundwater remedial action until its completion. The permit program has already been established for the MPA as part of Zone 2, and DOE and/or its agent will maintain responsibility for the program (including on transferred land) until concentrations of hazardous substances are at levels to allow for UU/UE or goals set forth in a final remedy are achieved.

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a])

Type of control	Purpose of control	Duration	Implementation	Affected area
1. Property record restrictions:				
A. Land use	Impose limitations to restrict use of property	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	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)	NA[b]
B. Groundwater	Prohibit groundwater use[c]	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
C. Vapor intrusion	Mitigate the vapor intrusion pathway on existing and future enclosed building structures, as needed	Until concentrations of volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
2. Property record notices	Notify anyone searching records about existence and location of contaminated areas and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Recorded by DOE in accordance with state law at County Register of Deeds office and copied to the appropriate zoning office (verified every 5 years). (1) Tennessee Code Annotated notice of land use restrictions after signing the ROD. (2) Upon completion of remedial action that leaves hazardous substances in place	MPA Groundwater[d]
3. Excavation/ Penetration permit program	Notify worker/ developer (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 or goals set forth in a final remedy are achieved	Implemented by DOE and its contractors. Initiated by permit request (verified annually)	MPA Groundwater
4. Access controls (e.g., fences, gates, signs, and portals)	Control and restrict access to workers and the public to prevent unauthorized uses	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Maintained by DOE (verified annually)	NA

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a]) (cont.)

[a]*East Tennessee Technology Park Administrative Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2477&D4).
[b]While NA to MPA groundwater, this LUC is part of the ETTP LUCIP and applies to ETTP sitewide.
[c]Consistent with language in the quitclaim deeds for property transfer, the prohibition of groundwater use includes the prohibition of any groundwater use, extraction, consumption, and exposure without prior written approval of DOE, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation.
[d]A general property record notice that restricts access/use of groundwater has been filed for ETTP.

CMP = Comprehensive Monitoring Plan
DOE = U.S. Department of Energy
ETTP = East Tennessee Technology Park
IROD = Interim Record of Decision
LUC = land use control
LUCIP = Land Use Control Implementation Plan
MPA = Main Plant Area
NA = not applicable
RAR = Remedial Action Report
ROD = Record of Decision
UU/UE = unlimited use/unrestricted exposure

LUCs in Table 2.5 are those presented in the ETTP LUCIP, which is included in the ETTP RAR CMP, including those listed as not applicable for the MPA groundwater remedy. Property record restrictions for land use and the vapor intrusion controls are in the ETTP LUCIP for application across ETTP sitewide. Access controls are only required for specific areas of ETTP.

DOE is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although DOE may later transfer or has already transferred these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity. The ETTP RAR CMP also identifies guidelines for property transfer and LUC verification and reporting. The application of LUCs will be the same for all alternatives. These LUCs would remain in effect until they are updated or removed in a future decision document.

2.10 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

CERCLA Section 121, as amended, specifies statutory requirements for remedial actions. These requirements include protection of human health and the environment, compliance with ARARs, a preference for permanent solutions that incorporate treatment as a principal element to the maximum extent practicable, and cost effectiveness. To assess whether alternatives meet the requirements, nine criteria (*Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* [EPA 1998]) are identified in the NCP (40 CFR 300.430(f)(2)) and must be evaluated for each alternative (Section 300.430(e)(9)(iii)).

The first two criteria are threshold criteria that relate directly to statutory findings that must be documented in a final ROD (or RODs). The next five criteria—balancing criteria—address performance of the alternative and verify the alternative is realistic. The last two modifying criteria are considered after public comment is received on the Proposed Plan. Provided below is a brief explanation of the nine CERCLA evaluation criteria:

- Overall protection of human health and the environment addresses whether a remedial action provides overall protection of human health and the environment. This criterion must be met for a remedial alternative to be eligible for selection.
- Compliance with ARARs addresses whether a remedial action meets all applicable or relevant and appropriate federal and state environmental requirements or provides grounds for invoking a waiver of the requirements. This criterion must be met for a remedial alternative to be eligible for selection.

- Long-term effectiveness and permanence considers the ability of an alternative to protect human health and the environment over time.
- Reduction of toxicity, mobility, or volume through treatment evaluates an alternative's use of treatment to reduce harmful effects of contaminants, their ability to move in the environment, and the amount of contamination present.
- Short-term effectiveness refers to potential adverse effects on workers, human health, and the environment during the construction and implementation phases of a remedial action.
- Implementability refers to the technical and administrative feasibility of a remedial action alternative, including the availability of materials and services needed to implement the alternative.
- Cost refers to an evaluation of the capital, O&M, and monitoring costs for each alternative, including present-worth costs.
- State acceptance indicates whether the state concurs with the preferred alternative.
- Community acceptance assesses the general public's response to the Proposed Plan following a review of public comments received during the public comment period. The remedial action is selected only after comments are received on the Proposed Plan.
- NEPA considerations.

In addition to these CERCLA evaluation criteria, DOE policy directs the substantive requirements of NEPA be incorporated into CERCLA decision documents (DOE 1994). Elements common to both CERCLA and NEPA include protectiveness, compliance with ARARs, long-term effectiveness and permanence, short-term effectiveness, and cost. These elements were considered in the comparative analysis of the alternatives. Additional NEPA values not specifically included in CERCLA criteria include socioeconomic impacts, environmental justice, irreversible and irretrievable commitment of resources, and cumulative impacts. These elements will be considered in a final ROD (or RODs) for the MPA.

Table 2.6 summarizes how each alternative performs against each criterion. This table uses a 10-point scale. Table 2.7 explains the rationale used for scoring each alternative against each criterion.

Overall protection of human health and the environment. Because LUCs are in place at ETTP, the no action alternative does not pose a threat to human health. However, the no action alternative does not achieve the interim remedial action objective of substantially reducing source mass, which is the first step in overall protection of human health in the long term. The three treatment alternatives are expected to substantially reduce contaminant mass and achieve interim remedial action objectives to support a final cleanup decision and final remedial action objectives.

Compliance with ARARs. As the goal of the interim action is groundwater plume mass reduction and DOE's use of the interim action waiver, treatment to chemical-specific ARARs is not applicable at this time.

Long-term effectiveness and permanence. The no action alternative is not considered an effective long-term solution to groundwater contamination problems in the MPA.

The three treatment alternatives are expected to be effective in the long term, aid toward achieving a permanent solution, and have the following attributes in common:

- Treatment will target the most highly contaminated groundwater that represents the greatest risks at the site and where concentrations of specific CVOCs exceed 1000 µg/L (or 400 µg/L for VC).

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Table 2.6. Detailed evaluation of remedial alternatives

Alternative description/ criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
1. Overall protection of human health and the environment	Alternative would protect human health and the environment because LUCs currently in place would remain	Alternative would protect human health and the environment during implementation and after completing the interim remedial action: • Treatment would target source of CVOCs greater than 1000 µg/L (or 400 µg/L for VC) in groundwater, and a large amount of the contaminant mass would be removed • Current and future receptors would be protected from exposure to any residual contamination in groundwater through LUCs	Alternative would protect human health and the environment during implementation and after completing the interim remedial action: • Treatment would target source of CVOCs greater than 1000 µg/L (or 400 µg/L for VC) in groundwater, and a large amount of the contaminant mass would be treated • Current and future receptors would be protected from exposure to any residual contamination in groundwater through LUCs	Alternative would protect human health and the environment during implementation and after completing the interim remedial action: • Same as Alternative 2	• This is a threshold criterion; thus, an alternative either passes or fails • Alternatives 1, 2, and 3 pass this threshold criterion because risks are managed with LUCs • Alternative 0 passes this threshold criterion because facility-wide LUCs would be in place • Because no monitoring is performed, Alternative 0 does not provide any measurable reduction in contamination, compared to the other alternatives
Criterion score	Pass	Pass	Pass	Pass	
2. Compliance with ARARs	• Because no actions are taken, no location- or action-specific ARARs would be applicable • No measurable contaminant reductions would be assessed to determine if mass reduction, which could accelerate compliance of chemical-specific ARARs in the future, is occurring	• The interim remedial action would be designed to comply with the location- and action-specific ARARs • As achieving restoration of groundwater is not an interim remedial action objective, no chemical-specific ARARs would be achieved	• Same as Alternative 1	• Same as Alternative 1	• This is a threshold criterion; thus, an alternative either passes or fails • Alternatives 1, 2, and 3 would be designed to comply with action- and location-specific ARARs • Chemical-specific ARARs are not a goal of the interim remedial action objectives • Alternative 0 can be considered to pass because there are no ARARs that are applicable to the no action alternative, and this alternative would be no different than any other source area not addressed in the MPA FFS
Criterion score	Pass	Pass	Pass	Pass	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/ criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
3. Long-term effectiveness and permanence					
(a) Magnitude of residual risks	• No treatment or monitoring is implemented; therefore, the only reduction in contaminants would come from attenuation. However, because monitoring is not conducted, there would be no knowledge of when the interim remedial action objectives would be achieved • This alternative would likely result in minimal risk reduction	• Treatment would target the most highly contaminated source material • Capturing all contamination volatilized by heating using vapor extraction may be a challenge given the heterogeneity and anisotropy within both the unconsolidated zone and bedrock • Unrecovered vapors would likely be condensed in a location outside the treatment area, causing potential migration of contaminants • Once the active interim remedial action is completed, a decision would be made on whether further contaminant reduction is necessary • Given the uncertainties in vapor recovery in bedrock, there is potential for some vapors to migrate outside the capture zone of the vapor recovery system, resulting in pockets of untreated contamination being left behind • At completion of active treatment, only low residual concentrations would remain (if treatment is effective) • Once active treatment is complete, all treatment residuals would have been managed at appropriately permitted TSDFs • The residual risks, after the interim remedial action is completed, are still expected to be unacceptable. However, a substantial amount of mass reduction is anticipated with this alternative	• EISB results in the in situ reduction of CVOCs via enhanced reductive dechlorination; when successfully implemented, parent and daughter products are degraded; therefore, there is no need to capture any byproducts or manage treatment residuals • Given the hydraulic characteristics of the saturated zones at ETTP, delivery of carbon substrate and amendments to all parts of the source area represents a challenge. A PDI tracer test, or potentially other design strategies, can help to identify placement of injection wells to optimize substrate distribution and monitor the remedy. Optimization would also be conducted during implementation to help manage the challenges • When the interim remedial action is completed, a decision would be made on whether further contaminant reduction is necessary • The residual risks, after the interim remedial action is completed, are still expected to be unacceptable. However, a substantial amount of mass reduction is anticipated with this alternative	• Soil mixing would be most effective in source materials with the geotechnical properties conducive to mixing; materials not readily mixed may retain contamination that results in pockets of untreated source material in the unconsolidated zone • EISB in the bedrock has similar benefits and limitations as described for Alternative 2 • Given the hydraulic characteristics of the bedrock at ETTP, delivery of carbon substrate and amendments to all parts of the source area represents a challenge. A PDI tracer test, or potentially other design strategies, can help to identify placement of injection wells to optimize substrate distribution and monitor the remedy. Optimization would also be conducted during implementation to help manage the challenges. When the interim remedial action is completed, a decision would be made on whether further contaminant reduction is necessary • The residual risks, after the interim remedial action is completed, are still expected to be unacceptable. However, a substantial amount of mass reduction is anticipated with this alternative	• The potential for high concentrations of residual contaminants is possible for all three alternatives • Alternative 1 employs a technology considered to be robust; however, the fate and distribution of volatilized contaminants in the bedrock is unknown and reflected in the score • All three active treatment alternatives are expected to provide substantial risk reduction, with Alternatives 1 and 3 being comparable and Alternative 2 being slightly lower, as mass reduction in the unconsolidated zone is expected to be greater for Alternatives 1 and 3 • Alternative 0 provides the least risk reduction
Criterion score	1	7	6	7	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/ criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(b) Adequacy and reliability of controls	• After the interim remedial action period is complete, the remaining mass would be addressed by the final remedial action, which would be designed to have adequate controls, as well as the ongoing LUCs • LUCs are expected to be effective over the course of the interim remedial action period	• After the interim remedial action is completed, the remaining mass would be addressed by the final remedial action, which would be designed to have adequate controls, as well as ongoing LUCs • Groundwater monitoring would be performed to assess the progress of the alternative in reducing contaminants • After active treatment, the remaining mass would be addressed by a final decision in a future FFS or final FS • LUCs are expected to be effective over the course of the interim remedial action period	• Same as Alternative 1	• Same as Alternative 1	• For all active treatment alternatives, follow-on decisions would be made based on the findings of the interim remedial action activities • Sitewide LUCs would remain in place until a final decision is made for source sites
Criterion score	10	9	9	9	
4. Reduction of toxicity, mobility, or volume through treatment					
(a) Treatment process used	• No active treatment processes used. COCs are treated via degradation through natural attenuation. However, no monitoring of the processes would be performed	• In situ heating of soil and groundwater to drive volatilization of contaminants with concurrent vapor extraction and ex situ treatment for contaminant recovery or destruction	• Injection of substrate and other treatment reagents to promote biological degradation of contaminants within the unconsolidated zone and bedrock	• Physical mixing of soil with ZVI and stabilization material to treat contaminants in the unconsolidated media through abiotic processes • Injection of substrate and other treatment reagents to promote biological degradation of contaminants within the bedrock	• Treatment is used for Alternatives 1, 2, and 3; there is no differentiation in how these three alternatives were scored • While active treatment is not used for Alternative 0, attenuation does provide treatment via natural attenuation processes. The processes are not monitored for Alternative 0
Criterion score	2	10	10	10	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/ criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(b) Degree or quantity of contaminant destroyed or treated	• Some level of toxicity, mobility, or volume would be accomplished through natural attenuation. However, because monitoring is not performed, reduction in toxicity, mobility, or volume would not be tracked and assessed	• Mass reduction of 98 to 99.9% within the treatment zone is anticipated • The most effective mass reduction would come from the unconsolidated zone • Unknown mass stored in rock. Heating of rock is expected to liberate some of this mass, though the amount of mass is uncertain • It is difficult to predict the migration of vapors in bedrock; recovery of these vapors with the soil vapor extraction system may be incomplete. Unrecovered vapors would likely be condensed in a location outside the treatment area, causing potential migration of contaminants	• Mass reduction of 50 to 80% is anticipated through the interim remedial action period of 5 years. Additional mass removal is likely if operation of the remedy is extended • The most effective mass reduction would come from the unconsolidated zone • Unknown mass stored in the rock. Long-lasting substrate is expected to help address back diffusion. The amount of mass that can be removed from the rock matrix with this alternative is uncertain • Some residual high-concentration areas may remain in bedrock after the interim remedial action, though overall, the interim remedial action objectives are expected to be achieved • Transient intermediate degradation products in the bedrock would have greater toxicity and mobility than parent compounds but are expected to be reduced through continued EISB processes • Biological activity may reduce pH and temporarily mobilize metals	• Mass reduction of 80 to 90% is anticipated through the interim remedial action period of 5 years. Additional mass removal is likely if the operation of the EISB is extended • The most effective mass reduction would come from the unconsolidated zone • Unknown mass stored in the rock. Long-lasting substrate is expected to help address back diffusion. The amount of mass that can be removed from the rock matrix with this alternative is uncertain • Some residual high-concentration areas may remain in bedrock after the interim remedial action, though overall, the interim remedial action objectives are expected to be achieved • Transient intermediate degradation products in the bedrock would have greater toxicity and mobility than parent compounds but are expected to be reduced through EISB or natural attenuation processes • Biological activity may reduce pH and temporarily mobilize metals	• Alternative 1 treats the most contaminant mass. Compared to the other active treatment alternatives, it is least likely to leave residual high-concentration areas in place after active treatment • Alternative 3 is likely to treat more mass compared to Alternative 2 in the interim remedial action period because better contact between the treatment chemicals and the overburden material is achieved • While less mass may be treated with Alternative 2 (compared to the other active treatment alternatives), interim remedial action objectives are expected to be achieved with Alternative 2 • Natural attenuation is expected to result in contaminant reduction (Alternative 0). The processes are not monitored, and amount of contaminant treated would be comparatively low to the other alternatives
Criterion score	1	10	6	7	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(c) Irreversibility of toxicity, mobility, or volume reduction	Biogeochemical degradation associated with natural attenuation is irreversible. Natural attenuation through adsorption is reversible. However, monitoring is not performed; therefore, this criterion cannot be tracked	• ISTT is irreversible. There is the potential for recontamination of the treated area due to influx of contaminated groundwater from areas not treated; however, the amount of mass influx is not expected to be significant because the greatest amount of mass would be addressed in the source area	• Biodegradation associated with EISB processes is irreversible. There is the potential for recontamination of the treated area due to influx of contaminated groundwater from areas not treated; however, the amount of mass influx is not expected to be significant because the greatest amount of mass would be addressed in the source area	• ISSM is considered irreversible, but over time, changes in aquifer geochemistry may result in breakdown of the solidified material • Biodegradation associated with EISB processes is irreversible. There is the potential for recontamination of the treated area due to influx of contaminated groundwater from areas not treated; however, the amount of mass influx is not expected to be significant because the greatest amount of mass would be addressed in the source area	• Alternatives 1, 2, and 3 are considered to be relatively irreversible • Alternative 0 does not involve monitoring to track the irreversibility, and any attenuation through adsorption could be reversible • Alternative 1 was assigned a score of 9 because it would likely be less impacted by reversibility compared to Alternatives 2 and 3 • Alternative 2 was assigned a score of 7 because it is fully reliant on EISB • Alternative 3 scored slightly higher because the ISSM in the unconsolidated zone would not allow inflow of upgradient contaminants, though the EISB component of this alternative has potential for greater reversibility
Criterion score	1	9	7	8	
(d) Type and quantity of treatment residuals	• No treatment processes that generate residuals are included with this alternative and, thus, no residuals would be generated	• Treatment residuals (liquid- and vapor-phase carbon) generated during thermal treatment would be managed appropriately and dispositioned at a permitted TSDF • Recovered groundwater would be treated using liquid-phase carbon and discharged to a permitted NPDES outfall • No treatment residuals are anticipated to remain at the site at the completion of treatment	• No treatment residuals are anticipated to remain at the site at the completion of treatment	• Treatment residuals generated from capture of vapors during mixing would be managed appropriately and dispositioned at a permitted TSDF • ISSM media are expected to treat contaminants and are not considered treatment residuals • No treatment residuals are anticipated to remain at the site at the completion of treatment	• All alternatives would have no treatment residuals onsite after treatment is complete. The scores for Alternatives 1 and 3 are lower than Alternatives 0 and 2 to reflect that treatment residuals are produced as a result of implementing the alternative and have to be managed outside the footprint of the source area
Criterion score	10	8	10	8	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
5. Short-term effectiveness					
(a) Protection of workers during remedial action	No action; therefore, no risks to workers	• Low to moderate risk to workers during construction due to drill rigs • Moderate risk to workers during operation of ISTT due to increased soil and groundwater temperatures and work around high-voltage equipment • Moderate risk to workers from vapors that are not properly captured • Low risk to workers during the monitoring phase • Risks can be properly managed with a thorough health and safety plan and appropriately trained staff	• Low to moderate risk to workers during drilling activities • Low to moderate risk to workers during injection of chemicals into the target treatment interval due to drill rigs and pressurized injection lines • Low risk to workers during the monitoring phase • Risks can be properly managed with a thorough health and safety plan and appropriately trained staff	• Low to moderate risk to workers during drilling activities • Moderate risk to workers during soil mixing activities due to construction equipment and potential exposure to chemicals in a tent environment • Low to moderate risk to workers during injection of chemicals into the target treatment interval due to drill rigs and pressurized injection lines • Low risk to workers during the monitoring phase • Risks can be properly managed with a thorough health and safety plan and appropriately trained staff	• Alternatives 1 and 3 require some level of construction. However, workers in the remediation industry operate under approved health and safety plans and must be properly trained to work on contaminated waste sites • Alternatives 1 and 3 scored lower due to the complex processes involved in the treatment remedy, and Alternative 3 scored lower than Alternative 1 due to the soil mixing element of the alternative being considered higher risk • Alternative 2 is considered to have less worker risk because construction can be completed quickly and there is limited operator attention required • Alternative 0 has no site activities and, thus, no risk to workers
Criterion score	10	7	9	5	
(b) Protection of community during remedial action	No action; therefore, no short-term risks to the community	• Minimal risk to the community if a loss of process control (incomplete vapor recovery using soil vapor extraction) would lead to escape of contaminant vapors to the atmosphere or the recondensing of contaminant vapors outside the treatment area • The MPA is isolated from the surrounding community, but additional safety measures may be needed in areas near the Manhattan Project National Historic Park • Minimal risk to the community during transportation of treatment equipment and treatment residuals • Proper access controls for community access around remediation activities in the Historical Park footprint and transferred properties would be required	• Minimal impacts to the community during injection delivery as delivery rates are low and completed infrequently • Minimal risk to the community during transportation of treatment equipment and chemicals to the site • Proper access controls for community access around remediation activities in the Historical Park footprint and transferred properties would be required	• All mixing areas would require vapor and dust control. No unacceptable risks to the community are anticipated • Additional safety measures may be needed in actions conducted near the Historical Park • Proper access controls for community access around remediation activities in the Historical Park footprint and transferred properties would be required	• Risks to the community are primarily related to construction traffic entering and leaving the site and are the same for all three alternatives and are relatively comparable among Alternatives 1, 2, and 3 • Proper access controls for community access around active remediation activities in the Historical Park footprint and transferred properties would be required • Alternative 0 has no action and, thus, no risk to the community
Criterion score	10	8	8	8	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(c) Environmental impacts of remedial action	• No action; therefore, no environmental impacts	• System operation requires high energy use, which also generates greenhouse gas, nitrogen oxide, sulfur oxide, and particulate matter emissions in a short period of time. This alternative has a relatively high environmental footprint from an emissions standpoint due to electrical usage, though the energy mixture in the Oak Ridge area is considered relatively green • Incomplete vapor recovery in the subsurface might redistribute the mass (rather than recover) • A loss of process control (incomplete vapor recovery using soil vapor extraction) would lead to escape of COC vapors to the atmosphere or the recondensing of COC vapors outside the treatment area and may negatively impact the environment	• Environmental impacts would include increased greenhouse gas, nitrogen oxide, sulfur oxide, and particulate matter emissions due to the transportation and operation of equipment during construction and implementation of EISB; energy requirements for this alternative are minimal. This alternative has a relatively low environmental footprint for an active treatment alternative because it does not involve continuous treatment and only involves using treatment reagents, which are applied periodically • Treatment reagents are considered green materials and are derived from renewable plant-based, carbon sources, although carbon substrates have a high water footprint	• Environmental impacts would include increased greenhouse gas, nitrogen oxide, sulfur oxide, and particulate matter emissions due to the transportation and operation of equipment during construction and implementation of ISSM. This alternative has a slightly higher environmental footprint than Alternative 2 due to the energy requirements for the mixing equipment • Moderate treatment reagent (footprint related to production of ZVI and bentonite-related emissions)	• Qualitatively, Alternative 1 has the highest footprint. Alternatives 2 and 3 have much lower footprints • Alternative 0 has no remedial construction; therefore, it has no environmental impacts from remedial action
Criterion score	10	4	9	7	
(d) Time until interim remedial action objectives are achieved	• Interim remedial action objectives would not be achieved; therefore, there is no time period applicable for this alternative	• Interim remedial action objectives should be met in a relatively short time (the time to implement ISTT), unless it is difficult to control the vapors generated in the bedrock and they spread. The ISTT phase and post-treatment monitoring are expected to occur for 5 years	• Interim remedial action objectives may not be met in the 5 years of the interim remedial action, although they are likely to be if the operating period is extended. However, the 5-year period is expected to be adequate to assess performance of the remedy and if significant mass reduction could be likely	• ISSM should achieve interim remedial action objectives in the 5 years of the interim remedial action. However, EISB in the bedrock may not achieve interim remedial action objectives in the 5 years of the interim remedial action, although they could be if the operating period is extended. However, the 5-year period is expected to be adequate to assess EISB bedrock performance of the remedy and if significant mass reduction could be likely	• Alternative 1 is expected to achieve interim remedial action objectives in the shortest amount of time, though there is some potential for contaminant migration due to vapor migration • Alternatives 2 and 3 are comparable, though Alternative 2 scores slightly lower, as Alternative 3 is expected to achieve mass reduction goals in the unconsolidated zone relatively quickly • Alternative 0 would not achieve interim remedial action objectives in 5 years, and monitoring would not be performed to track contaminant reductions
Criterion score	1	9	7	8	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
6. Implementability					
Technical feasibility (a) Construction and operation	• No action; therefore, there would be no construction or operational feasibility issues	• ISTT requires common well installation and construction methods and equipment. It is moderately difficult to implement due to the higher level of infrastructure required for providing energy and heat for the technology • Once constructed, operation is considered moderately complex. However, the use of instrumentation and controls helps operators maintain optimal conditions • The need to comply with rigorous electrical safety requirements on a DOE site also complicates both planning and implementation • While there is reasonable confidence the remedy can be constructed, the ability to successfully capture vapors in the bedrock is an uncertainty	• Installation of injection wells requires common well installation and construction methods and equipment • EISB implementation only requires the installation of injection wells and delivery of substrate and other treatment reagents. The remedial design would need to consider how to best optimize substrate delivery and monitoring in low-permeability media	• ISSM implementation requires common soil mixing equipment, but specialized construction methods and expertise would be required for deep mixing in the weathered bedrock portion of the unconsolidated zone • A tent would be required for vapor capture during soil mixing operations. ISSM in a tented structure would be challenging to implement • EISB implementation only requires the installation of injection wells and delivery of substrate and other treatment reagents. The remedial design would need to consider how to best optimize substrate delivery and monitoring in the bedrock	• Alternative 2 scored highest but still has challenges due to the ability to deliver substrate to bedrock and treat mass from the bedrock • Alternative 1 scored second lowest due to overall complexity of the operation and expected hurdles related to electrical safety • Alternative 3 scored lowest, primarily due to technical difficulties associated with deep soil mixing in weathered bedrock and the need to do the mixing inside a tent • Alternative 0 has no action; therefore, there would be no construction or operational feasibility issues
Criterion score	10	7	9	2	
(b) Reliability of technology (potential for schedule delays)	• No action; therefore, there would be no schedule delays	• Implementation of this technology may encounter some delays due to infrastructure considerations, coordination of subcontractors and utility companies, and use of specialty vendors that are very limited. Additionally, time required to achieve the target temperature and maintain the temperature may take longer than anticipated • Implementation of this technology may entail some delays due to Zone 2 remedial activities in source area where Zone 2 work is being implemented • If radiological contamination is discovered during the course of implementing this technology, significant schedule delays could occur	• Implementation of this technology may encounter some delays due to ongoing remedial activities as part of the Zone 2 Soil ROD in source areas where Zone 2 remedial activities are being implemented • Injection technology is generally reliable • Regular monitoring would be required to provide feedback on how the system is performing and may involve revising delivery methods or injection points to optimize future reagent addition • If radiological contamination is discovered during the course of implementing this technology, significant schedule delays could occur	• Implementation of this technology may encounter delays related to the specialized nature of the ISSM construction activities, the need to complete the work in an enclosure (e.g., not being able to perform work in the heat of the summer), and uncertainty regarding ISSM performance in the weathered bedrock • Implementation of this technology may entail some delays due to ongoing remedial activities as part of the Zone 2 Soil ROD in source areas where Zone 2 remedial activities are being implemented. Injection technology is generally reliable; a well-designed remedy would minimize the potential for schedule delays • Regular monitoring would be required to provide feedback on how the system is performing and may involve revising delivery methods or injection points to optimize future reagent addition • If radiological contamination is discovered during the course of implementing this technology, significant schedule delays could occur	• Alternative 2 scored highest of the active treatment alternatives because its footprint is relatively low profile • Alternatives 1 and 3 are similar in their complexity and potential schedule impacts. Some level of schedule delay is expected due to the high level of contractor oversight required at ETTP • Alternative 0 has no remedial action; therefore, there would be no schedule delays
Criterion score	10	5	9	5	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(c) Ease of undertaking additional remedial action	• No impediments exist to undertake additional actions should they be necessary • Additional remedial action would need to consider the transfer status of the source areas, as described in Section 6.2.5 and Appendix D of the MPA FFS	• At the end of implementation, all above-grade infrastructure would be removed from the site. All subgrade infrastructure would be properly abandoned (e.g., extraction and heater wells and subsurface conveyance piping). Implementation of this alternative would not inhibit future potential remedial action • Additional remedial action would need to consider the transfer status of the source areas, as described in Section 6.2.5 and Appendix D of the MPA FFS	• This alternative has a relatively limited footprint that could easily support future actions, if needed. Wells used for EISB monitoring would have to be factored into the planning and execution for such actions • Additional remedial action would need to consider the transfer status of the source areas, as described in Section 6.2.5 and Appendix D of the MPA FFS	• At the end of implementation, infrastructure for this technology is removed. In the unlikely event additional remedial actions within the footprint of the ISSM are required, the change in the unconsolidated material through soil mixing (e.g., reduced permeability) would need to be considered • Additional remedial action would need to consider the transfer status of the source areas, as described in Section 6.2.5 and Appendix D of the MPA FFS	• Alternative 1 can be decommissioned in a manner that would not prevent or constrain future remedial actions • Alternative 2 can easily support future actions • Alternative 3 results in creation of subgrade treatment zones that have much different geotechnical and hydraulic properties than surrounding soils or weathered bedrock • Alternative 0 has no impediments that exist to undertake additional actions • All follow-up remedial actions would need to consider the transfer status of the source areas, as described in Section 6.2.5 and Appendix D of the MPA FFS
Criterion score	10	10	10	5	
(d) Monitoring considerations	• No monitoring would be performed	• Monitoring for the unconsolidated zone would be relatively easy to implement. However, monitoring the bedrock may be difficult due to complexity of the fracture network. PDI testing may be necessary to optimize the monitoring network. State-of-the-art bedrock monitoring technologies (e.g., FLUTe™ samplers) could be used as part of the monitoring program. Temperature sensors would be used to assess the amount of heating at different locations and depths. Groundwater monitoring would be used to assess changes in concentration related to active treatment. Vapor measurements would provide information to estimate the amount of mass removed due to thermal treatment • LUCs would be continuously monitored for compliance with the approved LUC plan	• Monitoring for the unconsolidated zone would be relatively easy to implement. However, monitoring the bedrock may be difficult due to complexity of the fracture network. PDI testing may be necessary to optimize the monitoring network. State-of-the-art bedrock monitoring technologies (e.g., FLUTe™ samplers) could be used as part of the monitoring program. Groundwater monitoring would be used to assess changes in concentration related to active treatment. Tracer tests (e.g., dyes or bromide) and water quality parameters could be used to assess the distribution of treatment reagents • LUCs would be continuously monitored for compliance with the approved LUC plan	• Monitoring for the unconsolidated zone would be relatively easy to implement. However, monitoring the bedrock may be difficult due to complexity of the fracture network. PDI testing may be necessary to optimize the monitoring network. State-of-the-art bedrock monitoring technologies (e.g., FLUTe™ samplers) could be used as part of the monitoring program. Groundwater monitoring would be used to assess changes in concentration and contaminant flux from the ISSM treatment area resulting from active treatment. Tracer tests and water quality parameters could be used to assess the distribution of treatment reagents • LUCs would be continuously monitored for compliance with the approved LUC plan	• All three active treatment alternatives can be effectively monitored. Monitoring is more challenging in fractured rock, and the scores for this criterion represent this challenge • No monitoring would be performed for Alternative 0
Criterion score	10	8	8	8	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(e) Administrative feasibility	• Regulators would likely prefer some type of interim remedial action at the source areas, rather than no action. Action would eventually be required	• Technology is relatively common with a proven track record of being administratively feasible • Meeting the substantive requirements of permits for this alternative is fairly routine • LUCs would require coordination with local, state, and federal entities. LUCs would need to be updated to reflect this alternative activity • Implementation of this alternative requires coordination with current and future property owners/tenants to maintain access to treatment components of this alternative and the monitoring network and ensure compliance with LUCs. Section 6.2.5 of the MPA FFS describes the status of land transfer and the location of the source areas with respect to transfer status, as presented in Appendix D of the MPA FFS • This alternative is compatible with future reuse or reindustrialization because the active treatment components can be completed relatively quickly and follow-on monitoring would be accomplished using low-profile wells (flush-mount), although specific engineering and institutional controls (e.g., vapor barriers) may be required for new construction	• EISB is relatively common with a proven track record of being administratively acceptable • Meeting the substantive requirements of permits for this alternative is fairly routine. LUCs would require coordination with local, state, and federal entities. LUCs would need to be updated to reflect this alternative activity • Implementation of this alternative requires coordination with current and future property owners/tenants to maintain access to treatment components of this alternative and the monitoring network and ensure compliance with LUCs. Section 6.2.5 of the MPA FFS describes the status of land transfer and the location of the source areas with respect to transfer status, as presented in Appendix D of the MPA FFS • This alternative generally is compatible with future reuse or reindustrialization, but the type of redevelopment may be impacted by the presence of the injection wells, although specific engineering and institutional controls (e.g., vapor barriers) may be required for new construction	• ISSM is not commonly used for CERCLA remedial actions, but where it has been applied, it is considered administratively feasible • Meeting the substantive requirements of permits for this alternative is fairly routine. LUCs would require coordination with local, state, and federal entities. LUCs would need to be updated to reflect this alternative activity • Implementation of this alternative requires coordination with current and future property owners/tenants to maintain access to treatment components of this alternative and the monitoring network and ensure compliance with LUCs. Section 6.2.5 of the MPA FFS describes the status of land transfer and the location of the source areas with respect to transfer status, as presented in Appendix D of the MPA FFS • This alternative may limit the type of redevelopment allowed for areas directly above the ISSM treatment zone and is compatible with all types of reuse elsewhere • The bedrock component of this alternative is favorable for reindustrialization because all elements are below grade, although specific engineering and institutional controls (e.g., vapor barriers) may be required for new construction	• Alternative 1 scored the highest because it has the shortest time of remediation and allows faster reindustrialization • Alternative 2 requires more access to injection and monitoring wells due to the long-term EISB in the unconsolidated zone and bedrock • Alternative 3 scored lower due to the limitations imposed by ISSM-treated media, although treatment of ISSM can be completed quickly • Alternative 0 is unlikely to be acceptable to regulators as they would rather see earlier action at the source areas
Criterion score	1	9	8	5	

Table 2.6. Detailed evaluation of remedial alternatives (cont.)

Alternative description/criterion	Alternative 0 – No action	Alternative 1 – ISTT and LUCs	Alternative 2 – EISB and LUCs	Alternative 3 – ISSM, EISB, and LUCs	Comparative assessment among alternatives
(f) Availability of services and materials	• None needed	• Services for disposal of treatment residuals are available, and water recovered as investigation-derived waste and from ISTT operations would be treated onsite and discharged to an appropriately permitted NPDES outfall • A relatively limited number of vendors specializing in thermal treatment technology are available • Service providers with radiological experience may be required if radiological contamination is identified in the future	• Drill cuttings can be disposed of at the EMWMF and investigation-derived waste can be managed onsite • EISB technology services are readily available • Service providers with radiological experience may be required if radiological contamination is identified in the future	• Drill cuttings can be disposed of at the EMWMF and investigation-derived waste can be managed onsite • A relatively limited number of vendors specializing in soil mixing technology are available • EISB technology for bedrock services is readily available • Service providers with radiological experience may be required if radiological contamination is identified in the future	• Alternative 2 uses services and materials that are commonly used and expected to be readily available • Alternatives 1 and 3 use highly specialized services, equipment, and materials that are less readily available, and the ability to obtain competitive bids is uncertain • Service providers with radiological experience may be required if radiological contamination is identified in the future • No services are needed for Alternative 0
Criterion score	10	6	9	6	
7. Total cost (all source areas; see 5d for duration) (all costs in $1000)					• There are no costs for the no action alternative. Costs for continued LUCs are addressed in the ETTP sitewide plan • All costs represent combined source area sites (total of six) • Capital costs for Alternatives 1 and 3 are comparable; however, NPV O&M costs are greater with Alternative 3 due to reapplication of EISB reagents in the bedrock. Alternative 2 has the lowest total costs but has the highest O&M costs due to reapplication of EISB in the unconsolidated zone and bedrock
Direct capital cost:	$0	$122,003	$15,621	$152,794	
NPV O&M[a]:	$0	$7420	$12,583	$10,121	
Annualized NPV O&M[b]:	$0	$1484	$2517	$2024	
NPV total:	$0	$129,423	$28,474	$162,914	

[a]Includes remediation O&M and performance monitoring.
[b]Calculated as NPV O&M divided by total number of years of alternative. For example, for Alternative 2, NPV O&M would be divided by 5.

MPA FFS = DOE/OR/01-2894&D2. *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee*, 2022, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
Zone 2 Soil ROD = Zone 2 Soil ROD = *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2.

ARAR = applicable or relevant and appropriate requirement
COC = contaminant of concern
CVOC = chlorinated volatile organic compound
DOE = U.S. Department of Energy
EISB = enhanced in situ bioremediation
EMWMF = Environmental Management Waste Management Facility
ETTP = East Tennessee Technology Park
FFS = focused feasibility study
FLUTe™ = Flexible Liner Underground Technologies, LLC™
FS = feasibility study
ISSM = in situ soil mixing
ISTT = in situ thermal treatment
LUC = land use control
MPA = Main Plant Area
NPDES = National Pollutant Discharge Elimination System
NPV = net present value
O&M = operation and maintenance
PDI = pre-design investigation
ROD = Record of Decision
TSDF = treatment, storage, and disposal facility
ZVI = zero-valent iron

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Table 2.7. Scoring rationale for alternative analysis

Score	Description
10	There is high confidence the alternative fully meets the expectations of the criterion
8	There is probable confidence the alternative meets the expectations of the criterion; however, there is minor uncertainty in specific components of the alternative. This value can also be used to represent differences in quantity (e.g., environmental footprint is 20% larger)
6	There is general confidence the alternative meets the expectations of the criterion; however, there is some uncertainty in specific components of the alternative. This value can also be used to represent differences in quantity (e.g., environmental footprint is 40% larger)
4	There is some confidence the alternative meets the expectations of the criterion, but there are significant uncertainties to overcome. This value can also be used to represent differences in quantity (e.g., environmental footprint is 60% larger)
2	There is low confidence the alternative meets the expectations of the criterion. This value can also be used to represent differences in quantity (e.g., environmental footprint is 80% larger)
1	There is no confidence the alternative meets the expectations of the criterion

- Treatment in bedrock represents a challenge that will be addressed incrementally over time. It is likely some pockets of contaminants above 1000 µg/L (or 400 µg/L for VC) will remain in the bedrock.
- Treatment will continue until target contaminants are reduced to less than or equal to 1000 µg/L (or 400 µg/L for VC), at which point treatment will continue as long as it is technically and economically feasible.
- Groundwater will be monitored to assess treatment progress.
- Treatment is expected to substantially reduce contaminant concentrations in the groundwater plumes.

The ISTT alternative is limited in delivering heat to the high-concentration area in a complex geologic environment and capturing volatilized mass. Some unrecovered volatilized organic mass in the bedrock may migrate outside the treatment zone and condense, resulting in moving of contaminant mass rather than achieving full recovery of volatilized contaminants.

EISB treatment has been demonstrated at multiple sites to be effective at removing contaminant mass, including a successful treatability study at ORNL in 2010 that resulted in strong reduction of TCE and daughter product concentrations (7000 Area Treatability Study), and a pilot study for in situ reductive dechlorination of a solvent plume in karst bedrock (Alexander et al. 2013). There are some challenges where soil material has less permeability, which may create challenges to distributing treatment reagents. The RD will assess engineering options to improve confidence in distributing treatment reagents.

Both EISB and ISSM rely on liquid injections to deliver treatment reagents to the bedrock, which poses challenges due to the network of fractures that are present and the potential to create preferential flow paths for treatment reagents.

Overall, the amount of mass and risk reduction in the unconsolidated zone is expected to be comparable for ISTT and ISSM; the risk reduction for EISB is expected to be slightly less due to potential reagent delivery challenges in the less permeable soils and bedrock.

While different elements of the three treatment alternatives have different strengths and challenges, overall, the alternatives were considered to be comparable, with EISB scoring slightly less than ISTT and ISSM because less mass reduction is anticipated. However, EISB is still expected to achieve interim remedial action objectives.

Reduction of toxicity, mobility, or volume through treatment. The no action alternative does not use treatment to reduce groundwater contaminant mass.

ISTT involves heating the soils or rock, which volatilizes the contaminants. The resulting vapors are collected by vapor extraction wells and passed through an aboveground treatment unit that uses activated carbon to remove contaminants from the vapors. The carbon media containing the contaminants are ultimately sent offsite to an appropriately permitted disposal facility. Because the contamination is removed from the soil/rock and eventually sent offsite for disposal, thermal treatment is considered an irreversible treatment technology. Treatment residuals from ISTT involve generating spent carbon, which will be managed at an appropriately permitted disposal facility.

EISB involves implementing biological treatment in the unconsolidated zone. With this technology, transient intermediate degradation products may have greater toxicity and mobility than parent compounds, but they are expected to be reduced by properly implementing the treatment process.

EISB and ISSM both involve implementing biological treatment in the unconsolidated zone and bedrock. EISB involves injecting either or both microbial populations and a food source to increase aquifer biological populations. ISSM uses stabilizing material that will be left behind in the treated soils. Contaminants will be treated with ZVI or will remain immobile in the stabilized material.

Overall, ISTT scored highest for this criterion and EISB and ISSM were considered comparable. The no action alternative scored the lowest.

Short-term effectiveness. There are no risks to workers with the no action alternative. This alternative does not impact workers or the community, and it does not have an environmental impact. There is no timeframe to operate the no action alternative.

EISB scored the highest in protecting workers because of the limited mechanical components of the alternative. ISSM has the greatest potential to impact workers due to the need to work with a high level of personal protective equipment and mechanical mixing for soil. ISTT rated in the middle because it uses heat to treat contaminated groundwater and includes mechanical treatment components.

The three treatment alternatives were evaluated to have limited and similar impacts on the community.

The environmental impacts of ISTT were considered highest due to the energy demand of the treatment components, followed by ISSM due to energy required for mixing soils and material intensity. EISB has the lowest environmental impacts.

The three treatment alternatives are planned to be operated for 5 years and are expected to achieve the interim remedial action objectives in this period of time.

Overall, EISB scored higher than the other treatment alternatives.

Implementability. There are no activities implemented with the no action alternative.

The three treatment alternatives will need to comply with DOE's rigorous on-site requirements for construction and operation of treatment systems. CERCLA considerations related to implementability are discussed below:

- The need to perform all treatment activities in a tent for the unconsolidated zone will be challenging for ISSM.

- EISB has the least potential for schedule delays, while ISTT and ISSM have greater potential for schedule delays.
- ISTT and EISB were considered compatible with the potential for future remedial actions if needed at the treatment sites. The use of stabilizing agents in the unconsolidated zone limits the type of additional remediation that could be implemented if ISSM is selected. This alternative also has limitations on what kind of redevelopment could occur at the treatment sites because of the potential for subsidence of soils as a result of mixing and adding ZVI and stabilization materials.
- The three treatment alternatives were considered comparable in the ability to monitor the remedy.
- Based on availability of services and materials, EISB was evaluated to be best due to its use of common treatment reagent material as well as availability of contractors that can implement the technology. There are few technology vendors that can implement ISTT and ISSM.

Overall, EISB scored higher than ISTT, and ISSM scored the lowest.

Cost. There are no costs for implementing the no action alternative.

EISB is the lowest cost alternative because the technology only uses injection wells and episodic reagent injection events. It is the least expensive alternative, being 19.5% of the costs of ISSM and 24.0% of the costs of ISTT on a net present-value basis.

ISTT and ISSM have significantly greater costs than EISB due to their need to use significant groundwater treatment equipment (thermal) or heavy construction equipment, with work being performed in a high level of personal protective equipment in a ventilated tent (soil mixing). The PDI and performance monitoring components of these two alternatives are comparable.

State acceptance. The State of Tennessee supports the selection of Alternative 2 as the interim remedial action for the MPA.

Community acceptance. Section 2.3 summarizes community participation in evaluating MPA IROD remediation options; comments provided by the public are addressed in Part 3.

NEPA values. NEPA values are incorporated into the alternatives evaluation consistent with DOE policy. There is little difference between the irreversible and irretrievable commitment of resources between alternatives.

2.11 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

Should DOE encounter principal threat source material (e.g., DNAPL, or concentrations of CVOCs that might be indicative of DNAPL) that remains below the water table during the PDI phase of implementing this MPA IROD, the proposed EISB treatment would be applied to the principal waste to the extent practicable. If encountered, measuring and documenting the effectiveness of treatment to this type of waste are one of the desired outcomes of this MPA IROD.

2.12 SELECTED REMEDY

2.12.1 Summary of Rationale for Preferred Alternative

With EPA and TDEC concurrence, DOE has determined Alternative 2, the preferred alternative presented in the MPA Proposed Plan, is the most appropriate alternative for commencing interim treatment of MPA groundwater. Alternative 2 is active remediation of the six high-concentration plume areas using EISB. The selected remedy includes continuing LUCs that are currently in place at ETTP. In addition, the selected remedy includes continuous monitoring to measure effectiveness of the active treatment to help make additional groundwater decisions at ETTP.

The selected remedy meets the interim remedial action objective target performance metric identified for the interim action; complies with ARARs except for those chemical-specific ARARs being waived under the interim action ARARs waiver; uses active treatment to address principal threat materials; and accounts for the best balance of all criteria presented in the comparative analysis of alternatives.

2.12.2 Description of Selected Remedy

The preferred alternative is implementing EISB to meet the interim goal to "reduce contaminant mass" (EPA 1990) in selected groundwater source areas. EISB refers to remediation systems that are designed to remediate chlorinated solvents by input of an organic source, nutrients, electron acceptors, and/or microbial cultures into a plume to stimulate degradation of the contamination. The precise delivery system for the inputs will be described in the RDR/RAWP. EISB is proposed at the following sites:

- Mitchell Branch Comingled Plume/K-1407-B
- K-1401
- K-25/K-1024
- K-1035
- K-27/K-1232
- K-1239

If successful, EISB likely will be considered for additional CVOC remedial actions in the MPA.

Additional data are required to complete the final design and implement the selected remedy. These data will be collected as part of a PDI outlined in the RDWP. The PDI will be designed to address and manage uncertainties and challenges with the selected remedy. This investigation primarily will consist of installing groundwater wells and/or piezometers in the unconsolidated zone and bedrock to better characterize the nature and extent of the target CVOC concentrations greater than 1000 µg/L (or VC greater than 400 µg/L) to design the injection network.

Once design is complete, permanent injection wells will be constructed to treat groundwater within the unconsolidated zone and bedrock. Figure 2.16 exemplifies how the injection wells will be configured at an example groundwater plume (K-1401). The injection wells will be clustered with two separate screen intervals: one in the overburden, and one in the weathered bedrock. The EISB injection wells would distribute a carbon substrate to the area. The substrate used for injections is assumed to be commercially available EVO. Other substrates could also be used (e.g., EVO with ZVI), and/or the EVO might be amended with other organics (e.g., lactate) plus buffers and bioaugmentation cultures. Sampling and analysis of geochemical and microbial parameters will be performed as part of the PDI to help assess the

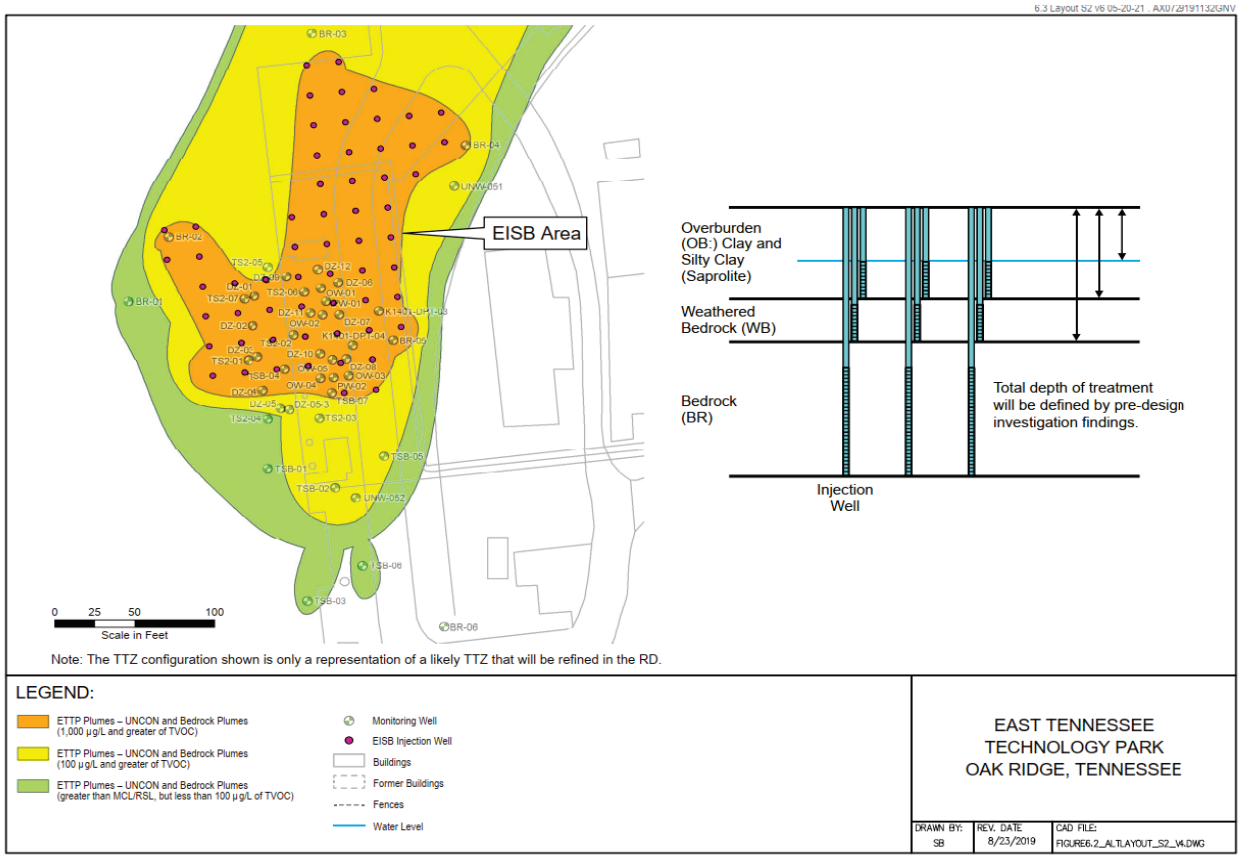

Figure 2.16. Example of injection well configuration.

need for other amendments. The effectiveness of substrate delivery is a key variable in the effectiveness of this alternative. PDI testing (e.g., tracer testing or other strategies) will help identify injection wells placement to optimize substrate distribution and monitoring of the remedy. Figure 2.16 shows a subtle difference from the remediation approach presented in Figure 2.14. Instead of ending treatment at approximately 50 ft bgs, the selected alternative will treat as deep as PDI information indicates priority CVOCs concentrations are greater than 1000 µg/L of individual CVOCs (or 400 µg/L for VC).

O&M activities associated with this alternative include initial injections, groundwater monitoring, and potential follow-up injections. Additional optimizations of the injections may be carried out based on monitoring data. These optimizations would be designed to target treatment reagent distribution, reagent concentration, and resulting changes in microbial populations and geochemistry; optimization could include additional injections and changing the substrate mixture to optimize delivery to more challenging intervals within the formation. For cost-estimating purposes, a second round of injections is assumed to occur at year 2 and be followed by a 3-year period of post-injection monitoring. Injection well fouling may require routine well maintenance and rehabilitation prior to each injection.

For this interim action, remedies are assumed to be implemented and evaluated for 5 years, a time period considered appropriate for determining if interim remedial action objectives can be achieved in a reasonable period of time.

This alternative actively treats source areas using EISB. EISB injection wells would be used to treat groundwater within the unconsolidated zone and shallow bedrock to a depth of 50 to 100 ft bgs. If the PDI determines the depth of treatment should be greater at some locations, then deeper injection wells will be installed to address locations where individual CVOCs exceed 1000 µg/L or VC exceeds 400 µg/L. The EISB injection wells would distribute a carbon substrate to the source area. Other potential additives (e.g., bioaugmentation cultures, nutrients, buffers, and ZVI) could also be injected, if the geochemical and microbial parameters that would be collected during the PDI suggest they are beneficial.

The significant components of this remedy include:

- Permanent injection wells (in some unconsolidated zones, it may be more appropriate to use direct-push points).
- EVO with other supporting treatment reagents (e.g., pH buffer, vitamin B12, bioaugmentation culture, and ZVI).
- Performance monitoring network.

Injections will be carried out through permanent injection wells that are installed in the unconsolidated zone and bedrock. The injection wells would be clustered with two separate screen intervals: one in the overburden, and one in the weathered bedrock. An injection well spacing of 20 ft is typical. This will allow the substrate to move radially a distance of 10 ft between injection wells (i.e., the radius of influence), based on experience at other EISB applications. In some cases, it may be appropriate to replace or supplement the permanent injection wells with direct-push technology points in the unconsolidated zone to allow more flexibility in locating injection locations. As indicated, the substrate used for injections is assumed to be commercially available EVO. Other substrates could also be used (e.g., EVO with ZVI), and/or the EVO might be amended with other organics (e.g., lactate) plus buffers and bioaugmentation cultures. Sampling and analysis of geochemical and microbial parameters will be performed as part of the PDI to help assess the need for other amendments. The radius of influence of the substrate delivery is a key variable in the effectiveness of this alternative.

O&M activities associated with this alternative include initial injections, groundwater monitoring, performance monitoring, and potential follow-up injections, as needed. Additional optimizations of the injections may be carried out based on monitoring data. For the purposes of the MPA FFS evaluation, a second round of injections was assumed to occur at year 2 and be followed with a 3-year period of post-injection monitoring. Two years is considered conservative, based on the longevity of EVO that has been observed at many other EISB sites. At most sites, a second round of injection is only required at a subset of the injection wells because some areas might be adequately treated with one injection. Injection well fouling may require routine well maintenance and rehabilitation prior to each injection. Performance monitoring will evaluate the production of byproducts created by EISB. This will include dissolved metals (e.g., iron, manganese, and arsenic), as well as methane in groundwater. Methane will also be monitored in the headspace of the monitoring wells.

Periodic maintenance of the injection wells will be required; therefore, future reuse or reindustrialization of source areas where this alternative is applied must allow access to the treatment and monitoring components of this alternative.

EISB will temporarily change the geochemistry of the subsurface and will have secondary groundwater quality impacts. These impacts have been thoroughly studied (SERDP 2015, Tillotson 2015). EISB is designed to create anaerobic conditions that are favorable for reductive dechlorination of the CVOCs. Anaerobic conditions may also reduce the mobility of some radionuclides (e.g., uranium and Tc-99) due to their transformation to less-soluble forms. Alternately, the reducing conditions will also result in increased concentrations of dissolved manganese, iron, and methane. These are typically monitored as indicators that EISB has the potential to be successful. The solubility of arsenic will also increase under reducing conditions. Research at numerous sites has confirmed concentrations of all parameters decline with distance downgradient; elevated concentrations are usually confined within the original contaminated area where EISB was performed; and there are unlikely to be any widespread, adverse impacts on groundwater (Enviro Wiki 2018). As mentioned previously, metals and radionuclides will be monitored in downgradient monitoring wells to evaluate potential mobilization of these byproducts of the degradation process.

LUCs will be addressed under the ETTP RAR CMP.

2.12.3 Summary of Estimated Remedy Costs

Table 2.8 summarizes the treatment area and costs for implementing EISB treatment at the six different CVOC plumes described in this MPA IROD.

The estimated cost to perform the interim selected remedy is approximately $32.7 million.

Cost information is based on the best available information regarding the anticipated scope of the remedial alternative at the time the MPA FFS was finalized. Changes in the cost elements are likely to occur as a result of inflation, new information, and data collected during the engineering design of the remedial alternative. The MPA FFS cost estimate was an order-of-magnitude engineering cost estimate.

2.12.4 Expected Outcomes of Selected Remedy

The interim selected remedy for the six plumes addressed by this MPA IROD is not expected to reduce the human health risk at the site to acceptable levels immediately upon completion of the interim remedial action; however, it is expected to address the most significant contamination at the six plumes and result in significant mass and concentration reduction of CVOCs. The interim remedial action is estimated to require 5 years to achieve the interim remedial action objective of reducing contaminant concentrations to less than or equal to 1000 µg/L for individual CVOCs or 400 µg/L for VC. Groundwater in the MPA will not be available for use until a final remedy is implemented and remedial action objectives and cleanup levels of a final ROD (or RODs) for the MPA are met. The expected future land use at the MPA is industrial.

Table 2.8. Summary of preferred alternative

Site	Primary COCs	Initial treatment area (ft^2)	Selected technology[a]	Cost		
				Capital (M$)	5-Year O&M (M$)	Total (M$)
Mitchell Branch Comingled Plume/K-1407-B	CVOC	69,260	EISB	$5.9	$5.5	$11.4
K-1401	CVOC	23,522	EISB	$2.0	$1.9	$3.9
K-25/K-1024	CVOC	33,106	EISB	$2.8	$2.6	$5.4
K-1035	CVOC	6098	EISB	$0.52	$0.48	$1.0
K-27/K-1232	CVOC	59,677	EISB	$5.1	$4.7	$9.8
K-1239	CVOC	7405	EISB	$0.63	$0.59	$1.2
			TOTAL	**$16.95**	**$15.8**	**$32.7**

[a]Common components to all actions are pre-design investigations, performance monitoring, land use controls, and Five-Year Reviews.

COC = contaminant of concern
CVOC = chlorinated volatile organic compound
EISB = enhanced in situ bioremediation
M$ = millions of dollars
O&M = operation and maintenance

2.13 STATUTORY DETERMINATIONS

The selected interim remedy for this MPA IROD is protective of human health and the environment. The interim remedy is cost effective and satisfies the statutory preference for permanent solutions through treatment.

2.13.1 Overall Protection of Human Health and the Environment

Protectiveness during the period of the MPA IROD is achieved through a combination of ongoing LUCs and monitoring to ensure no exposures to unacceptable contaminant levels in groundwater. The action also provides contaminant mass removal to address potential longer term exposures.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected interim remedy is not designed to meet chemical-specific requirements of the SDWA, hence DOE is initiating an ARAR waiver; however, it will meet all applicable, relevant, and appropriate action- and location-specific requirements. The final ROD (or RODs) for the MPA will demonstrate compliance with all federal and state requirements that are identified ARARs, including any potential ARAR waivers.

2.13.3 National Environmental Policy Act of 1969

NEPA is not an ARAR. However, throughout the CERCLA process, NEPA values are incorporated in accordance with the Secretarial Policy Statement on NEPA (DOE 1994).

2.13.4 Cost Effectiveness

The three alternatives evaluated all use treatment to reduce contaminant mass in groundwater. EISB is the lowest cost of the three active treatment alternatives evaluated because the technology only uses injection wells and episodic reagent injection events. The other alternatives use significant groundwater treatment equipment (thermal) or heavy construction equipment, with work being performed in a high level of personal protective equipment in a ventilated tent (soil mixing). EISB is 19.5% of the costs of ISSM and 24.0% of the costs of ISTT on a net present-value basis.

2.13.5 Preference for Treatment as Principal Element

CERCLA Section 121 established a preference for remedial actions in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants is a principal element. The selected remedy satisfies this preference by using non-reversible treatment to destroy contaminant mass.

2.13.6 Five-Year Review Requirements

Because this selected remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE, a statutory review will be conducted within 5 years after initiation and at least every 5 years thereafter to ensure the remedy will be protective of human health and the environment, as long as hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for UU/UE remain. The first review will be prepared after this MPA IROD is approved, within the first 5 years after remedial action initiation, and again every 5 years until concentrations in groundwater allow for UU/UE. DOE will submit the results of these FYRs in accordance with the requirements of CERCLA, the NCP, and the ORR FFA for the Oak Ridge NPL Site.

2.14 DOCUMENTATION OF SIGNIFICANT CHANGES

The selected remedy described herein is the preferred alternative proposed in the MPA Proposed Plan. Since development of the MPA FFS and MPA Proposed Plan, the Zone 2 Soil ROD project has completed characterization and delineation work in the former Poplar Creek buildings area (Zone 2 Exposure Unit 13). Information collected for that project provided additional understanding of the primary source(s) of the K-27/K-1232 plume, which is part of the scope of this MPA IROD.

For cost-estimating purposes, the MPA FFS assumed a single treatment area of 59,677 ft^2. The Zone 2 findings suggest there could be additional treatment areas downgradient of former Building K-413 and possibly another area. PDI efforts will focus on identifying the total area of CVOCs > 1000 µg/L (or 400 µg/L for VC) associated with that plume. (See Section 2.5.6 for additional information on this topic.)

A second change from the MPA FFS analysis, but one that was reflected in the MPA Proposed Plan, is the agreement to treat below the 50-ft-bgs depth assumed for pricing in the MPA FFS. This agreement results in deeper characterization efforts in the PDI stage of the action and may result in deeper injections in the treatment phase of the action.

This new information, while significant, could be reasonably anticipated by the public, as described in 40 CFR 300.430(f)(3)(ii)(A), and, therefore, it does not require issuance of a revised MPA Proposed Plan or announcement of a new public comment period.

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PART 3. RESPONSIVENESS SUMMARY

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RESPONSIVENESS SUMMARY

This Responsiveness Summary was prepared in accordance with the requirements of Section 117(b) of CERCLA, as amended. The purpose of this Responsiveness Summary is to summarize and respond to public comments on the MPA Proposed Plan.

This Responsiveness Summary achieves two of the major objectives of the CERCLA process—it documents community concerns about both the site and the preferred remedy, and it demonstrates how public comments are integrated into the decision-making process. This Responsiveness Summary also provides DOE with the opportunity to formally respond to public comments as an element of the decision-making process.

The MPA Proposed Plan was issued for public comment on April 5, 2023, and the review period was completed on May 19, 2023, for a total review period of 45 days. This Responsiveness Summary presents DOE's responses to comments received from the public review and comment period. DOE received comments from seven individual commenters via several methods: email, comment cards submitted directly to DOE representatives, comment cards turned in at public meetings, speakers asking questions at the public meeting, and correspondence sent via U.S. Postal Service. Below are responses to the comments:

Comment 1: Samantha Pack. "I think it's great that EPA, TDEC, and DOE came together to make this decision. I congratulate them."

Response 1: The U.S. Department of Energy thanks you for your participation in the public comment process.

Comment 2: Ellen Smith. "Just a quick comment, I'm supportive of the technical analysis and recommended conclusions in the proposed plan, but I was disappointed by the manner of presentation and proposed plan. I felt like the document had an excessive number of acronyms or initialisms that were used. Often times, is the only reference to something like the four different alternatives were typically referred to by their four-letter abbreviations, which are very difficult for people to understand you know. I understand the nouns behind them, the sequence of four letters is very confusing. I thought that there were far more abbreviations than necessary. I was also distressed to see at least one pretty clear error in the document. There's a reference to Alexander 2003, Alexander et al 2003 document, and in fact, it's Alexander et al 2013. So, I looked and wondered, why are we looking at something 20 years old. It's only 10 years old, but I'd like to see better attention to making a document understandable to the public. I read a lot of these things, and so I don't feel that I was affected, but I think that the public in general needs a better presentation so thank you."

Response 2: The commentor is correct on the Alexander reference; this is a typo. The full citation is provided below. Use of acronyms is ubiquitous in Comprehensive Environmental Response, Compensation, and Liability Act of 1980 documents, and those produced by U.S. Department of Energy (DOE) Oak Ridge and their contractors follow style guides that outline the content. The purpose of the Document Preparation Guide (Style Guide) is to provide preparation requirements for formal documents to ensure compliance and consistency in the creation of contractor-prepared documents. The requirements outlined in the Style Guide apply to all Federal Facility Agreement (FFA) and non-FFA documents prepared by contractor or subcontractor employees. DOE made efforts to minimize the number of acronyms in the Main Plant Area Proposed Plan because it is for public comment; however, DOE decided to use the acronyms for the remedial alternatives because repeating the long four-word names would become cumbersome and potentially awkward.

Comment 3: Virginia Dale. "I just have a brief comment. I wanted to thank DOE and others for having this meeting and allowing the public to comment. I hope to look at it in more detail later, and I wanted to thank the organizers for providing a Spanish translation. Thank you."

Response 3: The U.S. Department of Energy thanks you for your participation in the public comment process.

Comment 4: Joel Hewett. "Thank you. I apologize for asking to skip. I didn't quite realize we're just reading names rather than people who decided to comment. My name is Joel Hewett. I'm the chair of the City of Oak Ridge Environmental Quality Advisory Board, EQAB. I have a question and comment, but first just a question for the room - if I could get a show of hands who's just a pure local unaffiliated with the project in any way? That's not a problem, that's not a critique. Walking in here tonight, I overheard someone say there's going to be almost no locals here, and names are not a problem because I've signed up for as many distribution lists and newsletters as I can as Chair of this board. I received a TDEC notification I think six days ago and forwarded that onto the board. I only saw a notification within the news as an ad for this meeting two days ago I think in Oak Ridge Today. So, one question is, and I think this is what we can answer today, is when was this meeting first publicly announced, if anyone knows? Again, I'm not here to critique, I'm just curious."

"I don't doubt that's true, which is why it was an honest question. I've worked for DOE in the past; I'm a fan, worked for them locally and worked for them nationally in DC, trying to follow as much as I can, and I want to make sure I'm on the proper mailing list. Maybe we can discuss later on to make sure that I am, because there's a bunch, I get a lot of the other news as well. One question for the substance, I wouldn't mind if we could go back on slides of the billboard depth chart. There we go, also good. You know, I reviewed as much as I could so far as I understand it, in some informal discussions with board members, understand this to be one of the best generally accepted ways to do groundwater remediation. One question I had, having a bit of background in the oil and gas industry, part of what comes, part of which comes from some DOE time you know, and I think alternative one mentioned was sometimes called thermal flood. I wonder if, what the question is, there a feasibility or what was the reason behind there not being a hybrid alternative that used live remediation as the central core target of achieving this, but then also potentially using wellbore water flood on the outer extremes of the plume, potentially thermal flood as well, and again, this is an honest question. I know that that can do a lot of good things when you know the extent of an oil and gas reservoir, it may be applicable to something like this, it may not, but given that they're both presented, I'd like to know. Thank you."

Response 4: In the oil industry, waterflooding—or water injection—is when water is injected into the oil reservoir to maintain the pressure and/or to drive oil towards the wells and thereby increase overall production. In situ thermal treatment (ISTT) is one of the alternatives considered for treatment of the ETTP Main Plant Area chlorinated volatile organic compounds source areas and consists of three variations, including electrical resistance heating, thermal conduction heating, and steam enhanced extraction. These technologies can accomplish steam stripping, volatilization, and boiling of volatile organic compounds and semivolatile organic compounds from in situ soils and groundwater. ISTT is supplemented by vapor collection within the subsurface and aboveground treatment of recovered separated gaseous and liquid phases. This method of remediation involves drilling a regular grid of boreholes, whereby heat is introduced into the subsurface (provided either by steam or electrical methods) to volatize the contaminants. The design intent of these systems is to minimize the amount of potential excursions of contaminants away from the treatment zone; therefore, injection of appreciable amounts of water into subsurface (i.e., waterflooding) is avoided.

Roane County Environmental Review Board review comments (comments 5 through 13 below) on DOE/OR/01-2921&D2, *Proposed Plan for an Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park*

Comment 5: Section 2, Scope of Proposed Remedial Action. Additional groundwater CVOC areas of concern are identified in Figure 2.1 and are not covered under this interim ROD plan. Additional data gathering activities will be part of a Remedial Investigation Work Plan (RIWP) to support final decisions on MPA groundwater.

It is suggested this RIWP have a public comment period.

Response 5: In the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) document sequence, the Proposed Plan is open for comments both at the associated public meeting and via alternate written routes (Mr. Roger Petrie, Oak Ridge Office of Environmental Management Federal Facility Agreement Project Manager, P.O. Box 2001, Oak Ridge, TN 37831 or OakRidgeEM@orem.doe.gov). Remedial Investigation Work Plans (RIWPs) are not provided to the public for comment per CERCLA, but they undergo independent technical review by the Tennessee Department of Environment and Conservation and the U.S. Environmental Protection Agency. With respect to public comments on the Main Plant Area Proposed Plan, the U.S. Department of Energy (DOE) records and responds to all comments it receives in the Responsiveness Summary (Part 3) to the *Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee*. The RIWP is available at the DOE Information Center.

Comment 6: Section 4, Summary of Site Risks. This section discusses risks for current and future land uses. The K-27/K1232 plume is shown to touch Poplar Creek in at least three places. There is also the Mitchell Branch Comingled Plume/K-1407-B.

What are the risks for current and future surface water uses? What are the risks for sediments? How are these going to be addressed? Even though it is indicated surface water and sediment contamination will be addressed in remaining CERCLA decisions, a discussion in this IROD would provide better clarification.

Response 6*:* The U.S. Department of Energy (DOE) has and continues to address surface water and sediment as part of other projects. In 1997, the Federal Facility Agreement parties signed the *Record of Decision for the Clinch River/Poplar Creek Operable Unit, Oak Ridge, Tennessee* (DOE/OR/02-1547&D3) that was preceded by the *Remedial Investigation/Feasibility Study of the Clinch River/Poplar Creek Operable Unit* (DOE/OR/01-1393/V1-V5&D2). The risk assessment conducted during the remedial investigation suggested consuming substantial quantities of contaminated fish from the Clinch River/Poplar Creek over many years may result in a health risk from polychlorinated biphenyls, mercury, chlordane, and arsenic. Surface water exceeded ambient water quality criteria for protection of aquatic life for mercury in Poplar Creek. Chlorinated volatile organic compounds were not identified as contaminants of concern in that study. DOE continues to perform 5-year reviews on that decision.

In addition, sediment and surface water media are being addressed in a separate ongoing project called Remaining Ecology/Surface Water/Sediment at the East Tennessee Technology Park, and that project has its own series of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 documents. Information regarding the approved *Remedial Investigation Work Plan for Remaining Ecology/Surface Water/Sediment at East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2912&D2) for that project can be found at the DOE Information Center website (https://doeic.science.energy.gov/uploads/E.0527.027.0010.pdf).

Comment 7: Onsite only CVOCs are considered important, but offsite inorganics (Li, Fl, Mn) are listed for non-cancer effects. Why are these not being monitored onsite? To dismiss because these elements are naturally occurring is not valid especially since high Fl may have come from use of UF6.

Response 7: The Main Plant Area (MPA) Interim Record of Decision (IROD) does not imply other chemicals are not considered important; rather, the original remedial investigation for the MPA identified chlorinated volatile organic compounds (CVOCs) as the primary contributor to human health risk. Potential contaminants of concern, including the mentioned metals, will be addressed as part of future investigations in the MPA, including defining the nature, extent, and risks associated with these materials. The East Tennessee Technology Park MPA IROD is focused specifically on mass reduction of CVOCs at source areas.

Comment 8: Will the full baseline human health risk assessment, to be included in the remedial investigation report for the Final ROD, be available for public comment?

Response 8: The human health risk assessment (HHRA) will be part of the additional remedial investigation (RI)/feasibility study (FS). As indicated in the response to comment 5 above, traditionally, the Proposed Plan is the only document open to public comment, and the U.S. Environmental Protection Agency and the Tennessee Department of Environment and Conservation provide thorough reviews and approvals of Proposed Plans and other primary Comprehensive Environmental Response, Compensation, and Liability Act of 1980 documents. The HHRA in the RI/FS will be available for informational purposes at the U.S. Department of Energy (DOE) Information Center website but will not be available for public comment. The HHRA will be summarized in the Proposed Plan. DOE also provides routine updates on East Tennessee Technology Park groundwater projects to the Site-Specific Advisory Board and solicits inputs during those updates.

Comment 9: Section 5, Remedial Action Objectives. A target performance metric is to reduce contaminant concentrations below 1000 μg/L. This threshold was selected as it is a practical goal for CVOCs (or 400 μg/L for VC) and similar to other CERCLA sites.

How will the next stage of remediation (after this IROD) ensure inclusion of CVOC MCLs as DOE is seeking a waiver from these ARARs for this interim action?

Response 9: The intent moving forward with the Main Plant Area (MPA) Proposed Plan and MPA Interim Record of Decision (ROD) is to begin in situ treatments at the six selected high chlorinated volatile organic compound source areas and to monitor and evaluate effectiveness of the degradation process. Mass reduction may continue to levels below those target values (ideally to the respective maximum contaminant levels [MCLs]) for trichloroethene and daughter products. Although an interim action waiver is being invoked for this interim action, waivers are not being sought at this time for any final remedy for groundwater but may be included in a final remedy if restoration to MCLs is determined to be technically impracticable in the future.

Comment 10: Section 7, CERCLA of 1980 Process for Evaluation of Alternatives. It is stated that DOE policy directs substantive elements of analysis required under NEPA be incorporated into CERCLA decision documents.

NEPA values not specifically included in CERCLA criteria include socioeconomic impacts, environmental justice, irreversible and irretrievable commitment of resources, and cumulative impacts. How are these NEPA values being analyzed and addressed. What document will include these analyses?

Response 10: U.S. Department of Energy (DOE) policy (DOE 1994, 2010) directs that Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) documents will incorporate the substantive elements of the National Environmental Policy Act of 1969 (NEPA) to the extent practicable.

DOE uses the U.S. Environmental Protection Agency's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final* (EPA/540/G-89/004) and *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (EPA/540/R-98/031) as the primary instruments to integrate the requirements of NEPA and CERCLA. The evaluation of alternatives incorporates values where appropriate.

Comment 11: Table 7.1, Criterion Long-term effectiveness and permanence.

Under ISTT - entry should be "Comparable to ISSM and EISB" instead of "Comparable to ISTT and EISB."

Response 11: Yes, this is a typo and it should read "Comparable to ISSM and EISB."

Comment 12: Section 8.1, Identify the Preferred Alternative. EISB is identified as the preferred alternative.

Consideration should be given to using both EISB and ISTT for this IROD. ISTT has been used successfully at other DOE sites and is the most effective for the criterion of Reduction of toxicity, mobility, or volume through treatment. ISTT could be used where contaminant concentrations are highest, particularly for the K-27/K-1232 plumes. This would reduce more CVOCs and TCEs earlier and help prevent the further spread of contaminants into groundwaters. This IROD should not limit itself to one alternative.

Response 12: The intent of the Main Plant Area (MPA) Proposed Plan and MPA Interim Record of Decision is to demonstrate efficacy (or not) of enhanced in situ bioremediation for chlorinated volatile organic compounds (CVOCs). This alternative has been demonstrated to be highly successful in similar geologic materials at the Oak Ridge National Laboratory7000 Area CVOC plume, as discussed in the recent *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), and the operating assumption is that it will work commensurately at the East Tennessee Technology Park in treating the CVOC source areas. Yearly reports on treatment progress will allow for evaluation of this alternative, and if use of a different technology is warranted, then it will be considered as part of the selection of a final remedy for the MPA. In situ thermal treatment (ISTT) was considered in the *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2) but was not selected, primarily because enhanced in situ bioremediation was shown to be effective at treating the plume source areas for a significantly lower cost than ISTT ($32.7 million versus $133.5 million).

Comment 13: Section 9, Natural Resource Damages.

How does this relate to the recent issue of the Oak Ridge Reservation Natural Resource Damage Assessment: Restoration and Compensation Determination Plan/Environmental Assessment; Final December 2022? Is it intended that any natural resource damages associated with this IROD are included in the FINAL NRDA document?

Response 13: Natural Resource Damage Assessment-related damages for groundwater beneath and flowing offsite from the Oak Ridge Reservation are addressed under the *December 2022 Oak Ridge Reservation Natural Resource Damage Assessment Restoration and Compensation Determination Plan/Environmental Assessment*. This includes groundwater addressed under the Main Plant Area Interim Record of Decision.

Comment 14: Proposed Plan page 20 includes Table 7.1 specifying that for reduction of toxicity, mobility, or volume; in-situ thermal treatment (ISTT) does a better job than either enhanced in-situ bioremediation (EISB) or in-situ soil mixing (ISSM). *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study Oak Ridge, Tennessee* (DOE/OR/01-2894&D2) (FFS) Table 7.1 on page 7-7 assigns a mass reduction of 98 to 99.9% within the treatment zone for ISTT, 50 to 80% through the Interim Remedial Action (IRA) 5-year period for EISB, and 80 to 90 % through the IRA 5-year period for ISSM. It is important for the community that the remedial action be effective in cleaning up releases at ETTP sufficient to support redevelopment. Without estimating contaminant mass remaining after treatment, it may be hard to understand the impact on redevelopment of potentially only removing 50% of the mass using EISB.

Response 14: The proposed enhanced in situ bioremediation (EISB) treatment, as outlined in the Main Plant Area (MPA) Proposed Plan, represents an initial stage of treatment focused on significant mass reduction (down to 1000 µg/L or 400 µg/L for vinyl chloride) in high chlorinated volatile organic compound (CVOC) groundwater source areas. Further reduction towards maximum contaminant levels for CVOCs in groundwater will be accomplished by either additional stages of EISB treatment, polishing via monitored natural attenuation, or alternative treatments should EISB be less effective than anticipated. Follow-on plans will be outlined in yearly reports and a final remedy for the MPA. Yearly reports on treatment progress will allow for evaluation of the EISB alternative, and if use of a different technology is warranted, then it will be considered.

Comment 15: FFS Table 7.1 states that the most effective mass reduction will occur in the unconsolidated zone, contaminant mass in bedrock is unknown, and percentage of mass that can be removed from bedrock is unknown. The Proposed Plan selected enhanced in-situ bioremediation (EISB) as the remedial action for mass reduction in bedrock. If EISB is implemented, injection of substrate or other material may potentially displace dense nonaqueous phase liquid (DNAPL) away from the well bore or cause biofouling that reduces permeability. Where pretreatment concentrations in groundwater indicate DNAPL in bedrock near the monitoring well and the well boring is connected to fractures, conduits, bedding planes, or other features capable of producing significant volumes of groundwater, it may be effective to utilize pump and treat methodology for contaminant mass removal before implementing other remedial action for bedrock in the Proposed Plan. Field scale treatability studies appear appropriate to determine effectiveness of pump and treat methodology to remove contaminant mass from said bedrock zones before remedial action utilizing injection into bedrock. Utilizing vacuum enhanced extraction should also be tested in field scale treatability studies prior to EISB.

Response 15: Extensive hydrologic testing was completed as part of the K-1401 Treatability Study, and an understanding of the frequency and type of bedrock fractures was established. This study included many individual slug, packer, and aquifer (pump) tests. Additional characterization at all six high chlorinated volatile organic compound source areas will be completed as part of enhanced in situ bioremediation (EISB) design-phase activities (i.e., pre-design characterization studies). Any treatment in the subsurface introduces the possibility of contaminants migrating away from the treated zone, including excursions during in situ thermal treatment. Performance monitoring during operations of the remedy is key to understanding both efficacy of the treatment and potential mobility of constituents. If such events were to occur, the overall plan would be evaluated for changes in monitoring, addition of wells and/or recirculation systems, and other changes to the treatment to mitigate the arising issue. The current approach is to provide EISB performance evaluations in yearly reports and to make changes as needed.

Comment 16: The Proposed Plan also selected EISB for mass removal of chlorinated volatile organic compounds from unconsolidated areas addressed by this Proposed Plan. There are several outstanding questions that I may have missed answers to including (1) are soil and fill properties including permeability in the unconsolidated zone sufficient to deliver substrate and associated treatment chemicals for EISB to be

effective and (2) how effective will EISB be in areas where current data does not indicate the presence of biodegradation products? If permeability or other properties are not verified conducive to effective EISB in an area(s) or it has not been determined why an area(s) has little to no biodegradation products; additional data gathering and/or treatability studies may be needed to verify EISB will be an effective remedial action in those areas. Any area EISB is not demonstrated an effective remedial action, should be evaluated to determine if ISTT would be effective. The Proposed Plan or FFS indicated that settling associated with ISSM may affect redevelopment. The Proposed Plan or FFS also indicated that unlike ISSM, either EISB or ISTT would be conducive to additional remedial action, if needed.

Response 16: The East Tennessee Technology Park (ETTP) Main Plant Area (MPA) Proposed Plan and associated MPA Interim Record of Decision (IROD) represent an initial cleanup action with the primary goal to reduce chlorinated volatile organic compounds (CVOCs) at six high-concentration areas that are degradable via enhanced in situ bioremediation. The K-1401 Treatability Study (*Design Characterization Completion Report for the Sitewide Groundwater Treatability Study at the East Tennessee Technology Park, Oak Ridge, Tennessee* [DOE/OR/01-2768&D1]; https://doeic.science.energy.gov/uploads/E.0525.029.0043.pdf) performed extensive geohydrologic characterization of ETTP unconsolidated, weathered bedrock, and bedrock materials. Taking the findings from that report in conjunction with existing characterization and planned pre-design investigation studies (that will be undertaken at each of the six high CVOC source areas) will allow for proper design of injection grids, including their lateral spacing and vertical extents. Areas, plumes, and other contaminants of concern outside of the six high CVOC source areas are not included in the MPA Proposed Plan or MPA IROD and will be addressed in future investigations. Enhanced in situ bioremediation (EISB) performance will be evaluated in yearly reports, and should EISB not perform as planned, then other technologies may be introduced as needed.

Comment 17: The Proposed Plan refers to *Offsite Groundwater Assessment Remedial Site Evaluation* (DOE/OR/01-2715&D2) for comfort concerning potential impact on residents north and west of ETTP. This report says sampling was completed at a total of 49 locations (34 wells and 15 springs) in Roane County and Figure 1 of that report shows the offsite evaluate subareas including OFFMV (offsite Melton Valley), Subarea, OFFBV (offsite Bethel Valley) Subarea, OFFBC (offsite Bear Creek) Subarea, and OFFET (offsite ETTP) Subarea. The number of sample locations and analytical results by subarea was not disclosed. Results were also not presented in a manner that allowed evaluation of specific locations or subareas.

a. During ETTP groundwater remediation and for a period after remediation sufficient for offsite migration of pollutants, a groundwater sampling program focused on the Offsite ETTP (OFFET) Subarea should be implemented and maintained to identify, evaluate, and address any impact on offsite residents.

b. In addition to other offsite monitoring, an offsite sampling program should be implemented where any concerned citizen in ORR offsite areas subject to *Offsite Groundwater Assessment Remedial Site Evaluation* (DOE/OR/01-2715&D2) including OFFET may request to have their well or spring sampled and evaluated for ORR contaminants. There should also be contingencies to address identified ORR impacts on offsite residents.

Response 17: The *Phase 2 Offsite Detection Monitoring Remedial Site Evaluation* (DOE/OR/01-2917&D2; Phase 2 Offsite Detection Monitoring Remedial Site Evaluation [RSE]) presents the results of the investigation conducted in fiscal years (FYs) 2019 through 2021. The Phase 2 Offsite Detection Monitoring RSE is a follow-on to the *Phase 1 Offsite Groundwater Assessment Remedial Site Evaluation, Oak Ridge, Tennessee* (DOE/OR/01-2715&D2_R; Phase 1 Offsite Groundwater Assessment RSE) conducted in FYs 2014 through 2016 and provides an additional 3 years of detection monitoring at 14 previously sampled off-site monitoring locations to determine if volatile organic compounds and select Oak Ridge Reservation signature radiological contaminants are detected, and if so, to determine whether trends exist.

Regulator approval of the Phase 2 Offsite Detection Monitoring RSE concluded the Phase 1 Offsite Groundwater Assessment RSE. As agreed upon in the June 7, 2022, Federal Facility Agreement Managers Meeting, the U.S. Department of Energy (DOE) is continuing off-site groundwater monitoring consistent with the *Remedial Site Evaluation Phase 2 Offsite Detection Monitoring Work Plan, Oak Ridge, Tennessee* (DOE/OR/01-2788&D2) through incorporation of the monitoring requirements into the *Lower Watts Bar Reservoir and Clinch River/Poplar Creek Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-1820&D3; Lower Watts Bar Reservoir [LWBR] and Clinch River/Poplar Creek Remedial Action Report [RAR] Comprehensive Monitoring Plan [CMP]). The LWBR and Clinch River/Poplar Creek RAR CMP includes continued monitoring of five locations (four wells and one spring) in the East Tennessee Technology Park (ETTP) subarea (OFFET). It was submitted on May 18, 2023, and is pending approval. Evaluation and reporting of the yearly monitoring results will be provided in the annual *Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Site, Oak Ridge, Tennessee.*

One of the components of ETTP groundwater restoration plans over the next decade is installation of exit pathway wells similar to those that have been drilled and set at Melton Valley and Bethel Valley. A data quality objective session to addresses the number, location, and design of these wells currently is being developed and will involve regulator input. The intent of these wells is to provide a greater understanding of potential deep flow paths, establish groundwater gradients near administrative or water body boundaries, and alert the tri-party (DOE, U.S. Environmental Protection Agency, and Tennessee Department of Environment and Conservation) to potential off-site migration of contaminants. The exit pathway wells are part of the follow-on investigations.

Comment 18: For more information on biodegradation in karst, please see *Biodegradation of Chlorinated Ethenes at a Karst Site in Middle Tennessee*, Water Resources Investigations Report 99-4285 by Tom Byle and Shannon Williams. This USGS report is available at https://pubs.usgs.gov/wri/wri994285/.

Response 18: The U.S. Department of Energy thanks you for the link to this document. Within the referenced document, the authors noted: “multiple lines of evidence developed from chemical, biological, and hydrologic data demonstrate that a variety of biodegradation processes are active in this karst aquifer,” and “The greatest challenge to this investigation was interpreting the results within the framework of the complex karst hydrology.” These general observations are likely to hold true at the East Tennessee Technology Park.

Sid Jones comment

Comment 19: The Proposed Plan appears to be putting all eggs in the Enhanced In-Situ Bioremediation basket. This would seem to be justified if the only remedial action objective for this interim action is to reduce mass in the specific target plumes.

However, if the interim ROD actions are also to be used to inform final groundwater decisions, an approach that also provides data on the efficacy of other treatment technologies might be more beneficial. Should there exist bedrock wells within a plume having proximal-to-NAPL concentrations in groundwater and sufficient sustained yield when pumped (on the order of at least several gallons per minute), then single or dual phase pumping might be employed to reduce contaminant mass without interfering with bioremediation efforts elsewhere in the plume. Likewise, in-situ thermal treatment might be deployed locally within a plume where indicators for the success of bioremediation are inauspicious and contamination levels are high.

If such actions are deemed outside the scope of this interim ROD, the FFA parties should include the evaluation of additional technologies in addition to in-situ bioremediation in other ongoing groundwater investigations.

Response 19: The East Tennessee Technology Park (ETTP) Main Plant Area (MPA) Proposed Plan and associated MPA Interim Record of Decision (IROD) represent an initial cleanup action with the primary goal to reduce chlorinated volatile organic compounds (CVOCs) at six high-concentration areas that are degradable via enhanced in situ bioremediation (EISB). Areas, plumes, and other contaminants of concern outside of the six high CVOC source areas are not included in the MPA Proposed Plan or MPA IROD and will be addressed in future investigations. EISB performance will be evaluated in yearly reports, and should EISB not perform as planned, then other technologies may be introduced as needed.

Gareth Davies comments

Comment 20: The alternatives evaluated for the six groundwater plumes are:

- No action
- In situ thermal treatment that heats the groundwater to vaporize the contaminants
- EISB that uses microorganisms to reduce contamination levels
- In situ soil mixing, along with EISB. This involves adding chemicals to reduce migration in shallow areas and using EISB in deeper areas

Introductory statement: The comments I make here are based upon data, published, reported, not reported and otherwise (referenced) that are highly pertinent to the issue of ETTP Groundwater. They should not be ignored.

Alternative: No Action.

This is not a good option as the site is known to be contaminated with many radionuclides, organic solvents and heavy metals. The record provided in the original Remedial Investigation Work Plan in the mid 1990's shows that almost no area of the entire site is, in particular, contaminated with transuranic radionuclides as documented in soil samples many more than ten times background. Obviously the most prominent radionuclide is uranium (this was an uranium enrichment plant…) and also handled materials that resulted in contamination by transuranic nuclides and fission products. The '"plumes" as referred to are not such that would occur in a porous medium, and atypically are not easily delineated by drilling borings and constructing wells. Instead large concentrations and activities of contaminants remain near the individual sites but channels and conduits transport them rapidly away long distances (kilometers). The rivers and streams surrounding the site do not create a barrier for groundwater flow - as described below. Any alternatives for action are vastly preferable. Plumes as referred to herein are dealt with by tracers, and there are many available that include contaminants (organics and radionuclides). Typically the best options are: removal and in situ treatment of source materials, and tracers to evaluate what have already migrated to mitigate the impact on offsite contact with contaminants via ground and surface water. This is discussed later in these comments.

Response 20: The No Action alternative is always included in feasibility studies, but it is essentially never chosen because the site being evaluated has proceeded into the remedial investigation and feasibility study phases due to identified contamination. In short, "The no-action alternative is used as a baseline to compare other alternatives. Measures, such as actions taken to reduce the potential for exposure (e.g., site fencing) should not be included as components of no-action alternatives. Such minimal actions should be studied as a separate, limited-action alternative. Environmental monitoring may be included as part of a no-action alternative."

As indicated in the *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2), the No Action alternative includes no remediation or monitoring over time. The pace of attenuation would not be assessed, the nature and extent of contamination in the future would be unknown, and there would be no knowledge of how much natural attenuation has occurred over time. Because this alternative is not protective of human health, it was rejected.

Comment 21: Groundwater Plumes

The nature and extent and horizontal and vertical delineation of a "plume" is generally based upon a concept using well data and this has a problem in that wells are known to be less effective and even ineffective as monitoring devices in any bedrock settings (Worthington et al., 2016; Smart, 2000, Quinlan, 1990). This is primarily because of the low probability of drilled borings and thus monitoring wells intersecting natural fissures, conduits and channels in the subsurface. This is exacerbated by the greater probability of inadvertently intersecting subsidiary or tributary channels (Smart, 2000). In bedrock settings there is a hierarchical network of discharge as in surface streams with mine channels and tributaries, except in three dimensions. The complicated hydraulics of wells in general and how they are constructed exacerbates this problem even more.

One alternative is to using tracing techniques using in this case, mobile organics, mobile radionuclides (e.g., uranium, radon and polonium). Other radionuclides such as the transuranic elements (Pu, Am, Np, Cm) are also mobile as flocculants and they produce their own daughter isotopes that can often be more soluble, more mobile and more radioactive because they have shorter half lives.

Response 21: The U.S. Department of Energy agrees that tracing studies can be a very useful tool to establish flow paths and associated discharge networks. Trace studies have been completed at numerous locations at the East Tennessee Technology Park during previous Comprehensive Environmental Response, Compensation, and Liability Act of 1980 investigations. Their results have often been informative, and at other times, indeterminate. The *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2) notes that tracer testing, or other design strategies, can be used to help optimize delivery and monitoring of the selected remedy. Future investigations may use tracing for delineation of preferred pathways on specific subprojects, but that scope and associated details are not part of the remedy discussed in the Main Plant Area (MPA) Proposed Plan and MPA Interim Record of Decision.

Comment 22: Informative Note 1: Karst

ETTP (former K-25 Site), is situated in a karst terrain. Of this there should be no doubt. This is confirmed by early pre-development topographic maps and photographs of the site, that shows large sinkholes (particularly in the footprints of the K-33 and K-31 buildings). Ford and Williams (2007) state that the definitive feature for karst is the *doline* (the term used in North America often related to construction issues is *sinkhole*) – which includes terms such as doline, collapse, swallet, ponor, that occur in both the soil and bedrock. Waltham (2009) points out that 99% of subsidence sinkholes in limestone "form in the soil cover above cavernous rock, …. most commonly in soils 2 - 15 m thick." In fact it is rare that there is bedrock collapse - the best examples being large cave rooms such as the Rotunda at Mammoth Cave, Kentucky which is directly under the visitors center. This huge room has a massive unsupported roof span that is not prone to collapse and it is known that only a rarely occasional rock has fallen. The Rotunda is on the Historic Tour and many thousand of visitors and park employees pass through it every day.

It is known from the way that such features as *dolines and sinkholes* form, that they have direct, rapid pathways into the subsurface and bedrock (Gunn, 1981). This occurs at the scale of a few millimeters to very large shafts that are at the scale of meters. There is a possibility that these dissolutionally formed shafts can be covered with a roof of soil that has been indurated. This can continue through geological time and be potentially problematic for future development of any site.

During development of the site in about 1943, it can be observed (Pictures 1, 2, below) that there were closed depressions on the surface. One picture is taken from the air and another shows a ground-level view, looking from the west or southwest, of what (particularly) the K-33 and K-31 site (foreground in ground level view and bottom left of aerial picture) looked like before those buildings were constructed. Note the sloughing walls of small closed depressions and the overall large closed depression of much bigger scale in the ground level view.

It is obvious that the ground surface was flattened and low areas filled and high areas removed (referred to as cut and fill). In karst areas the change of the surface during construction only modifies the nature of recharge into the bedrock rather than prevent it. It most often changes from a natural process to one involving any subsurface infrastructure (sewer lines, electrical cable tunnels - and unfortunately these do not prevent groundwater entry as the stage (i.e., water table) rises, and they often also leak their contents from a pipe or conduit into the ground, into both soil and bedrock. The reverse also happens when groundwater enters a subsurface infrastructure and thus enters a rapid pathway.

One of the pictures attached at the end of these comments shows the whole site from the air, and where many buildings or parts of buildings were still under construction.

The groundwater situation, from the perspective of monitoring, is clearly deficient, in that there are an insufficient number of adequately deep wells. The picture from the borehole data is rather interesting. A 1986 Geraghty & Miller, Inc., (1989) report was written after the initial 100 borings were drilled and bedrock and "unconsolidated" (soil, residuum) and wells were constructed therein.

The drilling data (Geraghty & Miller, 1989) provides a lot of useful information, particularly about at what depths first groundwater was encountered in each borehole. A majority of the boreholes made first water below (some far below) the local rivers and creeks. The Figure Below shows the calculated depths below the average river and creek levels (aka pond level) for the bedrock wells. A rare few wells encountered first water above river and creek levels or at shallower depths. This is significant information and shows how it is that groundwater would underflow rivers and streams - this is a serious and very concerning issue and must be addressed.

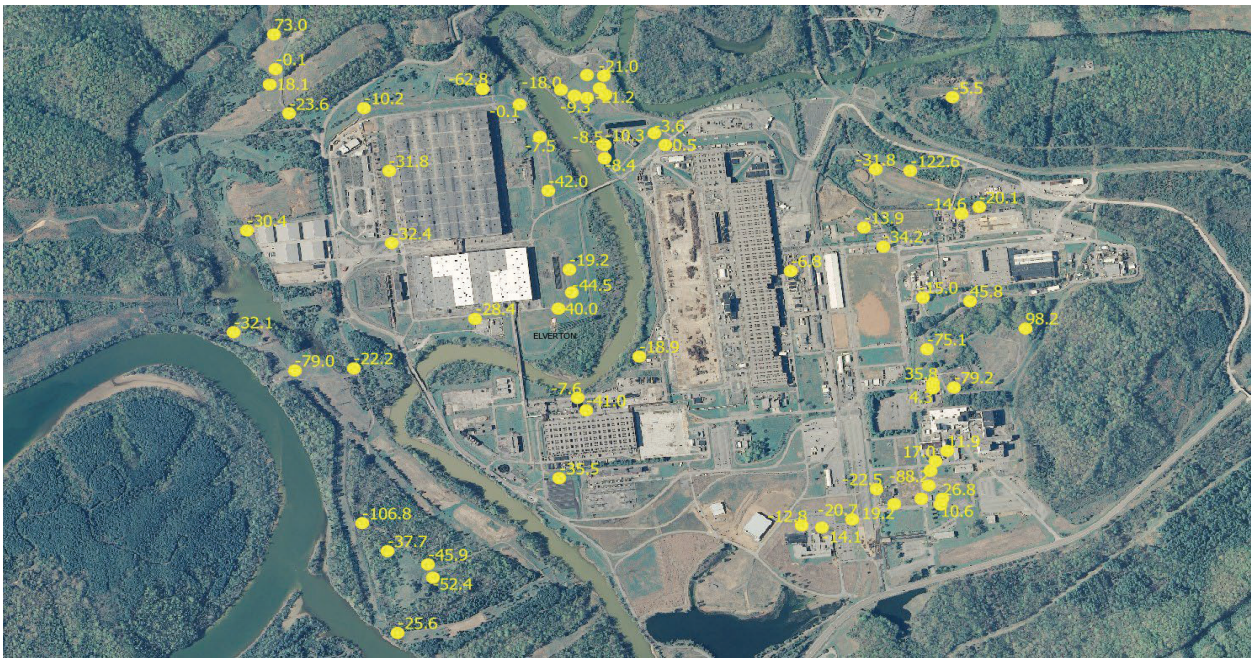

Figure Below. Bedrock Wells (ETTP) with elevations of "first water made" (during borehole drilling), above (+) and below (-) the Clinch River and East Fork Poplar Creek (from Geraghty & Miller, (1989) K/SUB/86-22224/12

The delineation of the plumes in karst and fractured rocks is challenging and can only be partially done on site and must include work offsite (at any site). However, if tracing techniques are used then a lot can be done to understand the true risk to offsite users and reasonably describe the magnitude of the problem. Conduits and channels that can be described as being pathways are those larger than a few millimeters (Quinlan et al., 1996) that can transport contaminated groundwater and contaminants at rapid velocities (meters (shales) to hundreds of meters or kilometers per day [carbonates]) and actually in any type of bedrock (Worthington et al., 2016).

It is important to note that the nature of groundwater speed in karst and fractured rocks is such that if flocculants and precipitates are produced for relatively insoluble or less soluble chemical species then they can migrate rapidly in the subsurface. This has been documented at other DOE facilities.

Although the mobility of radionuclides can be discussed, the principal radionuclide of concern at ETTP - uranium is highly mobile in the hydrosphere (Gascoyne 1992) and the main reason is association with the carbonate ion. In the bedrock this would seem to be restricted to carbonate rocks, however, as the table below shows the concentration of that ion is high in other lithologies. It is also derived from the atmosphere and thus in precipitation, that explains its overall mobility. The mobility of uranium means that all the decay products many of which are more radioactive than uranium and more soluble come into play, in particular for 238U this means radium, radon and polonium isotopes. Unfortunately these are short-lived thus highly radioactive, soluble and mobile. They must be specifically addressed in any future work both on site and offsite.

The most recent geological mapping of the K-25 site is by Lemiski et al., (being completed). It clearly shows structural bedrock trends and a structural trough heading roughly east-west that would likely channel groundwater toward the west and toward Knox Group carbonates that extend many kilometers southwest of the site and eventually more than 80 km down those valleys.

This would channel groundwater toward residential wells located just northeast of Kingston, TN. These wells as sampled by TDEC and DOE contractors for the past several years, show the some of the highest uranium concentration that have been measured off site. Uranium concentrations of those residential wells in the TDEC/DOE sampling program that are, to an uneducated eye not near (high enough) any criteria, but are high in terms of how much uranium is typically found in this part of the Valley and Ridge province and groundwater in general, and terrains like this in general (Osmond and Coward, 1992). These concentrations are anomalously high as compared to uranium concentrations typical of groundwater in carbonates in this area (Osmond and Cowart, 1992; USGS, 1962).

Response 22: There is no debate that all three U.S. Department of Energy (DOE) Oak Ridge Reservation plant sites are founded on a complicated and repeating sequence of carbonate and clastic rocks. The carbonate terranes do have variable amounts of karst development from negligible to significant. The K-31/K-33 Area had preconstruction karst features that were known at the time, and significant engineering resources were used during design of the large and heavy structures built in this area. Excellent high-definition topographic maps have been digitized by DOE's contractor to evaluate the preconstruction landscape. In addition, the acquisition of LiDAR (Light Detection and Ranging) data in nearly all of Tennessee has provided an outstanding dataset from which to evaluate karst terranes via review of hillshade or topographic processing workflows in ArcGIS. Both DOE's contractor and others have completed this style of evaluation. Observations of first water are exceedingly difficult using drilling methods that employ mud and telescoped casings, which are specifically designed to isolate the aquifer from the drill bore. Although previous generations of East Tennessee Technology Park (ETTP) contractor drill log forms typically had "first water," "water at completion," and "water level" fields, they very rarely had "first water" fields completed; therefore, the utility of such observations is inherently limited.

One of the components of ETTP groundwater restoration plans is installation of exit pathway wells similar to those that have been drilled and set at Melton Valley and Bethel Valley. A data quality objective session to address the number, location, and design of these wells currently is being developed and will involve regulator input. These wells are intended to provide a greater understanding of potential deep flow paths, establish groundwater gradients near administrative or water body boundaries, and alert the tri-party (DOE, U.S. Environmental Protection Agency, and Tennessee Department of Environment and Conservation) to potential off-site migration of contaminants.

Comment 23: Informative Note 2: The Role of Rivers and Streams in Relation to Groundwater Flow in East Tennessee. (This is a rather long-winded explanation, but for the record is important and relevant).

It is important to explain how groundwater in the bedrock underflows rivers and streams. Davies (2016) shows that the clues are provided by: local and regional geomorphology, geological history of uplift of the Appalachians, and initial groundwater flow paths deep in the subsurface in the geological past. It is commonly considered, and most often erroneously so in many fractured bedrock settings, that rivers and creeks are a barrier to groundwater flow and transport of contaminants. In these cases it always requires a thorough knowledge of the geological history of the setting, in this case the Valley and Ridge Province and its surroundings. The place to short cut start this discussion is in the primary bedrock aquifer for the ORR, the Cambrian-Ordovician Knox Group and clastic sediments below and above that lithological group. These sediments form the Paleozoic basement rocks and were in place in the subsurface well before the present landscape and river systems formed.

The evidence of similar deep circulation exists on and around the Oak Ridge Reservation e.g., (Nativ et al, 1992 + comments and responses). Some TDEC residential well data clearly point in the same direction. Some of these data did not get published in TDEC reports because upper- level management, lacking enough technical ability and knowledge about it, edited it out. Except a few contractors and DOE personnel (not working on the project) are maybe at the same point of difficulty. Chemists and other well credentialed professionals (not-geological) working for the contractors would not be well versed in much isotope geochemistry and geological data and that expertise and would thus not be expected to understand the data and its implications.

Garven et al., (1990) show during Appalachian uplift how gradient controlled recharge of deep basement rocks occurred. This allowed formation of the largest stratiform Pb-Zn deposits on Earth. Geochemical and isotopic data (Banner et al., 1989) show circulation and mixing of deep and shallow waters to depths of several kilometers and over distances of >1,000 km and how this deep groundwater mixes in the vertical rock column to depths >1,520 m (5,000 ft) below the surface. Davies et al., (2014) show how the tectonic and uplift affected the local area in the geological past with consequential abundant evidence from the age and nature of the Gray Fossil Site.

In summary, that information shows that a thick 50 million year-long blanket of sediments as preserved at the Gray Fossil Site in deep sinkholes - (Zaboaa et al., 2011) and as can be observed elsewhere from Virginia to Central Tennessee (the youngest age in caves, and other surface sites), but, covered the area and provides a simple explanation for why the rivers are meandering in this structural bedrock - a very anomalous landscape (Prof. Robert D. Hatcher, jr., personal communication). The removal of these extensive sediments began around 17 Ma (Poag and Sevon, 1989) after massive climate disruption caused by the eruption of the Columbia River Basalts. These eruptions persisted for 12 M.Y. and the effects were felt across the Northern Hemisphere and probably globally (ref). Note that the initiation of the Cenozoic sedimentation (~55 Ma - Gray Fossil Site) began following the catastrophic effects of the asteroid impact Chicxulub, Yucatan, Mexico, and the (PETM) Paleocene-Eocene Temperature Maximum and (ETO) Eocene Temperature Optimum. Several tectonic events are also documented in what is described as the "Crazy Eocene." (www.nickzentner.com).

I strongly emphasize that as with any site in this day and age, and in particular, ETTP (and the other ORR sites) that the use of serious technical expertise and use of isotopic techniques and new organic isotope techniques (Lollar 1992) be used to evaluate groundwater and its remediation.

Response 23: The U.S. Department of Energy (DOE) agrees the history, development, and understanding of the Appalachians are an exceptionally complicated and difficult endeavor. It is subject to many different interpretations and professional differences of opinion. One of the components of the East Tennessee Technology Park groundwater restoration plan is installation of deep exit pathway wells (similar to those that have been drilled and set at Melton Valley and Bethel Valley). A data quality objective session to address the number, location, and design of these wells currently is being developed and will involve regulator input. These wells are intended to provide a greater understanding of potential deep flow paths, establish groundwater gradients near administrative or water body boundaries, and alert the tri-party (DOE, U.S. Environmental Protection Agency, and Tennessee Department of Environment and Conservation) to potential off-site migration of contaminants.

Comment 24: Option: In situ thermal treatment….

Comment: Anything that reduces the source is an acceptable result, but please provide information about how this technology treats the U, transuranics and fission products. Among the separation methods for uranium and actinides is solvent extraction, so explain what the thermal treatment will do for the possible additional mobilization of the actinides and other inorganics and other heavy metal species as contaminants.

Option: EISB that uses microorganisms….

Comment: Same as previous comment, how does this treat the U, transuranics, fission products and inorganics?

Option: In situ soil mixing, along with EISB. This involves adding chemicals to reduce migration in shallow areas and using EISB in deeper areas

Comment: Same as previous two comments - The site was an uranium gaseous diffusion plant….

Response 24: The East Tennessee Technology Park Main Plant Area (MPA) Proposed Plan and associated MPA Interim Record of Decision (IROD) represent an initial cleanup action with the primary goal to reduce chlorinated volatile organic compounds (CVOCs) at six high-concentration areas that are degradable via enhanced in situ bioremediation. Areas, plumes, and other contaminants of concern outside of the six high CVOC source areas are not included in the MPA Proposed Plan or MPA IROD and will be addressed in future investigations. All remediation alternatives considered for treatment of high CVOC source areas have the potential to alter existing groundwater flow paths and plume configuration. Enhanced in situ bioremediation is intended to treat CVOCs with no intent to mitigate radionuclides, metals, or other contaminants of concern. Associated changes in groundwater geochemistry may reduce or enhance mobility of these other contaminants, but in general, these are local effects and natural conditions are reestablished outside of the immediate area of treatment. A future investigation will address contaminants of concern other than CVOCs in the high CVOC source areas.

Both early and more recent data collection efforts have gathered large amounts of data on uranium in the environment, including groundwater—most recently the MPA Feasibility Study and the Zone 2 Soil ROD projects. These efforts have shown, for the most part, uranium is not a widespread issue in the groundwater at ETTP. In the 2007 *Final Sitewide Remedial Investigation and Feasibility Study for East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2279&D3), uranium generally was found at levels at or near background. There have been no clearly delineated uranium plumes at the site. Even in cases

where a uranium source was identified and subsequently removed by the Zone 2 Soil ROD project, nearby wells did not show elevated concentrations of uranium, suggesting the prevalent form of uranium that was present at ETTP is not soluble.

Comment 25: Final General Comment: It appears that the remediation for uranium, transuranics and fission products is being ignored and the whole emphasis is only on organic solvents - this is seriously deficient as the half-lives are, for many radionuclides, so long that the site will be contaminated essentially for ever. There are some seriously toxic metals that are in the decay chains of many radionuclides and these are being ignored also. I believe the rationale for this came from the use of gross alpha and gross beta analysis of soils (which was not the way things should her been addressed) more recently. The original RI done in the mid 1990's, included analyses of individual radionuclides and was done properly. Then, if there was contamination in the soils there would have to had to have been contamination to groundwater, which was not addressed then, and is now being excluded form the work. I understand better than most people that dealing with radionuclides and transuranics is difficult but it simply cannot be ignored. These very serious deficiencies absolutely must be addressed.

Response 25: Radiological contaminants, metals, and other contaminants of concern are not part of the Main Plant Area (MPA) Proposed Plan and MPA Interim Record of Decision (ROD), but they will be addressed in a future investigation. Chlorinated volatile organic compound contaminants present the most significant percent of total risk to human health, and accordingly, are being addressed during initial phases of groundwater restoration.

Both early and more recent data collection efforts have gathered large amounts of data on uranium in the environment, including groundwater—most recently the MPA Feasibility Study and the Zone 2 Soil ROD projects. These efforts have shown, for the most part, uranium is not a widespread issue in the groundwater at the East Tennessee Technology Park (ETTP). In the 2007 *Final Sitewide Remedial Investigation and Feasibility Study for East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2279&D3), uranium generally was found at levels at or near background. There have been no clearly delineated uranium plumes at the site. Even in cases where a uranium source was identified and subsequently removed by the Zone 2 Soil ROD project, nearby wells did not show elevated concentrations of uranium, suggesting the prevalent form of uranium that was present at ETTP is not soluble. As stated above, the U.S. Department of Energy will continue to evaluate for isotopic uranium and its daughter projects as part of future investigations.

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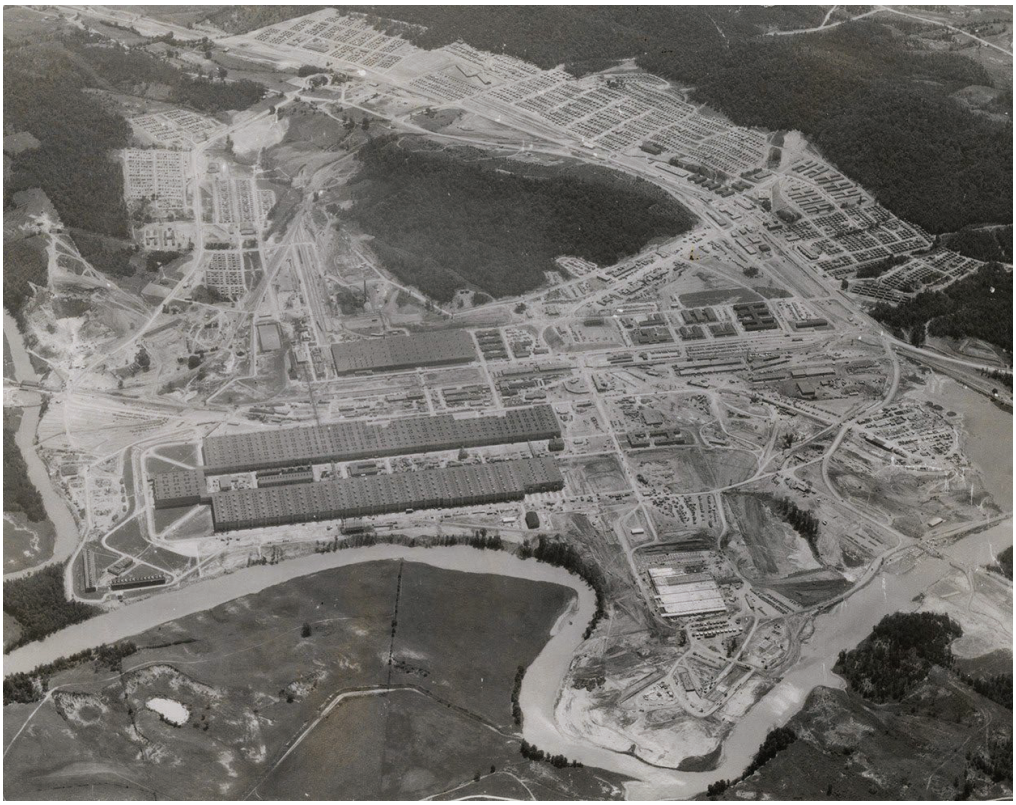

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APPENDIX A.
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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APPENDIX A.
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

A1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The selected remedy will be implemented to comply with the substantive requirements of action- and location-specific applicable or relevant and appropriate requirements (ARARs). As the goals of the *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2; Main Plant Area [MPA] Focused Feasibility Study [FFS]) are to reduce contaminant concentrations in the chlorinated volatile organic compound source areas and not attain chemical-specific ARARs, a Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) interim waiver is invoked, as described below.

Both CERCLA, Section 121, and Title 40 Code of Federal Regulations (CFR) Part 300.430(f)(1)(ii)(B) specify remedial actions for cleanup of hazardous substances must attain or have legally waived ARARs under federal or more stringent state environmental laws. Inherent in the interpretation of ARARs is the assumption that protection of human health and the environment is ensured.

Applicable requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (40 CFR 300.5). A requirement is applicable if all the jurisdictional and site-specific prerequisites of the requirement are met (i.e., if the requirement directly and fully addresses the situation at the site).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 CFR 300.5). The criteria for determining relevance and appropriateness are listed at 40 CFR 300.400(g)(2). A relevant and appropriate requirement must be complied with to the same extent as an applicable requirement.

To qualify as a state ARAR mandating cleanup standards under 40 CFR 300.400(g)(4) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), a state requirement must be: (1) promulgated (of general applicability and legally enforceable), (2) an environmental or facility siting law or regulation, (3) substantive (not procedural or administrative), (4) more stringent than a comparable federal requirement, (5) identified by the state in a timely manner, and (6) consistently applied throughout the state. Pursuant to U.S. Environmental Protection Agency (EPA) guidance (EPA 1989), where EPA has delegated to the State of Tennessee the authority to implement a federal program, the Tennessee regulations replace the equivalent federal requirements as the potential ARARs.

The CERCLA on-site remedial response actions must comply with only the substantive requirements of a regulation to obtain federal, state, or local permits (CERCLA, Section 121(e)). To ensure CERCLA response actions proceed as rapidly as possible, EPA has reaffirmed this position in the final NCP (55 Federal Register [FR] 8756, March 8, 1990). Substantive requirements directly pertain to the actions or conditions at a site, while administrative requirements facilitate their implementation (e.g., approval of or consultation with administrative bodies, documentation, permit issuance, reporting, record keeping, and enforcement). EPA recognizes certain administrative requirements (e.g., consultation with state agencies and reporting) are accomplished through state involvement and public participation. These administrative requirements should also be observed if they are useful in determining cleanup standards at the site (55 FR 8757).

The NCP at 40 CFR 300.400(e)(1) exempts on-site actions from having to obtain federal, state, or local permits and defines on-site as meaning "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for the implementation of the response action." However, on-site actions must still be in compliance with any substantive permit requirements. Off-site actions must comply with only requirements that are legally applicable, but they must comply with both the substantive and administrative parts of those requirements. Permits, if required, must be obtained for all remedial activities conducted offsite (40 CFR 300.400(e)(2)). Statutory waivers of ARARs (40 CFR 300.430(f)(1)(ii)(C)) may not be used for off-site actions.

ARARs include those federal and state regulations that are designed to protect the environment; ARARs do not include occupational safety regulations. EPA requires compliance with the Occupational Safety and Health Administration (OSHA) standards in Section 300.150 of the NCP, independent of the ARARs process. Therefore, neither the regulations promulgated by OSHA nor U.S. Department of Energy (DOE) Orders related to occupational safety are addressed as ARARs. These regulations would appear in the appropriate health and safety plans for this action.

In addition to ARARs, 40 CFR 300.400(g)(3) notes federal or state non-promulgated advisories or guidance may be identified as to-be-considered (TBC) guidance for contaminants, conditions, and/or actions at the site. TBC guidance include non-promulgated criteria, advisories, guidance, and proposed standards. TBC guidance are not ARARs because they are neither promulgated nor enforceable. TBC guidance may be used to interpret ARARs and to determine remediation levels when ARARs do not exist for particular contaminants or are not sufficiently protective to develop cleanup goals. TBC guidance, such as guidance or policy documents, developed to implement regulations may be considered and used where necessary to ensure protectiveness.

A1.1. Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limits in various environmental media (i.e., surface water, groundwater, soil, and air) for specific hazardous substances, pollutants, or contaminants.

The remedial action objective for the final MPA remedial action is expected to include groundwater restoration, and as such, the Final Record of Decision (or Records of Decision) for the MPA would be expected to attain ARARs for groundwater. The CERCLA NCP requires federal Safe Drinking Water Act of 1974 (SDWA) maximum contaminant levels (MCLs) and non-zero MCL goals (MCLGs) be attained for all remedial actions for groundwaters that are current or potential sources of drinking water, where the MCLs and non-zero MCLGs are relevant and appropriate under the circumstances of the release (40 CFR 300.430(e)(2)(i)(B)-(C)). Additionally, Tennessee Department of Environment and Conservation (TDEC) Chapter 0400-40-03-.07(4)(b) (TDEC 2019) designates all groundwater in the state as general use groundwater (except for groundwater that has been specifically designated otherwise); thus, this general use groundwater designation would apply to groundwater on the Oak Ridge Reservation (ORR). Groundwater designated as general use must meet the state's numeric water quality criteria under TDEC Chapter 0400-40-03-.03(1)(j) and (k) for surface waters classified as a domestic water supply and must contain no other constituents that pose an unreasonable risk to public health or the environment (TDEC Chapter 0400-40-03-.08(2)). Water quality criteria set out in TDEC Chapter 0400-40-03-.03(1)(j) reflect the MCLs.

Numeric criteria associated with SDWA MCLs are provided in Table A.1. Table A.2 provides a full listing of chemical-, location-, and action-specific ARARs. The selected remedy for the MPA FFS will be completed under an interim action, and the goal of this interim action is not groundwater restoration or attainment of MCLs but focuses mainly on plume contaminant mass reduction to identified interim numeric goals. Nonetheless, this

Table A.1. Numeric criteria for ORR groundwater (mg/L or parts per million)

Chemical	Value	Selection basis[a]
Arsenic	0.010	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Beryllium	0.004	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Bis-2-ethylhexyl-phlalate	0.006	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Cadmium	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Carbon tetrachloride	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Chromium (total)	0.1	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Copper	Treatment technique[b] (action level 1.3)	Federal MCL, TDEC MCL
1,2-Dichloroethane	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1-Dichloroethene	0.007	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
cis-1,2-Dichloroethene	0.07	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
trans-1,2-Dichloroethene	0.1	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Di-(2-ethylhexyl)-phthalate	0.006	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Dichloromethane (methylene chloride)	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Lead	0.005[c]	Tennessee groundwater quality criteria
Nickel	0.1[d]	TDEC MCL, Tennessee groundwater quality criteria
Polychlorinated biphenyls (total)	0.0005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Tetrachloroethene	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Thallium	0.002	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1,1-Trichloroethane	0.20	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1,2-Trichloroethane	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Trichloroethene	0.005	
Vinyl chloride	0.002	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Gross alpha particle activity (includes radium-226 but excludes radon and uranium)	15 pCi/L	Federal MCL, TDEC MCL
Beta particle and photon activity	4 mrem/year[e]	Federal MCL, TDEC MCL
Technetium-99	see beta particle and photon activity	Federal MCL, TDEC MCL
Uranium	0.030	Federal MCL, TDEC MCL

[a]TDEC MCLs are listed in TDEC Chapter 0400-45-01 (TDEC 2019). Currently, all federal MCLs are identical to the TDEC MCLs; the federal MCLs are listed in 40 Code of Federal Regulations (CFR) 141.61(a), 40 CFR 141.62(b), and 40 CFR 141.66(c). Tennessee groundwater quality criteria at TDEC 0400-40-03-.08 incorporate by reference the domestic water supply criteria in TDEC Chapter 0400-40-03-.03.

[b]Lead and copper are regulated by a treatment technique that requires systems to control corrosiveness of their water. If more than 10% of tap water samples exceed the action level, then water systems must take additional steps.

[c]In addition to the MCL/treatment technique under the State's Safe Drinking Water Act of 1974 program (TDEC Chapter 0400-45-01), Tennessee also has a lead groundwater quality criterion of 0.005 mg/L for domestic water supply in TDEC Chapter 0400-40-03-.03.

[d]The U.S. Environmental Protection Agency has deleted both the MCL and the MCL goal for nickel from the CFR, which was vacated by a court ruling. Tennessee has retained the nickel MCL in its current regulations.

[e]TDEC regulations at TDEC Chapter 0400-45-01-.06 (TDEC 2019) list tritium and strontium-90 levels in Table A of that regulation as "Average Annual Concentrations Assumed to Produce a Total Body or Organ Dose of 4 mrem/yr," which is the MCL for beta particle and photon radioactivity. Except for these radionuclides, the concentration of the other 179 manmade radionuclides causing 4-mrem total body or organ dose equivalents must be calculated on the basis of 2-L/day drinking water intake using the 168-hr data list in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," National Bureau of Standards Handbook 69, as amended August 1963, U.S. Department of Commerce. If two or more radionuclides are present, then the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.

TDEC 2019. Chapter 0400-40-03, *General Water Quality Criteria*, Rule 0400-40-03-.03, "Criteria for Water Uses," and Rule 0400-40-03-.07, "Ground Water Classification," Rules of the Tennessee Department of Environment and Conservation, Nashville, TN, Revised September 2019. URL: https://publications.tnsosfiles.com/rules/0400/0400-40/0400-40-03.20190911.pdf.

MCL = maximum contaminant level
ORR = Oak Ridge Reservation
TDEC = Tennessee Department of Environment and Conservation

Table A.2. ARARs

Media/Location/Action	Requirement	Prerequisite	Citation
	Chemical-specific		
Remediation of contaminated groundwater	Except for groundwater in areas that have been designated as Special Source Water, Site-Specific Impaired Ground Water or meet the definition of Unusable Ground Water, all groundwater is designated as General Use Ground Water	Classification of state groundwaters—**applicable**	TDEC 0400-40-03-.07(4)(b)
	Except for naturally occurring levels, General Use Ground Water: • Shall not contain constituents that exceed those levels specified in TDEC 0400-40-03-.03 subparagraphs j (levels equivalent to SDWA MCLs) and k (quantities detrimental to public health or that impair use of the water as domestic water supply); and • Shall contain no other constituents at levels and conditions that pose an unreasonable risk to the public health or the environment	Release of contaminants to groundwater or actions potentially impacting groundwater—**applicable**	TDEC 0400-40-03-.08(2)(a) and (b)
	The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man or animals, or impair the safety of conventionally treated water supplies. Available references include, but are not limited to: Quality Criteria for Water (Section 304(a) of Public Law 92-500 as amended), federal regulations under Section 307 of Public Law 92-500 as amended, and federal regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act of 1974 (Public Law 93-523)		TDEC 0400-40-03-.03(1)(j)
	The waters shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply		TDEC 0400-40-03-.03(1)(k)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement		Prerequisite	Citation
	MCLs are promulgated concentration levels in public drinking water supplies. Must not exceed the MCLs in public community water systems, as measured at the consumer's tap		Release of contaminants to groundwater or actions potentially impacting groundwater—**relevant and appropriate**	TDEC 0400-45-01-.06 and TDEC 0400-45-01-.25 40 CFR 141.61(a) 40 CFR 141.62(b)
	Arsenic	0.010 mg/L		
	Beryllium	0.004 mg/L		
	Bis-2-ethylhexyl-phlalate	0.006 mg/L		
	Cadmium	0.005 mg/L		
	Carbon tetrachloride	0.005 mg/L		
	Chromium (total)	0.1 mg/l		
	Copper	Treatment technique (action level 1.3 mg/L)		
	1,2-Dichloroethane	0.005 mg/L		
	1,1-Dichloroethene	0.007 mg/L		
	cis-1,2-Dichloroethene	0.07 mg/L		
	trans-1,2-Dichloroethene	0.1 mg/L		
	Di-(2-ethylhexyl)-phthalate	0.006 mg/L		
	Dichloromethane (methylene chloride)	0.005 mg/L		
	Lead	Treatment technique (action level 0.015 mg/L)		
	Nickel	0.1 mg/L (Tennessee only)		
	Polychlorinated biphenyls (total)	0.0005 mg/L		
	Tetrachloroethene	0.005 mg/L		
	Thallium	0.002 mg/L		
	1,1,1-Trichloroethane	0.20 mg/L		
	1,1,2-Trichloroethane	0.005 mg/L		
	Trichloroethene	0.005 mg/L		
	Vinyl chloride	0.002 mg/L		
	Gross alpha particle activity (includes radium-226 but excludes radon and uranium)	15 pCi/L		
	Beta particle and photon activity	4 mrem/year		
	Technetium-99	See beta particle and photon activity		
	Uranium	0.030 mg/L		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Location-specific		
	Wetlands		
Presence of wetlands as defined in 10 CFR 1022.4	Incorporate wetland protection considerations into its planning, regulatory, and decision-making processes, and shall, to the extent practicable, minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands	DOE actions that involve potential impacts to, or take place within, wetlands— **applicable**	10 CFR 1022.3(a)(7) and (8)
	Undertake a careful evaluation of the potential effects of any proposed wetland action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse wetland impacts		10 CFR 1022.3(b), (c), and (d)
	Project description. This section shall describe the proposed action and shall include a map showing its location with respect to the floodplain and/or wetland. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)
	Floodplain or wetland impacts. This section shall discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain and/or wetland. This section shall include impacts on the natural and beneficial floodplain and wetland values (Section 1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated. For an action proposed in a wetland, the effects on the survival, quality, and function of the wetland shall be evaluated		10 CFR 1022.13(a)(2)
	Alternatives. Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in a wetland area, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	If no practicable alternative to locating or conducting the action in the wetland is available, then before taking action, design or modify the action to minimize potential harm to or within the wetland, consistent with the policies set forth in Executive Order 11990		10 CFR 1022.14(a)
Presence of jurisdictional wetlands as defined in 40 CFR 230.3, 33 CFR 328.3(a), and 33 CFR 328.4	No discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands, is permitted if there is a practical alternative that would have less adverse impact on the wetland or if it will cause or contribute significant degradation of waters of the United States	Actions that involve the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands— **applicable**	40 CFR 230.10(a), (b), (c), and (d) 40 CFR 230, Subpart H
	Except as provided under CWA Section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps (in accordance with 40 CFR 230.70 *et seq*. *Actions to Minimize Adverse Effects*) have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem		40 CFR 230.10(d) CWA Regulations – Section 404(b) Guidelines
	No discharge of dredged or fill material shall be permitted if it: • Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard • Violates any applicable toxic effluent standard or prohibition under Section 307 of the CWA • Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat that is determined by the Secretary of Interior of Commerce, as appropriate, to be critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph • Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972		40 CFR 230.10(b)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Mitigation of impacts to state wetlands as defined under TDEC 0400-40-07-.03	If an activity in a wetland results in an appreciable permanent loss of resource values, mitigation must be provided, which results in no overall net loss of resource values from existing conditions. To the extent practicable, any required mitigation shall be completed, excluding monitoring, prior to, or simultaneous with, any impacts. Acceptable mitigation mechanisms include any combination of in-lieu fee programs, mitigation banks, or other mechanisms that are reasonably assured to result in no overall net loss of resource values from existing conditions. Acceptable mitigation methods are prioritized in the following order: restoration, enhancement, preservation, creation, or any other measures that are reasonably assured to result in no net loss of resource values from existing conditions Compensatory measures must be at a ratio no less than 2:1 for restoration, 4:1 for creation and enhancement, and 10:1 for preservation, or at a best professional judgment ratio agreed to by the state	Activity that would cause loss of wetlands as defined in TDEC 0400-40-07-.03—**applicable**	TDEC 0400-40-07-.04(7)(a) TDEC 0400-40-07-.04(7)(c)
Minor alterations to wetlands	Minor alteration to wetlands must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for minor alteration to wetlands include the following: • Excavation and fill activities associated with wetland alteration shall be kept to a minimum • Wetlands outside of the impact areas shall be clearly marked with signs, high-visibility fencing, or similar structures so that all the work performed by the contractor is solely within the permitted impact area • Wetland alterations shall not cause measurable degradation to resource values and classified uses of hydraulically connected wetlands or other waters of the state, including disruption of sustaining surface or groundwater hydrology	Minor alterations of up to 0.10 acre of moderate resource-value wetlands or of up to 0.25 acre of degraded and of low resource-value wetlands—**applicable**	Tennessee Code Annotated 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Minor Alterations to Wetlands (effective April 7, 2020) (**TBC**)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Temporary impacts to wetlands shall be mitigated by the removal and stockpiling of the first 12 in. of topsoil, prior to construction. Temporary wetland crossings or haul roads shall use timber matting. Gravel, riprap, or other rock is not approved for construction of temporary crossings or haul roads across wetlands. Upon completion of construction activities, all temporary wetland impact areas are to be restored to pre-construction contours, and the stockpiled topsoil spread to restore these areas to pre-construction elevation. Other side-cast material shall not be placed within the temporary impact locations. Permanent vegetative stabilization using native species of all disturbed areas in or near the wetland must be initiated within 14 days of project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • Erosion prevention and sediment control measures, such as fences, shall be removed following completion of construction • The amount of fill, stream channel, and bank modifications, or other impacts associated with the activity, shall be limited to the minimum necessary to accomplish the project purpose. Shall use the least impactful practicable method of construction • Clearing, grubbing, or other disturbance to wetland vegetation shall be kept at the minimum. Unnecessary native vegetation removal, including tree removal, and soil disturbance is prohibited. Native wetland vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed • Activity may not result in a disruption or barrier to the movement of fish or other aquatic life and wetland-dependent species upon project completion • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Where practicable, all activities shall be accomplished during drier times of the year or when recent conditions have been dry at the impact location. All surface water flowing towards or from the construction activity shall be diverted using cofferdams and/or berms constructed of sandbags; steel sheeting; or other non-erodible, non-toxic material. All such diversion materials shall be located outside the wetland and removed upon completion of the work. Activities may be conducted in the water if working in the dry will likely cause additional degradation. If work is conducted in the water, it must be of a short duration and with minimal impact • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank		
Presence of wetlands	Shall take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance beneficial values of wetlands NOTE*:* Federal agencies required to comply with Executive Order 11990 requirements	Federal actions that involve potential impacts to, or take place within, wetlands— **TBC**	Executive Order 11990 Section 1.(a) Protection of Wetlands
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction, and (2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use		Executive Order 11990, Section 2.(a) Protection of Wetlands

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Presence of wetlands (as defined in 44 CFR 9.4)	The Agency shall minimize[1] the destruction, loss, or degradation of wetlands The Agency shall preserve and enhance the natural and beneficial wetlands values	Federal actions affecting or affected by wetlands as defined in 44 CFR 9.4—**relevant and appropriate**	44 CFR 9.11(b)(2) and (b)(4) Mitigation
	The Agency shall minimize: • Potential adverse impact the action may have on wetland values		44 CFR 9.11(c)(3) Minimization provisions
General compensatory mitigation for wetlands	Compensatory mitigation required to offset unavoidable impacts to waters of the United States authorized by Department of the Army permits Compensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular Department of the Army permit • Amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions • Compensatory mitigation may be provided through mitigation banks or in lieu fee programs • Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the impact-causing activity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(1) General compensatory mitigation requirements
	Compensatory mitigation may be performed using the methods of restoration, enhancement, establishment, and in certain circumstances preservation Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(2)

[1]Minimize means to reduce to the smallest amount or degree possible. 44 CFR 9.4 definitions.

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	All compensatory mitigation projects must comply with the standards in this part (40 CFR Part 230), if they are to be used to provide compensatory mitigation for activities authorized by Department of the Army permits, regardless of whether they are sited on public or private lands and whether the sponsor is a governmental or private entity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action		40 CFR 230.93(a)(3)
	Required compensatory mitigation should be located within the same watershed as the impact site and should be located where it is most likely to successfully replace lost functions and services, taking into account such watershed-scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses		40 CFR 230.93(b) Type and location of mitigation
	Project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the district engineer must consider, to the extent practicable, the factors in subsections (i) thru (vi) Applicants should propose compensation sites adjacent to existing aquatic resources or where aquatic resources previously existed		40 CFR 230.93(d)(1) and (3) Site selection
	In general, in-kind mitigation is preferable to out-of-kind mitigation because it is most likely to compensate for the functions and services lost at the impact site Except as provided in paragraph (e)(2) of this section, the required compensatory mitigation shall be of a similar type to the affected aquatic resource		40 CFR 230.93(e)(1) Mitigation type

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. Where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratio must be used		40 CFR 230.93(f)(1) Amount of compensatory mitigation
	Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the activity causing the authorized impacts. The district engineer shall require, to the extent appropriate and practicable, additional compensatory mitigation to offset temporal losses of aquatic functions that will result from the permitted activity		40 CFR 230.93(m) Timing
Compensatory mitigation planning	Prepare a mitigation plan addressing objectives, site selection, site protection, baseline information, determination of credits, mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term management, and adaptive management NOTE*:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan. Plan to include items described in 40 CFR 230.94(c)(2) through (c)(14)[2]	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.94(c) Mitigation Plan
Compensatory mitigation performance standards	The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres)	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.95(a) Ecological Performance Standards

[2]If mitigation obligations will be met by securing credits from approved mitigation banks or in lieu fee programs, mitigation plan needs to include only items described in Sections 230.94(c)(5) and (c)(6), and name of mitigation bank or in lieu fee program. 40 CFR 230.94(c)(1).

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Performance standards must be based on attributes that are objective and verifiable. Ecological performance standards must be based on the best available science that can be measured or assessed in a practicable manner Performance standards may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position. The use of reference aquatic resources to establish performance standards will help ensure those performance standards are reasonably achievable, by reflecting the range of variability exhibited by the regional class of aquatic resources as a result of natural processes and anthropogenic disturbances. Performance standards based on measurements of hydrology should take into consideration the hydrologic variability exhibited by reference aquatic resources, especially wetlands		40 CFR 230.95(b) Ecological Performance Standards
Compensatory mitigation project monitoring	Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure the compensatory mitigation project is accomplishing its objectives Compensatory mitigation project monitoring period shall be sufficient to demonstrate that project has met performance standards, but not less than 5 years	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.96(a) and (b) Monitoring
Compensatory mitigation project management	The aquatic habitats, riparian areas, buffers, and uplands that comprise the overall compensatory mitigation project must be provided long-term protection through real estate instruments or other available mechanisms, as appropriate For government property, long-term protection may be provided through federal facility management plans or integrated natural resources management plans NOTE*:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan and/or Operations and Maintenance Plan	Alteration of wetlands on government property requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.97(a)(1) Site Protection

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Projects shall be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved This includes minimization of active engineering features (e.g., pumps) and appropriate siting to ensure natural hydrology and landscape context will support long-term sustainability. Where active long-term management and maintenance are necessary to ensure long-term sustainability (e.g., prescribed burning, invasive species control, maintenance of water control structures, easement enforcement), the responsible party must provide for such management and maintenance		40 CFR 230.97(b) Sustainability
	Floodplains		
Presence of floodplain as defined in 10 CFR 1022.4	Incorporate floodplain management goals into planning, regulatory, and decision-making processes, and, to the extent practicable, reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; restore and preserve natural and beneficial values served by floodplains; require the construction of DOE structures and facilities to be, at a minimum, in accordance with Federal Emergency Management Agency National Flood Insurance Program building standards; and promote public awareness of flood hazards by providing conspicuous delineations of past and probable flood heights on DOE property that is in an identified floodplain	DOE actions that involve potential impacts to, or take place within, floodplains—**applicable**	10 CFR 1022.3(a)(1) through (6)
	Undertake a careful evaluation of the potential effects of any proposed floodplain action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Avoid direct and indirect support of development in a floodplain wherever there is a practicable alternative Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse floodplain impacts		10 CFR 1022.3(b), (c), and (d)
	Describe the proposed action and include a map showing its location with respect to the floodplain. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain. Include impacts on the natural and beneficial floodplain values (Section1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated		10 CFR 1022.13(a)(2)
	Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in the floodplain, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a floodplain including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)
	If no practicable alternative to locating or conducting the action in the floodplain is available, then before taking action, design or modify the action to minimize potential harm to or within the floodplain, consistent with the policies set forth in Executive Order 11988		10 CFR 1022.14(a)
	Cultural resources		
Presence of the Manhattan Project National Historical Park and associated buildings	Preserve and protect the nationally significant historic resources associated with the Manhattan Project National Historical Park Improve public understanding of the Project through interpretation of its historic resources Enhance public access to the Park consistent with protection of public safety, national security, and other aspects of DOE's missions Preserve and protect the historically significant resources associated with the Manhattan Project National Historical Park	Action that could adversely impact the Manhattan Project National Historical Park and associated buildings and elements— **applicable**	Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015, Section 3039, Publication L. No. 113-291 (December 19, 2014)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	DOE retains authority and legal obligation for historic preservation and maintenance, including ensuring safe access in connection with DOE's Manhattan Project National Historical Park resources. Consistent with existing Historic Preservation plans, DOE will protect and maintain all DOE sites, structures, and landscapes included in the Park, as well as associated contributing elements located outside of the Park, in accordance with the requirements of the National Historic Preservation Act. DOE will follow the Secretary of the Interior's Standards for Treatment of Historic Properties. DOE will make every effort to avoid adverse impacts to the Park's resources, values, and contributing historic elements. Consistent with existing Historic Preservation plans, DOE will maintain and preserve contributing elements as if they were included in the Park boundary	**TBC**	MOA between DOE and DOI for the Manhattan Project National Historical Park (November 10, 2015)
Presence of archaeological resources on public land	No person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface, any archaeological resource located on public lands or Indian lands unless such activity is pursuant to a permit issued under Section 7.8 or exempted by Section 7.5(b) of this part	Federal agency construction or excavation projects that would cause the irreparable loss or destruction of significant historic or archaeological resources or data—**applicable**	43 CFR 7.4(a)
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony	If inadvertent discovery occurred in connection with an ongoing activity on federal or tribal lands, in addition to providing the notice described above, must stop activities in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently	Excavation activities that inadvertently discover such resources on federal lands or under federal control—**applicable**	43 CFR 10.4(c)
	Must take immediate steps, if necessary, to further secure and protect inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony, including, as appropriate, stabilization or covering		43 CFR 10.4(d)(ii)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Action-specific			
Site preparation, construction, and excavation activities			
Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following: Use, where possible, of water or chemicals for control of dust, and Application of asphalt, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces, which can create airborne dusts	Use, construction, alteration, repair, or demolition of a building, or appurtenances or a road or the handling transport or storage of material—**applicable**	TDEC 1200-3-8-.01(1) TDEC 1200-3-8-.01(1)(a) TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 min/hr or 20 min/day beyond property boundary lines on which emission originates		TDEC 1200-3-8-.01(2)
Activities causing stormwater runoff (e.g., clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion, vegetative controls, and structural controls) in accordance with the substantive requirements of General Permits TNR10-0000 and TNR05-0000 to ensure stormwater discharge is properly managed, and: • Does not violate water quality criteria as stated in TDEC 0400-40-03-.03, including, but not limited to, prevention of discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any designated uses for that water body by TDEC 0400-40-04; • Does not contain distinctly visible floating scum, oil, or other matter; • Does not cause an objectionable color contrast in the receiving stream; and	Stormwater discharges associated with construction activities that disturb ≥ 1 acre total**—relevant and appropriate**	Tennessee Code Annotated 69-3-108(1) Tennessee General Permit TNR10-0000, Sections 5.3.2 and 5.4.1 (effective October 1, 2016) **(TBC)**

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream • Discharges that would cause measurable degradation of waters with unavailable parameters are not authorized. To be eligible to obtain and maintain coverage, must satisfy, at a minimum, the following additional requirement for discharges into waters with unavailable parameters for siltation and habitat alterations due to in-channel erosion: • Measures used at the site must be designed to control stormwater runoff generated by a 5-year, 24-hr storm event at a minimum Additional physical or chemical treatment of stormwater runoff, such as use of treatment chemicals, may be necessary to minimize the amount of sediment being discharged when clay and other fine particle soils are found on sites		
Airborne radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/year	Radionuclide air emissions from point sources, as well as diffuse or fugitive emissions, at DOE facilities—**applicable**	40 CFR 61.92 TDEC 1200-3-11-.08(6)
	Radionuclide emission measurements shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured NOTE: DOE has an ORR-wide radionuclide emissions monitoring program in place to comply with these requirements under 40 CFR 61, Subpart H. Adherence to the ORR-wide National Emission Standards for Hazardous Air Pollutants monitoring program will constitute compliance with this ARAR requirement	Release points which have the potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of 10 mrem/year to any member of the public—**applicable**	40 CFR 61.93(b)(4)(i) TDEC 1200-03-11-.08(6)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Groundwater monitoring activities		
Placement of monitoring wells	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards	Class V injection systems—**relevant and appropriate** to placement of monitoring wells	TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)
Construction of monitoring wells	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole; this casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples; the annular space above the sampling depth must be seated to prevent contamination of samples and the groundwater	Construction of RCRA groundwater monitoring wells**—relevant and appropriate**	40 CFR 264.97(c) TDEC 0400-12-01-.06(6)(h)(3)
Construction and abandonment of monitoring wells	Establishes quality and workmanship requirements for well drilling, installation, and abandonment, and for sampling, borehole geophysical logging, and hydrologic testing. The substantive requirements of this procedure are TBC for construction and abandonment of monitoring wells	Construction and abandonment of monitoring wells—**TBC**	*Standard Specifications for Installation, Well Drilling, and Abandonment*, SPG-00000-A005/Rev 2 (October 14, 2011)
Closure of monitoring wells	Before abandonment, clean well of obstructions and disinfect using bleach or hypochlorite granules to produce free chlorine residual concentrations of 25 parts per million	Plugging and closure of a water production well—**relevant and appropriate**	TDEC 0400-45-09-.16(1)(a) through (c)
	Use one of several different methods to close well depending on depth of well, construction details, whether it is cased or uncased, and whether it intercepts multiple aquifers		TDEC 0400-45-09-.16(2)(a) through (c)
	Backfill must be placed so that there are no gaps or bridging. Backfill top must be level with land surface		TDEC 0400-45-09-.16(2)(d)
	Wells extending into more than one aquifer shall be filled and sealed in such a way that exchange of water from one aquifer to another is prevented		TDEC 0400-45-09-.16(3)
	Flowing wells must be treated to reduce flow to zero before sealing		TDEC 0400-45-09-.16(4)
	An alternate method of closure may be approved by TDEC		TDEC 0400-45-09-.16(5)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Injection well activities		
Reinjection of contaminated groundwater amended with treatment reagents	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons	Underground injection into an USDW—**applicable**	40 CFR 144.12(a) TDEC 0400-45-06-.04(1)
	Wells are not prohibited if injection is approved by EPA or a state pursuant to provisions for cleanup of releases under CERCLA or RCRA	Class IV wells (as defined in 40 CFR 144.6(d)) used to inject contaminated groundwater that has been treated and reinjected into the same formation from which it was drawn—**applicable**	40 CFR 144.13(c) RCRA Section 3020(b) TDEC 0400-45-06-.13(3)
	The variety of Class V wells and their uses dictate a variety of construction designs consistent with those uses and precludes specific construction standards. However, a well must be designed and constructed for its intended use, in accordance with good engineering practices, and the design and construction must be approved by the Commissioner NOTE: Approval of the design and construction of the well will be through the CERCLA process and approval of the Remedial Action Work Plan	Class V injection systems—**applicable**	TDEC 0400-45-06-.14(7)(a)
	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards		TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	No injection activity can allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of any primary drinking water standard, or other health-based standards, or may otherwise adversely affect the health of persons. This prohibition applies to well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity		TDEC 0400-45-06-.14(12)(a)1
Plugging and abandonment of all classes of injection wells	Any well that is to be permanently plugged and abandoned shall be completely filled and sealed in such a manner that vertical movement of fluid either into or between formation(s) containing USDWs through the borehole is not allowed	The injection well is no longer usable for its intended purpose or the well poses a potential threat to water quality or the well has not operated for 2 years (unless notice has been provided to the TDEC Commissioner and actions taken to ensure USDWs will not be endangered during period of temporary abandonment)—**applicable**	TDEC 0400-45-06-.09(6)(d)
	As a minimum, permanent seals must be placed in the borehole opposite (1) the lowermost confining bed, and (2) each intermediate confining bed between successive formation(s) containing USDWs		TDEC 0400-45-06-.09(6)(e)
	Seals intended to prevent vertical movement of water in a well borehole shall be composed of cement, sand-and-cement, or concrete or other sealing materials demonstrated to the satisfaction of the Commissioner to be effective. The minimum length of a seal shall be 20 ft		TDEC 0400-45-06-.09(6)(f) and (g)
	The borehole above the uppermost formation(s) containing a USDW shall be filled with materials less permeable than the surrounding undisturbed formations; the uppermost 5 ft of the borehole (at land surface) shall be filled with a material appropriate to the intended use of the land		TDEC 0400-45-06-.09(6)(h)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The materials used to fill spaces between well seals shall be filled with disinfected dimensionally stable materials, compacted mechanically if necessary to avoid later settlement except that cement, cement and sand, and concrete do not require disinfection. Disinfection of well-filling materials shall be accomplished by using chlorine compounds, such as sodium hypochlorite or calcium hypochlorite		TDEC 0400-45-06-.09(6)(i)
	Temporary bridges may be used to avoid having to fill very deep holes below the deepest point at which a permanent seal is required. Temporary bridges used to provide a base for a permanent seal shall consist of materials approved by the Commissioner		TDEC 0400-45-06-.09(6)(j)
	Approved sealing materials used in abandonment operations shall be introduced at the bottom of the well or interval to be sealed and placed progressively upward to the top of the well. All such sealing materials shall be placed in such a way as to avoid segregation or dilution of the sealing materials. Dumping sealing material from the top of the well shall not be allowed		TDEC 0400-45-06-.09(7)(a)
	Permanent seals shall be placed in wells or boreholes opposite confining beds between aquifers, which are identifiable as, or are suspected of being, hydraulically separated under natural, undisturbed conditions. After the required seal has been installed, the remainder of the confining zone between formations containing USDWs may be filled with sand, sand and gravel, or other rock material acceptable to the Commissioner		TDEC 0400-45-06-.09(7)(b)
	Management of secondary wastes from well development and rehabilitation or maintenance		
Characterization of solid waste	Must determine if waste is hazardous waste or if waste is excluded under TDEC 0400-12-01-.02(1)(d); and	Generation of solid waste as defined in TDEC 0400-12-01-.02(1)(b), and which is not excluded under TDEC 0400-12-01-.02(1)(d)(1)—**applicable**	40 CFR 262.11(a) and (b) TDEC 0400-12-01-.03(1)(b)(1) TDEC 0400-12-01-.03(1)(b)(2)
	Must determine if waste is listed under TDEC 0400-12-01-.02(4); or		40 CFR 262.11(c) TDEC 0400-12-01-.03(1)(b)(3)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used		40 CFR 262.11(d) TDEC 0400-12-01-.03(1)(b)(4)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Characterization of hazardous waste	If waste is determined to be hazardous, must refer to TDEC 0400-12-01-.02, .05, .06, .09, .10, and .12 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 CFR 262.11(e) TDEC 0400-12-01-.03(1)(b)(5)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 262.11(d)(2) TDEC 0400-12-01-.06(2)(d)(1)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 264.13(a)(1) TDEC 0400-12-01-.06(2)(d)(1)
	Must determine if the waste meets the treatment standards in subparagraphs (3)(a), (3)(f), or (3)(j) of TDEC 0400-12-01-.10 by testing in accordance with prescribed methods or use of generator knowledge of waste		40 CFR 268.7(a) TDEC 0400-12-01-.10(1)(g)(1)
	Must determine each EPA Hazardous Waste Number (waste code) to determine the applicable treatment standards under TDEC 0400-12-01-.10(3)		40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
	Must determine the underlying hazardous constituents (as defined in TDEC 0400-12-01-.10(1)(b)(10)) in the waste	Generation of RCRA characteristically hazardous waste (and is not D001 non-wastewaters treated by combustion, recovery of organics, or polymerization of subparagraph (3)(c) of TDEC 0400-12-01-.10) for storage, treatment, or disposal—**applicable**	40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
Management of hazardous waste onsite	A generator who treats, stores, or disposes of hazardous waste onsite must comply with the applicable (substantive) standards and requirements set forth in TDEC 0400-12-01-.05, .06, .07, and .09	Generation of RCRA hazardous waste for storage, treatment, or disposal onsite—**applicable** if secondary wastes are determined to be hazardous	40 CFR 262.10, Note 2 TDEC 0400-12-01-.03(1)(a)(2)(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of hazardous waste in containers onsite (satellite accumulation area)	A generator may accumulate as much as 55 gal of hazardous waste at or near any point of generation where wastes initially accumulate which is under the control of the operator of the process generating the waste, provided: • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition and does not leak, or immediately transfer and manage the waste in a central accumulation area operated in compliance with Part (g)2 or (h)1 of this paragraph • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be accumulated, so that the ability of the container to contain the waste is not impaired • A container holding hazardous waste must be closed at all times during accumulation, except when adding, removing, or consolidating waste: or, when temporary venting of a container is necessary for the proper operation of equipment or to prevent dangerous situations, such as build-up of extreme pressure • Container must be marked or labeled with the words "Hazardous Waste" and an indication of the hazards of the contents	Accumulation of 55 gal or less of RCRA hazardous waste at or near any point of generation—**applicable**	40 CFR 262.15(a)(1), (2), (4), and (5) TDEC 0400-12-01-.03(1)(f)(1)(i), (ii), (iv), and (v)
Temporary storage of hazardous waste in containers onsite (90-day storage area)	A generator may accumulate hazardous waste at the facility, provided: • The waste is placed in containers that comply with the air emission standards in TDEC 0400-12-01-.05(27), (28), and (29); • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition, or immediately manage the waste in some other way that complies with the conditions for exemption of this part; • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired;	Accumulation of RCRA hazardous waste onsite as defined in TDEC 0400-12-01-.01(2)(a)—**applicable**	40 CFR 262.17(a)(1)(i) through (iv) TDEC 0400-12-01-.03(1)(h)(1)(i)(I) through (IV)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• A container holding hazardous waste must always be closed during accumulation, except when it is necessary to add or remove waste. A container holding hazardous waste must not be opened, handled, or stored in a manner that may rupture the container or cause it to leak.		
	• Container must be marked or labeled with the words "Hazardous Waste," an indication of the hazards of the contents, and the date upon which each period of accumulation begins clearly visible for inspection on each container		40 CFR 262.17(a)(5)(i) TDEC 0400-12-01-.03(1)(h)(1)(v)(I)
Temporary storage of RCRA remediation waste in a staging pile	Must be located within the contiguous property under the control of the owner/operator where the wastes that are to be managed in the staging pile originated For purposes of this section, storage includes mixing, sizing, blending, or other similar physical operations so long as intended to prepare the wastes for subsequent management or treatment	Accumulation of non-flowing hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR 260.10—**applicable**	40 CFR 264.554(a)(1) TDEC 0400-12-01-.06(22)(e)1
	May be temporarily stored (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility provided the staging pile will be designed to:		40 CFR 264.554(d)(1) TDEC 0400-12-01-.06(22)(e)4(i)
	• Facilitate a reliable, effective, and protective remedy;		40 CFR 264.554(d)(1)(i) TDEC 0400-12-01-.06(22)(e)4(i)(I)
	• Prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer, as necessary, to protect human health and the environment (e.g., through the use of liners, covers, runon/runoff controls, as appropriate)		40 CFR 264.554(d)(1)(ii) TDEC 0400-12-01-.06(22)(e)4(i)(II)
Operation of a staging pile	Must not place ignitable or reactive waste in a staging pile unless the remediation waste has been treated, rendered, or mixed before placed in the staging pile so that: • The remediation waste no longer meets the definition of ignitable or reactive under 40 CFR 261.21 or 40 CFR 261.23; and	Storage of ignitable or reactive remediation waste in a staging pile—**applicable**	40 CFR 264.554(e)(1)(i) TDEC 0400-12-01-.06(22)(e)5(i)
	• One has complied with 40 CFR 264.17(b); or		40 CFR 264.554(e)(1)(ii) TDEC 0400-12-01-.06(22)(e)5(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Must manage the remediation waste to protect it from exposure to any material or condition that may cause it to ignite or react		40 CFR 264.554(e)(2) TDEC 0400-12-01-.06(22)(e)5(ii)
	Must not place incompatible wastes in same pile unless they comply with 40 CFR 264.17(b)	Storage of incompatible remediation waste in staging pile—**applicable**	40 CFR 264.554(f)(1) TDEC 0400-12-01-.06(22)(e)6(i)
	Incompatible wastes must be separated from any waste or nearby materials or must protect them from one another by using a dike, berm, wall, or other device		40 CFR 264.554(f)(2) TDEC 0400-12-01-.06(22)(e)6(ii)
	Must not pile remediation waste on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 274.17(b)		40 CFR 264.554(f)(3) TDEC 0400-12-01-.06(22)(e)6(iii)
Use and management of hazardous waste in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers—**applicable**	40 CFR 264.171 TDEC 0400-12-01-.06(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired		40 CFR 264.172 TDEC 0400-12-01-.06(9)(c)
	Container holding hazardous waste must always be kept closed during storage, except to add/remove waste		40 CFR 264.173(a) and (b) TDEC 0400-12-01-.06(9)(d)
	Container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak		
Operation of a RCRA container area	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or containers must be elevated or otherwise protected from contact with accumulated liquid	Storage in containers of RCRA hazardous waste that do not contain free liquids—**applicable**	40 CFR 264.175(c) TDEC 0400-12-01-.06(9)(f)(3)
Storage of RCRA hazardous waste with free liquids in containers	Area must have a containment system designed and operated in accordance with TDEC 0400-12-01-.06(9)(f)(2) as follows:	Storage of RCRA hazardous waste with free liquids or storage of waste codes F020, F021, F022, F023, F026, and F027 that do not contain free liquids in containers—**applicable**	40 CFR 264.175(a) and (d) TDEC 0400-12-01-.06(9)(f)(1)-(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	A base must underlie the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;		40 CFR 264.175(b)(1) TDEC 0400-12-01-.06(9)(f)(2)(i)
	Base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;		40 CFR 264.175(b)(2) TDEC 0400-12-01-.06(9)(f)(2)(ii)
	Must have sufficient capacity to contain 10% of the volume of containers or volume of largest container, whichever is greater;		40 CFR 264.175(b)(3) TDEC 0400-12-01-.06(9)(f)(2)(iii)
	Runon into the system must be prevented unless the collection system has sufficient capacity to contain any runon which might enter the system, along with the volume required for containers as listed immediately above; and		40 CFR 264.175(b)(4) TDEC 0400-12-01-.06(9)(f)(2)(iv)
	Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in as timely a manner as is necessary to prevent overflow of the collection system		40 CFR 264.175(b)(5) TDEC 0400-12-01-.06(9)(f)(2)(v)
Disposal of RCRA hazardous waste in a land-based unit	May be land-disposed only if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at TDEC 0400-12-01-.10(3)(a) before land disposal. The table lists either total waste standards, waste-extract standards, or technology-specific standards (as detailed further in TDEC 0400-12-01-.10(3)(c))	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted waste—**applicable**	40 CFR 268.40(a) TDEC 0400-12-01-.10(3)(a)
	Prior to land disposal, soil contaminated with hazardous waste must be treated to meet the applicable alternative treatment standards of TDEC 0400-12-01-.10(3)(j)(3) or according to the applicable Universal Treatment Standards in TDEC 0400-12-01-.10(3)(i) applicable to the listed hazardous waste and/or applicable characteristic of hazardous waste if the soil is characteristic	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted hazardous soils—**applicable**	40 CFR 268.49(b) TDEC 0400-12-01-.10(3)(j)(2)
Management of water generated from well development, rehabilitation, or maintenance	On-site wastewater treatment units that are part of a wastewater treatment facility subject to regulation under Section 402 or Section 307(b) of the CWA are exempt from the requirements of RCRA Subtitle C for all tank systems, conveyance systems (whether piped or trucked), and ancillary equipment used to store or transport RCRA-contaminated water	On-site wastewater treatment units subject to regulation under Section 402 or Section 307(b) of the CWA—**applicable** if water is determined to be hazardous	40 CFR 264.1(g)(6) 40 CFR 260.10 40 CFR 270.1(c)(2)(v) TDEC 0400-12-01-.06(1)(b)(2)(v) TDEC 0400-12-01-.01(2)(a) TDEC 0400-12-01-.07(1)(b)(4)(iv)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Management of PCB waste	Any person storing or disposing of PCB waste must do so in accordance with 40 CFR 761, Subpart D	Generation of waste containing PCBs at concentrations ≥ 50 parts per million—**applicable**	40 CFR 761.50(a)
	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found	Generation of PCB remediation waste as defined in 40 CFR 761.3—**applicable**	40 CFR 761.61
Temporary storage of PCB waste	Storage area must be clearly marked as required by 40 CFR 761.40(a)(10)	Storage of PCBs and PCB items at concentration ≥ 50 parts per million for disposal—**applicable**	40 CFR 761.65(c)(3)
	Container(s) shall be in accordance with requirements set forth in U.S. Department of Transportation Hazardous Materials Regulations at 49 CFR 171–180		40 CFR 761.65(c)(6)
Risk-based storage of PCB remediation waste	May store in a manner other than prescribed in 40 CFR 761.65 if application approved in writing by EPA Regional Administrator and EPA finds that the method will not pose an unreasonable risk of injury to [sic] human health or the environment Each application must include information described in 40 CFR 761.61(a)(3) NOTE: Appropriate substantive information required in an application is provided in CERCLA documents [e.g., feasibility study, Proposed Plan, Record of Decision, or post-Record of Decision documents] that are approved by EPA	Storage of PCB remediation waste (as defined in 40 CFR 761.3) prior to disposal—**applicable**	40 CFR 761.61(c)
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be nonleaking For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 CFR 761.65(b)(1)(ii); and	Storage of PCB/radioactive waste in containers other than those meeting U.S. Department of Transportation Hazardous Materials Regulations performance standards—**applicable**	40 CFR 761.65(c)(6)(i)(A) 40 CFR 761.65(c)(6(i)(B)
	For both liquid and nonliquid wastes, containers must meet all regulations and requirements pertaining to nuclear criticality safety		40 CFR 761.65(c)(6)(i)(C)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of PCB remediation waste in a waste pile	Waste must be placed in a pile that: • Is designed and operated to control dispersal by wind, where necessary, by means other than wetting; • Does not generate leachate through decomposition or other reactions;	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation—**applicable**	40 CFR 761.65(c)(9)(i) and (ii)
	• Is at a storage site with a liner designed, constructed, and installed to prevent any migration of wastes off or through liner into adjacent subsurface soil, groundwater, or surface water		40 CFR 761.65(c)(9)(iii)(A)
	Liner must be: • Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;		40 CFR 761.65(c)(9)(iii)(A)(1)
	• Placed on foundation or base capable of providing support to liner and resistance to pressure gradients above and below the liner to present failure because of settlement compression or uplift;		40 CFR 761.65 (c)(9)(iii)(A)(2)
	• Installed to cover all surrounding earth likely to be in contact with waste		40 CFR 761.65 (c)(9)(iii)(A)(3)
	Has a cover that meets the above requirements and is installed to cover all the stored waste likely to be contacted by precipitation, and is secured so as not to be functionally disabled by winds expected under normal weather conditions; and		40 CFR 761.65 (c)(9)(iii)(B)
	Has a runon control system designed, constructed, operated, and maintained such that it prevents flow on the stored waste during peak discharge from at least a 25-year storm, and collects and controls at least the water volume resulting from a 24-hr, 25-year storm		40 CFR 761.65 (c)(9)(iii)(C)(1) and (2)
	Requirements of 40 CFR 761.65(c)(9) of this part may be modified under the risk-based storage option of Section 761.61(c)		40 CFR 761.65(c)(9)(iv)
Disposal of containers of Toxic Substances Control Act of 1976 PCB wastes	Container(s) shall be marked as illustrated in 40 CFR 761.45(a)	Disposal of PCBs in chemical waste landfill—**applicable**	40 CFR 761.40(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Performance-based disposal of PCB remediation waste	Shall be disposed according to 40 CFR 761.60(a) or (e), or decontaminated in accordance with 40 CFR 761.79	Disposal of liquid PCB remediation waste—**applicable**	40 CFR 761.61(b)(1)
	May dispose by one of the following methods: • In a high-temperature incinerator approved under 40 CFR 761.70(b); • By an alternate disposal method approved under 40 CFR 761.60(e); • In a chemical waste landfill approved under 40 CFR 761.75; • In a facility with a coordinated approval issued under 40 CFR 761.77; or	Disposal of nonliquid PCB remediation waste [as defined in 40 CFR 761.3]—**applicable**	40 CFR 761.61(b)(2) 40 CFR 761.61(b)(2)(i)
	• Through decontamination in accordance with 40 CFR 761.79		40 CFR 761.61(b)(2)(ii)
Management of PCB/radioactive waste	Any person storing such waste ≥ 50 parts per million PCBs must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 CFR 761.65(a)(1), (b)(1)(ii) and (c)(6)(i)	Generation of PCB/radioactive waste for storage and disposal—**applicable**	40 CFR 761.50(b)(7)(i)
	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties in accordance with applicable requirements		40 CFR 761.50(b)(7)(ii)
	If, after taking into account only the PCB properties in the waste, the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a state as a municipal or non-municipal non-hazardous waste landfill, then the person may dispose of such waste without regard to the PCBs, based on its radioactive properties alone		40 CFR 761.50(b)(7)(ii)
Characterization of low-level waste (e.g., wastewater, contaminated personal protective equipment)	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance criteria of the receiving facility	Generation of low-level waste for storage and disposal at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(I)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste: • physical and chemical characteristics • volume, including the waste and any stabilization or absorbent media • weight of the container and contents • identities, activities, and concentrations of major radionuclides • characterization date • generating source		DOE Manual 435.1-1(IV)(I)(2)
Temporary storage of low-level waste	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water	Management of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure		DOE Manual 435.1-1(IV)(N)(3)
	Shall be managed to identify and segregate low-level waste from mixed waste		DOE Manual 435.1-1(IV)(N)(6)
	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container	Storage of low-level waste in containers at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(L)(1)(a)
	Vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container		DOE Manual 435.1-1(IV)(L)(1)(b)
Packaging of low-level waste for disposal	Must not be packaged for disposal in cardboard or fiberboard boxes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(1)
	Must be solidified or packaged in sufficient absorbent material to absorb twice the volume of liquid	Generation of liquid low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume	Generation of solid low-level waste containing liquid for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(3)
	Must not be capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures or of explosive reaction with water	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(4)
	Must not contain, or be capable of, generating quantities of toxic gases, vapor, or fumes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(5)
	Must not be pyrophoric	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(6)
	Must have structural stability either by processing the waste or placing the waste in a container or structure that provides stability after disposal	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(1)
	Must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form	Generation of liquid low-level waste or low-level waste containing liquids for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(2)
	Void spaces within the waste and between the waste and its package must be reduced to the extent practicable	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Disposal of low-level waste	Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility	Generation for disposal of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(J)(2)

ARAP = aquatic resource alteration permit
ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = Code of Federal Regulations
CWA = Clean Water Act of 1972
DOE = U.S. Department of Energy
DOI = U.S. Department of Interior
EPA = U.S. Environmental Protection Agency
MCL = maximum contaminant level
MOA = Memorandum of Agreement
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
ORR = Oak Ridge Reservation
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act of 1976
SDWA = Safe Drinking Water Act of 1974
TBC = to be considered
TDEC = Tennessee Department of Environment and Conservation
USDW = underground source of drinking water

action identifies Tennessee groundwater criteria as chemical-specific applicable requirements and the SDWA MCLs as chemical-specific relevant and appropriate requirements because they are still well suited to establishing remedial goals for groundwater. Because this is an interim action, however, DOE is invoking a waiver from these ARARs under CERCLA Section 121(d)(4)A), 42 United States Code Section 9621(d)(4)(A), which allows for remedial actions to be selected that will not attain ARARs, if the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed (commonly called the interim action waiver).

A1.2. Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., wetlands, floodplains, critical habitats, historic districts, and streams).

A1.2.1. Wetlands and Floodplains

Certain wetlands and floodplains (e.g., adjacent to East Fork Poplar Creek) could potentially be impacted by remediation activities. In accordance with Executive Order 11990 and 10 CFR 1022, remedial actions must avoid, to the extent possible, long- and short-term adverse impacts to wetlands and floodplains. Mitigation measures listed in 10 CFR 1022.12, which include minimum grading requirements, runoff controls, and design and construction constraints, would need to be implemented to restore and preserve the beneficial values of the wetlands and floodplains. Portions of the K-1407-B groundwater plume are located in the 100-year floodplain.

A1.2.2. Cultural Resources

In December 2014, Congress passed the National Defense Authorization Act of 2015 (NDAA), which included provisions authorizing the Manhattan Project National Historic Park to be located at three sites: Oak Ridge, Tennessee; Hanford, Washington; and Los Alamos, New Mexico. President Obama signed the NDAA into law on December 19, 2014. On November 10, 2015, Secretary of the Interior Sally Jewell and Secretary of Energy Ernest Moniz signed the Memorandum of Agreement between the two agencies defining the respective roles in creating and managing the park. The agreement included provisions for enhanced public access, management, interpretation, and historic preservation. With the signing, the Manhattan Project National Historic Park was officially established. The park includes five different buildings/sites at Oak Ridge, including the K-25 building site at the East Tennessee Technology Park (ETTP), the X-10 Graphite Reactor at the Oak Ridge National Laboratory, Buildings 9731 and 9204-3 at the Y-12 National Security Complex, and the former Guest House in downtown Oak Ridge. If any of the actions impact the K-25 building site at ETTP, either directly or indirectly, the requirements identified under the NDAA and Memorandum of Agreement may provide ARARs or TBC guidance.

A1.3. Action-Specific Applicable or Relevant and Appropriate Requirements

Performance-, design-, or action-specific requirements set controls or restrictions on particular kinds of activities. All actions of the selected remedy involve in situ activities to address groundwater.

A1.3.1. Groundwater Remediation and Monitoring Wells

The selected remedy involves the action of injecting treatment reagents. These actions will trigger ARARs from the underground injection controls regulations at TDEC 0400-45-06 (TDEC 2014) for the construction, operation, plugging, and abandonment of injection wells. Monitoring well construction will follow standard monitoring well construction techniques, which are reflected in the Resource Conservation

and Recovery Act of 1976 (RCRA) general monitoring well requirements that have been included as relevant and appropriate. Plugging and abandoning any monitoring well will require the well to be filled and sealed in accordance with the provisions listed in Tennessee Well Construction standards at TDEC 0400-45-09 (TDEC 2015). The only wastes from the enhanced in situ bioremediation remedy will be the secondary wastes from well development and rehabilitation or maintenance. Such secondary wastes may contain polychlorinated biphenyls above regulatory levels. Toxic Substances Control Act of 1976 requirements for managing polychlorinated biphenyls remediation wastes have been included as ARARs in Table A.2. In areas where groundwater may carry the listed wastes codes, a contained-in determination is anticipated to be requested, as in the past for these wastes. It is also possible secondary wastes could be RCRA characteristic. If secondary wastes are RCRA characteristic or there is some time between generation to the contained-in determination for listed wastes, the RCRA provisions for characterization and storage have been included as ARARs in Table A.2. Based on previous sampling of existing and historical wells, it is possible some waste may be low-level waste. Relevant provision of DOE Manual 435.1 for characterizing and temporarily storing LLW has been included as TBC along with the low-level waste packaging provisions from TDEC 0400-20-11-.17(7) as relevant and appropriate in Table A.2.

A2. REFERENCES

40 Code of Federal Regulations 300, et seq. *National Oil and Hazardous Substances Pollution Contingency Plan*, 1990, U.S. Environmental Protection Agency, Washington, D.C.

42 United States Code Chapter 103, 9621(d)(4)(A). *Comprehensive Environmental Response, Compensation, and Liability Subchapter 1 – Hazardous Substances Releases, Liability, Compensation, Cleanup Standards*.

DOE/OR/01-2894&D2. *East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee*, 2022, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

EPA 1989. *CERCLA Compliance with Other Laws Manual*, EPA/540/G-89/009, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

TDEC 2014. Chapter 0400-45-06, *Underground Injection Control*, Rules of the Tennessee Department of Environment and Conservation, Division of Water Supply, 2014, Tennessee Department of Environment and Conservation, Nashville, TN.

TDEC 2015. Chapter 0400-45-09, *Water Well Licensing Regulations and Well Construction Standards*, Rules of the Tennessee Department of Environment and Conservation, Division of Water Resources, 2015, Tennessee Department of Environment and Conservation, Nashville, TN.

TDEC 2019. Chapter 0400-40-03, *General Water Quality Criteria*, Rule 0400-40-03-.03, "Criteria for Water Uses," and Rule 0400-40-03-.07, "Ground Water Classification," Rules of the Tennessee Department of Environment and Conservation, 2019, Tennessee Department of Environment and Conservation, Nashville, TN.

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United Cleanup Oak Ridge LLC

Comment Resolution Form

Document Number:	Document Title:	
DOE/OR/01-2949&D1	*Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee*	
Name of Reviewer:	**Organization:**	**Date Comments Transmitted:**
Randy Young	Tennessee Department of Environment and Conservation	10/19/2023

Comment No.	Sect./Page	Comment	Response
		General	
1.		Provide additional detail and specificity regarding applicable or relevant and appropriate requirements (ARARs) [including those intended to be waived during this event] within the ARAR table (Table A.1. Numeric criteria for ORR groundwater) located in section A1.1. Please include: a. Revisions to the numerical criteria table as requested/recommended in these provided comments. (See the specific comments below). b. Inclusion of the ARARs that are expected to be relevant to the selected remedy during construction, operation, and management, such as industrial derived waste (IDW) waste management ARARs, monitoring well construction ARARs and injection well ARARs.	Agree. This information has been provided in response to specific comments below.
2.		Land Use Controls (LUCs) directly applicable to this groundwater IROD and the selected remedy should be clearly defined in this IROD. Where overlap or redundancy of LUC requirements may occur from multiple RODs addressing the same area on this site, the FFA/Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) record should clearly designate which LUC requirements are correlated with which IROD. This IROD is a great first step in our ongoing goal to manage groundwater at ETTP and across the reservation in accordance with all state and federal requirements.	Agree. Section 2.9.5 has been revised, including Table 2.5. The revised section and table are attached to the end of this comment resolution form.
3.		**Final ROD vs. ROD(s*)*** DOE reiterates throughout this document the intent is that this Interim ROD will be followed by a "Final	Agree. Where the term 'final ROD' is used in the document, "(or RODs)" has been added after it.

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		ROD." It is not our agreement that the next document will necessarily be a final ROD. Whether the document is another Interim ROD or Final ROD will be guided by the work scope completed and the additional data collected in the follow-on work that remains for the MPA. Please replace "Final ROD" where referenced throughout this document with "Final ROD(s)".	
4.		**Clarification of approved or unapproved documents** In all places where documents are listed, please clearly identify those documents as "approved" or "unapproved" by the FFA tri-parties.	Clarification. The following text has been added as the last paragraph of Section 2.1: "DOE has completed numerous CERCLA documents to support information presented in this MPA IROD and has submitted those documents to EPA and TDEC for review. With the exception of the *Remedial Investigation Report for the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-1778&D1; 1999 Remedial Investigation [RI]); the *Final Sitewide Remedial Investigation and Feasibility Study for East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2279&D3; 2007 Sitewide RI); and the *East Tennessee Technology Park Main Plant Groundwater Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2835&D1; MPA FS), all other CERCLA documents cited in this MPA IROD have been approved by EPA and TDEC. Any use of information from those unapproved documents in this MPA IROD is considered appropriate and accurate."
5.		**Clarification for the "prohibition of groundwater use" text** For all areas where "prohibition of groundwater" use is discussed, please expand the statement to state "prohibits groundwater use, extraction, consumption, and exposure" to be consistent with the	Agree. The U.S. Department of Energy has added a footnote to Table 2.5, as follows. The footnote will be carried over into the East Tennessee Technology Park

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		tri-party approved language in the final Covenant Deferral Requests (CDRs) for this area.	Remedial Action Report Comprehensive Monitoring Plan upon Record of Decision approval. "Consistent with language in the quitclaim deeds for property transfer, the prohibition of groundwater use includes the prohibition of any groundwater use, extraction, consumption, and exposure without prior written approval of DOE, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation." In addition, wherever the land use control plan that prohibits groundwater use is used in the document, the more specific language has been incorporated.
6.		**Vinyl Chloride (VC)** Vinyl Chloride (VC) is intended to be considered in this work scope; however, VC is left out of the descriptions in areas where it may exist in proximity to this IROD's six areas of concern. Please ensure the VC component of this treatment remedy and its 400 ug/L goal is included where appropriate.	Agree. Text stating "(or 400 µg/L for VC)" or similar has been added as appropriate.
Specific			
1.	Section 1.2 Statement of Basis and Purpose, 3rd paragraph, Page 1-3	Please revise the sentence that states "land use restrictions are in place until a final ROD(s) for the MPA is in place" to state that land use restrictions are in place "until groundwater is restored to beneficial use and the RAOs are met."	Clarification. In response to U.S. Environmental Protection Agency specific comment 1, the subject text has been revised to: "The selected remedy is an interim remedy, and land use restrictions will be required until groundwater contamination concentrations are below federal and state maximum contaminant levels (MCLs) and Tennessee groundwater quality criteria and the remedy is protective for all uses."

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2.	Section 2.6 Current and Potential Future Land and Resource Uses, 4th paragraph, Page 2-32	The vapor intrusion (VI) language in the CDRs varies between the CDRs depending on which Exposure Unit(s) the CDRs covered. Please propose new language that will capture all the VI requirements for the ETTP MPA.	Agree. The current vapor intrusion language included in the deeds for property transfers, agreed to by the tri-parties, has been added to Section 2.6 as follows: "Portions of the ETTP MPA have been or will be leased or transferred for reindustrialization. In all cases, the transfer deeds transfer the property but prevent groundwater use at the site and require actions to ensure indirect exposures via vapor intrusion are mitigated. Vapor intrusion LUC implementation is outlined in the specific property transfer deed covenants."
3.	Section 2.9.5 Common Components of Alternatives, LUCs, Page 2-44	As specified in the ORR Land Use Control Assurance Plan (LUCAP), when a remedial action that includes LUCs is selected for an area, a Land Use Control Implementation Plan (LUCIP) must be developed. Once the LUCIP has been developed and approved, the LUCs can be rolled into the ETTP Remedial Action Report (RAR) Comprehensive Monitoring Plan (CMP). The ETTP RAR CMP is the document that compiles all the LUCs for the different decision documents for ETTP. Please revise this section as follows: • Remove the sentences that states "LUCs will be implemented in accordance with the ETTP RAR CMP, which includes the LUC Implementation Plan …and includes the following applicable LUCs (Table 2.5):" • Replace those sentences with the following sentences: *"A LUCIP will be developed in accordance with the ORR LUCAP, will be included as an appendix to the RDWP, and will specify how the DOE will implement, maintain, and monitor the LUC elements of this remedy. The following LUCs are included as part of the MPA selected interim groundwater remedy."*	Clarification. The Federal Facility Agreement tri-party agreed to create the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan (DOE/OR/01-2477&D4), which serves as the East Tennessee Technology Park Land Use Control Implementation Plan, for the purpose of providing a centralized location for land use control implementation to be described and updated. This document was designated a Remedial Action Report with the intention of ensuring it was a primary Federal Facility Agreement document for regulatory review and approval. The East Tennessee Technology Park Land Use Control Implementation Plan will be updated with the land use controls in this Main Plant Area Interim Record of Decision. The U.S. Department of Energy will meet with the Project Team to clarify the purpose and benefits of the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan, understand the Tennessee Department of Environment and Conservation's concerns about the level of detail in the East Tennessee Technology Park Remedial Action Report

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		• Follow these two sentences with a list of the LUCs associated with the MPA selected interim groundwater remedy and include a description, their objectives, and the conditions of their use per the ORR LUCAP section 2.5.	Comprehensive Monitoring Plan/Land Use Control Implementation Plan, and discuss how the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan should be revised to address the Tennessee Department of Environment and Conservation's concerns. This includes clarifying which areas the specific land use controls apply to and which regulatory documents provide the basis for these land use controls. The text discussing the Land Use Control Implementation Plan has been revised for clarification. Revised Section 2.9.5 and revised Table 2.5 are included at the end of this comment resolution form.
4.	Section 2.9.5, Common Components of Alternatives, LUCs, Page 2-44, Table 2.5 LUCs for MPA in place during preferred alternative	The generic ETTP RAR CMP LUC table appearing as Table D.1 in the East Tennessee Technology Park Administrative Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee, DOE/OR/01-2477&D4 seems to have been duplicated in this ROD document as Table 2.5. Using this table is not suitable for documenting the specific LUCs associated with this Main Plant Area selected groundwater remedy, because it is not specifically tailored to the selected remedy. Please revise Table 2.5 to be specific to the LUCs associated with the MPA selected interim groundwater remedy (for example, there are references to Waste Management Area (WMA) and Zone 1 in Table 2.5, neither of which apply to the MPA area). Given the reliance on land use controls within the scope of this IROD and the importance of those controls to protect human health in the area, TDEC expects to work closely with DOE to develop land use control language which represents TDEC interests regarding long-term land use control commitments.	Agree. Table 2.5 has been revised to be more specific to the land use controls associated with the interim groundwater remedy. Revised Section 2.9.5 and revised Table 2.5 are included at the end of this comment resolution form.
5.	Section 2.2 Site History and	This statement reads "All of the buildings at ETTP have been demolished under CERCLA removal authority." This is not completely correct. Certain buildings are still standing. Suggest	Agree. The text has been revised as suggested:

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	Enforcement Activities, First paragraph after bullets, Page 2-4	revision of the sentence. Consider "All of the buildings at ETTP under CERCLA removal authority have been demolished," if that is accurate.	"All the buildings at ETTP under CERCLA removal authority have been demolished."
6.	Figure 2.3 Average Potentiometric Surface for MPA ETTP, Page 2-14	As consistently requested by TDEC, please provide the date range that was used to construct the average potentiometric surface map.	Agree. The Figure 2.3 caption has been revised as follows: "Figure 2.3. Average potentiometric surface for MPA of ETTP (average of all data between 1985 and 2023)." Revised Figure 2.3 is included at the end of this comment resolution form.
7.	Section 2.5.1.4 COCs, Page 2-15	Please revise the sentence "There are also additional COCs (e.g., chromium in the Mitchell Branch area, and other potential COCs detected in the plume source areas) that are not being directly addressed by this interim action" to state "There are also additional COCs including, but not limited to, metals, radionuclides, and inorganics, that are not being directly addressed by this interim action".	Agree. The text has been revised as suggested: "There are also additional COCs including, but not limited to, metals, radionuclides, and inorganics, that are not being directly addressed by this interim action."
8.	Section 2.6 Current and Potential Future Land and Resource Uses, second paragraph, Page 2-32	Please revise the sentence "The State of Tennessee designates groundwater at ETTP as general use, per State of Tennessee Water Quality Criteria General Use Ground Water (0400-40-03-.07(4)(b) requirements; however, currently, there are prohibitions against groundwater use at ETTP" to state "The State of Tennessee designates groundwater at ETTP as general use, per State of Tennessee Water Quality Criteria General Use Ground Water (0400-40-03-.07(4)(b) requirements." Strike the "however…." text.	Agree. The last portion of the sentence has been deleted as suggested.
9.	Section 2.6 Current and Potential	Please revise the last sentence to state: "The goal will remain in place until groundwater is cleaned up to meet State and Federal	Agree. The text has been revised as suggested: "The goal will remain in place until groundwater is restored to meet state and federal numerical criteria

<table>
<tr><th>Comment No.</th><th>Sect./Page</th><th>Comment</th><th>Response</th></tr>
<tr><td></td><td>Future Land and Resource Uses, third paragraph, Page 2-32</td><td>numerical criteria or until such time in the future that an ARAR waiver may be requested and granted.”</td><td>or until such time in the future that an ARAR waiver is granted.”</td></tr>
<tr><td>10.</td><td>Section A1.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements, Table A.1. Numerical criteria for ORR groundwater (mg/L or parts per million), Page A-5</td><td>TDEC recommends revision of the Numeric Criteria Table to better represent the numerical criteria for the site based on the defined ARARs, and the selection basis for the values selected.

Please revise Table A.1 to emulate the formatting example and information in the table presented below for the Contaminants of Concern (COCs) currently listed in Table A.1.

A general format example is shown below that has been used by TDEC in the past and is included for consideration. This alternate formatting is intended to make clearer the selection of the numerical criteria associated with this IROD and to help address the excessive footnotes on the current Table 2.5 and Table A.1 portions of this document.

Numeric Criteria for K31/33 Area Groundwater (draft example)
<table>
<tr><th>Chemical of Concern</th><th>TDEC 0400-40-03 General Water | Quality Rule ug/L</th><th>TDEC DW MCLs 0400-45-01-.06 and 0400-45-01-.25 ug/L</th><th>SDWA EPA MCLs</th><th>EPA RSLs if no MCL available</th><th>Remediation goal</th><th>Selection basis</th></tr>
<tr><td>Gross alpha</td><td></td><td></td><td>15 pCi/L</td><td></td><td>15pCi/L</td><td>EPA- SDWA</td></tr>
<tr><td>antimony</td><td>6</td><td>6</td><td>6</td><td></td><td>6</td><td>EPA- SDWA & TDEC</td></tr>
<tr><td>arsenic</td><td>10</td><td>10</td><td>10</td><td></td><td>10</td><td>EPA – SDWA & TDEC</td></tr>
<tr><td>lead</td><td>5</td><td></td><td>.015 TT5actio n level</td><td></td><td>5</td><td>TDEC 0400-40-03</td></tr>
<tr><td>nickel</td><td>100</td><td>100</td><td></td><td></td><td>100</td><td>TDEC 0400-40-03 and 0400-45-01</td></tr>
</table></td><td>Agree. Table A.1 has been revised to address this comment. Details provided in the revised table are functionally equivalent to the example provided by the Tennessee Department of Environment and Conservation. Revised Table A.1 is included at the end of this comment resolution form.</td></tr>
</table>

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		Include footnotes as appropriate.	
11.	Section A1.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements, Table A.1. Numerical criteria for ORR groundwater (mg/L or parts per million), Page A-5	Uranium is not currently listed in the existing table, please include uranium and all currently known COCs in the A.1 table.	Agree. Table A.1 has been revised to include uranium. Revised Table A.1 is included at the end of this comment resolution form.
12.	Section 2.12.2, Summary of Rationale for Preferred Alternative, p. 2-63. ARAR waiver vs ARAR compliance	DOE states the remedy complies with ARARs (because it is using an ARAR waiver). Please revise the statement to read "because the remedial action is utilizing an ARAR waiver under CERCLA 121(d), it does not comply with ARARs."	Clarification. This sentence in Section 2.12.1 has been revised as follows: "The selected remedy meets the interim remedial action objective target performance metric identified for the interim action; complies with ARARs except for those chemical-specific ARARs being waived under the interim action waiver; uses active treatment to address principal threat materials; and accounts for the best balance of all criteria presented in the comparative analysis of alternatives."
13.	Section A1.1 Chemical-Specific Applicable or Relevant and Appropriate	TDEC recommends including the following Text in table A.1 on page A-6 under the 2nd listing for "Remediation of contaminated groundwater" under the Chemical-specific section:	Please see page 14 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The recommended text has been added to the subject section of Table A.2. In addition, these additional chemical-specific requirements will be included in the

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	Requirements, Table A.2. page A-6		interim waiver. Revised Table A.2 is included at the end of this comment resolution form.
14.	Section A1.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-6	TDEC recommends including the specific numerical criteria associated with any COCs identified in this IROD scope into the table. For example, include in the table a statement such as:	Please see page 14 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The recommended text has been added to Table A.2, which is included at the end of this comment resolution form.
15.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-14	Under header: Site preparation, construction, and excavation activities, TDEC recommends including:	Please see page 14 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The current substantive stormwater runoff control requirements of Tennessee General Permit TNR10-0000 have been included as to-be-considered criteria (similar entry to that included in the Environmental Management Disposal Facility Record of Decision [DOE/OR/01-2794&D2/R2]) in Table A.2, which is included at the end of this comment resolution form.
16.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-14	Under header: Groundwater Monitoring activities, TDEC recommends including the following in addition to the To Be Considered (TBC) Specifications already listed	Please see page 15 of this comment resolution form to view the table/recommendation referenced in this comment. Agree. The Resource Conservation and Recovery Act of 1976 general monitoring well construction requirements have been added as relevant and appropriate because they reflect the methods currently being followed in groundwater monitoring well installation and are consistent with the United Cleanup Oak Ridge LLC Standard cited as to-be-considered critiera. Revised

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			Table A.2 is included at the end of this comment resolution form.
17.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-14, A-15, A-16, A-17	Under header: Groundwater Monitoring activities. While page A-14, A-15, A-16, and A-17 do address some Action Specific ARARs for Groundwater Monitoring Activities, TDEC recommends that Groundwater Monitoring ARARs be split out from the Injection Well ARARs in this table for clarity.	Agree. The requested change has been incorporated into Table A.2, which is included at the end of this comment resolution form.
18.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-15	Under header: Groundwater Monitoring activities – Reinjection of contaminated groundwater amended with treatment reagents, TDEC recommends including the following for Injection Well ARARs:	Please see page 15 of this comment resolution form to view the table/recommendation referenced in this comment. Agree. The applicable or relevant and appropriate requirements already contain Tennessee Department of Environment and Conservation 0400-45-06-.14(1)(b). The suggested additional requirement for Class V wells in Tennessee Department of Environment and Conservation 0400-45-06-.14(12)(a)(1) has been added to Table A.2, which is consistent with the exisiting applicable or relevant and appropriate requirement. Revised Table A.2 is included at the end of this comment resolution form.
19.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements,	Under header: Groundwater Monitoring activities – Construction, Operation and Monitoring Standards for Class V Injection wells, TDEC recommends including:	Please see page 16 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The Class V injection well requirement in Tennessee Department of Environment and Conservation 0400-45-06-.14(7)(a) has been added to Table A.2, with a note specifiying approval of the design and construction

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	Table A.2, page A-14/15		of the well will be through the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 process and approval of the Remedial Action Work Plan. Revised Table A.2 is included at the end of this comment resolution form. Disagree. The requirement in Tennessee Department of Environment and Conservation 0400-45-06-.14(9)(a) and (b) states: *The Commissioner may require monitoring of Class V injection wells; the nature of which will be determined by the type of well, nature of the injected fluid, and water quality of the receiving aquifer. The Commissioner shall determine the extent and frequency of monitoring based on the type of injection well and the nature of the injected fluid*. There is no substantive requirement in this regulation that would qualify as an applicable or relevant and appropriate requirement.
20.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-17	It is unclear what ARARs will correlate to waste characterization for the contaminated media and debris that may be generated during this action. Waste management for excavated soils, drill cuttings, waste waters and spent treatment materials etc. should also be addressed where appropriate for this selected remedy. These ARARS may include staging of contaminated waters, alternate dispersal of fluids etc. Please provide the appropriate ARARs for waste management associated with this selected remedy. Potentially relevant citations may include but are not limited to: • Rules of the Tennessee Department of Environment and Conservation Division of Solid / Hazardous Waste Management previously listed as 1200-02-11 – now renumbered as 0400-12-01-(.01) through (.12) where appropriate. • 40 CFR 261, 40 CFR 262, 40 CFR 264, 40 CFR 265,	Please see response to specific comment 21.

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		40 CFR 268, 40 CFR 761 etc. • DOE M 435.1-1	
21.	Section A1.1 Action Specific Applicable or Relevant and Appropriate Requirements, Table A.2, page A-17	Please see the IDW and Waste Management ARARs taken from the Record of Decision for Soil, Buried Waste and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge TN DOE/OR/01-2161&D2. These are provided for discussion and recommended potential inclusion in this IROD ARAR table:	Please see page 16 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The only wastes from the enhanced in situ bioremediation remedy will be the secondary wastes from well development and rehabilitation or maintenance. Such secondary wastes may contain Resource Conservation and Recovery Act of 1976 characteristic waste or contain polychlorinated biphenyls. Based on previous sampling of existing and historical wells, there is also the possibility some waste may be low-level waste. In areas where groundwater may carry the listed wastes codes, a contained-in determination is anticipated to be requested; however, there could be some time between generation and the contained-in determination when the wastewater may need to be stored in accordance with the Resource Conservation and Recovery Act of 1976 hazardous waste regulations. The Resource Conservation and Recovery Act of 1976 provisions as requested will be added to the Appendix A applicable or relevant and appropriate requirements. Based on the above, the Main Plant Area Interim Record of Decision applicable or relevant and appropriate requirements were amended to add: • Resource Conservation and Recovery Act of 1976 characterization, storage, and land disposal restriction requirements (similar entries to those included in the Environmental Management Disposal Facility Record of Decision [DOE/OR/01-2794&D2/R2]).

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			• The Toxic Substances Control Act of 1976 polychlorinated biphenyl storage and disposal requirements. • The low-level waste characterization, packaging, and temporary storage requirements from U.S. Department of Energy Manual 435.1 as to-be-considered criteria. • The low-level waste packaging requirements from Tennessee Department of Environment and Conservation 0400-20-11-.17(7)(b)(1) and (3) as relevant and appropriate. Revised Table A.2 is included at the end of this comment resolution form.

For ease of viewing, please see the following table attached in reference to comment #13:

The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man or animals, or impair the safety of conventionally treated water supplies. Available references include, but are not limited to: Quality Criteria for Water (Section 304(a) of Public Law 92-500 as amended); Federal Regulations under Section 307 of Public Law 92-500 as amended; and Federal Regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act, (Public Law 93-523).			TDEC 0400-40-03-.03(1)(j)	All groundwater alternatives
The waters shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply.			TDEC 0400-40-03-.03(1)(k)	All groundwater alternatives

For ease of viewing, please see the following tables attached in reference to comment #14:

	Shall not exceed the Safe Drinking Water Act National Primary Drinking Water Regulations MCLs for *inorganic* site related contaminants of concern, specified in 40 Code of Federal Regulations (CFR) 141.62(b), or criteria specified in TDEC 0400-40-03.03. Inorganic Contaminants of Concern: • Lead – 5 µg/L	Class GU ground waters which are an existing or potential drinking water source - **applicable**	TDEC 0400-45-01-.06(1)(b) 40 CFR 141.62(b)	All groundwater alternatives
	Shall not exceed the Safe Drinking Water Act National Primary Drinking Water Regulations MCLs for *organic and volatile organic* site related contaminants of concern, specified in 40 CFR 141.61 Organic/Volatile Organic Contaminants of Concern: • Trichloroethylene - 5 µg/L • 1,2-Dichloroethane - 5 µg/L • Benzene - 5 µg/L • 1,1 Dichloroethylene 7 µg/L • 1,1,1-Trichloroethane - 200 µg/L • cis 1,2-Dichloroethylene - 70 µg/L • Tetrachloroethylene - 5 µg/L		TDEC 0400-45-01-.06(2)(a) TDEC 0400-45-01-.25(2) 40 CFR 141.61	All groundwater alternatives

For ease of viewing, please see the following tables attached in reference to comment #15:

Activities causing storm water runoff (*e.g.*, clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion controls, vegetative controls, and structural controls) in accordance with the substantive requirements of *General Permit No. TNR100000* to ensure that storm water discharge:	Dewatering or storm water runoff discharges from land disturbed by construction activity— disturbance of ≥1 acre of total land —**applicable**	40 CFR §122.26(c)(1)(ii)(C) and (D) Tennessee Water Quality Control Act (TCA) 69-3-108(j) TDEC 0400-40-10-.03(2)	All Alternatives

Comment 15 (cont.). Recommended additions to the ARAR table are continued here:

Action	Requirements	Prerequisite	Citation(s)	Remedial Alternative
Activities causing storm water runoff (e.g., clearing, grading, excavation)	Design, install and maintain effective erosion prevention and sediment controls to minimize the discharge of pollutants. At a minimum, such controls must be designed, installed and maintained to: (1) Control stormwater volume and velocity to minimize soil erosion in order to minimize pollutant discharges; (2) Control stormwater discharges, including both peak flowrates and total stormwater volume, to minimize channel and streambank erosion and scour in the immediate vicinity of discharge points; (3) Minimize the amount of soil exposed during construction activity; (4) Minimize the disturbance of steep slopes; (5) Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site; (6) Provide and maintain natural buffers as described in Section 4.1.2, direct stormwater to vegetated areas and maximize stormwater infiltration to reduce pollutant discharges, unless infeasible; (7) Minimize soil compaction. Minimizing soil compaction is not required where the intended function of a specific area of the site dictates that it be compacted; and (8) Unless infeasible, preserve topsoil. Preserving topsoil is not required where the intended function of a specific area of the site dictates that the topsoil be disturbed or removed.	Storm water discharges from construction activities –TBC	General Permit No. TNR100000 Section 4.1.1(1)-(8)	All Alternatives

For ease of viewing, please see the following tables attached in reference to comment #16:

Construction of groundwater monitoring well	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well bore hole; this casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples; the annular space above the sampling depth must be sealed to prevent contamination of samples and the groundwater.	Construction of Resource Conservation and Recovery Act (RCRA) groundwater monitoring well—relevant and appropriate	40 CFR §264.97(c) TDEC 0400-12-01-.06(6)(h)3	All Alternatives

For ease of viewing, please see the following tables attached in reference to comment #18:

Injection of nutrients (or other treatments) into groundwater	The use of any Class V injection well in such a manner as to cause any underground source of drinking water (USDW) to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions which violate primary drinking water standards as given in Chapter 0400-45-01 or adversely affect the health of persons is prohibited. Per 0400-45-06-.02 (3): "Injection well" means structure or device which is used for the emplacement of fluids into a subsurface stratum including, but not limited to: (a) a well used for the emplacement of fluids; (b) a subsurface fluid distribution system; (c) an improved sinkhole; or (d) infiltration cell and any other structures or devices designed, constructed or used to emplace fluids into the subsurface, except as provided in paragraph (3) of Rule 0400-45-06-.03; or (e) modified recharge point.	Class V "injection well" associated with remedial activity and/or innovative or experimental technologies as defined in TDEC 0400-45-06-.06(5)—applicable	TDEC 0400-45-06-.14(1)(b)
	No injection activity can allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of any primary drinking water standard, or other health based standards, or may otherwise adversely affect the health of persons. This prohibition applies to well construction, operation, maintenance, conversion, plugging, closure or any other injection activity.		TDEC 0400-45-06-.14(12)(a)1

For ease of viewing, please see the following tables attached in reference to comment #19:

Construction Standards for Class V injection wells	The variety of Class V well and their uses dictate a variety of construction designs consistent with those uses and precludes specific construction standards. However, a well must be designed and constructed for its intended use, in accordance with good engineering practices, and the design and construction must be approved by the Commissioner. Class V wells shall be constructed so that their intended use does not violate the water quality standards.	Construction of Class V injection wells – applicable	TDEC 0400-45-06-.14(7)(a) and (b)
Operating Requirements for Class V injection wells	All Class V injection wells shall be operated in such a manner that they do not violate the provisions of TDEC 0400-45-06-.14(1) [i.e., prohibition against using UIC well in such a manner as to cause USDW to contain substances that are toxic, carcinogenic, mutagenic, or teratogenic at levels and conditions which violate primary drinking water standards].	Operation of Class V injection wells – applicable	TDEC 0400-45-06-.14(8)(a)
Monitoring Requirements for Class V Injection Systems	The Commissioner may require monitoring of Class V injection wells; the nature of which will be determined by the type of well, nature of the injected fluid, and water quality of the receiving aquifer. The Commissioner shall determine the extent and frequency of monitoring based on the type of injection well and the nature of the injected fluid. Note: Monitoring of any injection wells will be conducted pursuant to a CERCLA Remedial Design or Remedial Action Work Plan after review by TDEC and approval by the EPA.	Monitoring of Class V injection wells – applicable	TDEC 0400-45-06-.14(9)(a) and (b)

For ease of viewing, please see the following tables attached in reference to comment #21:

Waste generation, characterization, segregation, and storage—excavated soils, buried wastes, slabs, and subsurface structures, and secondary wastes			
Characterization of solid waste *(all primary and secondary wastes)*	Must determine if solid waste is hazardous waste or if waste is excluded under 40 *CFR* 261.4(b); and	Generation of solid waste as defined in 40 *CFR* 261.2 and which is not excluded under 40 *CFR* 261.4(a)—**applicable**	40 *CFR* 262.11(a) Rules of the TDEC Chap. 1200-1-11-.03(1)(b)(1)
	Must determine if waste is listed under 40 *CFR* Part 261; or		40 *CFR* 262.11(b) Rules of the TDEC Chap. 1200-1-11-.03(1)(b)(2)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used, and must manage waste in accordance with 40 *CFR* 260-272 if determined to be hazardous waste		40 *CFR* 262.11(c) Rules of the TDEC 1200-1-11-.03(1)(b)(3)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of solid waste which is determined to be hazardous—**applicable**	40 *CFR* 262.11(d); Rules of the TDEC Chap. 1200-1-11-.03(1)(b)(4)
Characterization of hazardous waste *(all primary and secondary wastes)*	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 *CFR* 264 and 268	Generation of RCRA-hazardous waste for storage, treatment, or disposal—**applicable**	40 *CFR* 264.13(a)(1) Rules of the TDEC Chap. 1200-1-11-.06(2)(d)(1)

Table B.3. Action-specific ARARs and TBC guidance for the selected alternative, ETTP Zone 2 soils, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Use and management of hazardous waste in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers—**applicable**	40 *CFR* 264.171; Rules of the TDEC Chap. 1200-1-11-.05(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired		40 *CFR* 264.172; Rules of the TDEC Chap. 1200-1-11-.05(9)(c)
	Keep container closed during storage, except to add/remove waste		40 *CFR* 264.173(a); Rules of the TDEC Chap. 1200-1-11-.05(9)(d)(1)
	Open, handle, and store containers in a manner that will not cause containers to rupture or leak		40 *CFR* 264.173(b); Rules of the TDEC Chap. 1200-1-11-.05(9)(d)(2)
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 *CFR* 264.175(b)	Storage in containers of RCRA-hazardous waste with free liquids—**applicable**	40 *CFR* 264.175(a); Rules of the TDEC, Chap. 1200-1-11-.06(9)(f)(1)
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid	Storage in containers of RCRA-hazardous waste that does not contain free liquids—**applicable**	40 *CFR* 264.175(c); Rules of the TDEC Chap. 1200-1-11-.06(9)(f)(3)
Characterization and management of universal wastes (*e.g., buried batteries, pesticides, thermostats*)	A large quantity handler of universal waste must manage universal waste in accordance with 40 *CFR* 273 (TDEC 1200-1-11-.12) in a way that prevents releases of any universal waste or component of a universal waste to the environment.	Generation of universal waste [as defined in TDEC 1200-1-11-.12(1)(a)] for disposal—**applicable**	40 *CFR* 273 Rules of the TDEC Chap. 1200-1-11-.12
Characterization of LLW (*e.g., contaminated PPE, buried waste and debris, basements, foundation slabs*)	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the WAC of the receiving facility	Generation of LLW for storage or disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(I)

Table B.3. Action-specific ARARs and TBC guidance for the selected alternative, ETTP Zone 2 soils, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste:		DOE M 435.1-1(IV)(I)(2)(a)
	• physical and chemical characteristics;		DOE M 435.1-1(IV)(I)(2)(a)
	• volume, including the waste and any stabilization or absorbent media;		DOE M 435.1-1(IV)(I)(2)(b)
	• weight of the container and contents;		DOE M 435.1-1(IV)(I)(2)(c)
	• identities, activities, and concentration of major radionuclides;		DOE M 435.1-1(IV)(I)(2)(d)
	• characterization date;		DOE M 435.1-1(IV)(I)(2)(e)
	• generating source; and		DOE M 435.1-1(IV)(I)(2)(f)
	• any other information that may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with performance objectives		DOE M 435.1-1(IV)(I)(2)(g)
Temporary storage of LLW *(e.g., soil, contaminated PPE, basement and foundation materials, debris)*	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water	Management of LLW at a DOE facility—**TBC**	DOE M 435.1-1 (IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage		DOE M 435.1-1 (IV)(N)(3)
	Shall be managed to identify and segregate LLW from mixed waste		DOE M 435.1-1 (IV)(N)(6)
Packaging of solid LLW *(e.g., soil, contaminated PPE, equipment, scrap metal, surface feature materials, debris)*	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container	Storage of LLW in containers at a DOE facility—**TBC**	DOE M 435.1-1(IV)(L)(1)(a)
Treatment/disposal of waste—excavated soils, buried waste, slabs, and subsurface structures, and secondary wastes			
Disposal of RCRA-hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 *CFR* 268.40 before land disposal	Land disposal, as defined in 40 *CFR* 268.2, of restricted RCRA waste—**applicable**	40 *CFR* 268.40(a) Rules of the TDEC Chap. 1200-1-11-.10(3)(a)
	May be land disposed if it meets the requirements in the table "Alternative Treatment Standards for Hazardous Debris" at 40 *CFR* 268.45 before land disposal or is treated to the waste-specific treatment standard provided in 40 *CFR* 268.40 for the waste contaminating the debris	Land disposal, as defined in 40 *CFR* 268.2, of restricted RCRA-hazardous debris—**applicable**	40 *CFR* 268.45(a) Rules of the TDEC Chap. 1200-1-11-.10(3) (f)(1)
	Must be treated according to the alternative treatment standards of 40 *CFR* 268.49(c) or according to the UTSs specified in 40 *CFR* 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal	Land disposal, as defined in 40 *CFR* 268.2, of restricted hazardous soils—**applicable**	40 *CFR* 268.49(b) Rules of the TDEC Chap. 1200-1-11-10(3)(j)(2)
	Are not prohibited if the wastes no longer exhibit a characteristic at the point of land disposal, unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* 268.40, or are D003 reactive cyanide	Land disposal of restricted RCRA characteristically hazardous wastes—**applicable**	40 *CFR* 268.1(c)(4)(iv) Rules of the TDEC Chap. 1200-1-11-.10(1) (a)(3)(iv)(IV)

Action	Requirements	Prerequisite	Citation(s)
Disposal of RCRA waste waters	Are not prohibited, unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* 268.40, or are D003 reactive cyanide	Restricted RCRA characteristic hazardous wastes managed in a wastewater treatment system which is CWA NPDES permitted—**applicable**	40 *CFR* 268.1(c)(4)(iv); Rules of the TDEC Chap. 1200-1-11-10(1)(a)(3)(iv)(IV)
Packaging of LLW for disposal (*e.g., contaminated PPE, foundation slab debris, excavated soils*)	Must have structural stability either by processing the waste or placing the waste in a container or structure that provides stability after disposal	Generation of LLW for disposal at a LLW disposal facility—**relevant and appropriate**	Rules of the TDEC Chap. 1200-2-11-.17(7)(b)(1)
	Void spaces within the waste and between the waste, and its package must be reduced to the extent practicable		Rules of the TDEC Chap. 1200-2-11-.17(7)(b)(3)
Treatment of LLW	Treatment to provide more stable waste forms and to improve the long-term performance of a LLW disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility	Generation of LLW for disposal at a LLW disposal facility—**TBC**	DOE M 435.1-1(IV)(O)

Revised Figure 2.3.

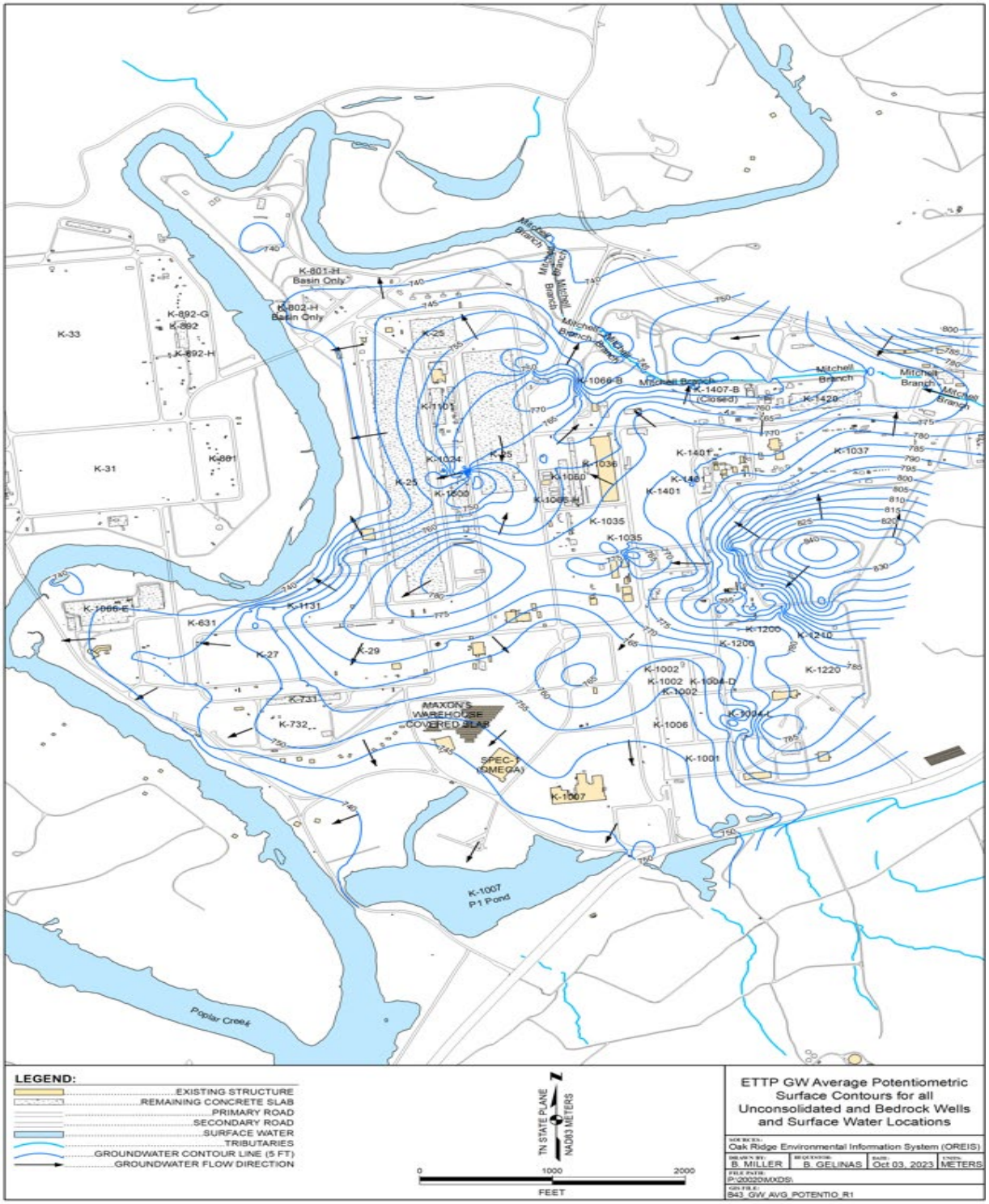

Figure 2.3. Average potentiometric surface for MPA of ETTP (average of all data between 1985 and 2023).

Revised Section 2.9.5

2.9.5 Common Components of Alternatives

With the exception of the no action alternative, the alternatives described in Table 2.4 have several common components. First, implementing all alternatives will require a PDI as well as performance monitoring. Additionally, LUCs are components of all alternatives. Rather than repeating these details for each detailed description of each alternative, these components are discussed below.

PDIs

Data collected for the MPA FFS were sufficient to evaluate technologies and alternatives for the plume source areas. However, additional data are required to design, install, and operate the remedy.

To simplify the scope of the PDI work, five unconsolidated zone monitoring wells and five bedrock wells were assumed to be installed at each plume source area. For sites where treatment is only in the unconsolidated zone or bedrock, 10 wells total will be installed in a single zone. Some sites may require additional investigation and others may require less investigation. However, as a whole, the total number of 10 wells is considered appropriate for costing and evaluating against MPA FFS criteria.

To develop an MPA FFS cost estimate, the total treatment depth was assumed to be 50 ft. The plume source areas have CVOC concentrations exceeding 1000 µg/L (or 400 µg/L for VC). Additionally, there is confirmed DNAPL at two locations (K-1401 based on visual observation, and K-1024 based on dye tests). It should be noted the presence of DNAPL is difficult to confirm on a repeated basis and, often, resampling at locations with DNAPL observations may not be confirmed. In areas where CVOC concentrations are suspected to be present at concentrations greater than the source treatment thresholds, the PDI will further evaluate the depth of contamination. As a result, the preferred alternative in the MPA Proposed Plan states some PDI wells and some remedial action will occur deeper than 50 ft (see Section 2.14).

The challenge with treating deeper depths is the bedrock is less fractured and less amendable to treatment. However, this condition also results in a reduced chance of contaminant migration in low groundwater flow zones. Implementing these interim remedies will provide valuable data to determine a treatment technology's ability to effectively treat contaminants in the bedrock.

Performance Monitoring

Performance monitoring will be implemented to help assess remedies' effectiveness and determine when the interim action has achieved target performance metrics for each plume source area. Performance metrics for the interim action will be established in the RDR/RAWP. For the purposes of the MPA FFS, the remedies were assumed to be implemented and evaluated for 5 years, which is appropriate for determining if target performance metrics can be achieved in a reasonable period of time. Performance monitoring will include collecting groundwater, the details of which will be developed in the RDR/RAWP. For the conceptual design of each alternative, the following assumptions were made:

- A portion of the new wells installed in the source area as part of the PDIs is located such that they can be used as the performance monitoring wells for each remedy.
- The frequency of monitoring and the target analytes will be defined in the RDR/RAWP. For cost-estimating purposes, frequency is assumed to be semiannual at the 10 performance monitoring wells and the target analytes are assumed to be the same as currently used for the RER wells.

LUCs

A LUC Implementation Plan (LUCIP) for ETTP has been developed in accordance with the LUC Assurance Plan for the ORR that was published with a memorandum of understanding between the FFA parties. The ETTP LUCIP is found in the ETTP RAR CMP. The current ETTP LUCIP is outlined in Chapter 6 of the ETTP RAR CMP and detailed in Appendix D of the ETTP RAR CMP. The ETTP RAR CMP will be updated to incorporate the additional LUCs for this MPA IROD and ensure the appropriate level of detail is included in the existing ETTP LUCIP. Changes to the ETTP LUCIP will include, but are not limited to, adding MPA groundwater areas addressed by this MPA IROD as a specific subject (i.e., affected area) of the applicable LUCs to clarify these LUCs are separate from the general LUCs for restricting groundwater use at ETTP Zone 2 established by the Zone 2 Soil ROD.

The LUCs established in this MPA IROD have the following objectives:

- Prevent unauthorized access to or use of groundwater.
- Evaluate and mitigate, if necessary, the vapor intrusion pathway on existing and future enclosed building structures.

The LUCs in the following list will apply to the MPA. Table 2.5 lists the purpose, duration, and implementation of the LUCs for the MPA. The property record restrictions for restrictions on groundwater use and vapor intrusion, property record notices, and the excavation/penetration permit program for the existence and location of contaminated groundwater are required by this MPA IROD. Because these LUCs are existing LUCs for ETTP, an in-depth generic description of each one can be found in the ETTP RAR CMP. Site-specific information pertaining to the conditions of use for each LUC has been included in the bullets below. The LUCs are as follows:

- **Property record restrictions.** The purpose is to restrict property use and/or prohibit groundwater use by imposing limitations and mitigating the vapor intrusion pathway on existing and future enclosed building structures as needed. All property use is restricted to industrial use at ETTP Zone 2. All groundwater within the entire MPA IROD area, as shown in Figure 1.3, is restricted for use at least until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved. All current and future buildings in the MPA IROD area, as shown in Figure 1.3, will be mitigated for vapor intrusion if the pathway is found to be complete and exceed acceptable risk standards. Mitigation will continue until volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved.
- **Property record notices.** The purpose is to notify the public about the existence and location of regulated hazardous substances and the location of land that is not appropriate for UU/UE and limitations on the use. A general property record notice that restricts access/use of groundwater has been filed for ETTP.
- **Excavation/Penetration permit program.** The purpose is to notify the worker/developer (i.e., permit requestor) on the extent of contamination and prohibit or limit excavation/penetration activity to ensure the excavation/penetration activity is conducted safely. For MPA groundwater, permit requesters will be notified of the presence of contaminated groundwater at applicable depths and the ongoing groundwater remedial action until its completion. The permit program has already been established for the MPA as part of Zone 2, and DOE and/or its agent will maintain responsibility for the program (including on transferred land) until concentrations of hazardous substances are at levels to allow for UU/UE or goals set forth in a final remedy are achieved.

LUCs in Table 2.5 are those presented in the ETTP LUCIP, which is included in the ETTP RAR CMP, including those listed as not applicable for the MPA groundwater remedy. Property record restrictions for land use and the vapor intrusion controls are in the ETTP LUCIP for application across ETTP sitewide. Access controls are only required for specific areas of ETTP.

DOE is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although DOE may later transfer or has already transferred these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity. The ETTP RAR CMP also identifies guidelines for property transfer and LUC verification and reporting. The application of LUCs will be the same for all alternatives. These LUCs would remain in effect until they are updated or removed in a future decision document.

Revised Table 2.5.

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a])

Type of control	Purpose of control	Duration	Implementation	Affected area
1. Property record restrictions:				
A. Land use	Impose limitations to restrict use of property	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	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)	NA[b]
B. Groundwater	Prohibit groundwater use[c]	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
C. Vapor intrusion	Mitigate the vapor intrusion pathway on existing and future enclosed building structures, as needed	Until concentrations of volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
2. Property record notices	Notify anyone searching records about existence and location of contaminated areas and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Recorded by DOE in accordance with state law at County Register of Deeds office and copied to the appropriate zoning office (verified every 5 years). (1) Tennessee Code Annotated notice of land use restrictions after signing the ROD. (2) Upon completion of remedial action that leaves hazardous substances in place	MPA Groundwater[d]
3. Excavation/ Penetration permit program	Notify worker/ developer (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 or goals set forth in a final remedy are achieved	Implemented by DOE and its contractors. Initiated by permit request (verified annually)	MPA Groundwater

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a]) (cont.)

Type of control	Purpose of control	Duration	Implementation	Affected area
4. Access controls (e.g., fences, gates, signs, and portals)	Control and restrict access to workers and the public to prevent unauthorized uses	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Maintained by DOE (verified annually)	NA

[a]*East Tennessee Technology Park Administrative Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2477&D4).
[b]While NA to MPA groundwater, this LUC is part of the ETTP LUCIP and applies to ETTP sitewide.
[c]Consistent with language in the quitclaim deeds for property transfer, the prohibition of groundwater use includes the prohibition of any groundwater use, extraction, consumption, and exposure without prior written approval of DOE, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation.
[d]A general property record notice that restricts access/use of groundwater has been filed for ETTP.

CMP = Comprehensive Monitoring Plan
DOE = U.S. Department of Energy
ETTP = East Tennessee Technology Park
IROD = Interim Record of Decision
LUC = land use control
LUCIP = Land Use Control Implementation Plan
MPA = Main Plant Area
NA = not applicable
RAR = Remedial Action Report
ROD = Record of Decision
UU/UE = unlimited use/unrestricted exposure

Revised Table A.1.

Table A.1. Numeric criteria for ORR groundwater (mg/L or parts per million)

Chemical	Value	Selection basis[a]
Arsenic	0.010	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Beryllium	0.004	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Bis-2-ethylhexyl-phlalate	0.006	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Cadmium	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Carbon tetrachloride	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Chromium (total)	0.1	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Copper	Treatment technique[b] (action level 1.3)	Federal MCL, TDEC MCL
1,2-Dichloroethane	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1-Dichloroethene	0.007	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
cis-1,2-Dichloroethene	0.07	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
trans-1,2-Dichloroethene	0.1	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Di-(2-ethylhexyl)-phthalate	0.006	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Dichloromethane (methylene chloride)	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Lead	0.005[c]	Tennessee groundwater quality criteria
Nickel	0.1[d]	TDEC MCL, Tennessee groundwater quality criteria
Polychlorinated biphenyls (total)	0.0005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Tetrachloroethene	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Thallium	0.002	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1,1-Trichloroethane	0.20	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
1,1,2-Trichloroethane	0.005	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Trichloroethene	0.005	
Vinyl chloride	0.002	Federal MCL, TDEC MCL, Tennessee groundwater quality criteria
Gross alpha particle activity (includes radium-226 but excludes radon and uranium)	15 pCi/L	Federal MCL, TDEC MCL
Beta particle and photon activity	4 mrem/year[e]	Federal MCL, TDEC MCL
Technetium-99	see beta particle and photon activity	Federal MCL, TDEC MCL
Uranium	0.030	Federal MCL, TDEC MCL

[a]TDEC MCLs are listed in TDEC Chapter 0400-45-01 (TDEC 2019). Currently, all federal MCLs are identical to the TDEC MCLs; the federal MCLs are listed in 40 Code of Federal Regulations (CFR) 141.61(a), 40 CFR 141.62(b), and 40 CFR 141.66(c). Tennessee groundwater quality criteria at TDEC 0400-40-03-.08 incorporate by reference the domestic water supply criteria in TDEC Chapter 0400-40-03-.03.

[b]Lead and copper are regulated by a treatment technique that requires systems to control corrosiveness of their water. If more than 10% of tap water samples exceed the action level, then water systems must take additional steps.

[c]In addition to the MCL/treatment technique under the State's Safe Drinking Water Act of 1974 program (TDEC Chapter 0400-45-01), Tennessee also has a lead groundwater quality criterion of 0.005 mg/L for domestic water supply in TDEC Chapter 0400-40-03-.03.

[d]The U.S. Environmental Protection Agency has deleted both the MCL and the MCL goal for nickel from the CFR, which was vacated by a court ruling. Tennessee has retained the nickel MCL in its current regulations.

[e]TDEC regulations at TDEC Chapter 0400-45-01-.06 (TDEC 2019) list tritium and strontium-90 levels in Table A of that regulation as "Average Annual Concentrations Assumed to Produce a Total Body or Organ Dose of 4 mrem/yr," which is the MCL for beta particle and photon radioactivity. Except for these radionuclides, the concentration of the other 179 manmade radionuclides causing 4-mrem total body or organ dose equivalents must be calculated on the basis of 2-L/day drinking water intake using the 168-hr data list in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," National Bureau of Standards Handbook 69, as amended August 1963, U.S. Department of Commerce. If two or more radionuclides are present, then the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.

TDEC 2019. Chapter 0400-40-03, *General Water Quality Criteria*, Rule 0400-40-03-.03, "Criteria for Water Uses," and Rule 0400-40-03-.07, "Ground Water Classification," Rules of the Tennessee Department of Environment and Conservation, Nashville, TN, Revised September 2019. URL: https://publications.tnsosfiles.com/rules/0400/0400-40/0400-40-03.20190911.pdf.

MCL = maximum contaminant level
ORR = Oak Ridge Reservation
TDEC = Tennessee Department of Environment and Conservation

Revised Table A.2.

Table A.2. ARARs

Media/Location/Action	Requirement	Prerequisite	Citation
	Chemical-specific		
Remediation of contaminated groundwater	Except for groundwater in areas that have been designated as Special Source Water, Site-Specific Impaired Ground Water or meet the definition of Unusable Ground Water, all groundwater is designated as General Use Ground Water	Classification of state groundwaters—**applicable**	TDEC 0400-40-03-.07(4)(b)
	Except for naturally occurring levels, General Use Ground Water: • Shall not contain constituents that exceed those levels specified in TDEC 0400-40-03-.03 subparagraphs j (levels equivalent to SDWA MCLs) and k (quantities detrimental to public health or that impair use of the water as domestic water supply); and • Shall contain no other constituents at levels and conditions that pose an unreasonable risk to the public health or the environment	Release of contaminants to groundwater or actions potentially impacting groundwater—**applicable**	TDEC 0400-40-03-.08(2)(a) and (b)
	The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man or animals, or impair the safety of conventionally treated water supplies. Available references include, but are not limited to: Quality Criteria for Water (Section 304(a) of Public Law 92-500 as amended), federal regulations under Section 307 of Public Law 92-500 as amended, and federal regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act of 1974 (Public Law 93-523)		TDEC 0400-40-03-.03(1)(j)
	The waters shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply		TDEC 0400-40-03-.03(1)(k)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement		Prerequisite	Citation
	MCLs are promulgated concentration levels in public drinking water supplies. Must not exceed the MCLs in public community water systems, as measured at the consumer's tap		Release of contaminants to groundwater or actions potentially impacting groundwater—**relevant and appropriate**	TDEC 0400-45-01-.06 and TDEC 0400-45-01-.25 40 CFR 141.61(a) 40 CFR 141.62(b)
	Arsenic	0.010 mg/L		
	Beryllium	0.004 mg/L		
	Bis-2-ethylhexyl-phlalate	0.006 mg/L		
	Cadmium	0.005 mg/L		
	Carbon tetrachloride	0.005 mg/L		
	Chromium (total)	0.1 mg/l		
	Copper	Treatment technique (action level 1.3 mg/L)		
	1,2-Dichloroethane	0.005 mg/L		
	1,1-Dichloroethene	0.007 mg/L		
	cis-1,2-Dichloroethene	0.07 mg/L		
	trans-1,2-Dichloroethene	0.1 mg/L		
	Di-(2-ethylhexyl)-phthalate	0.006 mg/L		
	Dichloromethane (methylene chloride)	0.005 mg/L		
	Lead	Treatment technique (action level 0.015 mg/L)		
	Nickel	0.1 mg/L (Tennessee only)		
	Polychlorinated biphenyls (total)	0.0005 mg/L		
	Tetrachloroethene	0.005 mg/L		
	Thallium	0.002 mg/L		
	1,1,1-Trichloroethane	0.20 mg/L		
	1,1,2-Trichloroethane	0.005 mg/L		
	Trichloroethene	0.005 mg/L		
	Vinyl chloride	0.002 mg/L		
	Gross alpha particle activity (includes radium-226 but excludes radon and uranium)	15 pCi/L		
	Beta particle and photon activity	4 mrem/year		
	Technetium-99	See beta particle and photon activity		
	Uranium	0.030 mg/L		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Location-specific		
	Wetlands		
Presence of wetlands as defined in 10 CFR 1022.4	Incorporate wetland protection considerations into its planning, regulatory, and decision-making processes, and shall, to the extent practicable, minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands	DOE actions that involve potential impacts to, or take place within, wetlands—**applicable**	10 CFR 1022.3(a)(7) and (8)
	Undertake a careful evaluation of the potential effects of any proposed wetland action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse wetland impacts		10 CFR 1022.3(b), (c), and (d)
	Project description. This section shall describe the proposed action and shall include a map showing its location with respect to the floodplain and/or wetland. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)
	Floodplain or wetland impacts. This section shall discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain and/or wetland. This section shall include impacts on the natural and beneficial floodplain and wetland values (Section 1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated. For an action proposed in a wetland, the effects on the survival, quality, and function of the wetland shall be evaluated		10 CFR 1022.13(a)(2)
	Alternatives. Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in a wetland area, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	If no practicable alternative to locating or conducting the action in the wetland is available, then before taking action, design or modify the action to minimize potential harm to or within the wetland, consistent with the policies set forth in Executive Order 11990		10 CFR 1022.14(a)
Presence of jurisdictional wetlands as defined in 40 CFR 230.3, 33 CFR 328.3(a), and 33 CFR 328.4	No discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands, is permitted if there is a practical alternative that would have less adverse impact on the wetland or if it will cause or contribute significant degradation of waters of the United States	Actions that involve the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands— **applicable**	40 CFR 230.10(a), (b), (c), and (d) 40 CFR 230, Subpart H
	Except as provided under CWA Section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps (in accordance with 40 CFR 230.70 *et seq*. *Actions to Minimize Adverse Effects*) have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem		40 CFR 230.10(d) CWA Regulations – Section 404(b) Guidelines
	No discharge of dredged or fill material shall be permitted if it: • Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard • Violates any applicable toxic effluent standard or prohibition under Section 307 of the CWA • Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat that is determined by the Secretary of Interior of Commerce, as appropriate, to be critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph • Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972		40 CFR 230.10(b)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Mitigation of impacts to state wetlands as defined under TDEC 0400-40-07-.03	If an activity in a wetland results in an appreciable permanent loss of resource values, mitigation must be provided, which results in no overall net loss of resource values from existing conditions. To the extent practicable, any required mitigation shall be completed, excluding monitoring, prior to, or simultaneous with, any impacts. Acceptable mitigation mechanisms include any combination of in-lieu fee programs, mitigation banks, or other mechanisms that are reasonably assured to result in no overall net loss of resource values from existing conditions. Acceptable mitigation methods are prioritized in the following order: restoration, enhancement, preservation, creation, or any other measures that are reasonably assured to result in no net loss of resource values from existing conditions Compensatory measures must be at a ratio no less than 2:1 for restoration, 4:1 for creation and enhancement, and 10:1 for preservation, or at a best professional judgment ratio agreed to by the state	Activity that would cause loss of wetlands as defined in TDEC 0400-40-07-.03— **applicable**	TDEC 0400-40-07-.04(7)(a) TDEC 0400-40-07-.04(7)(c)
Minor alterations to wetlands	Minor alteration to wetlands must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for minor alteration to wetlands include the following: • Excavation and fill activities associated with wetland alteration shall be kept to a minimum • Wetlands outside of the impact areas shall be clearly marked with signs, high-visibility fencing, or similar structures so that all the work performed by the contractor is solely within the permitted impact area • Wetland alterations shall not cause measurable degradation to resource values and classified uses of hydraulically connected wetlands or other waters of the state, including disruption of sustaining surface or groundwater hydrology	Minor alterations of up to 0.10 acre of moderate resource-value wetlands or of up to 0.25 acre of degraded and of low resource-value wetlands— **applicable**	Tennessee Code Annotated 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Minor Alterations to Wetlands (effective April 7, 2020) (**TBC**)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Temporary impacts to wetlands shall be mitigated by the removal and stockpiling of the first 12 in. of topsoil, prior to construction. Temporary wetland crossings or haul roads shall use timber matting. Gravel, riprap, or other rock is not approved for construction of temporary crossings or haul roads across wetlands. Upon completion of construction activities, all temporary wetland impact areas are to be restored to pre-construction contours, and the stockpiled topsoil spread to restore these areas to pre-construction elevation. Other side-cast material shall not be placed within the temporary impact locations. Permanent vegetative stabilization using native species of all disturbed areas in or near the wetland must be initiated within 14 days of project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • Erosion prevention and sediment control measures, such as fences, shall be removed following completion of construction • The amount of fill, stream channel, and bank modifications, or other impacts associated with the activity, shall be limited to the minimum necessary to accomplish the project purpose. Shall use the least impactful practicable method of construction • Clearing, grubbing, or other disturbance to wetland vegetation shall be kept at the minimum. Unnecessary native vegetation removal, including tree removal, and soil disturbance is prohibited. Native wetland vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed • Activity may not result in a disruption or barrier to the movement of fish or other aquatic life and wetland-dependent species upon project completion • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Where practicable, all activities shall be accomplished during drier times of the year or when recent conditions have been dry at the impact location. All surface water flowing towards or from the construction activity shall be diverted using cofferdams and/or berms constructed of sandbags; steel sheeting; or other non-erodible, non-toxic material. All such diversion materials shall be located outside the wetland and removed upon completion of the work. Activities may be conducted in the water if working in the dry will likely cause additional degradation. If work is conducted in the water, it must be of a short duration and with minimal impact • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank		
Presence of wetlands	Shall take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance beneficial values of wetlands NOTE: Federal agencies required to comply with Executive Order 11990 requirements	Federal actions that involve potential impacts to, or take place within, wetlands—**TBC**	Executive Order 11990 Section l.(a) Protection of Wetlands
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction, and (2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use		Executive Order 11990, Section 2.(a) Protection of Wetlands

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Presence of wetlands (as defined in 44 CFR 9.4)	The Agency shall minimize[1] the destruction, loss, or degradation of wetlands The Agency shall preserve and enhance the natural and beneficial wetlands values	Federal actions affecting or affected by wetlands as defined in 44 CFR 9.4—**relevant and appropriate**	44 CFR 9.11(b)(2) and (b)(4) Mitigation
	The Agency shall minimize: • Potential adverse impact the action may have on wetland values		44 CFR 9.11(c)(3) Minimization provisions
General compensatory mitigation for wetlands	Compensatory mitigation required to offset unavoidable impacts to waters of the United States authorized by Department of the Army permits Compensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular Department of the Army permit • Amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions • Compensatory mitigation may be provided through mitigation banks or in lieu fee programs • Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the impact-causing activity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(1) General compensatory mitigation requirements
	Compensatory mitigation may be performed using the methods of restoration, enhancement, establishment, and in certain circumstances preservation Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(2)

[1]Minimize means to reduce to the smallest amount or degree possible. 44 CFR 9.4 definitions.

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	All compensatory mitigation projects must comply with the standards in this part (40 CFR Part 230), if they are to be used to provide compensatory mitigation for activities authorized by Department of the Army permits, regardless of whether they are sited on public or private lands and whether the sponsor is a governmental or private entity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action		40 CFR 230.93(a)(3)
	Required compensatory mitigation should be located within the same watershed as the impact site and should be located where it is most likely to successfully replace lost functions and services, taking into account such watershed-scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses		40 CFR 230.93(b) Type and location of mitigation
	Project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the district engineer must consider, to the extent practicable, the factors in subsections (i) thru (vi) Applicants should propose compensation sites adjacent to existing aquatic resources or where aquatic resources previously existed		40 CFR 230.93(d)(1) and (3) Site selection
	In general, in-kind mitigation is preferable to out-of-kind mitigation because it is most likely to compensate for the functions and services lost at the impact site Except as provided in paragraph (e)(2) of this section, the required compensatory mitigation shall be of a similar type to the affected aquatic resource		40 CFR 230.93(e)(1) Mitigation type

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. Where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratio must be used		40 CFR 230.93(f)(1) Amount of compensatory mitigation
	Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the activity causing the authorized impacts. The district engineer shall require, to the extent appropriate and practicable, additional compensatory mitigation to offset temporal losses of aquatic functions that will result from the permitted activity		40 CFR 230.93(m) Timing
Compensatory mitigation planning	Prepare a mitigation plan addressing objectives, site selection, site protection, baseline information, determination of credits, mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term management, and adaptive management NOTE*:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan. Plan to include items described in 40 CFR 230.94(c)(2) through (c)(14)[2]	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.94(c) Mitigation Plan
Compensatory mitigation performance standards	The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres)	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.95(a) Ecological Performance Standards

[2]If mitigation obligations will be met by securing credits from approved mitigation banks or in lieu fee programs, mitigation plan needs to include only items described in Sections 230.94(c)(5) and (c)(6), and name of mitigation bank or in lieu fee program. 40 CFR 230.94(c)(1).

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Performance standards must be based on attributes that are objective and verifiable. Ecological performance standards must be based on the best available science that can be measured or assessed in a practicable manner Performance standards may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position. The use of reference aquatic resources to establish performance standards will help ensure those performance standards are reasonably achievable, by reflecting the range of variability exhibited by the regional class of aquatic resources as a result of natural processes and anthropogenic disturbances. Performance standards based on measurements of hydrology should take into consideration the hydrologic variability exhibited by reference aquatic resources, especially wetlands		40 CFR 230.95(b) Ecological Performance Standards
Compensatory mitigation project monitoring	Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure the compensatory mitigation project is accomplishing its objectives Compensatory mitigation project monitoring period shall be sufficient to demonstrate that project has met performance standards, but not less than 5 years	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.96(a) and (b) Monitoring
Compensatory mitigation project management	The aquatic habitats, riparian areas, buffers, and uplands that comprise the overall compensatory mitigation project must be provided long-term protection through real estate instruments or other available mechanisms, as appropriate For government property, long-term protection may be provided through federal facility management plans or integrated natural resources management plans NOTE: Plan would be part of CERCLA document, such as a Remedial Action Work Plan and/or Operations and Maintenance Plan	Alteration of wetlands on government property requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.97(a)(1) Site Protection

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Projects shall be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved This includes minimization of active engineering features (e.g., pumps) and appropriate siting to ensure natural hydrology and landscape context will support long-term sustainability. Where active long-term management and maintenance are necessary to ensure long-term sustainability (e.g., prescribed burning, invasive species control, maintenance of water control structures, easement enforcement), the responsible party must provide for such management and maintenance		40 CFR 230.97(b) Sustainability
	Floodplains		
Presence of floodplain as defined in 10 CFR 1022.4	Incorporate floodplain management goals into planning, regulatory, and decision-making processes, and, to the extent practicable, reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; restore and preserve natural and beneficial values served by floodplains; require the construction of DOE structures and facilities to be, at a minimum, in accordance with Federal Emergency Management Agency National Flood Insurance Program building standards; and promote public awareness of flood hazards by providing conspicuous delineations of past and probable flood heights on DOE property that is in an identified floodplain	DOE actions that involve potential impacts to, or take place within, floodplains—**applicable**	10 CFR 1022.3(a)(1) through (6)
	Undertake a careful evaluation of the potential effects of any proposed floodplain action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Avoid direct and indirect support of development in a floodplain wherever there is a practicable alternative Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse floodplain impacts		10 CFR 1022.3(b), (c), and (d)
	Describe the proposed action and include a map showing its location with respect to the floodplain. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain. Include impacts on the natural and beneficial floodplain values (Section1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated		10 CFR 1022.13(a)(2)
	Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in the floodplain, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a floodplain including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)
	If no practicable alternative to locating or conducting the action in the floodplain is available, then before taking action, design or modify the action to minimize potential harm to or within the floodplain, consistent with the policies set forth in Executive Order 11988		10 CFR 1022.14(a)
	Cultural resources		
Presence of the Manhattan Project National Historical Park and associated buildings	Preserve and protect the nationally significant historic resources associated with the Manhattan Project National Historical Park Improve public understanding of the Project through interpretation of its historic resources Enhance public access to the Park consistent with protection of public safety, national security, and other aspects of DOE's missions Preserve and protect the historically significant resources associated with the Manhattan Project National Historical Park	Action that could adversely impact the Manhattan Project National Historical Park and associated buildings and elements—**applicable**	Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015, Section 3039, Publication L. No. 113-291 (December 19, 2014)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	DOE retains authority and legal obligation for historic preservation and maintenance, including ensuring safe access in connection with DOE's Manhattan Project National Historical Park resources. Consistent with existing Historic Preservation plans, DOE will protect and maintain all DOE sites, structures, and landscapes included in the Park, as well as associated contributing elements located outside of the Park, in accordance with the requirements of the National Historic Preservation Act. DOE will follow the Secretary of the Interior's Standards for Treatment of Historic Properties. DOE will make every effort to avoid adverse impacts to the Park's resources, values, and contributing historic elements. Consistent with existing Historic Preservation plans, DOE will maintain and preserve contributing elements as if they were included in the Park boundary	**TBC**	MOA between DOE and DOI for the Manhattan Project National Historical Park (November 10, 2015)
Presence of archaeological resources on public land	No person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface, any archaeological resource located on public lands or Indian lands unless such activity is pursuant to a permit issued under Section 7.8 or exempted by Section 7.5(b) of this part	Federal agency construction or excavation projects that would cause the irreparable loss or destruction of significant historic or archaeological resources or data—**applicable**	43 CFR 7.4(a)
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony	If inadvertent discovery occurred in connection with an ongoing activity on federal or tribal lands, in addition to providing the notice described above, must stop activities in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently	Excavation activities that inadvertently discover such resources on federal lands or under federal control—**applicable**	43 CFR 10.4(c)
	Must take immediate steps, if necessary, to further secure and protect inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony, including, as appropriate, stabilization or covering		43 CFR 10.4(d)(ii)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Action-specific		
	Site preparation, construction, and excavation activities		
Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following: Use, where possible, of water or chemicals for control of dust, and Application of asphalt, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces, which can create airborne dusts	Use, construction, alteration, repair, or demolition of a building, or appurtenances or a road or the handling transport or storage of material—**applicable**	TDEC 1200-3-8-.01(1) TDEC 1200-3-8-.01(1)(a) TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 min/hr or 20 min/day beyond property boundary lines on which emission originates		TDEC 1200-3-8-.01(2)
Activities causing stormwater runoff (e.g., clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion, vegetative controls, and structural controls) in accordance with the substantive requirements of General Permits TNR10-0000 and TNR05-0000 to ensure stormwater discharge is properly managed, and: • Does not violate water quality criteria as stated in TDEC 0400-40-03-.03, including, but not limited to, prevention of discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any designated uses for that water body by TDEC 0400-40-04; • Does not contain distinctly visible floating scum, oil, or other matter; • Does not cause an objectionable color contrast in the receiving stream; and	Stormwater discharges associated with construction activities that disturb ≥ 1 acre total**—relevant and appropriate**	Tennessee Code Annotated 69-3-108(1) Tennessee General Permit TNR10-0000, Sections 5.3.2 and 5.4.1 (effective October 1, 2016) **(TBC)**

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream • Discharges that would cause measurable degradation of waters with unavailable parameters are not authorized. To be eligible to obtain and maintain coverage, must satisfy, at a minimum, the following additional requirement for discharges into waters with unavailable parameters for siltation and habitat alterations due to in-channel erosion: • Measures used at the site must be designed to control stormwater runoff generated by a 5-year, 24-hr storm event at a minimum Additional physical or chemical treatment of stormwater runoff, such as use of treatment chemicals, may be necessary to minimize the amount of sediment being discharged when clay and other fine particle soils are found on sites		
Airborne radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/year	Radionuclide air emissions from point sources, as well as diffuse or fugitive emissions, at DOE facilities—**applicable**	40 CFR 61.92 TDEC 1200-3-11-.08(6)
	Radionuclide emission measurements shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured NOTE: DOE has an ORR-wide radionuclide emissions monitoring program in place to comply with these requirements under 40 CFR 61, Subpart H. Adherence to the ORR-wide National Emission Standards for Hazardous Air Pollutants monitoring program will constitute compliance with this ARAR requirement	Release points which have the potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of 10 mrem/year to any member of the public—**applicable**	40 CFR 61.93(b)(4)(i) TDEC 1200-03-11-.08(6)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Groundwater monitoring activities		
Placement of monitoring wells	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards	Class V injection systems—**relevant and appropriate** to placement of monitoring wells	TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)
Construction of monitoring wells	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole; this casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples; the annular space above the sampling depth must be seated to prevent contamination of samples and the groundwater	Construction of RCRA groundwater monitoring wells—**relevant and appropriate**	40 CFR 264.97(c) TDEC 0400-12-01-.06(6)(h)(3)
Construction and abandonment of monitoring wells	Establishes quality and workmanship requirements for well drilling, installation, and abandonment, and for sampling, borehole geophysical logging, and hydrologic testing. The substantive requirements of this procedure are TBC for construction and abandonment of monitoring wells	Construction and abandonment of monitoring wells—**TBC**	*Standard Specifications for Installation, Well Drilling, and Abandonment*, SPG-00000-A005/Rev 2 (October 14, 2011)
Closure of monitoring wells	Before abandonment, clean well of obstructions and disinfect using bleach or hypochlorite granules to produce free chlorine residual concentrations of 25 parts per million	Plugging and closure of a water production well—**relevant and appropriate**	TDEC 0400-45-09-.16(1)(a) through (c)
	Use one of several different methods to close well depending on depth of well, construction details, whether it is cased or uncased, and whether it intercepts multiple aquifers		TDEC 0400-45-09-.16(2)(a) through (c)
	Backfill must be placed so that there are no gaps or bridging. Backfill top must be level with land surface		TDEC 0400-45-09-.16(2)(d)
	Wells extending into more than one aquifer shall be filled and sealed in such a way that exchange of water from one aquifer to another is prevented		TDEC 0400-45-09-.16(3)
	Flowing wells must be treated to reduce flow to zero before sealing		TDEC 0400-45-09-.16(4)
	An alternate method of closure may be approved by TDEC		TDEC 0400-45-09-.16(5)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Injection well activities		
Reinjection of contaminated groundwater amended with treatment reagents	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons	Underground injection into an USDW—**applicable**	40 CFR 144.12(a) TDEC 0400-45-06-.04(1)
	Wells are not prohibited if injection is approved by EPA or a state pursuant to provisions for cleanup of releases under CERCLA or RCRA	Class IV wells (as defined in 40 CFR 144.6(d)) used to inject contaminated groundwater that has been treated and reinjected into the same formation from which it was drawn—**applicable**	40 CFR 144.13(c) RCRA Section 3020(b) TDEC 0400-45-06-.13(3)
	The variety of Class V wells and their uses dictate a variety of construction designs consistent with those uses and precludes specific construction standards. However, a well must be designed and constructed for its intended use, in accordance with good engineering practices, and the design and construction must be approved by the Commissioner NOTE: Approval of the design and construction of the well will be through the CERCLA process and approval of the Remedial Action Work Plan	Class V injection systems—**applicable**	TDEC 0400-45-06-.14(7)(a)
	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards		TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	No injection activity can allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of any primary drinking water standard, or other health-based standards, or may otherwise adversely affect the health of persons. This prohibition applies to well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity		TDEC 0400-45-06-.14(12)(a)1
Plugging and abandonment of all classes of injection wells	Any well that is to be permanently plugged and abandoned shall be completely filled and sealed in such a manner that vertical movement of fluid either into or between formation(s) containing USDWs through the borehole is not allowed	The injection well is no longer usable for its intended purpose or the well poses a potential threat to water quality or the well has not operated for 2 years (unless notice has been provided to the TDEC Commissioner and actions taken to ensure USDWs will not be endangered during period of temporary abandonment)—**applicable**	TDEC 0400-45-06-.09(6)(d)
	As a minimum, permanent seals must be placed in the borehole opposite (1) the lowermost confining bed, and (2) each intermediate confining bed between successive formation(s) containing USDWs		TDEC 0400-45-06-.09(6)(e)
	Seals intended to prevent vertical movement of water in a well borehole shall be composed of cement, sand-and-cement, or concrete or other sealing materials demonstrated to the satisfaction of the Commissioner to be effective. The minimum length of a seal shall be 20 ft		TDEC 0400-45-06-.09(6)(f) and (g)
	The borehole above the uppermost formation(s) containing a USDW shall be filled with materials less permeable than the surrounding undisturbed formations; the uppermost 5 ft of the borehole (at land surface) shall be filled with a material appropriate to the intended use of the land		TDEC 0400-45-06-.09(6)(h)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The materials used to fill spaces between well seals shall be filled with disinfected dimensionally stable materials, compacted mechanically if necessary to avoid later settlement except that cement, cement and sand, and concrete do not require disinfection. Disinfection of well-filling materials shall be accomplished by using chlorine compounds, such as sodium hypochlorite or calcium hypochlorite		TDEC 0400-45-06-.09(6)(i)
	Temporary bridges may be used to avoid having to fill very deep holes below the deepest point at which a permanent seal is required. Temporary bridges used to provide a base for a permanent seal shall consist of materials approved by the Commissioner		TDEC 0400-45-06-.09(6)(j)
	Approved sealing materials used in abandonment operations shall be introduced at the bottom of the well or interval to be sealed and placed progressively upward to the top of the well. All such sealing materials shall be placed in such a way as to avoid segregation or dilution of the sealing materials. Dumping sealing material from the top of the well shall not be allowed		TDEC 0400-45-06-.09(7)(a)
	Permanent seals shall be placed in wells or boreholes opposite confining beds between aquifers, which are identifiable as, or are suspected of being, hydraulically separated under natural, undisturbed conditions. After the required seal has been installed, the remainder of the confining zone between formations containing USDWs may be filled with sand, sand and gravel, or other rock material acceptable to the Commissioner		TDEC 0400-45-06-.09(7)(b)
	Management of secondary wastes from well development and rehabilitation or maintenance		
Characterization of solid waste	Must determine if waste is hazardous waste or if waste is excluded under TDEC 0400-12-01-.02(1)(d); and	Generation of solid waste as defined in TDEC 0400-12-01-.02(1)(b), and which is not excluded under TDEC 0400-12-01-.02(1)(d)(1)— **applicable**	40 CFR 262.11(a) and (b) TDEC 0400-12-01-.03(1)(b)(1) TDEC 0400-12-01-.03(1)(b)(2)
	Must determine if waste is listed under TDEC 0400-12-01-.02(4); or		40 CFR 262.11(c) TDEC 0400-12-01-.03(1)(b)(3)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used		40 CFR 262.11(d) TDEC 0400-12-01-.03(1)(b)(4)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Characterization of hazardous waste	If waste is determined to be hazardous, must refer to TDEC 0400-12-01-.02, .05, .06, .09, .10, and .12 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 CFR 262.11(e) TDEC 0400-12-01-.03(1)(b)(5)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 262.11(d)(2) TDEC 0400-12-01-.06(2)(d)(1)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 264.13(a)(1) TDEC 0400-12-01-.06(2)(d)(1)
	Must determine if the waste meets the treatment standards in subparagraphs (3)(a), (3)(f), or (3)(j) of TDEC 0400-12-01-.10 by testing in accordance with prescribed methods or use of generator knowledge of waste		40 CFR 268.7(a) TDEC 0400-12-01-.10(1)(g)(1)
	Must determine each EPA Hazardous Waste Number (waste code) to determine the applicable treatment standards under TDEC 0400-12-01-.10(3)		40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
	Must determine the underlying hazardous constituents (as defined in TDEC 0400-12-01-.10(1)(b)(10)) in the waste	Generation of RCRA characteristically hazardous waste (and is not D001 non-wastewaters treated by combustion, recovery of organics, or polymerization of subparagraph (3)(c) of TDEC 0400-12-01-.10) for storage, treatment, or disposal—**applicable**	40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
Management of hazardous waste onsite	A generator who treats, stores, or disposes of hazardous waste onsite must comply with the applicable (substantive) standards and requirements set forth in TDEC 0400-12-01-.05, .06, .07, and .09	Generation of RCRA hazardous waste for storage, treatment, or disposal onsite—**applicable** if secondary wastes are determined to be hazardous	40 CFR 262.10, Note 2 TDEC 0400-12-01-.03(1)(a)(2)(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of hazardous waste in containers onsite (satellite accumulation area)	A generator may accumulate as much as 55 gal of hazardous waste at or near any point of generation where wastes initially accumulate which is under the control of the operator of the process generating the waste, provided: • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition and does not leak, or immediately transfer and manage the waste in a central accumulation area operated in compliance with Part (g)2 or (h)1 of this paragraph • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be accumulated, so that the ability of the container to contain the waste is not impaired • A container holding hazardous waste must be closed at all times during accumulation, except when adding, removing, or consolidating waste: or, when temporary venting of a container is necessary for the proper operation of equipment or to prevent dangerous situations, such as build-up of extreme pressure • Container must be marked or labeled with the words "Hazardous Waste" and an indication of the hazards of the contents	Accumulation of 55 gal or less of RCRA hazardous waste at or near any point of generation—**applicable**	40 CFR 262.15(a)(1), (2), (4), and (5) TDEC 0400-12-01-.03(1)(f)(1)(i), (ii), (iv), and (v)
Temporary storage of hazardous waste in containers onsite (90-day storage area)	A generator may accumulate hazardous waste at the facility, provided: • The waste is placed in containers that comply with the air emission standards in TDEC 0400-12-01-.05(27), (28), and (29); • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition, or immediately manage the waste in some other way that complies with the conditions for exemption of this part; • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired;	Accumulation of RCRA hazardous waste onsite as defined in TDEC 0400-12-01-.01(2)(a)—**applicable**	40 CFR 262.17(a)(1)(i) through (iv) TDEC 0400-12-01-.03(1)(h)(1)(i)(I) through (IV)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• A container holding hazardous waste must always be closed during accumulation, except when it is necessary to add or remove waste. A container holding hazardous waste must not be opened, handled, or stored in a manner that may rupture the container or cause it to leak.		
	• Container must be marked or labeled with the words "Hazardous Waste," an indication of the hazards of the contents, and the date upon which each period of accumulation begins clearly visible for inspection on each container		40 CFR 262.17(a)(5)(i) TDEC 0400-12-01-.03(1)(h)(1)(v)(I)
Temporary storage of RCRA remediation waste in a staging pile	Must be located within the contiguous property under the control of the owner/operator where the wastes that are to be managed in the staging pile originated For purposes of this section, storage includes mixing, sizing, blending, or other similar physical operations so long as intended to prepare the wastes for subsequent management or treatment	Accumulation of non-flowing hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR 260.10—**applicable**	40 CFR 264.554(a)(1) TDEC 0400-12-01-.06(22)(e)1
	May be temporarily stored (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility provided the staging pile will be designed to:		40 CFR 264.554(d)(1) TDEC 0400-12-01-.06(22)(e)4(i)
	• Facilitate a reliable, effective, and protective remedy;		40 CFR 264.554(d)(1)(i) TDEC 0400-12-01-.06(22)(e)4(i)(I)
	• Prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer, as necessary, to protect human health and the environment (e.g., through the use of liners, covers, runon/runoff controls, as appropriate)		40 CFR 264.554(d)(1)(ii) TDEC 0400-12-01-.06(22)(e)4(i)(II)
Operation of a staging pile	Must not place ignitable or reactive waste in a staging pile unless the remediation waste has been treated, rendered, or mixed before placed in the staging pile so that: • The remediation waste no longer meets the definition of ignitable or reactive under 40 CFR 261.21 or 40 CFR 261.23; and	Storage of ignitable or reactive remediation waste in a staging pile—**applicable**	40 CFR 264.554(e)(1)(i) TDEC 0400-12-01-.06(22)(e)5(i)
	• One has complied with 40 CFR 264.17(b); or		40 CFR 264.554(e)(1)(ii) TDEC 0400-12-01-.06(22)(e)5(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Must manage the remediation waste to protect it from exposure to any material or condition that may cause it to ignite or react		40 CFR 264.554(e)(2) TDEC 0400-12-01-.06(22)(e)5(ii)
	Must not place incompatible wastes in same pile unless they comply with 40 CFR 264.17(b)	Storage of incompatible remediation waste in staging pile—**applicable**	40 CFR 264.554(f)(1) TDEC 0400-12-01-.06(22)(e)6(i)
	Incompatible wastes must be separated from any waste or nearby materials or must protect them from one another by using a dike, berm, wall, or other device		40 CFR 264.554(f)(2) TDEC 0400-12-01-.06(22)(e)6(ii)
	Must not pile remediation waste on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 274.17(b)		40 CFR 264.554(f)(3) TDEC 0400-12-01-.06(22)(e)6(iii)
Use and management of hazardous waste in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers—**applicable**	40 CFR 264.171 TDEC 0400-12-01-.06(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired		40 CFR 264.172 TDEC 0400-12-01-.06(9)(c)
	Container holding hazardous waste must always be kept closed during storage, except to add/remove waste		40 CFR 264.173(a) and (b) TDEC 0400-12-01-.06(9)(d)
	Container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak		
Operation of a RCRA container area	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or containers must be elevated or otherwise protected from contact with accumulated liquid	Storage in containers of RCRA hazardous waste that do not contain free liquids—**applicable**	40 CFR 264.175(c) TDEC 0400-12-01-.06(9)(f)(3)
Storage of RCRA hazardous waste with free liquids in containers	Area must have a containment system designed and operated in accordance with TDEC 0400-12-01-.06(9)(f)(2) as follows:	Storage of RCRA hazardous waste with free liquids or storage of waste codes F020, F021, F022, F023, F026, and F027 that do not contain free liquids in containers—**applicable**	40 CFR 264.175(a) and (d) TDEC 0400-12-01-.06(9)(f)(1)-(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	A base must underlie the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;		40 CFR 264.175(b)(1) TDEC 0400-12-01-.06(9)(f)(2)(i)
	Base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;		40 CFR 264.175(b)(2) TDEC 0400-12-01-.06(9)(f)(2)(ii)
	Must have sufficient capacity to contain 10% of the volume of containers or volume of largest container, whichever is greater;		40 CFR 264.175(b)(3) TDEC 0400-12-01-.06(9)(f)(2)(iii)
	Runon into the system must be prevented unless the collection system has sufficient capacity to contain any runon which might enter the system, along with the volume required for containers as listed immediately above; and		40 CFR 264.175(b)(4) TDEC 0400-12-01-.06(9)(f)(2)(iv)
	Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in as timely a manner as is necessary to prevent overflow of the collection system		40 CFR 264.175(b)(5) TDEC 0400-12-01-.06(9)(f)(2)(v)
Disposal of RCRA hazardous waste in a land-based unit	May be land-disposed only if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at TDEC 0400-12-01-.10(3)(a) before land disposal. The table lists either total waste standards, waste-extract standards, or technology-specific standards (as detailed further in TDEC 0400-12-01-.10(3)(c))	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted waste—**applicable**	40 CFR 268.40(a) TDEC 0400-12-01-.10(3)(a)
	Prior to land disposal, soil contaminated with hazardous waste must be treated to meet the applicable alternative treatment standards of TDEC 0400-12-01-.10(3)(j)(3) or according to the applicable Universal Treatment Standards in TDEC 0400-12-01-.10(3)(i) applicable to the listed hazardous waste and/or applicable characteristic of hazardous waste if the soil is characteristic	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted hazardous soils—**applicable**	40 CFR 268.49(b) TDEC 0400-12-01-.10(3)(j)(2)
Management of water generated from well development, rehabilitation, or maintenance	On-site wastewater treatment units that are part of a wastewater treatment facility subject to regulation under Section 402 or Section 307(b) of the CWA are exempt from the requirements of RCRA Subtitle C for all tank systems, conveyance systems (whether piped or trucked), and ancillary equipment used to store or transport RCRA-contaminated water	On-site wastewater treatment units subject to regulation under Section 402 or Section 307(b) of the CWA—**applicable** if water is determined to be hazardous	40 CFR 264.1(g)(6) 40 CFR 260.10 40 CFR 270.1(c)(2)(v) TDEC 0400-12-01-.06(1)(b)(2)(v) TDEC 0400-12-01-.01(2)(a) TDEC 0400-12-01-.07(1)(b)(4)(iv)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Management of PCB waste	Any person storing or disposing of PCB waste must do so in accordance with 40 CFR 761, Subpart D	Generation of waste containing PCBs at concentrations ≥ 50 parts per million—**applicable**	40 CFR 761.50(a)
	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found	Generation of PCB remediation waste as defined in 40 CFR 761.3—**applicable**	40 CFR 761.61
Temporary storage of PCB waste	Storage area must be clearly marked as required by 40 CFR 761.40(a)(10)	Storage of PCBs and PCB items at concentration ≥ 50 parts per million for disposal—**applicable**	40 CFR 761.65(c)(3)
	Container(s) shall be in accordance with requirements set forth in U.S. Department of Transportation Hazardous Materials Regulations at 49 CFR 171–180		40 CFR 761.65(c)(6)
Risk-based storage of PCB remediation waste	May store in a manner other than prescribed in 40 CFR 761.65 if application approved in writing by EPA Regional Administrator and EPA finds that the method will not pose an unreasonable risk of injury to [sic] human health or the environment Each application must include information described in 40 CFR 761.61(a)(3) NOTE: Appropriate substantive information required in an application is provided in CERCLA documents [e.g., feasibility study, Proposed Plan, Record of Decision, or post-Record of Decision documents] that are approved by EPA	Storage of PCB remediation waste (as defined in 40 CFR 761.3) prior to disposal—**applicable**	40 CFR 761.61(c)
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be nonleaking For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 CFR 761.65(b)(1)(ii); and	Storage of PCB/radioactive waste in containers other than those meeting U.S. Department of Transportation Hazardous Materials Regulations performance standards—**applicable**	40 CFR 761.65(c)(6)(i)(A) 40 CFR 761.65(c)(6(i)(B)
	For both liquid and nonliquid wastes, containers must meet all regulations and requirements pertaining to nuclear criticality safety		40 CFR 761.65(c)(6)(i)(C)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of PCB remediation waste in a waste pile	Waste must be placed in a pile that: • Is designed and operated to control dispersal by wind, where necessary, by means other than wetting; • Does not generate leachate through decomposition or other reactions;	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation—**applicable**	40 CFR 761.65(c)(9)(i) and (ii)
	• Is at a storage site with a liner designed, constructed, and installed to prevent any migration of wastes off or through liner into adjacent subsurface soil, groundwater, or surface water		40 CFR 761.65(c)(9)(iii)(A)
	Liner must be: • Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;		40 CFR 761.65(c)(9)(iii)(A)(1)
	• Placed on foundation or base capable of providing support to liner and resistance to pressure gradients above and below the liner to present failure because of settlement compression or uplift;		40 CFR 761.65 (c)(9)(iii)(A)(2)
	• Installed to cover all surrounding earth likely to be in contact with waste		40 CFR 761.65 (c)(9)(iii)(A)(3)
	Has a cover that meets the above requirements and is installed to cover all the stored waste likely to be contacted by precipitation, and is secured so as not to be functionally disabled by winds expected under normal weather conditions; and		40 CFR 761.65 (c)(9)(iii)(B)
	Has a runon control system designed, constructed, operated, and maintained such that it prevents flow on the stored waste during peak discharge from at least a 25-year storm, and collects and controls at least the water volume resulting from a 24-hr, 25-year storm		40 CFR 761.65 (c)(9)(iii)(C)(1) and (2)
	Requirements of 40 CFR 761.65(c)(9) of this part may be modified under the risk-based storage option of Section 761.61(c)		40 CFR 761.65(c)(9)(iv)
Disposal of containers of Toxic Substances Control Act of 1976 PCB wastes	Container(s) shall be marked as illustrated in 40 CFR 761.45(a)	Disposal of PCBs in chemical waste landfill—**applicable**	40 CFR 761.40(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Performance-based disposal of PCB remediation waste	Shall be disposed according to 40 CFR 761.60(a) or (e), or decontaminated in accordance with 40 CFR 761.79	Disposal of liquid PCB remediation waste—**applicable**	40 CFR 761.61(b)(1)
	May dispose by one of the following methods: • In a high-temperature incinerator approved under 40 CFR 761.70(b); • By an alternate disposal method approved under 40 CFR 761.60(e); • In a chemical waste landfill approved under 40 CFR 761.75; • In a facility with a coordinated approval issued under 40 CFR 761.77; or	Disposal of nonliquid PCB remediation waste [as defined in 40 CFR 761.3]—**applicable**	40 CFR 761.61(b)(2) 40 CFR 761.61(b)(2)(i)
	• Through decontamination in accordance with 40 CFR 761.79		40 CFR 761.61(b)(2)(ii)
Management of PCB/radioactive waste	Any person storing such waste ≥ 50 parts per million PCBs must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 CFR 761.65(a)(1), (b)(1)(ii) and (c)(6)(i)	Generation of PCB/radioactive waste for storage and disposal—**applicable**	40 CFR 761.50(b)(7)(i)
	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties in accordance with applicable requirements		40 CFR 761.50(b)(7)(ii)
	If, after taking into account only the PCB properties in the waste, the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a state as a municipal or non-municipal non-hazardous waste landfill, then the person may dispose of such waste without regard to the PCBs, based on its radioactive properties alone		40 CFR 761.50(b)(7)(ii)
Characterization of low-level waste (e.g., wastewater, contaminated personal protective equipment)	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance criteria of the receiving facility	Generation of low-level waste for storage and disposal at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(I)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste: • physical and chemical characteristics • volume, including the waste and any stabilization or absorbent media • weight of the container and contents • identities, activities, and concentrations of major radionuclides • characterization date • generating source		DOE Manual 435.1-1(IV)(I)(2)
Temporary storage of low-level waste	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water	Management of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure		DOE Manual 435.1-1(IV)(N)(3)
	Shall be managed to identify and segregate low-level waste from mixed waste		DOE Manual 435.1-1(IV)(N)(6)
	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container	Storage of low-level waste in containers at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(L)(1)(a)
	Vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container		DOE Manual 435.1-1(IV)(L)(1)(b)
Packaging of low-level waste for disposal	Must not be packaged for disposal in cardboard or fiberboard boxes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(1)
	Must be solidified or packaged in sufficient absorbent material to absorb twice the volume of liquid	Generation of liquid low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume	Generation of solid low-level waste containing liquid for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(3)
	Must not be capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures or of explosive reaction with water	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(4)
	Must not contain, or be capable of, generating quantities of toxic gases, vapor, or fumes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(5)
	Must not be pyrophoric	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(6)
	Must have structural stability either by processing the waste or placing the waste in a container or structure that provides stability after disposal	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(1)
	Must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form	Generation of liquid low-level waste or low-level waste containing liquids for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(2)
	Void spaces within the waste and between the waste and its package must be reduced to the extent practicable	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Disposal of low-level waste	Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility	Generation for disposal of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(J)(2)

ARAP = aquatic resource alteration permit
ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = Code of Federal Regulations
CWA = Clean Water Act of 1972
DOE = U.S. Department of Energy
DOI = U.S. Department of Interior
EPA = U.S. Environmental Protection Agency
MCL = maximum contaminant level
MOA = Memorandum of Agreement
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
ORR = Oak Ridge Reservation
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act of 1976
SDWA = Safe Drinking Water Act of 1974
TBC = to be considered
TDEC = Tennessee Department of Environment and Conservation
USDW = underground source of drinking water

UCOR
United Cleanup Oak Ridge LLC

Comment Resolution Form

Document Number:	Document Title:	
DOE/OR/01-2949&D1	*Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee*	
Name of Reviewer:	**Organization:**	**Date Comments Transmitted:**
Carl Froede	U.S. Environmental Protection Agency	09/15/2023

Comment No.	Sect./Page	Comment	Response
		General	
1.		The contaminant vinyl chloride (VC) and its target concentration limit of 400 µg/L is often not cited when reference is made to the CVOC target concentration limit of 1000 µg/L. In places, the text can be read where the contaminants are an either/or statement – creating confusion. It is recommended that the text be rewritten to clarify that this interim remedial action has two contaminants with specific target concentration limits. Specific examples in need of clarity can be found at: Section 1.4, Description of Selected Remedy, p. 1-4; Section 2.5.1.4, COCs, p. 2-13; Section 2.8, Remedial Action Objectives, p. 2-35; Section 2.12.2, Description of Selected Remedy, p. 2-64; Section 2.14, Documentation of Significant Changes, p. 2-68.	Agree. Text stating "(or 400 µg/L for VC)" or similar has been added as appropriate.
2.		The presence of VC is mentioned at several locations across ETTP but with no indication of concentrations in the groundwater. Add text that states the PDI will also investigate for VC. Specific examples in need of clarity can be found at: Section 2.5.2, Mitchell Branch Comingled Plume/K-1407-B Conceptual Site Model, p. 2-16; Section 2.5.4, K-25/K-1024 Conceptual Site Model, p. 2-21; Section 2.5.6 K-27/K-1232 Conceptual Site Model, p. 2-28.	Agree. The text has been revised as appropriate.

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		Specific	
1.	Section 1.2, Statement of Basis and Purpose, p. 1-3	The third paragraph, third sentence, states that, "The selected remedy is an interim remedy, and land use restrictions will be required until a final ROD for the MPA is in place." Please replace "until a final ROD for the MPA is in place" with "until the groundwater contamination concentrations are below Federal and State Maximum Contaminant Levels (MCLs) and is protective for all uses."	Agree. The text has been revised as suggested: "The selected remedy is an interim remedy, and land use restrictions will be required until groundwater contamination concentrations are below federal and state maximum contaminant levels (MCLs) and Tennessee groundwater quality criteria and the remedy is protective for all uses."
2.	Section 1.2, Statement of Basis and Purpose, p. 1-3	The third paragraph, fourth sentence, describes the land use controls (LUCs) as being "reiterated" in the MPA IROD. Please change "reiterated" to "selected."	Agree. The text has been revised as suggested: "The interim land use controls (LUCs) that are already in place at the site and selected in this MPA IROD will continue in effect and remain enforceable as part of the selected CERCLA remedy until such time as they may be changed by a future CERCLA decision."
3.	Section 1.2, Statement of Basis and Purpose, p. 1-3	The third paragraph, last sentence, states, "DOE is committed to implementing and maintaining LUCs, including institutional controls, to ensure the selected remedy remains protective of human health and the environment." Please add at the end of the sentence, "for unrestricted use and unlimited exposure."	Agree. The text has been revised as suggested: "DOE will maintain LUCs until concentrations of hazardous substances in the soil and groundwater are at such levels to allow for unlimited use/unrestricted exposure (UU/UE) or goals set forth in a final remedy are achieved." The following text has been added to the end of the subsequent paragraph: "DOE is responsible for maintaining, monitoring, and enforcing such LUCs, including in the case these procedural responsibilities are assigned to another party by contract, property transfer agreement, or through other means. In these instances, DOE shall retain ultimate responsibility for remedy integrity."
4.	Section 1.2, Statement of	The fourth paragraph beginning on page 1-3 describes how the public can access the Administrative Record for this action and	Agree. A new sentence has been added to the last paragraph of Section 1.2 as follows:

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	Basis and Purpose, p. 1-3 and p. 1-4.	gives a physical address. EPA recommends that DOE also add a URL link so that the public can access the electronic Administrative Record Index. Please make changes consistent with this comment in other sections of the MPA IROD where public access to information is discussed.	"This information is also available online. (Note the link will be provided in the Final IROD)." Because the subject link is not currently available but will be included in the Final Interim Record of Decision, a placeholder has been included in the D2 version of this Main Plant Area Interim Record of Decision.
5.	Section 1.3, Assessment of the Site, p. 1-4	The third paragraph, first sentence, states, "Threatened releases of hazardous substances from the CVOC groundwater sources addressed by this MPA IROD could present a future endangerment to public health, welfare, or the environment if contaminants leaching from these sources migrate towards off-site locations or if land use restrictions were not maintained." In order to accurately describe the risk and the remedial actions at the site, please revise to read, "Releases of hazardous substances from the CVOC groundwater sources addressed by this MPA IROD present an endangerment to public health, welfare, or the environment. If land use restrictions which prevent access to or use of the groundwater are maintained as directed by the MPA IROD, onsite exposure to the public is minimized. If, however, contaminants leaching from these sources migrate towards off-site locations, additional remedial action may be warranted. A final remedial action will be taken in the future, if warranted, to address any unacceptable risk remaining at the conclusion of this interim action."	Agree. The text has been revised as suggested: "Releases of hazardous substances from the CVOC groundwater sources addressed by this MPA IROD present an endangerment to public health, welfare, or the environment. If land use restrictions that prevent access to or use of groundwater are maintained as directed by the MPA IROD, then on-site exposure to the public is minimized. If, however, contaminants leaching from these sources migrate toward off-site locations, additional remedial action may be warranted. A final remedial action will be taken in the future, if warranted, to address any unacceptable risk remaining at the conclusion of this interim action."
6.	Figure 1.3, Groundwater source areas addressed in this MPA IROD based on data available for the MPA FFS,	EPA recommends that DOE include a map that overlays the plumes shown on Figure 1.3 with the Exposure Units (EUs) from the *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2, East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01- 2161&D2* (Zone 2 Soils ROD). This will facilitate cross-referencing the plume nomenclature with the EU numbers when cited in the document.	Agree. Figure 1.3 has been revised to include the exposure units. Revised Figure 1.3 is included at the end of this comment resolution form. Additionally, the following text has been added to Section 1.3, where Figure 1.3 is first introduced: "Exposure unit numbers are associated with the *Record of Decision for Soil, Buried Waste, and Subsurface Structure Actions in Zone 2,*

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	p. 1-7		*East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2161&D2; Zone 2 Soil ROD) and are included on the figure to facilitate cross-referencing the plume nomenclature with the exposure unit numbers when cited in the document."
7.	Section 2.1, Site Name, Location, and Description, p. 2-3	The third paragraph, fourth sentence, describes this interim action as focusing on MPA groundwater. Please add "six specific, named plumes of" before the word, "groundwater," to specifically describe the scope of this interim action.	Agee. The text has been revised as suggested: "This interim action focuses on six specific sources of groundwater plumes in the MPA of the ETTP site (Mitchell Branch Comingled Plume/K-1407-B, K-1401, K-25/K-1024, K-1035, K-27/K-1232, and K-1239)."
8.	Section 2.2, Site History and Enforcement Actions, p. 2-4	The fourth paragraph, second sentence, states, "Actions under the Zone 1 Soil IROD and Zone 2 Soil ROD are based on protecting both human health and the environment, including requirements to remove soil that could continue to leach contaminants to groundwater." The scope of the Zone 2 Soils ROD did not include risks to the environment. Please revise this statement to read, "Actions under the Zone 1 Soil IROD are based on protecting both human health and the environment, including requirements to remove soil that could continue to leach contaminants to groundwater. Actions under the Zone 2 Soil ROD addressed only risks from soil to human health and leaching to groundwater. An ETTP site-wide Remaining Ecology, Surface Water, and Sediment investigation is currently being conducted under an EPA and TDEC approved Remedial Investigation/Feasibility Study (RI/FS) work plan."	Clarification. The Zone 2 Soil Record of Decision and Zone 1 Soil Interim Record of Decision both include remedial action objectives to protect groundwater from sources in soil and use the same East Tennessee Technology Park groundwater soil screening levels to evaluate potential impacts to groundwater from soil contamination. The paragraph has been revised as follows: "Remedial actions in Zone 2 are in progress, and all required soil excavations are anticipated to be completed by September 2025. Actions under both the Zone 2 Soil ROD and the Zone 1 Soil IROD are based on protecting both human health and the environment, including requirements to remove soil that poses an unacceptable risk to industrial workers or is determined to be a source to groundwater contamination. Neither ROD includes actions that extend below the water table (or below the top of bedrock). An ETTP sitewide surface water/sediment/remaining ecology investigation is currently being conducted under the EPA- and TDEC-approved *Remedial Investigation Work Plan*

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			for Remaining Ecology/Surface Water/Sediment at East Tennessee Technology Park, Oak Ridge, Tennessee (DOE/OR/01-2912&D2). Any required remedial actions will be completed under a ROD that follows this work.""
9.	Section 2.2, Site History and Enforcement Actions, p. 2-4	The fourth paragraph, third sentence, states, "The Zone 1 Soil IROD remedial actions are complete." Given that it is currently unknown what remedial actions may be necessary to address ecological risk, please revise this statement to read, "The Zone 1 Soil IROD remedial actions that address risks to human health are complete. Specific decisions to address ecological risk have not yet been made."	Clarification. Ecological remedial actions for Zone 1 soils were identified in Zone 1 through the Final Zone 1 Proposed Plan (DOE/OR/01-2648&D3) and the Interim Zone 1 Record of Decision Amendment for Final Soil Actions (DOE/OR/01-2817&D3). Remedial actions for protection of ecological terrestrial receptors have been completed. Discussions with the U.S. Environmental Protection Agency and Tennessee Department of Environment and Conservation on how to document ecological protection clearly in the Final Zone 1 Record of Decision (a No Further Action Record of Decision) Administrative Record are ongoing. Ecological protection for aquatic receptors from surface water and sediment in the Zone 1 ponds are being addressed as part of the future Surface Water/Sediment/Remaining Ecology Record of Decision.
10.	Section 2.2, Site History and Enforcement Actions, p. 2-6	Please add at the beginning of the first sentence, "As described above," See text in specific comment 8.	Agree. The text has been revised as suggested: "As described above, remaining CERCLA decisions at ETTP will address contamination in saturated soil; below the water table and in bedrock groundwater; soil vapor; surface water; and sediment in the ponds, wetlands, and perennial streams."
11.	Section 2.3, Highlights of Community	In the second paragraph, first sentence, please change the citation to CERCLA Section 117(a), 42 U.S.C. 9617(a), and add a reference to the NCP at 40 CFR 300.430(f)(3)(i).	Agree. The text has been revised as suggested: "As required in CERCLA Section 117(a), 42 United States Code 9617(a), and the NCP at 40 CFR 300.430(f)(3)(i), DOE published a public notice of

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	Participation, p. 2-6		availability for the *Proposed Plan for an Interim Record of Decision for Groundwater in the Main Plant Area at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE/OR/01-2921&D2/R1; MPA Proposed Plan) in *The Oak Ridger*, *Knoxville News-Sentinel*, *Loudon County News-Harriman Record*, *Rockwood Times*, and other local newspapers within the region."
12.	Section 2.4, Scope and Role of Remedial Action, p. 2-8	The text states: DOE will initiate the CERCLA work on these additional areas through a data quality objectives session that identifies additional data needs to develop an RI/FS and subsequent CERCLA decision document. DOE anticipates this effort to be dynamic as more information becomes available through both implementation of the IROD work and additional data characterization work. Therefore, DOE plans to use an adaptive management approach to complete the groundwater restoration work at ETTP. Comment: The last sentence uses the term "adaptive management" (AM). That term is not used anywhere else in the MPA IROD. Also, the term was not mentioned in the Proposed Plan. However, the term is found in the approved Focused Feasibility Study (FFS, DOE/OR/01-2894&D2): In all situations, the Adaptive Management process, which will be developed in the RDR/RAWP phase of work, will be used to define the conditions for continued operation, or for expanding the treatment footprint outside the original plume source areas. The Adaptive Management SMP [Site Management Plan] will also provide the criteria for ceasing active treatment operations and determine any potential follow-on actions that may be required. It will be developed during the	Agree. The following text has been added to the subject paragraph to reference the Main Plant Area Focused Feasibility Study (*East Tennessee Technology Park Main Plant Groundwater Focused Feasibility Study, Oak Ridge, Tennessee* (DOE/OR/01-2894&D2): "The adaptive management process was presented in the approved MPA FFS. DOE will follow the adaptive management process consistent with EPA Office of Land and Emergency Management Directives 9200.3-120 and 9200.3-123."

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		remedial design in collaboration with DOE, TDEC, and EPA. (p. ES-4, Brackets added) The IROD will need to be revised to either footnote the FFS text above or rewrite the last sentence to be consistent with the AM process outlined in the approved FFS. The public must understand DOE's use of this term/process. Additionally, the following text must be added for clarity: The DOE will follow the Adaptive Management process consistent with EPA OLEM Directive 9200.3-120 (dated July 3, 2018) and EPA OLEM Directive 9200.3-123 (dated June 23, 2022).	
13.	Figure 2.3, p. 2-14	Average potentiometric surface for MPA of ETTP: The legend shows tan-colored shapes and identifies them as "Existing Structures." This is confusing because Figure 1.2 (p. 1- 6) shows many of these same structures as "Remaining Slab Foundation" or it seems to indicate that there is nothing present at the former building site. Please consider revising the legends to be consistent between figures and if possible, revise the figures to more accurately convey the current site conditions.	Agree. Figure 2.3 has been revised to reflect current site conditions. Revised Figure 2.3 is included at the end of this comment resolution form.
14.	Section 2.5.6, K-27/K-1232 Conceptual Site Model, p. 2-35	The third paragraph notes that Figure 2.9 (plume map) reflects information available at the time of the 2022 FFS, but recently conducted work under the Zone 2 Soils ROD identified additional sources and resulted in an updated CSM. Perhaps, for clarity, this paragraph should note that the PDI (mentioned in other paragraphs) will be based on an updated CSM?	Agree. The text has been revised as follows to note the Main Plant Area Focused Feasibility Study used data collected through June 2019: "Figure 2.9 shows the plumes configuration based on data available at the time of the MPA FFS (using data collected through June 2019)." The following text has been added to Section 2.4 to supplement the pre-design investigation discussion: "When the PDI is developed, it will consider all data collected since documentation of the CSM, described below, in the MPA FFS."

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15.	Section 2.5.7, K-1239 Conceptual Site Model, p. 2-31	The text states: The presence of TCE at a concentration exceeding 5% of its solubility suggests there is a strong probability that DNAPL is present in the bedrock at this location. Additional data collected during the PDI phase of the MPA IROD will be evaluated to improve the understanding of site conditions at the K-1239 Disposal Pit. Comment: Please define the "concentration exceeding 5% of its solubility" for TCE and put it in parentheses following the word solubility so the reader understands the magnitude of TCE contamination.	Clarification. The reference to 5% solubility was a typographical error. This percentage has been revised to 1% in the text. The subject sentence has been revised as follows: "The presence of TCE at a concentration exceeding 1% of its solubility (TCE solubility in water is 11,000 µg/L) suggests there is a strong probability that DNAPL is present in the bedrock at this location."
16.	Section 2.6, Current and Potential Future Land and Resource Uses, p. 2-32	The fourth paragraph, fourth sentence, states that "any buildings newly constructed on the property, which are intended to be occupied by workers 8 hr or more per scheduled work day or by public visitors, be designed and constructed to minimize exposure to volatile organic compound vapors, if determined to be necessary, using OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (EPA 2015) or an alternative, more recent EPA guidance document." This language was used in prior transfers, but as to future transfers, please revise to be consistent with the latest understanding among EPA, TDEC, and DOE and change "any buildings newly constructed on the property" to read, "any existing or newly constructed buildings on the property . . .".	Clarification. The Tennessee Department of Environment and Conservation requested the specific Covenant Deferral Request vapor intrusion language be used in the subject paragraph (see Tennessee Department of Environment and Conservation Comment Resolution Form, response to specific comment 2). The text now reads: "Portions of the ETTP MPA have been or will be leased or transferred for reindustrialization. In all cases, the transfer deeds transfer the property but prevent groundwater use at the site and require actions to ensure indirect exposures via vapor intrusion are mitigated. Vapor intrusion LUC implementation is outlined in the specific property transfer deed covenants."
17.	Section 2.6, Current and Potential Future Land	The fifth paragraph, first sentence, states that DOE has unrestricted access to the already transferred property. Please change this to "the United States," consistent with the language in deeds that states, "the United States and its officers, agents, employees, contractors, and subcontractors shall have the right	Agree. The text has been revised as suggested: "Despite having transferred the land for reuse at the MPA, the transfer deeds all contain language that ensures the United States retains access to the groundwater plumes at ETTP for the purpose of

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	and Resource Uses, p. 2-32	(upon reasonable notice to and coordination with the GRANTEE or the then-owner and any authorized occupant of the Property) at the direction of the GRANTOR to enter upon the Property." In addition, EPA recommends that the MPA IROD strike the word "unrestricted" in this sentence, given the "restriction" to provide reasonable notice and coordination with the Grantee and consistent with the following sentence.	investigations, remedial action, and monitoring sites to implement the selected remedy. Coordination with existing tenants may need to be accounted for in planning and implementing work."
18.	Section 2.6, Current and Potential Future Land and Resource Uses, p. 2-33	The first paragraph, last sentence before the bullets, states reasons why offsite groundwater contamination is not likely to be ORR-related. Please delete the second and third bullet because neither of these demonstrate or address the source of the contamination.	The subject text has been revised based on discussions during the comment resolution meeting on February 22, 2024, and to provide consistency with agreed-upon language in the K-31/K-33 Area Groundwater Record of Decision. The full paragraph now reads as follows: "In addition to the on-site uses of the land and groundwater resources, off-site land and groundwater uses are considered since groundwater flows to off-site locations. Residents currently are located offsite to the north and west of ETTP. DOE conducted the *Offsite Groundwater Assessment Remedial Site Evaluation* (DOE/OR/01-2715&D2) from fiscal years 2014–2016 to investigate groundwater quality and potential off-site migration of contaminants from the ORR. The study included sampling 15 residential wells and springs downgradient of ETTP. The study did not identify any contamination issues or other impacts at these 15 wells and springs sampled during the fiscal years 2014–2016 time period. Continued sampling in accordance with Phase 2 of the Offsite Groundwater Remedial Site Evaluation at a subset of five downgradient monitoring locations in fiscal years 2019–2021 has documented the absence of off-site contamination issues in those five residential wells."

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			The following text has been deleted from the referenced paragraph per recommendations from the Tennessee Department of Environment and Conservation during the February 22, 2024, comment resolution meeting: "~~The study concluded cancer risks at all off site monitoring locations are within the EPA acceptable risk range. Noncancer risks were above a hazard index (HI) of 1 at five locations; however, these HI values for noncancer toxic effects are associated with four inorganic constituents—lithium, fluoride, manganese, and thallium. The study concluded the inorganics contributing to the noncancer HI > 1 are not likely an ORR related issue because the inorganics may be naturally occurring. These four inorganics are not COCs identified in the ETTP soil RODs or the previous groundwater RIs~~." To make the text consistent with the K-31/K-33 Area Groundwater Record of Decision and based on discussions at the February 22, 2024, comment resolution meeting, the previous comment response, provided below, has not been included in this revised Main Plant Area Interim Record of Decision: ~~"The study concluded the inorganics contributing to the noncancer HI > 1 are not likely an ORR related issue because the inorganics may be naturally occurring. These three inorganics are not COCs identified in the ETTP soil RODs or the previous groundwater RIs."~~
19.	Section 2.8, Remedial Action Objectives	The RAOs as stated are not clear. EPA recommends using bullets to summarize the RAOs, for example (as summarized from the paragraphs in this section):	Agree. The remedial action objectives have been summarized at the end of Section 2.8 as follows: "To summarize, the interim remedial action objectives for this MPA IROD are to:

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	(RAOs), p. 2-34 and 2-35	• Reduce contaminant mass that continues to act as sources for groundwater contamination; • Reduce contaminant mass to below 1000 µg/L for CVOCs and 400 µg/L for VC (to less than 1% of the solubility of CVOCs and VC); • Achieve the greatest practicable reduction in contaminant mass; and • Further delineate contaminated groundwater plumes, source areas, and the transfer mechanisms between the two.	• Reduce contaminant mass that continues to act as sources for groundwater contamination. • Reduce contaminant concentrations to less than or equal to 1000 µg/L for individual CVOCs or 400 µg/L for VC. • Achieve the greatest practicable reduction in contaminant mass in the six source zones." The fourth bullet the U.S. Environmental Protection Agency provided has not been included in the revision because it is not an objective of the remedial action, and it has not previously been included in the remedial action objectives presented in the Main Plant Area Focused Feasibility Study (DOE/OR/01-2894&D2) and Main Plant Area Proposed Plan (DOE/OR/01-2921&D2/R1). This work will be completed as part of new work the U.S. Department of Energy is formalizing with the U.S. Environmental Protection Agency and Tennessee Department of Environment and Conservation.
20.	Section 2.9.5, Common Components of Alternatives, LUCs, p. 2-44	The first sentence states, "Each alternative requires LUCs to protect human health until future final cleanup goals are achieved." Since groundwater use restrictions must remain in place at least until the groundwater reaches MCLs, please revise this sentence to read, "Each alternative requires LUCs to protect human health until future final cleanup goals are achieved. In the case of this groundwater remedy, these LUCs will remain in place at least until the groundwater reaches levels that allow for unrestricted use and exposure, that is, at least until the groundwater reaches MCLs throughout the plume, and could be required even longer to prevent migration of groundwater on the site due to any such extraction."	Clarification. In response to Tennessee Department of Environment and Conservation specific comment 3 (see the Tennessee Department of Environment and Conservation Comment Resolution Form), Section 2.9.5 and Table 2.5 have been revised for clarification. Revised Section 2.9.5 and revised Table 2.5 are included at the end of this comment resolution form. The Federal Facility Agreement tri-party agreed to create the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan (DOE/OR/01-2477&D4), which serves as the East Tennessee Technology Park Land Use Control Implementation Plan, for the purpose of providing a centralized location for land use control implementation

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			to be described and updated. This document was designated a Remedial Action Report with the intention of ensuring it was a primary Federal Facility Agreement document for regulatory review and approval. The East Tennessee Technology Park Land Use Control Implementation Plan will be updated with the land use controls in this Main Plant Area Interim Record of Decision. The U.S. Department of Energy will meet with the Project Team to clarify the purpose and benefits of the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan, understand the Tennessee Department of Environment and Conservation's concerns about the level of detail in the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan/Land Use Control Implementation Plan, and discuss how the East Tennessee Technology Park Remedial Action Report Comprehensive Monitoring Plan should be revised to address the Tennessee Department of Environment and Conservation's concerns. This includes clarifying which areas the specific land use controls apply to and which regulatory documents provide the basis for these land use controls. Note the highlighted portion of the U.S. Environmental Protection Agency's comment has not been included in the subject text because the timeframe for land use controls was updated in response to U.S. Environmental Protection Agency's specific comment 3.
21.	Section 2.9.5, Common Components of	Please add a statement that LUCs apply to the entire Main Plant area shown on Figure 1-3.	Agree. Section 2.9.5 and Table 2.5 have been revised and are included at the end of this comment resolution form. The 'Property record restrictions' bullet in the revised section has been revised as follows:

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	Alternatives, LUCs, p. 2-44		"**Property record restrictions.** The purpose is to restrict property use and/or prohibit groundwater use by imposing limitations and mitigating the vapor intrusion pathway on existing and future enclosed building structures as needed. All property use is restricted to industrial use at ETTP Zone 2. All groundwater within the entire MPA IROD area, as shown in Figure 1.3, is restricted for use at least until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved. All current and future buildings in the MPA IROD area, as shown in Figure 1.3, will be mitigated for vapor intrusion if the pathway is found to be complete and exceed acceptable risk standards. Mitigation will continue until volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved."
22.	Section 2.9.5, Common Components of Alternatives, LUCs, p. 2-45	At the beginning of the last paragraph, please add the following statements, "The DOE is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although the DOE may later transfer or has already transferred these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the DOE shall retain ultimate responsibility for remedy integrity."	Agree. Section 2.9.5 and Table 2.5 have been revised and are included at the end of this comment resolution form. The last paragraph in the revised section has been revised as follows: "DOE is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although DOE may later transfer or has already transferred these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity. The ETTP RAR CMP also identifies guidelines for property transfer and LUC verification and reporting. The application of LUCs will be the same for all alternatives. These

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			LUCs would remain in effect until they are updated or removed in a future decision document."
23.	Section 2.9.5, Common Components of Alternatives, p. 2-45 and 2-46	FYRs are not part of remedial actions are but are requirements of CERCLA Section 121(d) whenever a remedy is selected that leaves waste in place above levels that allow for unrestricted use and unlimited exposure. Please remove from this section.	Agree. Section 2.9.5 and Table 2.5 have been revised and are included at the end of this comment resolution form. The Five-Year Review discussion has been deleted from Section 2.9.5. Note Five-Year Reviews are discussed at the end of Section 1.5. Additionally, references to Five-Year Reviews in each of the alternative descriptions have been removed. Each alternative had included the Five-Year Review as a component of the alternative. The text has been revised as follows in each alternative section (i.e., Sections 2.9.2, 2.9.3, and 2.9.4, as well as 2.12.2): "LUCs will be addressed under the ETTP RAR CMP ~~and FYRs will be completed~~."
24.	Section 2.10, Summary of Comparison of Alternatives, Overall Protection of Human Health and the Environment, p. 2-47	The first paragraph, first sentence states that "Because LUCs are in place at ETTP, no action . . . does not pose a threat to human health and the environment." This appears to be a typographic error and likely meant to state that no action poses a threat to human health and the environment. Please clarify and correct as appropriate.	Agree. The text has been revised as follows (note the revised text matches the text in Table 7.1 of the Main Plant Area Focused Feasibility Study [DOE/OR/01-2894&D2]): "**Overall protection of human health and the environment.** Because LUCs are in place at ETTP, the no action alternative does not pose a threat to human health. However, the no action alternative does not achieve the interim remedial action objective of substantially reducing source mass, which is the first step in overall protection of human health in the long term. The three treatment alternatives are expected to substantially reduce contaminant mass and achieve interim remedial action objectives to support a final cleanup decision and final remedial action objectives."

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25.	Section 2.10, Summary of Comparison of Alternatives, p. 2-47	The subsection "Long-term effectiveness and permanence" does not identify VC with a specific target concentration limit or mention the need for additional site characterization and possible interim remediation. Please address and/or clarify its absence.	Agree and clarification. The text has been revised as follows to note the cleanup goal of vinyl chloride. This change has been made throughout the document as appropriate (see response to general comment 1). Section 1.4 notes the pre-design investigation addresses vinyl chloride at a lower concentration. "**Long-term effectiveness and permanence.** The no action alternative is not considered an effective long-term solution to groundwater contamination problems in the MPA. The three treatment alternatives are expected to be effective in the long term, aid toward achieving a permanent solution, and have the following attributes in common: • Treatment will target the most highly contaminated groundwater that represents the greatest risks at the site and where concentrations of specific CVOCs exceed 1000 µg/L (or 400 µg/L for VC). • Treatment in bedrock represents a challenge that will be addressed incrementally over time. It is likely some pockets of contaminants above 1000 µg/L (or 400 µg/L for VC) will remain in the bedrock. • Treatment will continue until target contaminants are reduced below 1000 µg/L (or 400 µg/L for VC), at which point treatment will continue as long as it is technically and economically feasible. • Groundwater will be monitored to assess treatment progress. • Treatment is expected to substantially reduce contaminant concentrations in the groundwater

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			plumes."
26.	Table 2.6, Detailed evaluation of remedial alternatives, pp. 2-49 to 2-59	The table has a "Criterion score" for each alternative of the seven criteria listed. The meaning of these numbers is not clearly explained in the column titled "Comparative assessment among alternatives." Please add text in the legend on page 2-59 to clarify these values (e.g., 1 is low/not desired and 10 is high/best) relative to the scale in which they are presented, and define the various factors that impacted the score calculation. The numbers presented are not clear to the reader.	Agree. New Table 2.7 has been added to the text to describe the 10-point scale used. This is the same table as was used in the Main Plant Area Focused Feasibility Study (DOE/OR/01-2894&D2). Note that, with this new table, former Table 2.7 is now renumbered as Table 2.8. New Table 2.7 is included at the end of the comment resolution form.
27.	Section 2.11, Principal Threat Wastes, p. 2-63	The concentration of COCs that have been encountered are described in the MPA IROD as source material and could themselves be considered principal threat wastes, whether the Dense Non-Aqueous Phase Liquid (DNAPL) that is anticipated to be present is ever discovered. Please revise consistent with this comment.	Agree. The second paragraph of Section 2.11 has been revised as follows: "Should DOE encounter principal threat source material (e.g., DNAPL, or concentrations of CVOCs that might be indicative of DNAPL) that remains below the water table during the PDI phase of implementing this MPA IROD, the proposed EISB treatment would be applied to the principal waste to the extent practicable. If encountered, measuring and documenting the effectiveness of treatment to this type of waste are one of the desired outcomes of this MPA IROD."
28.	Section 2.12.2, Summary of Rationale for Preferred Alternative, p. 2-63	The second paragraph, first sentence, states the remedy complies with ARARs (because it is using an ARAR waiver). This is incorrect. Please revise to state that because the remedial action is utilizing an ARAR waiver under CERCLA 121(d), it does not comply with ARARs.	Clarification. The second paragraph in Section 2.12.1 has been revised as follows: "The selected remedy meets the interim remedial action objective target performance metric identified for the interim action; complies with ARARs except for those chemical-specific ARARs being waived under the interim action ARARs waiver; uses active treatment to address principal threat materials; and accounts for the best balance of all criteria presented in the comparative analysis of alternatives."

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29.	Section 2.12.4, Expected Outcomes of the Selected Remedy, p. 2-67	The second sentence states, "The interim remedial action is estimated to require 5 years to achieve interim remedial action objectives." Since the RAOs are qualitative, the MPA IROD should explain, perhaps in Section 2.8 or 2.10, how achieving RAOs will be established and measured, and then summarized here.	Agree. Section 2.12.4 has been revised as follows: "The interim selected remedy for the six plumes addressed by this MPA IROD is not expected to reduce the human health risk at the site to acceptable levels immediately upon completion of the interim remedial action; however, it is expected to address the most significant contamination at the six plumes and result in significant mass and concentration reduction of CVOCs. The interim remedial action is estimated to require 5 years to achieve the interim remedial action objective of reducing contaminant concentrations to less than or equal to 1000 µg/L for individual CVOCs or 400 µg/L for VC. Groundwater in the MPA will not be available for use until a final remedy is implemented and remedial action objectives and cleanup levels of a final ROD (or RODs) for the MPA are met. The expected future land use at the MPA is industrial."
30.	Section 2.13.5, Preference for Treatment as Principal Element, p. 2-68	This section confuses the statutory preference for treatment as a principal element, with the cited text from the NCP. While the NCP text can be retained, please note this following explanation to distinguish between the statutory preference and the expectation in the NCP regarding principal threat waste. As stated in EPA guidance, A Guide to Principal Threat and Low Level Threat Waste, 9380.3-06FS, November 1991, at page 3: The "Statutory Determinations" section should discuss how the selected remedy satisfies the statutory preference stated in CERCLA § 121 to select remedial actions "in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element."	Agree. Section 2.13.5 has been revised as suggested: "CERCLA Section 121 established a preference for remedial actions in which treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants is a principal element. The selected remedy satisfies this preference by using non-reversible treatment to destroy contaminant mass."

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		In evaluating this statutory preference, the site manager needs to decide whether treatment selected in the ROD constitutes treatment as a major component of the remedy for that site. Remedies which involve treatment of principal threat wastes likely will satisfy the statutory preference for treatment as a principal element, although this will not necessarily be true in all cases (e.g., when principal threat wastes that are treated represent only a small fraction of the wastes managed through containment).Ground water treatment remedies also may satisfy the statutory preference, even though contaminated ground water is not considered a principal threat waste and even though principal threat source material may not be treated. Please revise to state: "CERCLA Section 121 established a preference for remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of hazardous substances, pollutants, and contaminant is a principal element. The selected remedy satisfies this preference by utilizing non-reversible treatment to destroy contaminant mass."	
31.	Section 2.13.6, Five-Year Review Requirements, p. 2-68	Please revise the last sentence to read, "DOE will submit the results of these FYRs in accordance with the requirements of CERCLA, the NCP, and the ORR FFA for the Oak Ridge NPL Site."	Agree. The last sentence in Section 2.13.6 has been revised as suggested: "DOE will submit the results of these FYRs in accordance with the requirements of CERCLA, the NCP, and the ORR FFA for the Oak Ridge NPL Site."
32.	Section 2.14, Documentation of Significant	Consistent with the NCP at 40 CFR 300.430(f)(3)(ii)(A), which states that no additional public comment is needed "if the lead agency determines such changes could be reasonably anticipated by the public based on the alternatives and other	Agree. The last sentence in Section 2.14 has been revised as suggested: "This new information, while significant, could be reasonably anticipated by the public, as described in

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	Changes, p. 2-69	information available in the proposed plan or the supporting analysis and information in the administrative record," please change the last sentence to read, "This new information, while significant, could be reasonably anticipated by the public as described in 40 CFR 300.430(f)(3)(ii)(A), and, therefore, it does not require the issuance of a revised MPA Proposed Plan or announcement of a new public comment period."	40 CFR 300.430(f)(3)(ii)(A), and, therefore, it does not require issuance of a revised MPA Proposed Plan or announcement of a new public comment period."
33.	Responsiveness Summary, p. 3-8, Response 14	Missing is a reference to vinyl chloride and its interim target remedial goal. Please consider adding that information in this response.	Agree. The first sentence has been revised as follows: "The proposed enhanced in situ bioremediation (EISB) treatment, as outlined in the Main Plant Area (MPA) Proposed Plan, represents an initial stage of treatment focused on significant mass reduction (down to 1000 µg/L or 400 µg/L for vinyl chloride) in high chlorinated volatile organic compound (CVOC) groundwater source areas."
34.	Table A.2, ARARs, Chemical-specific, p. A-6	In the third citation, please remove the citation to 40 CFR 300.430(e)(2)(i)(B) and (C). References to the NCP state general requirements and expectations that inform the selection of CERCLA remedial actions. They are not, however, ARARs. In the "Requirements" column of this citation, please remove the following text, "Under CERCLA Section 121(d)(2)(A) and the NCP, MCLs are relevant and appropriate for groundwater response actions where the groundwater aquifer is used or classified for use as drinking water." While the citation is accurate, it does not, as above, establish or describe a specific ARAR. The appropriate ARAR would be to the SDWA requirement, which is 40 CFR 141.61(a) (for organic contaminants), which can be added as a parallel citation to TDEC 0400-45-01-.06 and/or .25. No additional text is required.	Agree. The National Oil and Hazardous Substances Pollution Contingency Plan text and citation have been removed, and parallel citation to the federal maximum contaminant levels has been added. Revised Table A.2 is included at the end of this comment resolution form.

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35.	Table A.2, ARARs	Location-specific, Wetlands. Please add the following wetlands requirements omitted from the table.	Please see page 23 of this comment resolution form to view the tables/recommendations referenced in this comment. Agree. The U.S. Environmental Protection Agency wetland requirements have been added as suggested. Revised Table A.2 is included at the end of this comment resolution form. Note the 'minor alterations to wetlands' rows were in the D1 version of this Main Plant Area Interim Record of Decision.
36.	Table A.2, ARAR, Location-specific, Aquatic Resources	Please add a new subheading "Aquatic Resources" after "Floodplains" and add the following requirements:	Please see page 26 of this comment resolution form to view the tables/recommendations referenced in this comment. Disagree. Remedial actions under this Main Plant Area Interim Record of Decision will occur some distance from any surface water bodies. No bank stabilization or culvert maintenance activities will take place under this remedial action. Likewise, no alteration of a wet-weather conveyance or any impact to a surface water body is anticipated, thus the Tennessee wet-weather conveyance, stream mitigation requirements, dredge and fill requirements, or Fish and Wildlife Coordination Act requirements will not be triggered as an applicable or relevant and appropriate requirement.
37.	Table A.2, ARARs, Location-Specific, Cultural Resources	Under the Cultural Resources subheading, please add the following requirements:	Please see page 29 of this comment resolution form to view the table/recommendation referenced in this comment. Disagree. Each of the steps identified from 36 Code of Federal Regulations 800 has been completed for the entire East Tennessee Technology Park site and has been documented in the executed National Historic Preservation Act of 1966 Memorandum of Agreement from August 2012. The only historic property in the Main Plant Area being affected by this remedial action is the

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			K-25 building footprint, which is addressed in the 2012 Memorandum of Agreement. The 2012 Memorandum of Agreement is the controlling document now for historic properties at the East Tennessee Technology Park.
38.	Table A-2, ARARs, Location-specific, Cultural Resources, p. A-13	In the second citation (to MOA between DOE and DOI for the Manhattan Project National Historical Park (November 10, 2015), please move the "TBC" to the "Prerequisites" column.	Agree. The 'TBC' notation has been moved as suggested. Revised Table A.2 is included at the end of this comment resolution form.
39.	Table A-2, ARARs, Location-specific, Cultural Resources, p. A-13	In the third citation, the citation was not included. Please deleted the text in the right-hand column and include the citation to 43 CFR 7.4(a).	Agree. The 'Citation' cell has been revised as suggested. Revised Table A.2 is included at the end of this comment resolution form.
40.	Table A-2, ARARs, Location-specific, Cultural Resources, after p. A-13	Please add the following additional requirements. While it is not clear that all the requirements are applicable or relevant and appropriate, DOE's inclusion of some related requirements suggests that others should also be included.	Please see page 29 of this comment resolution form to view the tables/recommendations listed in this comment. Disagree. As to citations to 36 Code of Federal Regulations 800, please see response to specific comment 37. There are no known historic archeological properties in the Main Plant Area. The area of potential effects is the Main Plant Area, which was entirely disturbed, including placement of extensive fill over 70 years ago. In addition, the area has been further disturbed by the cleanup actions over recent years. There is no reasonable expectation that historic archeological properties will be encountered based on the remedial actions under this Main Plant Area Interim Record of Decision; however, the applicable or relevant and

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			appropriate requirement for inadvertent discovery of archeological resources (43 Code of Federal Regulations 10.4(c)) was included in the D1 version of this Main Plant Area Record of Decision. There are no cemeteries in the Main Plant Area that would be near remedial activities under this Main Plant Area Interim Record of Decision.
41.	Table A-2, ARARs, Action-specific, Site Preparation, Construction, and Excavation Activities, p. A-14	Please add after 40 CFR 61.92 the following requirement. It is not clear that this is related to this specific activity but applies more generally; EPA has no objection to including in this section as long as it is clear that this ceiling applies to the sum of all releases.	Please see page 30 of this comment resolution form to view the table/recommendation listed in this comment. Agree. The U.S. Environmental Protection Agency's recommendation has been added as suggested. Revised Table A.2 is included at the end of this comment resolution form.

For ease of viewing, please see the following tables attached in reference to comment #35:

Location Resource	Requirements	Prerequisite	Citation
Presence of wetlands	Shall take action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands. *NOTE:* Federal agencies required to comply with E.O. 11990 requirements.	Federal actions that involve potential impacts to, or take place within, wetlands - TBC	Executive Order 11990 Section 1.(a) *Protection of Wetlands*
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction, and (2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.		Executive Order 11990, Section 2.(a) *Protection of Wetlands*
Presence of Wetlands (as defined in 44 *CFR* 9.4)	The Agency shall minimize[16] the destruction, loss or degradation of wetlands. The Agency shall preserve and enhance the natural and beneficial wetlands values	Federal *actions affecting or affected by Wetlands* as defined in 44 *CFR* 9.4 - relevant and appropriate	44 *CFR* 9.11(b)(2) and (b)(4) *Mitigation*
	The Agency shall minimize: • Potential adverse impact the action may have on wetland values.		44 *CFR* 9.11(c)(3) *Minimization provisions*
General Compensatory Mitigation for Wetlands	Compensatory mitigation required to offset unavoidable impacts to waters of the United States authorized by DA permits. Compensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular DA permit. • Amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. • Compensatory mitigation may be provided through mitigation banks or in-lieu fee programs. • Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the impact-causing activity. *NOTE:* Although permits are not required per CERCLA Section 121(e)(1), consultation with the USACE recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action.	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.93(a)(1) *General compensatory mitigation requirements*
	Compensatory mitigation may be performed using the methods of restoration, enhancement, establishment, and in certain circumstances preservation. Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation.	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.93 (a)(2)

Location Resource	Requirements	Prerequisite	Citation
General Compensatory Mitigation for Wetlands (cont.)	All compensatory mitigation projects must comply with the standards in this part [40 *CFR* Part 230], if they are to be used to provide compensatory mitigation for activities authorized by DA permits, regardless of whether they are sited on public or private lands and whether the sponsor is a governmental or private entity. *NOTE:* Although permits are not required per CERCLA Section 121(e)(1), consultation with the USACE recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action.		40 *CFR* 230.93 (a)(3)
	Required compensatory mitigation should be located within the same watershed as the impact site and should be located where it is most likely to successfully replace lost functions and services, taking into account such watershed scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses.		40 *CFR* 230.93 (b) *Type and location of mitigation*
	Project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the district engineer must consider, to the extent practicable, the factors in subsections (i) thru (vi). Applicants should propose compensation sites adjacent to existing aquatic resources or where aquatic resources previously existed.		40 *CFR* 230.93 (d)(1) and (3) *Site selection*
	In general, in-kind mitigation is preferable to out-of-kind mitigation because it is most likely to compensate for the functions and services lost at the impact site. Except as provided in paragraph (e)(2) of this section, the required compensatory mitigation shall be of a similar type to the affected aquatic resource.		40 *CFR* 230.93 (e)(1) *Mitigation type*
	The amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. Where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratio must be used.		40 *CFR* 230.93 (f)(1) *Amount of compensatory mitigation*
	Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the activity causing the authorized impacts. The district engineer shall require, to the extent appropriate and practicable, additional compensatory mitigation to offset temporal losses of aquatic functions that will result from the permitted activity.		40 *CFR* 230.93 (m) *Timing*

Location Resource	Requirements	Prerequisite	Citation
Compensatory Mitigation Planning	Prepare a mitigation plan addressing objectives, site selection, site protection, baseline information, determination of credits, mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term management, and adaptive management. *NOTE:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan. Plan to include items described in 40 *CFR* 230.94(c)(2) through (c)(14).[17]	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.94(c) *Mitigation Plan*
Compensatory Mitigation Performance Standards	The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres).	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.95 (a) *Ecological Performance Standards*
	Performance standards must be based on attributes that are objective and verifiable. Ecological performance standards must be based on the best available science that can be measured or assessed in a practicable manner. Performance standards may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position. The use of reference aquatic resources to establish performance standards will help ensure that those performance standards are reasonably achievable, by reflecting the range of variability exhibited by the regional class of aquatic resources as a result of natural processes and anthropogenic disturbances. Performance standards based on measurements of hydrology should take into consideration the hydrologic variability exhibited by reference aquatic resources, especially wetlands.		40 *CFR* 230.95 (b) *Ecological Performance Standards*
Compensatory Mitigation Project Monitoring	Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure that the compensatory mitigation project is accomplishing its objectives. Compensatory mitigation project monitoring period shall be sufficient to demonstrate that project has met performance standards, but not less than 5 years.	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.96 (a) and (b) *Monitoring*

Location Resource	Requirements	Prerequisite	Citation
Compensatory Mitigation Project Management	The aquatic habitats, riparian areas, buffers, and uplands that comprise the overall compensatory mitigation project must be provided long-term protection through real estate instruments or other available mechanisms, as appropriate. For government property, long-term protection may be provided through federal facility management plans or integrated natural resources management plans. *NOTE:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan and/or Operations and Maintenance Plan. Projects shall be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved. This includes minimization of active engineering features (e.g., pumps) and appropriate siting to ensure that natural hydrology and landscape context will support long-term sustainability. Where active long-term management and maintenance are necessary to ensure long-term sustainability (e.g., prescribed burning, invasive species control, maintenance of water control structures, easement enforcement), the responsible party must provide for such management and maintenance.	Alteration of wetlands on *government property* requiring compensatory mitigation to replace lost aquatic resource functions – relevant and appropriate	40 *CFR* 230.97 (a)(1) *Site Protection* 40 *CFR* 230.97 (b) *Sustainability*
Minor alterations to wetlands	Minor alteration to wetlands must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for minor alteration to wetlands include the following: • Excavation and fill activities associated with wetland alteration shall be kept to a minimum • Wetlands outside of the impact areas shall be clearly marked with signs, high visibility fencing, or similar structures so that all the work performed by the contractor is solely within the permitted impact area. • Wetland alterations shall not cause measureable degradation to resource values and classified uses of hydraulically connected wetlands or other waters of the state, including disruption of sustaining surface or groundwater hydrology. • Temporary impacts to wetlands shall be mitigated by the removal and stockpiling of the first 12 in. of topsoil, prior to construction. Temporary wetland crossings or haul roads shall utilize timber matting. Gravel, riprap or other rock is not approved for construction of temporary crossings or haul roads across wetlands. Upon completion of construction activities, all temporary wetland impact areas are to be restored to pre-construction contours, and the stockpiled topsoil spread to restore these areas to pre-construction elevation. Other side-cast material shall not be placed within the temporary impact locations. Permanent vegetative stabilization using native species of all disturbed areas in or near the wetland must be initiated within 14 days of project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established.	Minor alterations of up to 0.10 acre of moderate resource value wetlands or of up to 0.25 acre of degraded and of low resource value wetlands — applicable	*TCA* 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Minor Alterations to Wetlands (effective April 7, 2020) (TBC)

Location Resource	Requirements	Prerequisite	Citation
Minor alterations to wetlands	• Erosion prevention and sediment control measures such as fences shall be removed following completion of construction. • The amount of fill, stream channel and bank modifications, or other impacts associated with the activity shall be limited to the minimum necessary to accomplish the project purpose. Shall utilize the least impactful practicable method of construction. • Clearing, grubbing, or other disturbance to wetland vegetation shall be kept at the minimum. Unnecessary native vegetation removal, including tree removal, and soil disturbance is prohibited. Native wetland vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed. • Activity may not result in a disruption or barrier to the movement of fish or other aquatic life and wetland dependent species upon project completion. • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited. • Where practicable, all activities shall be accomplished during drier times of the year or when recent conditions have been dry at the impact location. All surface water flowing towards or from the construction activity shall be diverted using cofferdams and/or berms constructed of sandbags, steel sheeting, or other non-erodible, non-toxic material. All such diversion materials shall be located outside the wetland and removed upon completion of the work. Activities may be conducted in the water if working in the dry will likely cause additional degradation. If work is conducted in the water it must be of a short duration and with minimal impact. • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established. • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank.		

For ease of viewing, please see the following tables attached in reference to comment #36:

Aquatic Resources			
Waters of the state as defined in *TCA* 69-3-103(45) – Bank stabilization	Bank stabilization activities along state waters must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for stream bank stabilization include the following: • Any spraying, mowing, or other disturbance of the stabilization treatment that interferes with its ability to naturalize is prohibited. • Work performed by vehicles and other related heavy equipment may not be staged within the stream channel. Work performed by hand and related hand-operated equipment is allowed within the stream channel. • Materials used for bank stabilization shall consist of rock, wood, or products made specifically for use in earthen slope stabilization. Other salvaged materials not found in the natural environment cannot be used for bank stabilization.	Bank-stabilization activities affecting waters of the state—applicable	*TCA* 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Bank Armoring and Vegetative Stabilization Activities (effective January 6, 2021) (TBC)

Location Resource	Requirements	Prerequisite	Citation
Waters of the state as defined in *TCA* 69-3-103(45) – Bank stabilization (cont.)	• The amount of fill, stream channel and bank modifications, or other impacts associated with the activity shall be limited to the minimum necessary to accomplish the project purpose. Shall utilize the least impactful practicable method of construction. • Clearing, grubbing, or other disturbance to riparian vegetation shall be kept at the minimum necessary for slope construction and equipment operation. Unnecessary native riparian vegetation removal, including tree removal, is prohibited. Native riparian vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed. • Activity may not result in the permanent disruption to the movement of fish or other aquatic life upon project completion. • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited. • Backfill activities must be accomplished in the least impactful manner possible that stabilizes the streambed and banks to prevent erosion. The completed activities may not disrupt or impound stream flow. • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank. • Where practicable, all activities shall be accomplished in the dry. All surface water flowing towards the work shall be diverted using cofferdams and/or berms constructed of sandbags, clean rock (no fines or soils), steel sheeting, or other non-erodible, non-toxic material. All such diversion materials shall be removed upon completion of the work. Any disturbance to the stream bed or banks must be restored to its original condition. Activities may be conducted in the water if working in the dry will likely cause additional degradation. If work is conducted in the water it must be of a short duration and with minimal impact and conform to the Division-approved methodology. • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established. • Temporary stream crossings shall be limited to one point in the construction area and erosion control measures shall be utilized where stream bank vegetation is disturbed. Stream beds shall not be used as linear transportation routes for mechanized equipment, rather, the stream channel may be crossed perpendicularly with equipment provided no additional fill or excavation is necessary.		

Location Resource	Requirements	Prerequisite	Citation
Waters of the state as defined in *TCA* 69-3-103(45) – Bank stabilization (cont.)	• Hard armoring bank stabilization treatment shall not exceed 300 linear ft for the treatment of one bank, or 200 linear ft per bank if the treatment includes both banks.		
Waters of the state as defined in *TCA* 69-3-103(45) – Culvert maintenance activities	The maintenance of existing serviceable structures or fills along waters of the state must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for maintenance activities include the following: • The length of the pipe or culvert structure may not be increased in a manner that encapsulates any additional length of open stream or wetland • The capacity or diameter of the culvert may be increased during replacement, providing it does not result in channel widening or other channel destabilization • Dewatering of impoundments to conduct dam maintenance must be performed in a controlled manner designed to prevent the release of accumulated sediments into downstream waters. • All riprap associated with maintenance activities shall be placed to mimic the existing contours of the stream channel. Riprap shall be countersunk and placed at grade with the existing stream substrate. Voids in the riprap shall be filled with suitable bedload substrate to prevent stream flow loss within riprap areas. Suitable substrate does not include soil. • Work performed by vehicles and other heavy equipment may not be staged within the stream channel. Work performed by hand and related hand-operated equipment is allowed within the stream channel. • The amount of fill, stream channel and bank modifications, or other impacts associated with the activity shall be limited to the minimum necessary to accomplish the project purpose. Shall utilize the least impactful practicable method of construction. • Clearing, grubbing, or other disturbance to riparian vegetation shall be kept at the minimum necessary for slope construction and equipment operations. Unnecessary native riparian vegetation removal, including tree removal is prohibited. Native riparian vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed. • Widening of the stream channel is prohibited • Activity may not result in a permanent disruption to the movement of fish or other aquatic life upon project completion. • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited.	Maintenance activities affecting waters of the state—**applicable**	*TCA* 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Maintenance Activities (effective April 7, 2020) (TBC)

Location Resource	Requirements	Prerequisite	Citation
Waters of the state as defined in *TCA* 69-3-103(45) – Culvert maintenance activities (cont.)	• Backfill activities must be accomplished in the least impactful manner possible that stabilizes the streambed and banks to prevent erosion. The completed activities may not disrupt or impound stream flow. • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank. • Where practicable, all activities shall be accomplished in the dry. All surface water flowing towards the work shall be diverted using cofferdams and/or berms constructed of sandbags, clean rock (no fines or soils), steel sheeting, or other non-erodible, non-toxic material. All such diversion materials shall be removed upon completion of the work. Any disturbance to the stream bed or banks must be restored to its original condition. Activities may be conducted in the flowing water if working in the dry will likely cause additional degradation. If work is conducted in the flowing water it must be of a short duration and with minimal impact and conform to the Division-approved methodology. • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established. • Temporary stream crossings shall be limited to one point in the construction area and erosion control measures shall be utilized where stream bank vegetation is disturbed. Stream beds shall not be used as linear transportation routes for mechanized equipment, rather, the stream channel may be crossed perpendicularly with equipment provided no additional fill or excavation is necessary.		
Alteration of a Wet Weather Conveyance	Wet-weather conveyances may be altered provided the following conditions are met: • The activity must not result in the discharge of waste or other substances that may be harmful to humans or wildlife; • Material must not be placed in a location or manner so as to impair surface water flow into or out of any wetland area; and • Sediment shall be prevented from entering other waters of the state:	Activities that alter wet-weather conveyances—**applicable**	TCA 69-3-108(q)

Location Resource	Requirements	Prerequisite	Citation
Alteration of a Wet Weather Conveyance (cont.)	• Erosion/sediment controls shall be designed according to size and slope of disturbed or drainage areas to detain runoff and trap sediment and shall be properly selected, installed, and maintained in accordance with manufacturer's specifications and good engineering practices. • Erosion/sediment control measures must be in place and functional before earthmoving operations begin, and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the work day, but shall be replaced at end of the work day. • Checkdams must be utilized where runoff is concentrated. Clean rock, log, sandbag or straw bale checkdams shall be properly constructed to detain runoff and trap sediment. Checkdams or other erosion control devices are not to be constructed in stream. Clean rock can be of various type and size depending on the application and must not contain fines, soils, or other wastes or contaminants. • Appropriate steps must be taken to ensure that petroleum products or other chemical pollutants are prevented from entering waters of the state. All spills shall be reported to the appropriate emergency management agency and TDEC. In event of a spill, measures shall be taken immediately to prevent pollution of waters of the state, including groundwater.		
Location encompassing aquatic ecosystem as defined as 40 *CFR* 230.3(c)	No discharge of dredged or fill material into an aquatic ecosystem is permitted if there is a practical alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute significant degradation of waters of the U.S.	Action that involves the discharge of dredged or fill material into "waters of the U.S.," including jurisdictional wetlands—**applicable**	40 *CFR* 230.10(a), and (c) CWA Regulations – Sect. 404(b) Guidelines
	Except as provided under [CWA] Sect. 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps [in accordance with 40 *CFR* 230.70 *et seq. Actions to Minimize Adverse Effects*] have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem.		40 *CFR* 230.10(d) CWA Regulations – Sect. 404(b) Guidelines

Location Resource	Requirements	Prerequisite	Citation
Location encompassing aquatic ecosystem as defined as 40 *CFR* 230.3(c) (cont.)	No discharge of dredged or fill material shall be permitted if it: Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable State water quality standard; Violates any applicable toxic effluent standard or prohibition under Sect. 307 of the CWA: • Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat which is determined by the Secretary of Interior of Commerce, as appropriate, to be critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph. • Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.		40 *CFR* 230.10(b)
Mitigation of impacts to a stream as defined in TDEC 0400-40-07-.03 which includes all surface water except wetlands and wet weather conveyances	If an activity in a stream results in an appreciable permanent loss of resource values, the applicant must provide mitigation which results in no overall net loss of resource values from existing conditions. To the extent practicable, any required mitigation shall be completed, excluding monitoring, prior to, or simultaneous with, any impacts. Acceptable mitigation mechanisms include any combination of in-lieu fee programs, mitigation banks, or other mechanisms that are reasonably assured to result in no overall net loss of resource values from existing conditions. Acceptable mitigation methods are prioritized in the following order: restoration, enhancement, preservation, creation, or any other measures that are reasonably assured to result in no net loss of resource values from existing conditions. Mitigation for impacts to streams must be developed in a scientifically defensible manner that demonstrates a sufficient increase in resource values to compensate for impacts. At a minimum, all new or relocated streams must include a vegetated riparian zone, demonstrate lateral and vertical channel stability, and have a natural channel bottom. All mitigation watercourses must maintain or improve flow and classified uses after mitigation is complete.	Activity that would result in an appreciable permanent loss of resource value of a stream as defined in TDEC 0400-40-07-.03 —**applicable**	TDEC 0400-40-07-.04(7)(a) TDEC 0400-40-07-.04(7)(b) 2019 Tennessee Stream Mitigation Guidelines (**TBC**) TDEC Stream Quantitative Tool Workbook (**TBC**)
Within area impacting stream or any other body of water *-and-* presence of wildlife resources (e.g., fish)	The effects of water-related projects on fish and wildlife resources and their habitat should be considered with a view to the conservation of fish and wildlife resources by preventing loss of and damage to such resources.	Action that impounds, modifies, diverts, or controls waters, including navigation and drainage activities—**relevant and appropriate**	Fish and Wildlife Coordination Act [16 *USC* 662(a)]

For ease of viewing, please see the following tables attached in reference to comment #37:

Location Resource	Requirements	Prerequisite	Citation
	Cultural Resources		
Presence of historical resources on public land	Federal agencies must take into account the effects of their undertakings on historic properties.	Federal agency undertaking that may impact historical properties listed or eligible for inclusion on the National Register of Historic Places—**applicable**	36 *CFR* 800.1(a)
	Determine whether the proposed federal action is an undertaking as defined in §800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties.		36 *CFR* 800.3(a)
	Determine and document the area of potential effects, as defined in §800.16(d).		36 *CFR* 800.4(a)(1)–(2)
	Review existing information on historic properties within the area of potential effects, including any data concerning possible historic properties not yet identified.		
	Take the steps necessary to identify historic properties within the area of potential effects.		36 *CFR* 800.4(b)
	Apply the National Register criteria (36 *CFR* 63) to properties identified within the area of potential effects that have not been previously evaluated for National Register eligibility. If the agency official determines any of the National Register criteria are met and the SHPO/THPO agrees, the property shall be considered eligible for the National Register for Sect. 106 purposes.		36 *CFR* 800.4(c)(1)–(2)
	Shall apply the criteria of adverse effect to historic properties within the area of potential effects.		36 *CFR* 800.5(a)
	Shall ensure that a determination, finding, or agreement under the procedures in this subpart is supported by sufficient documentation to enable any reviewing parties to understand its basis.		36 *CFR* 800.11(a)

For ease of viewing, please see the following tables attached in reference to comment #40:

Location Resource	Requirements	Prerequisite	Citation
	Cultural Resources		
Presence of historical resources on public land	Federal agencies must take into account the effects of their undertakings on historic properties.	Federal agency undertaking that may impact historical properties listed or eligible for inclusion on the National Register of Historic Places—**applicable**	36 *CFR* 800.1(a)
	Determine whether the proposed federal action is an undertaking as defined in §800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties.		36 *CFR* 800.3(a)
	Determine and document the area of potential effects, as defined in §800.16(d).		36 *CFR* 800.4(a)(1)–(2)
	Review existing information on historic properties within the area of potential effects, including any data concerning possible historic properties not yet identified.		
	Take the steps necessary to identify historic properties within the area of potential effects.		36 *CFR* 800.4(b)
	Apply the National Register criteria (36 *CFR* 63) to properties identified within the area of potential effects that have not been previously evaluated for National Register eligibility. If the agency official determines any of the National Register criteria are met and the SHPO/THPO agrees, the property shall be considered eligible for the National Register for Sect. 106 purposes.		36 *CFR* 800.4(c)(1)–(2)
	Shall apply the criteria of adverse effect to historic properties within the area of potential effects.		36 *CFR* 800.5(a)
	Shall ensure that a determination, finding, or agreement under the procedures in this subpart is supported by sufficient documentation to enable any reviewing parties to understand its basis.		36 *CFR* 800.11(a)

Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony	Intentional excavation of human remains, funerary objects, sacred objects, or objects of cultural patrimony from federal or tribal lands may be conducted only if: • The objects are excavated or removed following the requirements of the ARPA (16 *USC* 470aa et seq.) and its implementing regulations, and • The disposition of the objects is consistent with their custody as described in §10.6.	Action involving alteration of terrain that might cause irreparable loss or destruction of any discovered significant scientific, prehistoric, historic, or archaeological resources—**applicable**	43 *CFR* 10.3(b)(1) and (3)

Location Resource	Requirements	Prerequisite	Citation
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony (cont.)	Must take reasonable steps to determine whether a planned activity may result in the excavation of human remains, funerary objects, sacred objects, or objects of cultural patrimony from federal lands.		43 *CFR* 10.3(c)
	If inadvertent discovery occurred in connection with an on-going activity on federal or tribal lands, in addition to providing the notice described above, must stop activities in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently.	Excavation activities that inadvertently discover such resources on federal lands or under federal control—**applicable**	43 *CFR* 10.4(c)
Presence of a cemetery	Intentional desecration of a place of burial without legal privilege or authority to do so is prohibited.	Action that would alter or destroy property in a cemetery—**applicable**	*TCA* 39-17-311(a)(1)
	Disinterment of a corpse that has been buried or otherwise interred, without legal privilege or authority to do so, is prohibited.		*TCA* 39-17-312(a)(2)

For ease of viewing, please see the following table attached in reference to comment #41:

	Radionuclide emission measurements shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective does equivalent in excess of 1 percent of the standard. All radionuclides which could contribute greater than 10 percent of the potential effective dose equivalent for a release point shall be measured.		40 *CFR* 61.93(b)(4)(i)

Revised Figure 1.3.

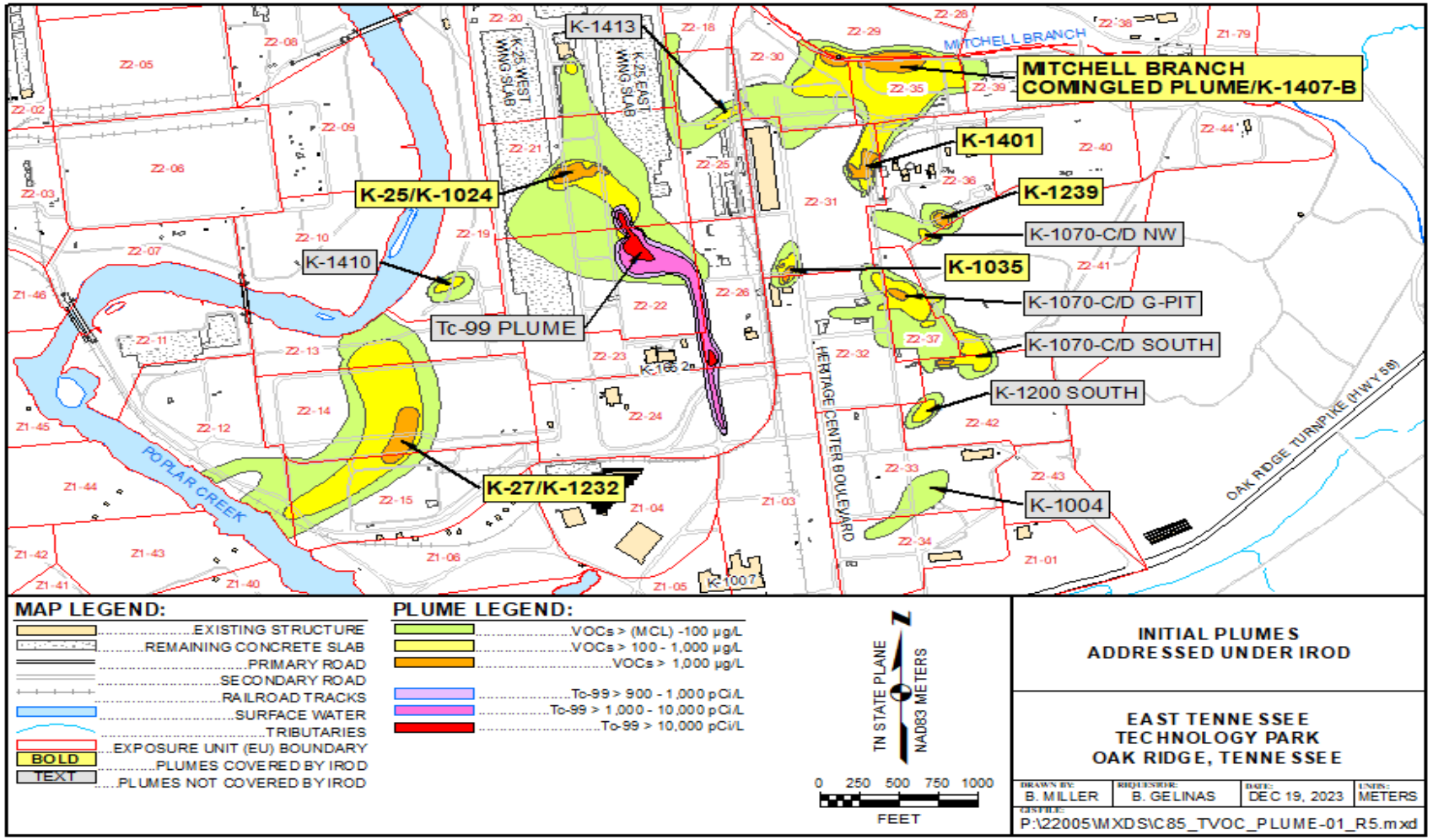

Figure 1.3. Groundwater source areas addressed in this MPA IROD based on data available for the MPA FFS, with exposure unit boundaries.

Revised Figure 2.3.

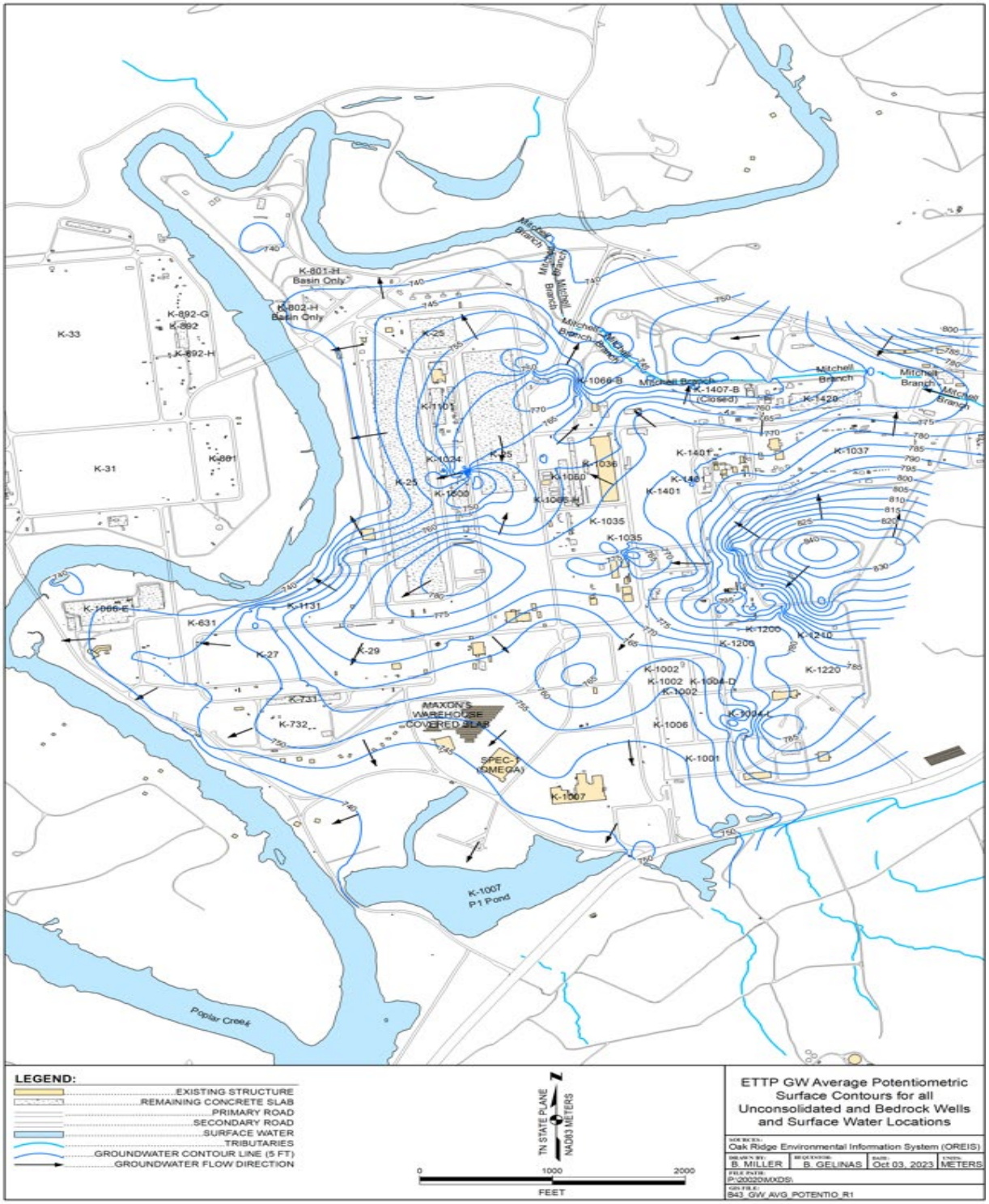

Figure 2.3. Average potentiometric surface for MPA of ETTP (average of all data between 1985 and 2023).

Revised Section 2.9.5

2.9.5 Common Components of Alternatives

With the exception of the no action alternative, the alternatives described in Table 2.4 have several common components. First, implementing all alternatives will require a PDI as well as performance monitoring. Additionally, LUCs are components of all alternatives. Rather than repeating these details for each detailed description of each alternative, these components are discussed below.

PDIs

Data collected for the MPA FFS were sufficient to evaluate technologies and alternatives for the plume source areas. However, additional data are required to design, install, and operate the remedy.

To simplify the scope of the PDI work, five unconsolidated zone monitoring wells and five bedrock wells were assumed to be installed at each plume source area. For sites where treatment is only in the unconsolidated zone or bedrock, 10 wells total will be installed in a single zone. Some sites may require additional investigation and others may require less investigation. However, as a whole, the total number of 10 wells is considered appropriate for costing and evaluating against MPA FFS criteria.

To develop an MPA FFS cost estimate, the total treatment depth was assumed to be 50 ft. The plume source areas have CVOC concentrations exceeding 1000 µg/L (or 400 µg/L for VC). Additionally, there is confirmed DNAPL at two locations (K-1401 based on visual observation, and K-1024 based on dye tests). It should be noted the presence of DNAPL is difficult to confirm on a repeated basis and, often, resampling at locations with DNAPL observations may not be confirmed. In areas where CVOC concentrations are suspected to be present at concentrations greater than the source treatment thresholds, the PDI will further evaluate the depth of contamination. As a result, the preferred alternative in the MPA Proposed Plan states some PDI wells and some remedial action will occur deeper than 50 ft (see Section 2.14).

The challenge with treating deeper depths is the bedrock is less fractured and less amendable to treatment. However, this condition also results in a reduced chance of contaminant migration in low groundwater flow zones. Implementing these interim remedies will provide valuable data to determine a treatment technology's ability to effectively treat contaminants in the bedrock.

Performance Monitoring

Performance monitoring will be implemented to help assess remedies' effectiveness and determine when the interim action has achieved target performance metrics for each plume source area. Performance metrics for the interim action will be established in the RDR/RAWP. For the purposes of the MPA FFS, the remedies were assumed to be implemented and evaluated for 5 years, which is appropriate for determining if target performance metrics can be achieved in a reasonable period of time. Performance monitoring will include collecting groundwater, the details of which will be developed in the RDR/RAWP. For the conceptual design of each alternative, the following assumptions were made:

- A portion of the new wells installed in the source area as part of the PDIs is located such that they can be used as the performance monitoring wells for each remedy.
- The frequency of monitoring and the target analytes will be defined in the RDR/RAWP. For cost-estimating purposes, frequency is assumed to be semiannual at the 10 performance monitoring wells and the target analytes are assumed to be the same as currently used for the RER wells.

LUCs

A LUC Implementation Plan (LUCIP) for ETTP has been developed in accordance with the LUC Assurance Plan for the ORR that was published with a memorandum of understanding between the FFA parties. The ETTP LUCIP is found in the ETTP RAR CMP. The current ETTP LUCIP is outlined in Chapter 6 of the ETTP RAR CMP and detailed in Appendix D of the ETTP RAR CMP. The ETTP RAR CMP will be updated to incorporate the additional LUCs for this MPA IROD and ensure the appropriate level of detail is included in the ETTP LUCIP. Changes to the ETTP LUCIP will include, but are not limited to, adding MPA groundwater areas addressed by this MPA IROD as a specific subject (i.e., affected area) of the applicable LUCs to clarify these LUCs are separate from the general LUCs for restricting groundwater use at ETTP Zone 2 established by the Zone 2 Soil ROD.

The LUCs established in this MPA IROD have the following objectives:

- Prevent unauthorized access to or use of groundwater.
- Evaluate and mitigate, if necessary, the vapor intrusion pathway on existing and future enclosed building structures.

The LUCs in the following list will apply to the MPA. Table 2.5 lists the purpose, duration, and implementation of the LUCs for the MPA. The property record restrictions for restrictions on groundwater use and vapor intrusion, property record notices, and the excavation/penetration permit program for the existence and location of contaminated groundwater are required by this MPA IROD. Because these LUCs are existing LUCs for ETTP, an in-depth generic description of each one can be found in the ETTP RAR CMP. Site-specific information pertaining to the conditions of use for each LUC has been included in the bullets below. The LUCs are as follows:

- **Property record restrictions.** The purpose is to restrict property use and/or prohibit groundwater use by imposing limitations and mitigating the vapor intrusion pathway on existing and future enclosed building structures as needed. All property use is restricted to industrial use at ETTP Zone 2. All groundwater within the entire MPA IROD area, as shown in Figure 1.3, is restricted for use at least until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved. All current and future buildings in the MPA IROD area, as shown in Figure 1.3, will be mitigated for vapor intrusion if the pathway is found to be complete and exceed acceptable risk standards. Mitigation will continue until volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved.
- **Property record notices.** The purpose is to notify the public about the existence and location of regulated hazardous substances and the location of land that is not appropriate for UU/UE and limitations on the use. A general property record notice that restricts access/use of groundwater has been filed for ETTP.
- **Excavation/Penetration permit program.** The purpose is to notify the worker/developer (i.e., permit requestor) on the extent of contamination and prohibit or limit excavation/penetration activity to ensure the excavation/penetration activity is conducted safely. For MPA groundwater, permit requesters will be notified of the presence of contaminated groundwater at applicable depths and the ongoing groundwater remedial action until its completion. The permit program has already been established for the MPA as part of Zone 2, and DOE and/or its agent will maintain responsibility for the program (including on transferred land) until concentrations of hazardous substances are at levels to allow for UU/UE or goals set forth in a final remedy are achieved.

LUCs in Table 2.5 are those presented in the ETTP LUCIP, which is included in the ETTP RAR CMP, including those listed as not applicable for the MPA groundwater remedy. Property record restrictions for land use and the vapor intrusion controls are in the ETTP LUCIP for application across ETTP sitewide. Access controls are only required for specific areas of ETTP.

DOE is responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although DOE may later transfer or has already transferred these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity. The ETTP RAR CMP also identifies guidelines for property transfer and LUC verification and reporting. The application of LUCs will be the same for all alternatives. These LUCs would remain in effect until they are updated or removed in a future decision document.

Revised Table 2.5.

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a])

Type of control	Purpose of control	Duration	Implementation	Affected area
1. Property record restrictions:				
A. Land use	Impose limitations to restrict use of property	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	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)	NA[b]
B. Groundwater	Prohibit groundwater use[c]	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
C. Vapor intrusion	Mitigate the vapor intrusion pathway on existing and future enclosed building structures, as needed	Until concentrations of volatile organic compound vapors reach levels to allow for UU/UE or goals set forth in a final remedy are achieved	Drafted and implemented by DOE upon transfer of affected areas. Recorded by DOE in accordance with state law at County Register of Deeds office	MPA Groundwater
2. Property record notices	Notify anyone searching records about existence and location of contaminated areas and limitations on their use	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Recorded by DOE in accordance with state law at County Register of Deeds office and copied to the appropriate zoning office (verified every 5 years). (1) Tennessee Code Annotated notice of land use restrictions after signing the ROD. (2) Upon completion of remedial action that leaves hazardous substances in place	MPA Groundwater[d]
3. Excavation/ Penetration permit program	Notify worker/ developer (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 or goals set forth in a final remedy are achieved	Implemented by DOE and its contractors. Initiated by permit request (verified annually)	MPA Groundwater

Table 2.5. LUCs for the MPA groundwater selected remedy as they apply to the existing ETTP LUCIP (ETTP RAR CMP[a]) (cont.)

Type of control	Purpose of control	Duration	Implementation	Affected area
4. Access controls (e.g., fences, gates, signs, and portals)	Control and restrict access to workers and the public to prevent unauthorized uses	Until concentrations of hazardous substances are at such levels to allow for UU/UE or goals set forth in a final remedy are achieved	Maintained by DOE (verified annually)	NA

[a]*East Tennessee Technology Park Administrative Watershed Remedial Action Report Comprehensive Monitoring Plan, Oak Ridge, Tennessee* (DOE/OR/01-2477&D4).
[b]While NA to MPA groundwater, this LUC is part of the ETTP LUCIP and applies to ETTP sitewide.
[c]Consistent with language in the quitclaim deeds for property transfer, the prohibition of groundwater use includes the prohibition of any groundwater use, extraction, consumption, and exposure without prior written approval of DOE, the U.S. Environmental Protection Agency, and the Tennessee Department of Environment and Conservation.
[d]A general property record notice that restricts access/use of groundwater has been filed for ETTP.

CMP = Comprehensive Monitoring Plan
DOE = U.S. Department of Energy
ETTP = East Tennessee Technology Park
IROD = Interim Record of Decision
LUC = land use control
LUCIP = Land Use Control Implementation Plan
MPA = Main Plant Area
NA = not applicable
RAR = Remedial Action Report
ROD = Record of Decision
UU/UE = unlimited use/unrestricted exposure

New Table 2.7.

Table 2.7. Scoring rationale for alternative analysis

Score	Description
10	There is high confidence the alternative fully meets the expectations of the criterion
8	There is probable confidence the alternative meets the expectations of the criterion; however, there is minor uncertainty in specific components of the alternative. This value can also be used to represent differences in quantity (e.g., environmental footprint is 20% larger)
6	There is general confidence the alternative meets the expectations of the criterion; however, there is some uncertainty in specific components of the alternative. This value can also be used to represent differences in quantity (e.g., environmental footprint is 40% larger)
4	There is some confidence the alternative meets the expectations of the criterion, but there are significant uncertainties to overcome. This value can also be used to represent differences in quantity (e.g., environmental footprint is 60% larger)
2	There is low confidence the alternative meets the expectations of the criterion. This value can also be used to represent differences in quantity (e.g., environmental footprint is 80% larger)
1	There is no confidence the alternative meets the expectations of the criterion

Revised Table A.2.

Table A.2. ARARs

Media/Location/Action	Requirement	Prerequisite	Citation
	Chemical-specific		
Remediation of contaminated groundwater	Except for groundwater in areas that have been designated as Special Source Water, Site-Specific Impaired Ground Water or meet the definition of Unusable Ground Water, all groundwater is designated as General Use Ground Water	Classification of state groundwaters—**applicable**	TDEC 0400-40-03-.07(4)(b)
	Except for naturally occurring levels, General Use Ground Water: • Shall not contain constituents that exceed those levels specified in TDEC 0400-40-03-.03 subparagraphs j (levels equivalent to SDWA MCLs) and k (quantities detrimental to public health or that impair use of the water as domestic water supply); and • Shall contain no other constituents at levels and conditions that pose an unreasonable risk to the public health or the environment	Release of contaminants to groundwater or actions potentially impacting groundwater—**applicable**	TDEC 0400-40-03-.08(2)(a) and (b)
	The waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man or animals, or impair the safety of conventionally treated water supplies. Available references include, but are not limited to: Quality Criteria for Water (Section 304(a) of Public Law 92-500 as amended), federal regulations under Section 307 of Public Law 92-500 as amended, and federal regulations under Section 1412 of the Public Health Service Act as amended by the Safe Drinking Water Act of 1974 (Public Law 93-523)		TDEC 0400-40-03-.03(1)(j)
	The waters shall not contain other pollutants in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply		TDEC 0400-40-03-.03(1)(k)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement		Prerequisite	Citation
	MCLs are promulgated concentration levels in public drinking water supplies. Must not exceed the MCLs in public community water systems, as measured at the consumer's tap		Release of contaminants to groundwater or actions potentially impacting groundwater—**relevant and appropriate**	TDEC 0400-45-01-.06 and TDEC 0400-45-01-.25 40 CFR 141.61(a) 40 CFR 141.62(b)
	Arsenic	0.010 mg/L		
	Beryllium	0.004 mg/L		
	Bis-2-ethylhexyl-phlalate	0.006 mg/L		
	Cadmium	0.005 mg/L		
	Carbon tetrachloride	0.005 mg/L		
	Chromium (total)	0.1 mg/l		
	Copper	Treatment technique (action level 1.3 mg/L)		
	1,2-Dichloroethane	0.005 mg/L		
	1,1-Dichloroethene	0.007 mg/L		
	cis-1,2-Dichloroethene	0.07 mg/L		
	trans-1,2-Dichloroethene	0.1 mg/L		
	Di-(2-ethylhexyl)-phthalate	0.006 mg/L		
	Dichloromethane (methylene chloride)	0.005 mg/L		
	Lead	Treatment technique (action level 0.015 mg/L)		
	Nickel	0.1 mg/L (Tennessee only)		
	Polychlorinated biphenyls (total)	0.0005 mg/L		
	Tetrachloroethene	0.005 mg/L		
	Thallium	0.002 mg/L		
	1,1,1-Trichloroethane	0.20 mg/L		
	1,1,2-Trichloroethane	0.005 mg/L		
	Trichloroethene	0.005 mg/L		
	Vinyl chloride	0.002 mg/L		
	Gross alpha particle activity (includes radium-226 but excludes radon and uranium)	15 pCi/L		
	Beta particle and photon activity	4 mrem/year		
	Technetium-99	See beta particle and photon activity		
	Uranium	0.030 mg/L		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Location-specific		
	Wetlands		
Presence of wetlands as defined in 10 CFR 1022.4	Incorporate wetland protection considerations into its planning, regulatory, and decision-making processes, and shall, to the extent practicable, minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands	DOE actions that involve potential impacts to, or take place within, wetlands—**applicable**	10 CFR 1022.3(a)(7) and (8)
	Undertake a careful evaluation of the potential effects of any proposed wetland action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse wetland impacts		10 CFR 1022.3(b), (c), and (d)
	Project description. This section shall describe the proposed action and shall include a map showing its location with respect to the floodplain and/or wetland. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)
	Floodplain or wetland impacts. This section shall discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain and/or wetland. This section shall include impacts on the natural and beneficial floodplain and wetland values (Section 1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated. For an action proposed in a wetland, the effects on the survival, quality, and function of the wetland shall be evaluated		10 CFR 1022.13(a)(2)
	Alternatives. Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in a wetland area, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	If no practicable alternative to locating or conducting the action in the wetland is available, then before taking action, design or modify the action to minimize potential harm to or within the wetland, consistent with the policies set forth in Executive Order 11990		10 CFR 1022.14(a)
Presence of jurisdictional wetlands as defined in 40 CFR 230.3, 33 CFR 328.3(a), and 33 CFR 328.4	No discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands, is permitted if there is a practical alternative that would have less adverse impact on the wetland or if it will cause or contribute significant degradation of waters of the United States	Actions that involve the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands— **applicable**	40 CFR 230.10(a), (b), (c), and (d) 40 CFR 230, Subpart H
	Except as provided under CWA Section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps (in accordance with 40 CFR 230.70 *et seq*. *Actions to Minimize Adverse Effects*) have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem		40 CFR 230.10(d) CWA Regulations – Section 404(b) Guidelines
	No discharge of dredged or fill material shall be permitted if it: • Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard • Violates any applicable toxic effluent standard or prohibition under Section 307 of the CWA • Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification of a habitat that is determined by the Secretary of Interior of Commerce, as appropriate, to be critical habitat under the Endangered Species Act of 1973, as amended. If an exemption has been granted by the Endangered Species Committee, the terms of such exemption shall apply in lieu of this subparagraph • Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary designated under Title III of the Marine Protection, Research, and Sanctuaries Act of 1972		40 CFR 230.10(b)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Mitigation of impacts to state wetlands as defined under TDEC 0400-40-07-.03	If an activity in a wetland results in an appreciable permanent loss of resource values, mitigation must be provided, which results in no overall net loss of resource values from existing conditions. To the extent practicable, any required mitigation shall be completed, excluding monitoring, prior to, or simultaneous with, any impacts. Acceptable mitigation mechanisms include any combination of in-lieu fee programs, mitigation banks, or other mechanisms that are reasonably assured to result in no overall net loss of resource values from existing conditions. Acceptable mitigation methods are prioritized in the following order: restoration, enhancement, preservation, creation, or any other measures that are reasonably assured to result in no net loss of resource values from existing conditions Compensatory measures must be at a ratio no less than 2:1 for restoration, 4:1 for creation and enhancement, and 10:1 for preservation, or at a best professional judgment ratio agreed to by the state	Activity that would cause loss of wetlands as defined in TDEC 0400-40-07-.03— **applicable**	TDEC 0400-40-07-.04(7)(a) TDEC 0400-40-07-.04(7)(c)
Minor alterations to wetlands	Minor alteration to wetlands must be conducted in accordance with the requirements of the ARAP Program (TDEC 0400-40-07). The substantive general permit requirements for minor alteration to wetlands include the following: • Excavation and fill activities associated with wetland alteration shall be kept to a minimum • Wetlands outside of the impact areas shall be clearly marked with signs, high-visibility fencing, or similar structures so that all the work performed by the contractor is solely within the permitted impact area • Wetland alterations shall not cause measurable degradation to resource values and classified uses of hydraulically connected wetlands or other waters of the state, including disruption of sustaining surface or groundwater hydrology	Minor alterations of up to 0.10 acre of moderate resource-value wetlands or of up to 0.25 acre of degraded and of low resource-value wetlands— **applicable**	Tennessee Code Annotated 69-3-108(l) TDEC 0400-40-07-.01 TDEC ARAP General Permit for Minor Alterations to Wetlands (effective April 7, 2020) (**TBC**)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Temporary impacts to wetlands shall be mitigated by the removal and stockpiling of the first 12 in. of topsoil, prior to construction. Temporary wetland crossings or haul roads shall use timber matting. Gravel, riprap, or other rock is not approved for construction of temporary crossings or haul roads across wetlands. Upon completion of construction activities, all temporary wetland impact areas are to be restored to pre-construction contours, and the stockpiled topsoil spread to restore these areas to pre-construction elevation. Other side-cast material shall not be placed within the temporary impact locations. Permanent vegetative stabilization using native species of all disturbed areas in or near the wetland must be initiated within 14 days of project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • Erosion prevention and sediment control measures, such as fences, shall be removed following completion of construction • The amount of fill, stream channel, and bank modifications, or other impacts associated with the activity, shall be limited to the minimum necessary to accomplish the project purpose. Shall use the least impactful practicable method of construction • Clearing, grubbing, or other disturbance to wetland vegetation shall be kept at the minimum. Unnecessary native vegetation removal, including tree removal, and soil disturbance is prohibited. Native wetland vegetation must be reestablished in all areas of disturbance outside of any permanent structure after work is completed • Activity may not result in a disruption or barrier to the movement of fish or other aquatic life and wetland-dependent species upon project completion • Blasting within 50 ft of any jurisdictional stream or wetland is prohibited		

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Where practicable, all activities shall be accomplished during drier times of the year or when recent conditions have been dry at the impact location. All surface water flowing towards or from the construction activity shall be diverted using cofferdams and/or berms constructed of sandbags; steel sheeting; or other non-erodible, non-toxic material. All such diversion materials shall be located outside the wetland and removed upon completion of the work. Activities may be conducted in the water if working in the dry will likely cause additional degradation. If work is conducted in the water, it must be of a short duration and with minimal impact • All activities must be carried out in such a manner as will prevent violations of water quality criteria or impairment of the designated uses of the waters of the state • Erosion and sedimentation control shall be in place and functional before earthmoving operations begin and shall be designed according to the department's Erosion and Sediment Control Handbook. Permanent vegetation stabilization using native species of all disturbed areas in or near the stream channel must be initiated within 14 days of the project completion. Non-native, non-invasive annuals may be used as cover crops until native species can be established • The use of monofilament-type erosion control netting or blanket is prohibited in the stream channel, stream banks, or any disturbed riparian areas within 30 ft of top of bank		
Presence of wetlands	Shall take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance beneficial values of wetlands NOTE: Federal agencies required to comply with Executive Order 11990 requirements	Federal actions that involve potential impacts to, or take place within, wetlands—**TBC**	Executive Order 11990 Section l.(a) Protection of Wetlands
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction, and (2) the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use		Executive Order 11990, Section 2.(a) Protection of Wetlands

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Presence of wetlands (as defined in 44 CFR 9.4)	The Agency shall minimize[1] the destruction, loss, or degradation of wetlands The Agency shall preserve and enhance the natural and beneficial wetlands values	Federal actions affecting or affected by wetlands as defined in 44 CFR 9.4—**relevant and appropriate**	44 CFR 9.11(b)(2) and (b)(4) Mitigation
	The Agency shall minimize: • Potential adverse impact the action may have on wetland values		44 CFR 9.11(c)(3) Minimization provisions
General compensatory mitigation for wetlands	Compensatory mitigation required to offset unavoidable impacts to waters of the United States authorized by Department of the Army permits Compensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular Department of the Army permit • Amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions • Compensatory mitigation may be provided through mitigation banks or in lieu fee programs • Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the impact-causing activity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(1) General compensatory mitigation requirements
	Compensatory mitigation may be performed using the methods of restoration, enhancement, establishment, and in certain circumstances preservation Restoration should generally be the first option considered because the likelihood of success is greater and the impacts to potentially ecologically important uplands are reduced compared to establishment, and the potential gains in terms of aquatic resource functions are greater, compared to enhancement and preservation	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.93(a)(2)

[1]Minimize means to reduce to the smallest amount or degree possible. 44 CFR 9.4 definitions.

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	All compensatory mitigation projects must comply with the standards in this part (40 CFR Part 230), if they are to be used to provide compensatory mitigation for activities authorized by Department of the Army permits, regardless of whether they are sited on public or private lands and whether the sponsor is a governmental or private entity NOTE: Although permits are not required per CERCLA Section 121(e)(1), consultation with the U.S. Army Corps of Engineers recommended to determine mitigation of any adverse impacts. Such mitigation would be performed as part of the remedial action		40 CFR 230.93(a)(3)
	Required compensatory mitigation should be located within the same watershed as the impact site and should be located where it is most likely to successfully replace lost functions and services, taking into account such watershed-scale features as aquatic habitat diversity, habitat connectivity, relationships to hydrologic sources (including the availability of water rights), trends in land use, ecological benefits, and compatibility with adjacent land uses		40 CFR 230.93(b) Type and location of mitigation
	Project site must be ecologically suitable for providing the desired aquatic resource functions. In determining the ecological suitability of the compensatory mitigation project site, the district engineer must consider, to the extent practicable, the factors in subsections (i) thru (vi) Applicants should propose compensation sites adjacent to existing aquatic resources or where aquatic resources previously existed		40 CFR 230.93(d)(1) and (3) Site selection
	In general, in-kind mitigation is preferable to out-of-kind mitigation because it is most likely to compensate for the functions and services lost at the impact site Except as provided in paragraph (e)(2) of this section, the required compensatory mitigation shall be of a similar type to the affected aquatic resource		40 CFR 230.93(e)(1) Mitigation type

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions. Where appropriate functional or condition assessment methods or other suitable metrics are available, these methods should be used where practicable to determine how much compensatory mitigation is required. If a functional or condition assessment or other suitable metric is not used, a minimum one-to-one acreage or linear foot compensation ratio must be used		40 CFR 230.93(f)(1) Amount of compensatory mitigation
	Implementation of the compensatory mitigation project shall be, to the maximum extent practicable, in advance of or concurrent with the activity causing the authorized impacts. The district engineer shall require, to the extent appropriate and practicable, additional compensatory mitigation to offset temporal losses of aquatic functions that will result from the permitted activity		40 CFR 230.93(m) Timing
Compensatory mitigation planning	Prepare a mitigation plan addressing objectives, site selection, site protection, baseline information, determination of credits, mitigation work plan, maintenance plan, performance standards, monitoring requirements, long-term management, and adaptive management NOTE*:* Plan would be part of CERCLA document, such as a Remedial Action Work Plan. Plan to include items described in 40 CFR 230.94(c)(2) through (c)(14)[2]	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.94(c) Mitigation Plan
Compensatory mitigation performance standards	The approved mitigation plan must contain performance standards that will be used to assess whether the project is achieving its objectives. Performance standards should relate to the objectives of the compensatory mitigation project, so that the project can be objectively evaluated to determine if it is developing into the desired resource type, providing the expected functions, and attaining any other applicable metrics (e.g., acres)	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.95(a) Ecological Performance Standards

[2]If mitigation obligations will be met by securing credits from approved mitigation banks or in lieu fee programs, mitigation plan needs to include only items described in Sections 230.94(c)(5) and (c)(6), and name of mitigation bank or in lieu fee program. 40 CFR 230.94(c)(1).

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Performance standards must be based on attributes that are objective and verifiable. Ecological performance standards must be based on the best available science that can be measured or assessed in a practicable manner Performance standards may be based on variables or measures of functional capacity described in functional assessment methodologies, measurements of hydrology or other aquatic resource characteristics, and/or comparisons to reference aquatic resources of similar type and landscape position. The use of reference aquatic resources to establish performance standards will help ensure those performance standards are reasonably achievable, by reflecting the range of variability exhibited by the regional class of aquatic resources as a result of natural processes and anthropogenic disturbances. Performance standards based on measurements of hydrology should take into consideration the hydrologic variability exhibited by reference aquatic resources, especially wetlands		40 CFR 230.95(b) Ecological Performance Standards
Compensatory mitigation project monitoring	Monitoring the compensatory mitigation project site is necessary to determine if the project is meeting its performance standards, and to determine if measures are necessary to ensure the compensatory mitigation project is accomplishing its objectives Compensatory mitigation project monitoring period shall be sufficient to demonstrate that project has met performance standards, but not less than 5 years	Alteration of wetlands requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.96(a) and (b) Monitoring
Compensatory mitigation project management	The aquatic habitats, riparian areas, buffers, and uplands that comprise the overall compensatory mitigation project must be provided long-term protection through real estate instruments or other available mechanisms, as appropriate For government property, long-term protection may be provided through federal facility management plans or integrated natural resources management plans NOTE: Plan would be part of CERCLA document, such as a Remedial Action Work Plan and/or Operations and Maintenance Plan	Alteration of wetlands on government property requiring compensatory mitigation to replace lost aquatic resource functions—**relevant and appropriate**	40 CFR 230.97(a)(1) Site Protection

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Projects shall be designed, to the maximum extent practicable, to be self-sustaining once performance standards have been achieved This includes minimization of active engineering features (e.g., pumps) and appropriate siting to ensure natural hydrology and landscape context will support long-term sustainability. Where active long-term management and maintenance are necessary to ensure long-term sustainability (e.g., prescribed burning, invasive species control, maintenance of water control structures, easement enforcement), the responsible party must provide for such management and maintenance		40 CFR 230.97(b) Sustainability
	Floodplains		
Presence of floodplain as defined in 10 CFR 1022.4	Incorporate floodplain management goals into planning, regulatory, and decision-making processes, and, to the extent practicable, reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; restore and preserve natural and beneficial values served by floodplains; require the construction of DOE structures and facilities to be, at a minimum, in accordance with Federal Emergency Management Agency National Flood Insurance Program building standards; and promote public awareness of flood hazards by providing conspicuous delineations of past and probable flood heights on DOE property that is in an identified floodplain	DOE actions that involve potential impacts to, or take place within, floodplains—**applicable**	10 CFR 1022.3(a)(1) through (6)
	Undertake a careful evaluation of the potential effects of any proposed floodplain action Avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains Avoid direct and indirect support of development in a floodplain wherever there is a practicable alternative Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse floodplain impacts		10 CFR 1022.3(b), (c), and (d)
	Describe the proposed action and include a map showing its location with respect to the floodplain. For actions located in a floodplain, the nature and extent of the flood hazard shall be described, including the nature and extent of hazards associated with any high-hazard areas		10 CFR 1022.13(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Discuss the positive and negative, direct and indirect, and long- and short-term effects of the proposed action on the floodplain. Include impacts on the natural and beneficial floodplain values (Section1022.4) appropriate to the location under evaluation. In addition, the effects of a proposed floodplain action on lives and property shall be evaluated		10 CFR 1022.13(a)(2)
	Consider alternatives to the proposed action that avoid adverse impacts and incompatible development in the floodplain, including alternate sites, alternate actions, and no action. DOE shall evaluate measures that mitigate the adverse effects of actions in a floodplain including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically sensitive areas		10 CFR 1022.13(a)(3)
	If no practicable alternative to locating or conducting the action in the floodplain is available, then before taking action, design or modify the action to minimize potential harm to or within the floodplain, consistent with the policies set forth in Executive Order 11988		10 CFR 1022.14(a)
	Cultural resources		
Presence of the Manhattan Project National Historical Park and associated buildings	Preserve and protect the nationally significant historic resources associated with the Manhattan Project National Historical Park Improve public understanding of the Project through interpretation of its historic resources Enhance public access to the Park consistent with protection of public safety, national security, and other aspects of DOE's missions Preserve and protect the historically significant resources associated with the Manhattan Project National Historical Park	Action that could adversely impact the Manhattan Project National Historical Park and associated buildings and elements—**applicable**	Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015, Section 3039, Publication L. No. 113-291 (December 19, 2014)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	DOE retains authority and legal obligation for historic preservation and maintenance, including ensuring safe access in connection with DOE's Manhattan Project National Historical Park resources. Consistent with existing Historic Preservation plans, DOE will protect and maintain all DOE sites, structures, and landscapes included in the Park, as well as associated contributing elements located outside of the Park, in accordance with the requirements of the National Historic Preservation Act. DOE will follow the Secretary of the Interior's Standards for Treatment of Historic Properties. DOE will make every effort to avoid adverse impacts to the Park's resources, values, and contributing historic elements. Consistent with existing Historic Preservation plans, DOE will maintain and preserve contributing elements as if they were included in the Park boundary	**TBC**	MOA between DOE and DOI for the Manhattan Project National Historical Park (November 10, 2015)
Presence of archaeological resources on public land	No person may excavate, remove, damage, or otherwise alter or deface, or attempt to excavate, remove, damage, or otherwise alter or deface, any archaeological resource located on public lands or Indian lands unless such activity is pursuant to a permit issued under Section 7.8 or exempted by Section 7.5(b) of this part	Federal agency construction or excavation projects that would cause the irreparable loss or destruction of significant historic or archaeological resources or data—**applicable**	43 CFR 7.4(a)
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony	If inadvertent discovery occurred in connection with an ongoing activity on federal or tribal lands, in addition to providing the notice described above, must stop activities in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently	Excavation activities that inadvertently discover such resources on federal lands or under federal control—**applicable**	43 CFR 10.4(c)
	Must take immediate steps, if necessary, to further secure and protect inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony, including, as appropriate, stabilization or covering		43 CFR 10.4(d)(ii)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Action-specific		
	Site preparation, construction, and excavation activities		
Activities causing fugitive dust emissions	Shall take reasonable precautions to prevent particulate matter from becoming airborne; reasonable precautions shall include, but are not limited to, the following: Use, where possible, of water or chemicals for control of dust, and Application of asphalt, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces, which can create airborne dusts	Use, construction, alteration, repair, or demolition of a building, or appurtenances or a road or the handling transport or storage of material—**applicable**	TDEC 1200-3-8-.01(1) TDEC 1200-3-8-.01(1)(a) TDEC 1200-3-8-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 min/hr or 20 min/day beyond property boundary lines on which emission originates		TDEC 1200-3-8-.01(2)
Activities causing stormwater runoff (e.g., clearing, grading, excavation)	Implement good construction management techniques (including sediment and erosion, vegetative controls, and structural controls) in accordance with the substantive requirements of General Permits TNR10-0000 and TNR05-0000 to ensure stormwater discharge is properly managed, and: • Does not violate water quality criteria as stated in TDEC 0400-40-03-.03, including, but not limited to, prevention of discharge that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any designated uses for that water body by TDEC 0400-40-04; • Does not contain distinctly visible floating scum, oil, or other matter; • Does not cause an objectionable color contrast in the receiving stream; and	Stormwater discharges associated with construction activities that disturb ≥ 1 acre total**—relevant and appropriate**	Tennessee Code Annotated 69-3-108(1) Tennessee General Permit TNR10-0000, Sections 5.3.2 and 5.4.1 (effective October 1, 2016) **(TBC)**

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Results in no materials in concentrations sufficient to be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream • Discharges that would cause measurable degradation of waters with unavailable parameters are not authorized. To be eligible to obtain and maintain coverage, must satisfy, at a minimum, the following additional requirement for discharges into waters with unavailable parameters for siltation and habitat alterations due to in-channel erosion: • Measures used at the site must be designed to control stormwater runoff generated by a 5-year, 24-hr storm event at a minimum Additional physical or chemical treatment of stormwater runoff, such as use of treatment chemicals, may be necessary to minimize the amount of sediment being discharged when clay and other fine particle soils are found on sites		
Airborne radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/year	Radionuclide air emissions from point sources, as well as diffuse or fugitive emissions, at DOE facilities—**applicable**	40 CFR 61.92 TDEC 1200-3-11-.08(6)
	Radionuclide emission measurements shall be made at all release points which have a potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of the standard. All radionuclides which could contribute greater than 10% of the potential effective dose equivalent for a release point shall be measured NOTE: DOE has an ORR-wide radionuclide emissions monitoring program in place to comply with these requirements under 40 CFR 61, Subpart H. Adherence to the ORR-wide National Emission Standards for Hazardous Air Pollutants monitoring program will constitute compliance with this ARAR requirement	Release points which have the potential to discharge radionuclides into the air in quantities which could cause an effective dose equivalent in excess of 1% of 10 mrem/year to any member of the public—**applicable**	40 CFR 61.93(b)(4)(i) TDEC 1200-03-11-.08(6)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Groundwater monitoring activities		
Placement of monitoring wells	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards	Class V injection systems—**relevant and appropriate** to placement of monitoring wells	TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)
Construction of monitoring wells	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole; this casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples; the annular space above the sampling depth must be seated to prevent contamination of samples and the groundwater	Construction of RCRA groundwater monitoring wells—**relevant and appropriate**	40 CFR 264.97(c) TDEC 0400-12-01-.06(6)(h)(3)
Construction and abandonment of monitoring wells	Establishes quality and workmanship requirements for well drilling, installation, and abandonment, and for sampling, borehole geophysical logging, and hydrologic testing. The substantive requirements of this procedure are TBC for construction and abandonment of monitoring wells	Construction and abandonment of monitoring wells—**TBC**	*Standard Specifications for Installation, Well Drilling, and Abandonment*, SPG-00000-A005/Rev 2 (October 14, 2011)
Closure of monitoring wells	Before abandonment, clean well of obstructions and disinfect using bleach or hypochlorite granules to produce free chlorine residual concentrations of 25 parts per million	Plugging and closure of a water production well—**relevant and appropriate**	TDEC 0400-45-09-.16(1)(a) through (c)
	Use one of several different methods to close well depending on depth of well, construction details, whether it is cased or uncased, and whether it intercepts multiple aquifers		TDEC 0400-45-09-.16(2)(a) through (c)
	Backfill must be placed so that there are no gaps or bridging. Backfill top must be level with land surface		TDEC 0400-45-09-.16(2)(d)
	Wells extending into more than one aquifer shall be filled and sealed in such a way that exchange of water from one aquifer to another is prevented		TDEC 0400-45-09-.16(3)
	Flowing wells must be treated to reduce flow to zero before sealing		TDEC 0400-45-09-.16(4)
	An alternate method of closure may be approved by TDEC		TDEC 0400-45-09-.16(5)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Injection well activities		
Reinjection of contaminated groundwater amended with treatment reagents	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons	Underground injection into an USDW—**applicable**	40 CFR 144.12(a) TDEC 0400-45-06-.04(1)
	Wells are not prohibited if injection is approved by EPA or a state pursuant to provisions for cleanup of releases under CERCLA or RCRA	Class IV wells (as defined in 40 CFR 144.6(d)) used to inject contaminated groundwater that has been treated and reinjected into the same formation from which it was drawn—**applicable**	40 CFR 144.13(c) RCRA Section 3020(b) TDEC 0400-45-06-.13(3)
	The variety of Class V wells and their uses dictate a variety of construction designs consistent with those uses and precludes specific construction standards. However, a well must be designed and constructed for its intended use, in accordance with good engineering practices, and the design and construction must be approved by the Commissioner NOTE: Approval of the design and construction of the well will be through the CERCLA process and approval of the Remedial Action Work Plan	Class V injection systems—**applicable**	TDEC 0400-45-06-.14(7)(a)
	Well(s) shall be designed, constructed, and operated in such a manner that their use does not cause any USDW to contain any substances that are toxic, carcinogenic, mutagenic, or teratogenic, other than those of natural origin, at levels and conditions that violate primary drinking water standards or adversely affect the health of persons and does not cause a violation of water quality standards		TDEC 0400-45-06-.14(1)(b) TDEC 0400-45-06-.14(7)(b) and (8)(a)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	No injection activity can allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of any primary drinking water standard, or other health-based standards, or may otherwise adversely affect the health of persons. This prohibition applies to well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity		TDEC 0400-45-06-.14(12)(a)1
Plugging and abandonment of all classes of injection wells	Any well that is to be permanently plugged and abandoned shall be completely filled and sealed in such a manner that vertical movement of fluid either into or between formation(s) containing USDWs through the borehole is not allowed	The injection well is no longer usable for its intended purpose or the well poses a potential threat to water quality or the well has not operated for 2 years (unless notice has been provided to the TDEC Commissioner and actions taken to ensure USDWs will not be endangered during period of temporary abandonment)—**applicable**	TDEC 0400-45-06-.09(6)(d)
	As a minimum, permanent seals must be placed in the borehole opposite (1) the lowermost confining bed, and (2) each intermediate confining bed between successive formation(s) containing USDWs		TDEC 0400-45-06-.09(6)(e)
	Seals intended to prevent vertical movement of water in a well borehole shall be composed of cement, sand-and-cement, or concrete or other sealing materials demonstrated to the satisfaction of the Commissioner to be effective. The minimum length of a seal shall be 20 ft		TDEC 0400-45-06-.09(6)(f) and (g)
	The borehole above the uppermost formation(s) containing a USDW shall be filled with materials less permeable than the surrounding undisturbed formations; the uppermost 5 ft of the borehole (at land surface) shall be filled with a material appropriate to the intended use of the land		TDEC 0400-45-06-.09(6)(h)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	The materials used to fill spaces between well seals shall be filled with disinfected dimensionally stable materials, compacted mechanically if necessary to avoid later settlement except that cement, cement and sand, and concrete do not require disinfection. Disinfection of well-filling materials shall be accomplished by using chlorine compounds, such as sodium hypochlorite or calcium hypochlorite		TDEC 0400-45-06-.09(6)(i)
	Temporary bridges may be used to avoid having to fill very deep holes below the deepest point at which a permanent seal is required. Temporary bridges used to provide a base for a permanent seal shall consist of materials approved by the Commissioner		TDEC 0400-45-06-.09(6)(j)
	Approved sealing materials used in abandonment operations shall be introduced at the bottom of the well or interval to be sealed and placed progressively upward to the top of the well. All such sealing materials shall be placed in such a way as to avoid segregation or dilution of the sealing materials. Dumping sealing material from the top of the well shall not be allowed		TDEC 0400-45-06-.09(7)(a)
	Permanent seals shall be placed in wells or boreholes opposite confining beds between aquifers, which are identifiable as, or are suspected of being, hydraulically separated under natural, undisturbed conditions. After the required seal has been installed, the remainder of the confining zone between formations containing USDWs may be filled with sand, sand and gravel, or other rock material acceptable to the Commissioner		TDEC 0400-45-06-.09(7)(b)
	Management of secondary wastes from well development and rehabilitation or maintenance		
Characterization of solid waste	Must determine if waste is hazardous waste or if waste is excluded under TDEC 0400-12-01-.02(1)(d); and	Generation of solid waste as defined in TDEC 0400-12-01-.02(1)(b), and which is not excluded under TDEC 0400-12-01-.02(1)(d)(1)— **applicable**	40 CFR 262.11(a) and (b) TDEC 0400-12-01-.03(1)(b)(1) TDEC 0400-12-01-.03(1)(b)(2)
	Must determine if waste is listed under TDEC 0400-12-01-.02(4); or		40 CFR 262.11(c) TDEC 0400-12-01-.03(1)(b)(3)
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used		40 CFR 262.11(d) TDEC 0400-12-01-.03(1)(b)(4)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Characterization of hazardous waste	If waste is determined to be hazardous, must refer to TDEC 0400-12-01-.02, .05, .06, .09, .10, and .12 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of RCRA hazardous waste for storage, treatment, or disposal—**applicable**	40 CFR 262.11(e) TDEC 0400-12-01-.03(1)(b)(5)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 262.11(d)(2) TDEC 0400-12-01-.06(2)(d)(1)
	Must obtain a detailed chemical and physical analysis of a representative sample of the waste(s) which, at a minimum, contains all the information that must be known to treat, store, or dispose of the waste in accordance with TDEC 0400-12-01-.06 and TDEC 0400-12-01-.10		40 CFR 264.13(a)(1) TDEC 0400-12-01-.06(2)(d)(1)
	Must determine if the waste meets the treatment standards in subparagraphs (3)(a), (3)(f), or (3)(j) of TDEC 0400-12-01-.10 by testing in accordance with prescribed methods or use of generator knowledge of waste		40 CFR 268.7(a) TDEC 0400-12-01-.10(1)(g)(1)
	Must determine each EPA Hazardous Waste Number (waste code) to determine the applicable treatment standards under TDEC 0400-12-01-.10(3)		40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
	Must determine the underlying hazardous constituents (as defined in TDEC 0400-12-01-.10(1)(b)(10)) in the waste	Generation of RCRA characteristically hazardous waste (and is not D001 non-wastewaters treated by combustion, recovery of organics, or polymerization of subparagraph (3)(c) of TDEC 0400-12-01-.10) for storage, treatment, or disposal—**applicable**	40 CFR 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
Management of hazardous waste onsite	A generator who treats, stores, or disposes of hazardous waste onsite must comply with the applicable (substantive) standards and requirements set forth in TDEC 0400-12-01-.05, .06, .07, and .09	Generation of RCRA hazardous waste for storage, treatment, or disposal onsite—**applicable** if secondary wastes are determined to be hazardous	40 CFR 262.10, Note 2 TDEC 0400-12-01-.03(1)(a)(2)(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of hazardous waste in containers onsite (satellite accumulation area)	A generator may accumulate as much as 55 gal of hazardous waste at or near any point of generation where wastes initially accumulate which is under the control of the operator of the process generating the waste, provided: • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition and does not leak, or immediately transfer and manage the waste in a central accumulation area operated in compliance with Part (g)2 or (h)1 of this paragraph • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be accumulated, so that the ability of the container to contain the waste is not impaired • A container holding hazardous waste must be closed at all times during accumulation, except when adding, removing, or consolidating waste: or, when temporary venting of a container is necessary for the proper operation of equipment or to prevent dangerous situations, such as build-up of extreme pressure • Container must be marked or labeled with the words "Hazardous Waste" and an indication of the hazards of the contents	Accumulation of 55 gal or less of RCRA hazardous waste at or near any point of generation—**applicable**	40 CFR 262.15(a)(1), (2), (4), and (5) TDEC 0400-12-01-.03(1)(f)(1)(i), (ii), (iv), and (v)
Temporary storage of hazardous waste in containers onsite (90-day storage area)	A generator may accumulate hazardous waste at the facility, provided: • The waste is placed in containers that comply with the air emission standards in TDEC 0400-12-01-.05(27), (28), and (29); • If a container holding hazardous waste is not in good condition, or if it begins to leak, the generator must immediately transfer the hazardous waste from this container to a container that is in good condition, or immediately manage the waste in some other way that complies with the conditions for exemption of this part; • The generator must use a container made of or lined with materials that will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired;	Accumulation of RCRA hazardous waste onsite as defined in TDEC 0400-12-01-.01(2)(a)—**applicable**	40 CFR 262.17(a)(1)(i) through (iv) TDEC 0400-12-01-.03(1)(h)(1)(i)(I) through (IV)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• A container holding hazardous waste must always be closed during accumulation, except when it is necessary to add or remove waste. A container holding hazardous waste must not be opened, handled, or stored in a manner that may rupture the container or cause it to leak.		
	• Container must be marked or labeled with the words "Hazardous Waste," an indication of the hazards of the contents, and the date upon which each period of accumulation begins clearly visible for inspection on each container		40 CFR 262.17(a)(5)(i) TDEC 0400-12-01-.03(1)(h)(1)(v)(I)
Temporary storage of RCRA remediation waste in a staging pile	Must be located within the contiguous property under the control of the owner/operator where the wastes that are to be managed in the staging pile originated For purposes of this section, storage includes mixing, sizing, blending, or other similar physical operations so long as intended to prepare the wastes for subsequent management or treatment	Accumulation of non-flowing hazardous remediation waste (or remediation waste otherwise subject to land disposal restrictions) as defined in 40 CFR 260.10—**applicable**	40 CFR 264.554(a)(1) TDEC 0400-12-01-.06(22)(e)1
	May be temporarily stored (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility provided the staging pile will be designed to:		40 CFR 264.554(d)(1) TDEC 0400-12-01-.06(22)(e)4(i)
	• Facilitate a reliable, effective, and protective remedy;		40 CFR 264.554(d)(1)(i) TDEC 0400-12-01-.06(22)(e)4(i)(I)
	• Prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer, as necessary, to protect human health and the environment (e.g., through the use of liners, covers, runon/runoff controls, as appropriate)		40 CFR 264.554(d)(1)(ii) TDEC 0400-12-01-.06(22)(e)4(i)(II)
Operation of a staging pile	Must not place ignitable or reactive waste in a staging pile unless the remediation waste has been treated, rendered, or mixed before placed in the staging pile so that: • The remediation waste no longer meets the definition of ignitable or reactive under 40 CFR 261.21 or 40 CFR 261.23; and	Storage of ignitable or reactive remediation waste in a staging pile—**applicable**	40 CFR 264.554(e)(1)(i) TDEC 0400-12-01-.06(22)(e)5(i)
	• One has complied with 40 CFR 264.17(b); or		40 CFR 264.554(e)(1)(ii) TDEC 0400-12-01-.06(22)(e)5(i)(II)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	• Must manage the remediation waste to protect it from exposure to any material or condition that may cause it to ignite or react		40 CFR 264.554(e)(2) TDEC 0400-12-01-.06(22)(e)5(ii)
	Must not place incompatible wastes in same pile unless they comply with 40 CFR 264.17(b)	Storage of incompatible remediation waste in staging pile—**applicable**	40 CFR 264.554(f)(1) TDEC 0400-12-01-.06(22)(e)6(i)
	Incompatible wastes must be separated from any waste or nearby materials or must protect them from one another by using a dike, berm, wall, or other device		40 CFR 264.554(f)(2) TDEC 0400-12-01-.06(22)(e)6(ii)
	Must not pile remediation waste on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 274.17(b)		40 CFR 264.554(f)(3) TDEC 0400-12-01-.06(22)(e)6(iii)
Use and management of hazardous waste in containers	If container is not in good condition (e.g., severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition	Storage of RCRA hazardous waste in containers—**applicable**	40 CFR 264.171 TDEC 0400-12-01-.06(9)(b)
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired		40 CFR 264.172 TDEC 0400-12-01-.06(9)(c)
	Container holding hazardous waste must always be kept closed during storage, except to add/remove waste		40 CFR 264.173(a) and (b) TDEC 0400-12-01-.06(9)(d)
	Container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak		
Operation of a RCRA container area	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or containers must be elevated or otherwise protected from contact with accumulated liquid	Storage in containers of RCRA hazardous waste that do not contain free liquids—**applicable**	40 CFR 264.175(c) TDEC 0400-12-01-.06(9)(f)(3)
Storage of RCRA hazardous waste with free liquids in containers	Area must have a containment system designed and operated in accordance with TDEC 0400-12-01-.06(9)(f)(2) as follows:	Storage of RCRA hazardous waste with free liquids or storage of waste codes F020, F021, F022, F023, F026, and F027 that do not contain free liquids in containers—**applicable**	40 CFR 264.175(a) and (d) TDEC 0400-12-01-.06(9)(f)(1)-(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	A base must underlie the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills, and accumulated precipitation until the collected material is detected and removed;		40 CFR 264.175(b)(1) TDEC 0400-12-01-.06(9)(f)(2)(i)
	Base must be sloped or the containment system must be otherwise designed and operated to drain and remove liquids resulting from leaks, spills, or precipitation, unless the containers are elevated or are otherwise protected from contact with accumulated liquids;		40 CFR 264.175(b)(2) TDEC 0400-12-01-.06(9)(f)(2)(ii)
	Must have sufficient capacity to contain 10% of the volume of containers or volume of largest container, whichever is greater;		40 CFR 264.175(b)(3) TDEC 0400-12-01-.06(9)(f)(2)(iii)
	Runon into the system must be prevented unless the collection system has sufficient capacity to contain any runon which might enter the system, along with the volume required for containers as listed immediately above; and		40 CFR 264.175(b)(4) TDEC 0400-12-01-.06(9)(f)(2)(iv)
	Spilled or leaked waste and accumulated precipitation must be removed from the sump or collection area in as timely a manner as is necessary to prevent overflow of the collection system		40 CFR 264.175(b)(5) TDEC 0400-12-01-.06(9)(f)(2)(v)
Disposal of RCRA hazardous waste in a land-based unit	May be land-disposed only if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at TDEC 0400-12-01-.10(3)(a) before land disposal. The table lists either total waste standards, waste-extract standards, or technology-specific standards (as detailed further in TDEC 0400-12-01-.10(3)(c))	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted waste—**applicable**	40 CFR 268.40(a) TDEC 0400-12-01-.10(3)(a)
	Prior to land disposal, soil contaminated with hazardous waste must be treated to meet the applicable alternative treatment standards of TDEC 0400-12-01-.10(3)(j)(3) or according to the applicable Universal Treatment Standards in TDEC 0400-12-01-.10(3)(i) applicable to the listed hazardous waste and/or applicable characteristic of hazardous waste if the soil is characteristic	Land disposal, as defined in TDEC 0400-12-01-.10(1)(b), of RCRA-restricted hazardous soils—**applicable**	40 CFR 268.49(b) TDEC 0400-12-01-.10(3)(j)(2)
Management of water generated from well development, rehabilitation, or maintenance	On-site wastewater treatment units that are part of a wastewater treatment facility subject to regulation under Section 402 or Section 307(b) of the CWA are exempt from the requirements of RCRA Subtitle C for all tank systems, conveyance systems (whether piped or trucked), and ancillary equipment used to store or transport RCRA-contaminated water	On-site wastewater treatment units subject to regulation under Section 402 or Section 307(b) of the CWA—**applicable** if water is determined to be hazardous	40 CFR 264.1(g)(6) 40 CFR 260.10 40 CFR 270.1(c)(2)(v) TDEC 0400-12-01-.06(1)(b)(2)(v) TDEC 0400-12-01-.01(2)(a) TDEC 0400-12-01-.07(1)(b)(4)(iv)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Management of PCB waste	Any person storing or disposing of PCB waste must do so in accordance with 40 CFR 761, Subpart D	Generation of waste containing PCBs at concentrations ≥ 50 parts per million—**applicable**	40 CFR 761.50(a)
	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found	Generation of PCB remediation waste as defined in 40 CFR 761.3—**applicable**	40 CFR 761.61
Temporary storage of PCB waste	Storage area must be clearly marked as required by 40 CFR 761.40(a)(10)	Storage of PCBs and PCB items at concentration ≥ 50 parts per million for disposal—**applicable**	40 CFR 761.65(c)(3)
	Container(s) shall be in accordance with requirements set forth in U.S. Department of Transportation Hazardous Materials Regulations at 49 CFR 171–180		40 CFR 761.65(c)(6)
Risk-based storage of PCB remediation waste	May store in a manner other than prescribed in 40 CFR 761.65 if application approved in writing by EPA Regional Administrator and EPA finds that the method will not pose an unreasonable risk of injury to [sic] human health or the environment Each application must include information described in 40 CFR 761.61(a)(3) NOTE: Appropriate substantive information required in an application is provided in CERCLA documents [e.g., feasibility study, Proposed Plan, Record of Decision, or post-Record of Decision documents] that are approved by EPA	Storage of PCB remediation waste (as defined in 40 CFR 761.3) prior to disposal—**applicable**	40 CFR 761.61(c)
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be nonleaking For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 CFR 761.65(b)(1)(ii); and	Storage of PCB/radioactive waste in containers other than those meeting U.S. Department of Transportation Hazardous Materials Regulations performance standards—**applicable**	40 CFR 761.65(c)(6)(i)(A) 40 CFR 761.65(c)(6(i)(B)
	For both liquid and nonliquid wastes, containers must meet all regulations and requirements pertaining to nuclear criticality safety		40 CFR 761.65(c)(6)(i)(C)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Temporary storage of PCB remediation waste in a waste pile	Waste must be placed in a pile that: • Is designed and operated to control dispersal by wind, where necessary, by means other than wetting; • Does not generate leachate through decomposition or other reactions;	Storage of PCB remediation waste or PCB bulk product waste at cleanup site or site of generation—**applicable**	40 CFR 761.65(c)(9)(i) and (ii)
	• Is at a storage site with a liner designed, constructed, and installed to prevent any migration of wastes off or through liner into adjacent subsurface soil, groundwater, or surface water		40 CFR 761.65(c)(9)(iii)(A)
	Liner must be: • Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;		40 CFR 761.65(c)(9)(iii)(A)(1)
	• Placed on foundation or base capable of providing support to liner and resistance to pressure gradients above and below the liner to present failure because of settlement compression or uplift;		40 CFR 761.65 (c)(9)(iii)(A)(2)
	• Installed to cover all surrounding earth likely to be in contact with waste		40 CFR 761.65 (c)(9)(iii)(A)(3)
	Has a cover that meets the above requirements and is installed to cover all the stored waste likely to be contacted by precipitation, and is secured so as not to be functionally disabled by winds expected under normal weather conditions; and		40 CFR 761.65 (c)(9)(iii)(B)
	Has a runon control system designed, constructed, operated, and maintained such that it prevents flow on the stored waste during peak discharge from at least a 25-year storm, and collects and controls at least the water volume resulting from a 24-hr, 25-year storm		40 CFR 761.65 (c)(9)(iii)(C)(1) and (2)
	Requirements of 40 CFR 761.65(c)(9) of this part may be modified under the risk-based storage option of Section 761.61(c)		40 CFR 761.65(c)(9)(iv)
Disposal of containers of Toxic Substances Control Act of 1976 PCB wastes	Container(s) shall be marked as illustrated in 40 CFR 761.45(a)	Disposal of PCBs in chemical waste landfill—**applicable**	40 CFR 761.40(a)(1)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Performance-based disposal of PCB remediation waste	Shall be disposed according to 40 CFR 761.60(a) or (e), or decontaminated in accordance with 40 CFR 761.79	Disposal of liquid PCB remediation waste—**applicable**	40 CFR 761.61(b)(1)
	May dispose by one of the following methods: • In a high-temperature incinerator approved under 40 CFR 761.70(b); • By an alternate disposal method approved under 40 CFR 761.60(e); • In a chemical waste landfill approved under 40 CFR 761.75; • In a facility with a coordinated approval issued under 40 CFR 761.77; or	Disposal of nonliquid PCB remediation waste [as defined in 40 CFR 761.3]—**applicable**	40 CFR 761.61(b)(2) 40 CFR 761.61(b)(2)(i)
	• Through decontamination in accordance with 40 CFR 761.79		40 CFR 761.61(b)(2)(ii)
Management of PCB/radioactive waste	Any person storing such waste ≥ 50 parts per million PCBs must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 CFR 761.65(a)(1), (b)(1)(ii) and (c)(6)(i)	Generation of PCB/radioactive waste for storage and disposal—**applicable**	40 CFR 761.50(b)(7)(i)
	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties in accordance with applicable requirements		40 CFR 761.50(b)(7)(ii)
	If, after taking into account only the PCB properties in the waste, the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a state as a municipal or non-municipal non-hazardous waste landfill, then the person may dispose of such waste without regard to the PCBs, based on its radioactive properties alone		40 CFR 761.50(b)(7)(ii)
Characterization of low-level waste (e.g., wastewater, contaminated personal protective equipment)	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the waste acceptance criteria of the receiving facility	Generation of low-level waste for storage and disposal at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(I)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste: • physical and chemical characteristics • volume, including the waste and any stabilization or absorbent media • weight of the container and contents • identities, activities, and concentrations of major radionuclides • characterization date • generating source		DOE Manual 435.1-1(IV)(I)(2)
Temporary storage of low-level waste	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water	Management of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(N)(1)
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage and minimizes worker exposure		DOE Manual 435.1-1(IV)(N)(3)
	Shall be managed to identify and segregate low-level waste from mixed waste		DOE Manual 435.1-1(IV)(N)(6)
	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container	Storage of low-level waste in containers at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(L)(1)(a)
	Vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container		DOE Manual 435.1-1(IV)(L)(1)(b)
Packaging of low-level waste for disposal	Must not be packaged for disposal in cardboard or fiberboard boxes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(1)
	Must be solidified or packaged in sufficient absorbent material to absorb twice the volume of liquid	Generation of liquid low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(2)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
	Shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume	Generation of solid low-level waste containing liquid for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(3)
	Must not be capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures or of explosive reaction with water	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(4)
	Must not contain, or be capable of, generating quantities of toxic gases, vapor, or fumes	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(5)
	Must not be pyrophoric	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(a)(6)
	Must have structural stability either by processing the waste or placing the waste in a container or structure that provides stability after disposal	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(1)
	Must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form	Generation of liquid low-level waste or low-level waste containing liquids for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(2)
	Void spaces within the waste and between the waste and its package must be reduced to the extent practicable	Generation of low-level waste for disposal at a low-level waste disposal facility—**relevant and appropriate**	TDEC 0400-20-11-.17(7)(b)(3)

Table A.2. ARARs (cont.)

Media/Location/Action	Requirement	Prerequisite	Citation
Disposal of low-level waste	Low-level waste shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility	Generation for disposal of low-level waste at a DOE facility—**TBC**	DOE Manual 435.1-1(IV)(J)(2)

ARAP = aquatic resource alteration permit
ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = Code of Federal Regulations
CWA = Clean Water Act of 1972
DOE = U.S. Department of Energy
DOI = U.S. Department of Interior
EPA = U.S. Environmental Protection Agency
MCL = maximum contaminant level
MOA = Memorandum of Agreement
NCP = National Oil and Hazardous Substances Pollution Contingency Plan
ORR = Oak Ridge Reservation
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act of 1976
SDWA = Safe Drinking Water Act of 1974
TBC = to be considered
TDEC = Tennessee Department of Environment and Conservation
USDW = underground source of drinking water