

4.4 Hazard Area 4 - Upper East Fork Poplar Creek

The Upper East Fork Poplar Creek (UEFPC) watershed, which includes the main industrial area of the Y-12 National Security Complex, is located between Pine Ridge and Chestnut Ridge in the northeast corner of the ORR and includes approximately 1170 acres. The boundaries of the UEFPC watershed extend along the top of Pine Ridge to the north, the top of Chestnut Ridge to the south, the eastern boundary of the Bear Creek Valley watershed to the west, and the DOE-ORR property boundary (Scarboro Road) to the east. UEFPC also includes a contaminated groundwater plume (the Y-12 Plant East End VOC Plume) that extends beyond the DOE-ORR property boundary to the east into Union Valley, where it terminates at springs and headwaters of Scarboro Creek located near Illinois Avenue. The headwaters of Upper East Fork Poplar Creek are near the S-3 Ponds. When the Y-12 Plant was built, the creek was rerouted through storm drains and its original tributaries were backfilled. The creek exits the ORR near Station 17 at the eastern boundary of the UEFPC watershed.

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The Y-12 National Security Complex occupies approximately 800 acres near the northeastern corner of the ORR, adjacent to the city of Oak Ridge. Y-12's original mission was to chemically separate and produce fissile uranium-235 from uranium-238 using an electromagnetic separations process (alpha process) and to manufacture weapons components as part of the national effort to produce the atomic bomb. As other uranium enrichment processes were developed and implemented at other installations, the role of Y-12 expanded to include weapon components manufacturing and precision machining, research and development, lithium isotope separation, and special nuclear materials storage and management. Y-12 continues to be operated by the National Nuclear Security Administration (NNSA) as an active manufacturing and developmental engineering facility. Its current mission includes the manufacturing and reworking of nuclear weapons components, dismantling nuclear weapons components, serving as the nation's stockpile for special nuclear materials, and providing special production support to other programs. More than 50% of the facilities currently in use at the Y-12 site are now more than 50 years old, and the site is undertaking a major modernization program.

It should be noted that the end-state land use at UEFPC assumed under both the current lifecycle baseline and the RBES conditions differs somewhat from the recommendations of the EUWG. The EUWG recommended that the future land use at Y-12 should be DOE/NNSA-controlled industrial use within the western and south-central portions of the complex, and unrestricted industrial use in the eastern and north-central plant areas. However, the NNSA has since determined that because of security concerns and the current modernization program, the anticipated land use for the foreseeable future will be DOE/NNSA-controlled industrial use throughout the entire Y-12 complex.

Remediation of the UEFPC watershed is being conducted in stages using a phased approach. The *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area* (DOE 2002c), issued in May 2002, constitutes the initial phase and addresses interim actions for remediation of principal-threat mercury-contaminated soil, sediment, and point groundwater discharges that contribute contamination to surface water. This

initial ROD did not address active facilities or waste management areas. Remedial actions include hydraulic isolation, soils/sediment removal, water treatment, monitoring, and land use controls. The second phase of remediation is focused on actions for the remediation of the balance of contaminated soil, scrap, and buried materials in the Y-12 main industrial complex, the major area of contamination in the UEFPC watershed. The initial draft of the *Upper East Fork Poplar Creek Soil Focused Feasibility Study* (DOE 2003d) was released in July 2003. In addition, a final surface water ROD is expected to be issued in the future.

The remedial action objective for the actions under the initial ROD is to restore mercury concentrations in surface water to risk-based (human health) levels for recreational use at Station 17 (the point where UEFPC exits the ORR). The mercury concentration limit of 200 ppt in UEFPC surface water was derived to limit the risk to potential receptors from the fish ingestion pathway.

Remediation levels for contaminants of concern in soil and sediment are currently under development. The draft Focused Feasibility Study (DOE 2003d) presents remediation criteria derived to limit risk to a future worker not to exceed 1×10^{-4} ELCR and $HI \leq 3$ for DOE/NNSA-controlled industrial land use. An exposure unit approach is used, which establishes an average remediation level across an exposure unit that will not be exceeded and a maximum remediation level not to be exceeded at any location. Contaminated soil in an EU will be remediated so that the residual concentration averaged across the exposure unit will be at or below the corresponding average remediation level, and the maximum contaminant concentration found at any location will be at or below the corresponding maximum remediation level. Contaminants of concern include uranium, mercury, radium-226, thorium-232, cesium-137, cadmium, and PCBs. In addition to the remediation levels for individual contaminants of concern, the cumulative risk to the future worker from all contaminants may not exceed 1×10^{-4} ELCR and $HI \leq 3$.

Table 4-4. Draft Soil Remediation Criteria from the UEFPC Focused Feasibility Study

Target COC in Soil	Proposed Remediation Concentration
Carcinogens	
Cesium-137	11 pCi/g
Radium-226+D	6 pCi/g *
Thorium-232+D	8 pCi/g *
Uranium-235+D	12 pCi/g
Uranium-238+D	50 pCi/g
PCB	10 mg/kg
Noncarcinogens	
Cadmium	30 mg/kg
Mercury	325 mg/kg
Uranium	1150 mg/kg

*Criteria for radium-226+D and thorium-232+D are non-risk-based values, set at 5 pCi/g above the site-specific background concentrations of 1.4 pCi/g and 2.75 pCi/g, respectively. All other criteria are risk-based for the protection of a hypothetical future worker under DOE/NNSA-controlled industrial use.

In addition to the risk-based criteria for protection of the industrial worker summarized in Table 4-4, the draft Focused Feasibility Study also specifies remedial action objectives to remediate any soils determined to be contributing to groundwater contamination that exceeds 1×10^{-4} ELCR for an industrial drinking water scenario, and any soils determined to be contributing to surface water contamination by mercury exceeding the 200 ppt criterion in the Phase I ROD.

The selected remedy also is expected to provide protection of aquatic populations in surface water through the removal of contaminated sediments and remediating many sources of contaminants.

UEFPC Current State:

More than 70 sources of contamination have been identified within the Upper East Fork Poplar Creek watershed. The major sources include:

- The area contains an almost continuous nitrate- and uranium-238 contaminated groundwater plume, which originates from the S-3 Ponds and other sources within the plant. This plume, located deep in bedrock (300 to 400 feet), has migrated 400 feet vertically and 4000 feet laterally from its sources. It also contains other radionuclides and metals.
- A carbon tetrachloride-contaminated groundwater plume exists in the east end of the site and extends off site under the Union Valley Industrial Park. The source of this plume is unknown; however, carbon tetrachloride was used in large amounts from 1943 to 1946 in processing source material for the electromagnetic separation process. An early action for collection and treatment of this East End VOC Plume is ongoing to control migration.
- Upper East Fork Poplar Creek surface water and sediments are contaminated with mercury from groundwater discharge and overland flow.
- Two ponds have been used to handle contaminated surface water exiting the Y-12 National Security Complex prior to entering Lower East Fork Poplar Creek. These ponds concentrated mercury and other contaminants in sediments. New Hope Pond was closed in 1989 under the Resource Conservation and Recovery Act but may still be contributing to groundwater contamination. A new lined pond, Lake Reality, was opened in 1988 when New Hope Pond was drained; contaminated sediment has accumulated in Lake Reality, and the flow in Upper East Fork Poplar Creek is currently routed around Lake Reality.
- A scrap yard has been used since the early 1970s to receive scrap metal from plant operations. Some of the scrap deposited here is contaminated with radioactive materials, primarily depleted uranium and uranium-235.
- The Alpha 4 building is contaminated with mercury from historical operations.

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The Baseline Risk Assessment (DOE 1998b) identified the following potentially unacceptable risks for the UEFPC watershed:

- Sediment Contamination - Mercury, PCBs, and other COCs in sediments of UEFPC present unacceptable risk ($>1 \times 10^{-4}$ ELCR) to a future recreational receptor via the dermal exposure pathway.

- Surface Water Contamination – Mercury in UEFPC surface water exceeds AWQC (51 ppt) and risk-based levels for ingestion of fish by recreational receptors (200 ppt).
- Soil Contamination – Radionuclide and PCB levels in contaminated soil at the Y-12 site exceed risk-based levels for industrial workers, which would present an unacceptable risk ($>1 \times 10^{-4}$ ELCR) to workers in the absence of current controls.
- Groundwater Contamination – VOC contamination in groundwater exceeds MCLs and acceptable risk levels ($>1 \times 10^{-4}$ ELCR) for the future industrial worker onsite and the future residential receptor offsite.
- Ecological Impacts – Levels of mercury and PCBs in fish tissue were considered to pose an unacceptable risk to both fish and fish-eating birds; radionuclide concentrations were not determined to present unacceptable risk to any ecological receptors.

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Life-Cycle Baseline for UEFPC:

Under the current baseline, certain actions with opportunities for high risk reduction in UEFPC would be completed by 2008:

- Installation of the Building 9201-2 Water Treatment System to mitigate off-site release of mercury via surface water releases to UEFPC.
- Bioremediation to mitigate the offsite East End VOC Plume. This bioremediation treatment would be used to enhance or replace the ex-situ pump-and-treat technology that has been in operation at this site since 2000 to reduce carbon tetrachloride concentrations.

The remainder of remedial actions in the UEFPC watershed would be completed by 2015, including the following:

- Alpha 4 and unneeded waste management facilities will be demolished.
- Mercury- and PCB-contaminated soil and sediment will be excavated, and subsurface contamination beneath process buildings will be hydraulically isolated.
- Groundwater exiting the facility will be collected and treated in above-ground treatment facilities or in-situ.
- The offsite VOC plume in Union Valley will be managed with institutional controls.
- Contaminated scrap metal will be removed.
- Soils containing contaminants of concern above risk-based levels will be removed.
- Institutional controls will be maintained in perpetuity to control future land use, to restrict access to soils below the depth of remediation, and to prohibit onsite use of groundwater.

Risk-Based End State Vision for UEFPC:

The Y-12 National Security Complex is expected to continue operations for the foreseeable future in support of national security needs. Current baseline plans for UEFPC are designed to support the planned DOE/NNSA-controlled industrial use of the Y-12 site, and remediation criteria are being derived to achieve an acceptably low level of risk to the future workers. The

Phase I ROD for UEFPC only addresses release of mercury in surface water exiting the ORR, and remedial action planning for other areas of concern is only in a developmental stage. These actions will be designed to build on previous interim measures, including RCRA closures of the S-3 Ponds, New Hope Pond and other facilities, and the ongoing groundwater treatment operations to control the migration of an offsite VOC plume. Actions planned under the current baseline are considered to be consistent with remedial actions designed solely on the basis of the risk-based end state, and no specific variances have been identified to date.

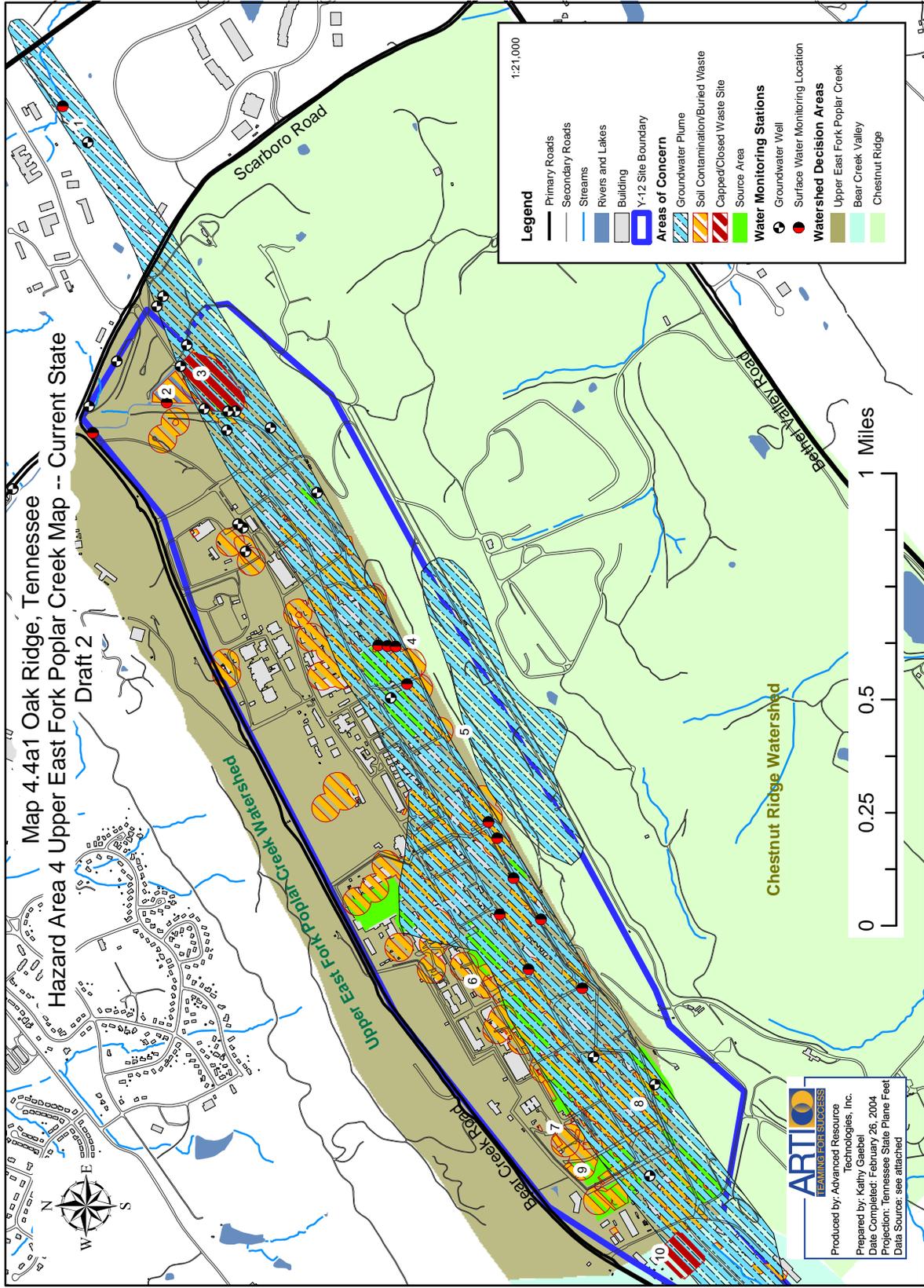
Under the current baseline plan, soil and sediment in the UEFPC watershed is expected to be remediated to a maximum depth of 2 feet to risk-based criteria derived to limit the potential risk to a future industrial worker not to exceed 1×10^{-4} ELCR and $HI \leq 3$. Source control measures currently being implemented under the Phase I ROD to reduce the release of mercury in surface water exiting the ORR include hydraulic isolation on mercury-contaminated areas, removal of contaminated sediments from UEFPC and Lake Reality, groundwater treatment, monitoring, and land use controls. The current pump-and-treat system for controlling the spread of the East End VOC Plume is planned to be replaced by a passive in-situ bioremediation system. While the concentration of carbon tetrachloride in the off-site groundwater plume exceeds levels that present an unacceptable future risk to an offsite industrial or residential receptor using groundwater as a drinking water source in the Union Valley area, there is no current use of groundwater at this location. The protection of surface water and groundwater to risk-based levels are also identified as remedial action objectives for the proposed soil action.

Maps of the UEFPC under current and RBES conditions are provided in Figures 4.4a1 and 4.4b1. Conceptual site models under current state and RBES conditions are illustrated in Figures 4.4a2 and 4.4b2, respectively.

The RBES remediation scenario for UEFPC is considered identical to the current baseline. Buildings, soils and other materials containing contaminants above risk-based criteria for future industrial use will be removed from the site for off-site disposal. A long-term stewardship program will ensure the continuing protectiveness of the remedy, including continuing surveillance and maintenance. Groundwater monitoring wells will require periodic maintenance and replacement at longer intervals (assumed 30 years). The passive in-situ bioremediation treatment system for the East End VOC plume is expected to require less maintenance than the current pump-and-treat system. Since contaminants will remain on site above levels suitable for unlimited use and unrestricted exposure, a statutory review will be conducted at least every five years to ensure that the remedy continues to be protective of human health and the environment.

The NNSA will retain ownership of the Upper East Fork Poplar Creek watershed and the remainder of the Y-12 National Security Complex for the foreseeable future.

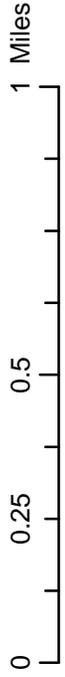
Map 4.4a1 Oak Ridge, Tennessee
 Hazard Area 4 Upper East Fork Poplar Creek Map -- Current State
 Draft 2



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Legend

- Primary Roads
- Secondary Roads
- Streams
- Rivers and Lakes
- Building
- Y-12 Site Boundary
- Areas of Concern**
- Groundwater Plume
- Soil Contamination/Buried Waste
- Capped/Closed Waste Site
- Source Area
- Water Monitoring Stations**
- Groundwater Well
- Surface Water Monitoring Location
- Watershed Decision Areas**
- Upper East Fork Poplar Creek
- Bear Creek Valley
- Chestnut Ridge



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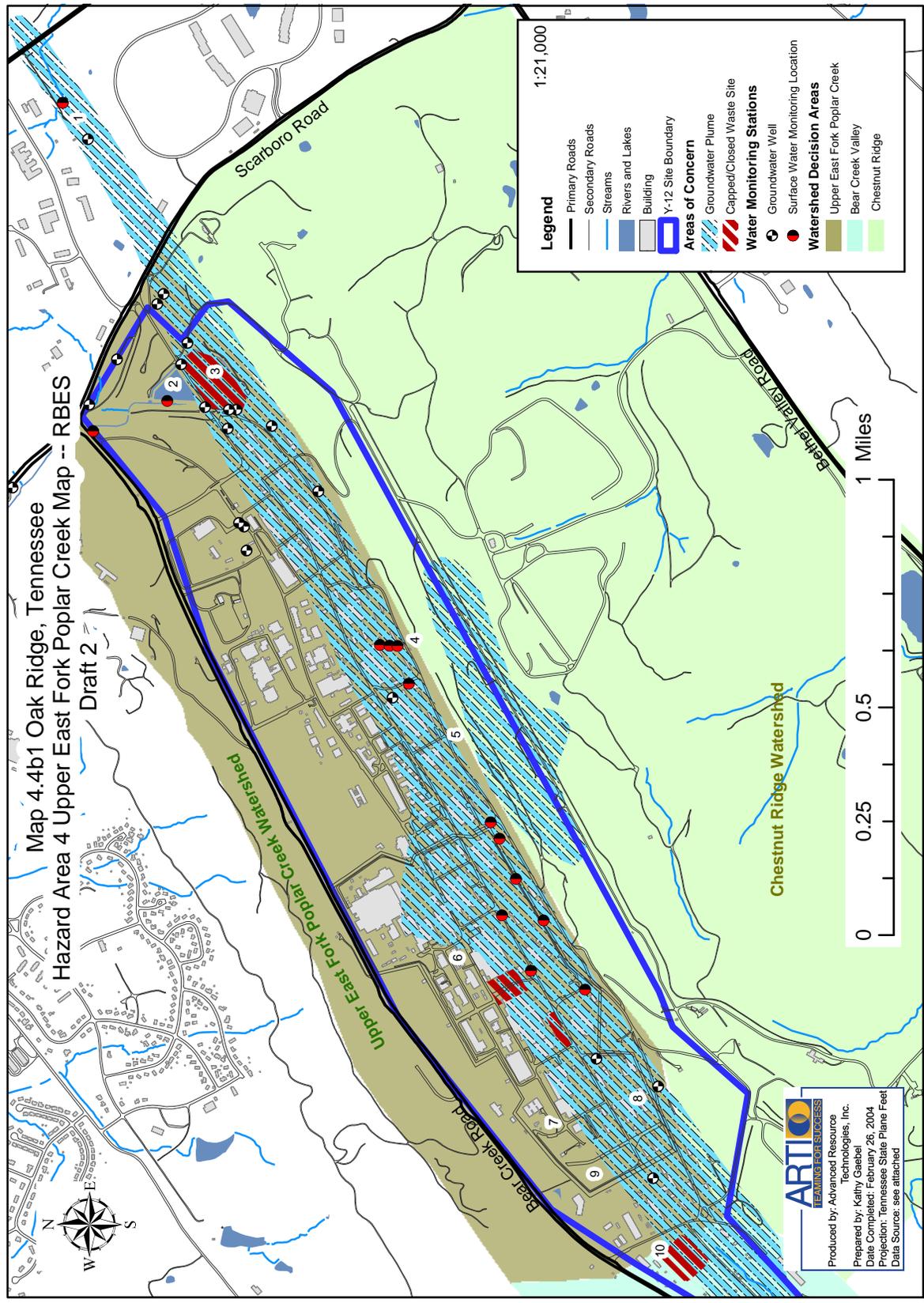
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 Prepared by: Kathy Gasbel
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Figure 4.4a1 Continued

Notes for Upper East Fork Poplar Creek current state map:

1. East-End Groundwater Plume – off-site VOC contamination exceeds risk-based levels for residential or industrial use, but there is no current use of this groundwater; pump-and-treat remedy currently in progress.
2. Lake Reality – 2.5-acre lined retention basin constructed after closure of New Hope Pond, has accumulated mercury-contaminated sediments.
3. New Hope Pond – former sediment and flow-control basin; closed under RCRA in 1989; post-closure monitoring program in place.
4. Upper East Fork Poplar Creek - stream channel and sediment contaminated with mercury and other radioactive and chemical COCs.
5. Building 9418-3 Uranium Vault – underground concrete vault used for temporary storage of approximately 200 metric tons of non-enriched uranium oxide dross.
6. West-End Mercury Area – mercury-contaminated buildings, associated process piping and tanks, storm sewer lines, and soils, resulting from lithium isotope separation operations conducted from 1950 to 1963; an estimated 230,000 pounds of elemental mercury was lost from processing operations in this area, primarily before 1960.
7. Beta-4 Security Pits – non-RCRA landfill consisting of four pits used for disposal of classified waste; an abandoned nitric acid pipeline located between the pits and a catch basin to the south.
8. Salvage Yard Oil/Solvent Drum Storage Area – former RCRA waste container storage area located in the northwestern part of the Y-12 Plant within the northern portion of the Salvage Yard; drums were stored in two areas on a compacted gravel/soil base with a clay and gravel berm on the downgradient side; combined storage capacity of approximately 3000 55-gallon drums containing radioactively and chemically contaminated waste oils, and solvents; RCRA closure conducted 1986-1989.
9. Interim Drum Yard – former RCRA waste container storage area in the southwestern portion of the Y-12 Plant, consisting of a gravel lot over native soil; RCRA closure actions conducted 1986-1996, but closure was never certified.
10. S-3 Ponds – S-3 Ponds, which were closed under RCRA in 1988, are physically located in Bear Creek Valley watershed, but are a source of groundwater contamination in UEFPC.

Map 4.4b1 Oak Ridge, Tennessee
 Hazard Area 4 Upper East Fork Poplar Creek Map -- RBES
 Draft 2



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Legend

- Primary Roads
- Secondary Roads
- Streams
- Rivers and Lakes
- Building
- Y-12 Site Boundary
- Areas of Concern**
- Groundwater Plume
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Figure 4.4b1 Continued

Notes for Upper East Fork Poplar Creek RBES map:

1. East-End Groundwater Plume – off-site VOC contamination exceeds risk-based levels for residential or industrial use, but there is no current use of this groundwater; pump-and-treat remedy currently in progress to be replaced by in-situ bioremediation treatment remedy.
2. Lake Reality – contaminated sediments will be removed for disposal, and basin will be renovated for use as stormwater retention pond.
3. New Hope Pond – RCRA closure completed 1990, post-closure monitoring program in place.
4. Upper East Fork Poplar Creek – contaminated sediments will be removed from stream channel for disposal; Building 9201-2 water treatment system will be constructed to remove mercury from the discharge from Outfall 51 and groundwater collected in sumps, the largest remaining point source of uranium in UEFPC.
5. Building 9418-3 Uranium Vault – uranium oxide waste will be removed for permanent disposal.
6. West-End Mercury Area – hydraulic isolation measures will include installation of caps over mercury runoff areas, and relining/cleaning mercury-contaminated storm sewer lines.
7. Beta-4 Security Pits – waste and contaminated soils will be remediated to risk-based criteria for industrial use.
8. Salvage Yard Oil/Solvent Drum Storage Area – residual contaminated soils will be remediated to risk-based criteria for industrial use.
9. Interim Drum Yard – residual contaminated soils will be remediated to risk-based criteria for industrial use.
10. S-3 Ponds - S-3 Ponds, which were closed under RCRA in 1988, are physically located in Bear Creek Valley watershed, but are a source of groundwater contamination in UEFPC.

Figure 4.4a2, Conceptual Site Model - Hazard Area 4, Upper East Fork Poplar Creek - Current State

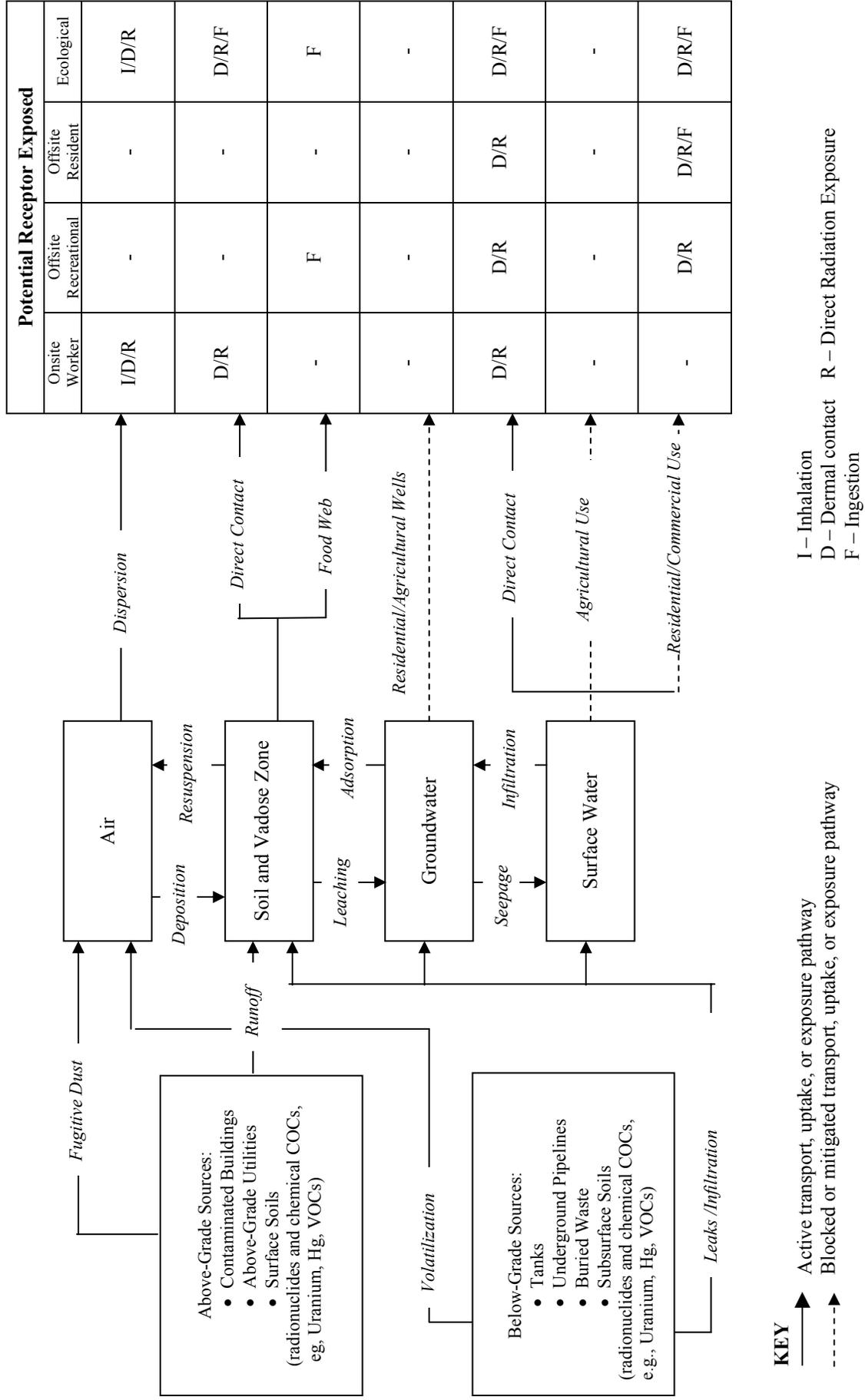


Figure 4.4a2, Conceptual Site Model - Hazard Area 4, Upper East Fork Poplar Creek – Current State

Narrative:

Contaminant Sources:

Hazard Area 4, Upper East Fork Poplar Creek, includes the main industrial complex of the Y-12 National Security Complex. This is a major industrial complex with hundreds of large buildings and an extensive industrial infrastructure of roadways, pipelines, and other utilities. Site operations during the past 60 years have included a number of manufacturing and machining operations involving a variety of hazardous materials, including uranium, mercury, beryllium, and VOCs. Y-12 remains an active facility with an important current and future mission in support of national security, and is currently embarking on a major modernization program to replace aging buildings and infrastructure.

Under current state conditions, numerous buildings, above- and below-grade pipelines and other utilities, tanks, soils and buried wastes contain contaminants of concern in concentrations above preliminary site remediation levels (the CERCLA decision documents to determine remediation criteria are currently under development). While remediation criteria are not yet finalized, they are expected to be risk-based values, derived to protect the future industrial worker at the Y-12 facility. Contaminants of concern include radionuclides (primarily uranium), Hg and other metals, and VOCs.

Current State Exposure Pathways and Receptors:

Under current conditions, potentially complete exposure pathways for onsite workers include: inhalation of particulates or volatiles; and direct exposure to contaminants in soils, buildings/structures, waste and surface water. Potentially complete exposure pathways to off-site recreationists include direct contact with surface water and ingestion of fish. Ecological receptors potentially may be exposed to contaminants in air, soil, surface water and the food chain. The Upper East Fork Poplar Creek exits the ORR about 0.5 km below Station 17 and flows through the city of Oak Ridge (designated Lower East Fork Poplar Creek outside the ORR boundary); potentially complete exposure pathways to offsite residents include direct contact with surface water, fish ingestion, and use of contaminated surface water for irrigation of home gardens. There is no current use of groundwater at UEFPC for residential, commercial, or agricultural purposes. A VOC groundwater plume extends offsite east from the Y-12 site into the Union Valley area, containing levels of carbon tetrachloride that present an unacceptable risk to a hypothetical offsite residential or industrial receptor obtaining drinking water from this source; however, there is no current use of this groundwater, so this potential exposure pathway is not complete.

Figure 4.4b2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – RBES

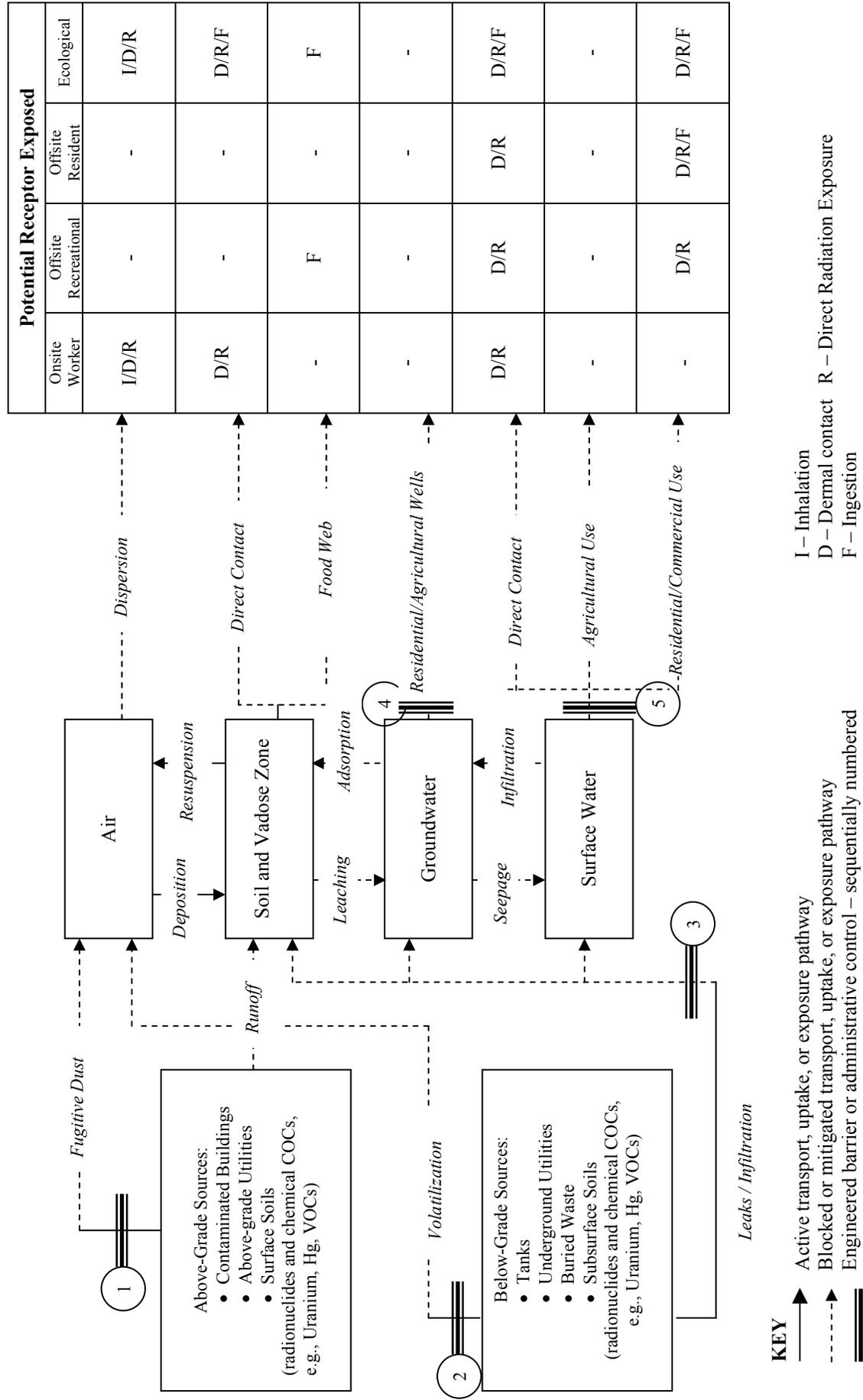


Figure 4.4b2, Conceptual Site Model – Hazard Area 4, Upper East Fork Poplar Creek – RBES

Narrative:

Contaminant Sources:

Under both current life-cycle baseline and Risk-Based End State conditions, the Upper East Fork Poplar Creek watershed will remain under DOE/NNSA control as the operations of the Y-12 National Security Complex continue for the foreseeable future. All buildings, pipelines and other utilities, soils, and other sources containing contaminants above remediation criteria derived for DOE/NNSA industrial use will be remediated. Residual contamination below the risk-based remediation criteria will remain in soils, sediments, surface water and groundwater, thus precluding unrestricted use of the site but not posing an unacceptable risk to future DOE/NNSA industrial workers. Institutional controls will include restrictions on future groundwater use.

Risk-Based End State Barriers/Interventions:

The steps taken to mitigate or remove these hazards are as follows:

1. Contaminant levels in buildings, utilities and soils will be reduced below risk-based remediation criteria. While remedial actions and criteria have yet to be finalized in the ROD, soils and sediments in the UEFPC watershed are expected to be remediated to a maximum depth of 2 ft to risk-based criteria designed to limit the potential risk to the future DOE/NNSA worker not to exceed 1 x 10⁻⁴ ELCR and HI<3. Residual contaminant levels will be below levels of concern for fugitive dust emissions and direct radiation exposure.
2. Contamination above risk-based remediation levels in tanks, below-grade pipelines and utilities, and soils will be removed for offsite disposal, eliminating potential for airborne emissions. Buried wastes would be excavated for offsite disposal or contained in place via capping. Residual contamination levels also will be below levels of concern for direct radiation exposure.
3. Remediation of contamination above risk-based remediation levels in tanks, below-grade pipelines and utilities, soils, and buried waste will eliminate potential for continuing releases to surface water or groundwater. Residual contamination levels also will be below levels of concern for direct radiation exposure.
4. Future land use is restricted to DOE/NNSA-controlled industrial use, with prohibitions on onsite use of groundwater. A VOC plume extends offsite to the east of the Y-12 site into the Union Valley area. The pump-and-treat system currently in place to contain this plume will be replaced by an in-situ bioremediation treatment system. Long-term stewardship and institutional controls will ensure continuing protectiveness of the remedy. Surveillance and maintenance will include monitoring of surface water and groundwater, with periodic maintenance and replacement of groundwater wells and ongoing maintenance of capped areas as required.
5. Actions under the Phase I ROD are designed to reduce the release of Hg in surface water exiting the ORR; these actions include hydraulic isolation of mercury-contaminated areas, removal of contaminated sediments from UEFPC and Lake Reality, groundwater treatment, monitoring, and land use controls.