DOE/OR/01-2660&D3

Focused Feasibility Study for Water Treatment at Outfall 200 under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee

APPROVED FOR PUBLIC RELEASE

This document has been approved for release to the public by:

Larry Sparks 6/23/2015
DOE Oak Ridge Office Classification Officer Date

THIS PAGE INTENTIONALLY LEFT BLANK.

DOE/OR/01-2660&D3

Focused Feasibility Study for Water Treatment at Outfall 200 under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee

June 2015

U. S. Department of Energy

Oak Ridge Office of Environmental Management

This page intentionally left blank.

CONTENTS

CONTENTS iii

FIGURES v

TABLES vi

ACRONYMS vii

EXECUTIVE SUMMARY ix

1. INTRODUCTION 1-1
    1.1 Overview and Purpose of the Study 1-1
        1.1.1 Site Description 1-2
        1.1.2 Soils/Geology/Hydrogeology 1-5
        1.1.3 Site Ecology 1-6
        1.1.4 Previous Cleanup Decisions and Actions 1-7
        1.1.5 Integrated Mercury Strategy for Y-12 1-12
    1.2 Summary of UEFPC Remedial Investigation Findings and Phase I Record of Decision 1-15
        1.2.1 Summary of UEFPC Remedial Investigation Findings 1-15
        1.2.2 Summary of UEFPC Feasibility Study and Phase I Record of Decision 1-22
        1.2.3 Problem Summary 1-27
    1.3 Organization of Report 1-28

2. REMEDIAL ACTION OBJECTIVES 2-1
    2.1 Anticipated Future Land Use 2-1
    2.2 Remedial Action Objectives 2-1
    2.3 Performance Monitoring for UEFPC Phase I ROD RAO 2-3

3. SCREENING OF REMEDIAL ACTION TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES 3-1
    3.1 Key Site Problems 3-2
    3.2 Identification and Screening of Technology Types and Process Options 3-3
        3.2.1 Identification of Process Options 3-3
        3.2.2 Screening of Treatment Technologies for Reduction of Mercury in Surface Water 3-5
    3.3 Development and Description of Alternatives 3-7

4. DETAILED DESCRIPTION OF ALTERNATIVES 4-1
    4.1 Alternative 1: No (Further) Action 4-1
    4.2 Alternative 2: Water Treatment at Outfall 200 4-1
        4.2.1 Alternative 2a: Water Treatment at Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage 4-3
        4.2.2 Alternative 2b: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage 4-9
        4.2.3 Alternative 2c: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage 4-11
        4.2.4 Alternative 2d: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 10 Million Gallons Stormwater Storage 4-16

5. ANALYSIS OF ALTERNATIVES 5-1
5.1 Evaluation Criteria 5-1
5.1.1 Overall Protection of Human Health and the Environment 5-2
5.1.2 Compliance with ARARs 5-2
5.1.3 Long-Term Effectiveness and Permanence 5-2
5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment 5-2
5.1.5 Short-Term Effectiveness 5-3
5.1.6 Implementability 5-3
5.1.7 Cost 5-3
5.1.8 State Acceptance 5-4
5.1.9 Community Acceptance 5-4
5.1.10 Additional Considerations – NEPA Criteria 5-4
5.2 Individual Analysis of Alternatives 5-4
5.2.1 Alternative 1: No (Further) Action 5-4
5.2.2 Alternative 2a: Water Treatment at Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage 5-6
5.2.3 Alternative 2b: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage 5-11
5.2.4 Alternative 2c: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage 5-15
5.2.5 Alternative 2d: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 10 Million Gallons Stormwater Storage 5-19
5.3 Comparative Analysis of Alternatives 5-23
5.3.1 Threshold Criteria 5-25
5.3.2 Balancing Criteria 5-26
5.3.3 Additional Considerations – CERCLA Modifying Criteria and NEPA Values 5-29
5.3.4 Summary 5-30

6. REFERENCES 6-1

APPENDIX A –APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS A-1

APPENDIX B – BASIS OF COST ESTIMATES B-1

FIGURES

Figure 1.1 Location of the Upper East Fork Poplar Creek Watershed. 1-3
Figure 1.2. Suspected Areas of Mercury Contamination in UEFPC Watershed. 1-4
Figure 1.3. Completed/ongoing cleanup actions in UEFPC Watershed. 1-8
Figure 1.4 Multi-Layered Strategy for Mercury Remediation at Y-12 (DOE 2014a). 1-14
Figure 1.5 Major Physical Features Affecting Mercury Processes and Transport at Y-12 (ORNL 2011). 1-19
Figure 1.6 Conceptual Model for Contaminant Transport at the UEFPC (ORNL 2011). 1-20
Figure 2.1 Mercury Concentration/Flux in UEFPC Surface Water at Station 17 and in Fish (DOE 2014b). 2-4
Figure 2.2 Annual Mercury Flux at Station 17 (DOE 2014a)..... 2-4
Figure 3.1 Locations of WEMA Former Mercury-Use Buildings and Outfalls. 3-11
Figure 4.1 Conceptual Process Block Flow Diagram for Outfall 200 Water Treatment System Alternative 2a/2b (UCOR 2014). 4-4
Figure 4.2 Alternative 2a/2b, Outfall 200 Water Treatment System, Preliminary System Process Flow Diagram (DOE 2014b)..... 4-5
Figure 4.3 Alternative 2a/2b, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout (DOE 2014b)..... 4-6
Figure 4.4 Conceptual Process Block Flow Diagram for Outfall 200 Water Treatment System Alternative 2c/2d..... 4-12
Figure 4.5 Alternative 2c/2d, Outfall 200 Water Treatment System, Preliminary System Process Flow Diagram. 4-13
Figure 4.6 Alternative 2c, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout. 4-14
Figure 4.7 Alternative 2d, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout. 4-17

TABLES

Table 3.1 Implementation Status of Component Actions in the Selected Remedy (Alternative 3a) of the Phase I ROD for UEFPC 3-8
Table 5.1 Summary of Treatment System Components Under Remedial Alternatives 5-24
Table 5.2 Comparative Analysis of Remedial Alternatives 5-32

ACRONYMS

AEA	Atomic Energy Act of 1954
A/E	architect/engineer
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
ARRA	American Recovery and Reinvestment Act of 2009
AWQC	aquatic water quality criteria
BHHRA	baseline human health risk assessment
BSWTS	Big Spring Water Treatment System
CA	characterization area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
CM	construction manager
COC	contaminant of concern
D&D	decontamination and decommissioning
DOE	U. S. Department of Energy
EE/CA	engineering evaluation/cost analysis
ELCR	excess lifetime cancer risk
EMWMF	Environmental Management Waste Management Facility
EPA	U. S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FFS	focused feasibility study
FS	feasibility study
gpm	gallons per minute
GRA	general response action
HI	hazard index
HQ	hazard quotient
LLW	low-level waste
LUC	land use control
LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
M&I	management and integration
M&O	management and operations
Mgd	million gallons per day
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Act of 1970
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PPE	personal protective equipment
ppm	parts per million
ppt	parts per trillion

RAO	remedial action objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act of 1976
RD	remedial design
RDWP	Remedial Design Work Plan
RGO	remedial goal option
RI	remedial investigation
ROD	Record of Decision
S&M	surveillance and maintenance
TBC	to be considered
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
TSCA	Toxic Substances Control Act of 1976
UEFPC	Upper East Fork Poplar Creek
UCOR	URS / CH2M Oak Ridge LLC
VOC	volatile organic compound
WAC	Waste Acceptance Criteria
WEMA	West End Mercury Area
Y-12	Y-12 National Security Complex

EXECUTIVE SUMMARY

Mercury contamination at the Y-12 National Security Complex (Y-12) has been identified as the greatest environmental risk at the DOE Oak Ridge Reservation, based on the on-going releases of mercury to offsite, public waters and the lack of response in fish mercury concentrations to overall reductions of mercury in Upper East Fork Poplar Creek (UEFPC) from pre-1980 highs. DOE is undertaking an aggressive program to mitigate potential future risk from mercury at Y-12. This focused feasibility study (FFS) develops and evaluates alternatives for modification of the remedy selected in the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* to include additional actions to reduce mercury releases from Y-12 to surface water in UEFPC. This Record of Decision (herein referred to as the Phase I ROD) was designed to be the first stage of a multi-phase remediation program for the UEFPC watershed. The Phase I ROD selected remedy focused on a series of interim source control actions designed to address the most significant sources of mercury contamination in UEFPC for which sufficient data existed at that time to support appropriate remedy selection decisions. Subsequently, the UEFPC Phase II ROD was issued in 2006 to address contaminated soil, scrap, and buried materials at the Y-12 site.

This FFS evaluates additional water treatment actions that could be taken to supplement the response actions already selected the Phase I ROD to achieve further reductions in mercury concentrations in UEFPC surface water and releases to the offsite environment. These supplemental actions would contribute to the attainment of the Remedial Action Objective (RAO) established in the Phase I ROD: "to restore surface water to human health recreational risk-based values at Station 17". This RAO was selected with the recognition that remediation of the UEFPC watershed would be conducted using a phased approach, and that the ultimate long-term goal would be the attainment of the Tennessee ambient water quality criteria (AWQC) in-stream standard for mercury. The interim action evaluated here would supplement the response actions already included in the selected remedy of the UEFPC Phase I ROD (as amended) to support attainment of the Phase I RAO and make substantial progress toward attainment of the long-term goal of meeting the AWQC in-stream standard.

A Remedial Investigation (RI) was completed in 1998 to evaluate the nature and extent of contamination at UEFPC, and the fate and transport of contaminants within and from the characterization area. A Feasibility Study (FS) was completed in 1999, and FS Addendum issued in 2000, to evaluate potential remedial action alternatives. From the larger range of potential remedial alternatives evaluated in the FS, three modified alternatives were further developed in the FS Addendum. All of these alternatives included similar source control actions (e.g., hydraulic isolation of contaminated soils and cleanout/relining of contaminated sewer lines in the West End Mercury Area, and excavation of contaminated sediments from UEFPC and Lake Reality), land use controls, and monitoring, but they differed primarily in the extent of water treatment operations proposed. These three alternatives were carried forward into the Proposed Plan issued for public comment in 2001, and subsequently into the Phase I ROD issued in 2002. The selected remedy included construction of a new water treatment facility at Building 9201-2 (Big Spring Water Treatment System, BSWTS) to treat water from in-leakage of groundwater into the basement of this building and the adjacent Outfall 51, while the other alternatives called for construction of a larger treatment system at Outfall 200 (the integration point for the Y-12 storm sewer effluent entering UEFPC) or at Station 17 (a monitoring location near the point where UEFPC exits the Y-12 site), respectively, instead of at Building 9201-2.

While the Phase I ROD selected remedy did not include construction of these larger-scale water treatment operations, it did include studies to evaluate the viability of long-term and large-scale treatment of mercury-contaminated surface water to support a future surface water decision. A treatability study and conceptual design study for a treatment system to reduce discharge of mercury from the WEMA

storm sewer system were initiated in 2012 to fulfill this requirement. These studies led to the development of a conceptual design for a water treatment system to treat discharges at Outfall 200, which was documented in a Conceptual Design Report and a Remedial Design Work Plan.

Some of the remedial actions selected in the Phase I ROD have been successfully completed while others are still scheduled for future implementation. While these actions have achieved significant progress in reducing mercury releases from the Y-12 site to the UEFPC surface water, mercury concentrations in surface water at Station 17 continue to exceed both the interim goal of 200 ng/L established in the Phase I ROD and the AWQC standard of 51 ng/L (for which a waiver was approved in the Phase I ROD). The purpose of this FFS is to evaluate additional actions that could be taken to supplement the actions already selected in the Phase I ROD to achieve further reductions in mercury releases and concentrations in the offsite environment – specifically, through the construction of a new water treatment facility to reduce mercury discharges from the West End Mercury Area (WEMA) storm sewer system to UEFPC at Outfall 200.

The storm sewer system adjacent to the former mercury-use buildings in the West End Mercury Area currently constitutes the largest source of mercury releases to UEFPC under base-flow conditions. Outfall 200 is the integration point for the WEMA storm sewer effluent entering UEFPC. The FS Addendum (DOE 2000) identified the discharge from the WEMA storm sewer system at Outfall 200 as one of the three primary sources of mercury releases to UEFPC under base-flow conditions. The other primary sources included: discharge of mercury-contaminated groundwater from Outfall 51 and the Building 9201-2 sumps, which are now treated by the BSWTS; and non-point sources between Outfall 200 and Outfall 109. Discharges from the WEMA storm sewer system at Outfall 200 now constitute the predominant source of mercury releases to UEFPC under base-flow conditions.

The identification and screening of remediation technologies and process options conducted in the original FS and FS-Addendum for UEFPC, and ultimately carried forward in the Phase I ROD, has been reevaluated in the context of the reduced scope of this focused feasibility study to evaluate additional actions to reduce mercury releases to surface water in UEFPC, to supplement those actions already included in the selected remedy. Remedial alternatives developed for this FFS are as follows:

- *Alternative 1, No (Further) Action*. The no-action alternative is required under CERCLA to provide a comparative baseline against which other alternatives can be evaluated. However, a true no-action alternative is not relevant for this FFS, since some remedial actions have already been performed under the Phase I ROD selected remedy, and other actions are ongoing and planned. Under this alternative, DOE would make no changes to the existing Phase I selected remedy, and would take no further remedial actions to reduce mercury releases to UEFPC.

- *Alternative 2, Water Treatment for Outfall 200 Discharge* - This alternative includes construction of a new water treatment facility to treat discharges from Outfall 200 designed to reduce mercury releases to UEFPC surface water. Sub-alternatives have been developed to evaluate different levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water:

  - *Alternative 2a* - A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 1500 gpm (2.2 Mgd) of influent surface water and no storage capacity for flows in excess of treatment capacity. This capacity would be sufficient to treat the average stream flow in UEFPC, but most storm events would exceed this capacity; historical records indicate that approximately 19-24% of flow records exceed 1500 gpm.

- *Alternative 2b* - A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water and no storage capacity for flows in excess of treatment capacity. This capacity is approximately equivalent to the 95th percentile flow in UEPFC – i.e., 95% of stream flow records for UEFPC do not exceed 3000 gpm. This capacity would address baseline flow conditions and small rain events.

- *Alternative 2c* - A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water and storage capacity (above-ground tanks or lined stormwater retention basin) for stormwater flows in excess of treatment capacity up to 2 million gallons. This storage capacity is estimated to be the amount necessary to capture the initial runoff from most storm events (i.e., the "first flush"); peak flows in excess of the treatment and storage capacity would bypass the treatment facility.

- *Alternative 2d* - A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water and storage capacity (above-ground tanks or lined stormwater retention basins) for stormwater flows in excess of treatment capacity up to 10 million gallons. Peak flows from larger storm events would bypass the treatment facility, although the initial runoff flow from these storm events (i.e., the "first flush") would be captured for treatment.

Under each of these action alternatives, influent flows exceeding the treatment and storage capacity would bypass the facility to UEFPC without treatment. While the final facility design would be determined during the remedial design process if this alternative is selected for implementation, the recommended conceptual design for the treatment system would include coarse solids (grit) removal, chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification), and dewatering with multi-media filtration. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed and if warranted by future conditions. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L or less in system effluents, to support the goal of reducing mercury concentrations in UEFPC surface water at Station 17 to the interim goal of 200 ng/L (i.e., the interim goal for recreational use established in the Phase I ROD) and ultimately the AWQC of 51 ng/L. The treatment capacity and stormwater storage capacity specified in each of the action alternatives are considered nominal values for the purpose of comparative analysis of these alternatives; however, the optimal treatment and storage capacity, as well as the optimal configuration of unit operations, would continue to be further evaluated during the remedial design process, and ultimately would be approved by all FFA parties in the remedial design report.

Outfall 200 has been identified as the proposed location for a new water treatment facility because it is the integration point for the WEMA storm sewer effluent entering UEFPC, and this storm sewer effluent constitutes the largest source of mercury releases to UEFPC under base-flow conditions. In addition, preliminary siting studies conducted under the Conceptual Design Report have identified feasible construction sites to support treatment of discharges from Outfall 200. Alternative locations that could be considered for a new water treatment facility, including the individual WEMA outfalls (Outfalls 150, 160, 163 or 169), Station 17, or locations between Outfall 200 and Station 17, are evaluated qualitatively for the purpose of this FFS. The optimal location for a new water treatment facility, if selected, will be determined through detailed siting studies and documented in greater detail during remedial design.

A series of pre-design studies have been performed in support of the conceptual design of the proposed water treatment system. These include studies of potential opportunities to reduce the quantity of water requiring treatment through diversion of noncontaminated stormwater and/or diversion of non-stormwater sources (e.g., once-through cooling water, condensate); however, potential reductions identified in these studies are not sufficient to significantly impact the design capacity for the proposed water treatment facility. Stormwater characterization and mercury flux modeling studies have provided a better understanding of flow dynamics in UEFPC and the flux of mercury and total suspended solids during base-flow conditions and storm events.

The detailed analysis of the alternatives shows that the no-action alternative is not protective of human health and the environment and, therefore, is not considered for selection. All action alternatives are expected to meet the CERCLA threshold criteria of overall protectiveness of human health and the environment; however, Alternatives 2c and 2d provide a higher level of protectiveness than Alternatives 2a and 2b, due to the presence of stormwater storage capacity which would result in fewer stormwater bypass events. All action alternatives also would be expected to achieve all chemical-specific, location-specific, and action-specific ARARs, with the exception of the AWQC in-stream standard for mercury, for which the interim waiver of the chemical-specific ARAR approved in the Phase I ROD would remain in effect. All action alternatives achieve protectiveness through the use of treatment technologies and institutional controls. They protect the future industrial worker at the Y-12 site as well as potential receptors downstream who might otherwise be exposed to contaminants in the surface water and in fish.

The action alternatives also are evaluated with respect to CERCLA balancing criteria of: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. All action alternatives are evaluated to be effective in the long term and provide permanent solutions for removal of mercury contamination from UEFPC surface water using treatment technologies. Alternative 2d would provide the greatest long-term effectiveness and reduction in toxicity, mobility, and volume by treating the largest volume of UEFPC surface water and achieving the greatest reduction in the mercury flux (~91%) discharged at Outfall 200 during a typical year, followed by Alternative 2c (~84%) and Alternative 2b (~68%), respectively; Alternative 2a would provide the lowest reduction (~52%) by treating the smallest volume of surface water.

All action alternatives are evaluated to have relatively minor short-term impacts. Short-term risks to remediation workers, the public, and the environment would be mitigated through use of appropriate engineering and institutional controls. All action alternatives include collection and treatment of surface water to reduce the mobility and toxicity of contaminants in UEFPC surface water. All alternatives are expected to be technically and administratively feasible to implement, and to require only services and materials that are readily available. While relative differences among the action alternatives are very small with respect to short-term impacts and implementability, Alternative 2a would be the most easily implemented with slightly lower short-term impacts as a result of its lower treatment capacity, followed by Alternative 2b; Alternatives 2c and 2d also would be readily implementable with no unacceptable short-term impacts but would require additional construction associated with the much larger headworks and stormwater storage tanks.

The estimated capital cost of the action alternatives range from $115 million for Alternative 2a, to $125 million for Alternative 2b, to $146 million for Alternative 2c, to $179 million for Alternative 2d. The present value cost estimates range from $142 million for Alternative 2a, to $158 million for Alternative 2b, to $185 million for Alternative 2c, to $221 million for Alternative 2d.

Under all action alternatives, the proposed water treatment system would be expected to reduce mercury concentrations to 51 ng/L or less in the treated effluent. Actual system performance would be evaluated following facility construction and two years of operation. If the actual performance does not

attain this target level, the FFA parties will collaborate on the selection and implementation of follow-on actions, which could include modifications of the facility to improve performance or other response actions determined to provide greater benefits in reduction of mercury releases to UEFPC. Under all action alternatives, the new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed. The water treatment facility that would be constructed under these action alternatives would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water - that is, planned remediation of mercury source areas at WEMA and other response actions may result in reduction of mercury releases to UEFPC to levels that no longer require treatment, in which case the treatment facility might be decommissioned following implementation of these other response actions. Continuing operation of this water treatment system may or may not be part of the final remedy ultimately selected for the UEFPC watershed; however, the final remedy is outside the scope of this FFS.

The proposed water treatment facility that would be constructed under all action alternatives also could have potential benefits for treatment of contact stormwater and decontamination waters from the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. Alternatives 2c and 2d would offer advantages over Alternatives 2a and 2b for potential future treatment of this source due to the presence of stormwater storage capacity which could allow more flexible wastewater inputs. The future WEMA demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water. The proposed water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. However, this source has not been specifically evaluated in the conceptual design of the treatment system, but would be evaluated during the planning for these future projects as additional characterization data become available to better define potential contaminants of concern. The modular design of the water treatment system would facilitate any change that might be needed.

The actions evaluated under this FFS to modify the Phase I ROD selected remedy to achieve further reductions in mercury releases to surface water in UEFPC are one component of an integrated multi-part strategy to reduce mercury contamination at Y-12. The *Strategic Plan for Mercury Remediation at the Y-12 National Security Center* describes DOE's integrated plan to remediate mercury contamination at Y-12 and impacted surface water downstream from Y-12 using an adaptive management approach. Adaptive management is an approach for natural resource management that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Adaptive management acknowledges uncertainty about how ecological and natural resource systems function and how they respond to management actions, and makes use of management interventions and follow-up monitoring to promote understanding and improve subsequent decision making through an iterative process. The *Strategic Plan* recognizes that the cleanup of mercury contamination and sources at Y-12 is a complex, multi-faceted problem that requires an equally multi-layered remediation approach. As an adaptive plan, the *Strategic Plan* is expected to evolve as results of implemented actions are obtained and evaluated, and modifications may be proposed as necessary. While it is important to evaluate the interim actions considered in this FFS in the context of the comprehensive mercury remediation program outlined in the *Strategic Plan*, the scope of this FFS includes only specific interim actions to further reduce mercury releases to UEFPC surface water, as evaluated in the action alternatives. Other response actions conducted under the *Strategic Plan* in the future will be documented under future CERCLA decisions.

The new water treatment system that would be constructed under all action alternatives would be designed to supplement other response actions already underway or planned for future implementation under the Phase I ROD, and would not modify or replace any of those actions. Similarly, construction of

this new facility would not impact the additional actions and studies are planned under the *Y-12 Mercury Reduction Project* and the *Strategic Plan for Mercury Remediation*, which are separate from the actions being conducted under the Phase I ROD. Completion of all response actions to reduce mercury in UEFPC surface will require many years and the interim action considered in this FFS is only one component of this comprehensive remediation program. A CERCLA Alternatives Analysis planned for ~2021 will provide input to a future FFA-party agreement on any additional actions to be implemented in UEFPC and would be followed by final RODs for UEFPC surface water and groundwater.

1. INTRODUCTION

This focused feasibility study (FFS) develops and evaluates alternatives for modification of the remedy selected in the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE 2002) to include additional actions to reduce mercury releases to surface water in Upper East Fork Poplar Creek (UEFPC) from the Y-12 National Security Complex (Y-12, formerly the Oak Ridge Y-12 Plant) at the U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR). This Record of Decision (ROD, herein referred to as the Phase I ROD) was designed to be the first stage of a multi-phase remediation program for the UEFPC watershed. The Phase I ROD selected remedy focused on a series of interim source control actions designed to address the most significant sources of mercury contamination in UEFPC for which sufficient data existed at that time to support appropriate remedy selection decisions.

Some of the remedial actions selected in the Phase I ROD have been successfully completed while others are still scheduled for future implementation. While these actions have achieved significant reductions in the mercury releases from the site, the level of mercury in UEFPC surface water remain above the interim goal established in the Phase I ROD and applicable regulatory criteria. The purpose of this FFS is to evaluate additional actions that could be taken to supplement the actions already selected in the Phase I ROD to achieve further reductions in mercury releases and concentrations in the offsite environment. Mercury contamination from Y-12 historical operations has been ranked as the greatest environmental risk at the DOE Oak Ridge Reservation (ORR), and DOE is undertaking an aggressive program to mitigate potential future risk from mercury.

This document is based upon the data and information presented in the *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1998a), *Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1999a), and *Addendum to the Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 2000), as updated to incorporate more recent information where available.

1.1 OVERVIEW AND PURPOSE OF THE STUDY

The Y-12 National Security Complex (formerly the Oak Ridge Y-12 Plant) was built by the U. S. Army Corps of Engineers in 1943 as part of the World War II-era Manhattan Project, and remains an active manufacturing and developmental engineering facility. It occupies approximately 600 acres within Bear Creek Valley near the northeastern corner of the ORR, adjacent to the city of Oak Ridge. The original mission of the facility was to chemically separate and produce fissile ^{235}U from ^{238}U using an electromagnetic separation 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. The current mission of the installation is multifaceted and includes the following National Nuclear Security Administration (NNSA) assignments: manufacturing and reworking 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.

Historic manufacturing processes, programs, and waste management practices associated with Y-12's mission have resulted in the contamination of soil, surface water, sediment, and groundwater. These processes included chemical separation techniques; weapons manufacturing; research and development; waste

storage, management, and disposal; and physical plant maintenance activities. These processes also resulted in the release of large quantities of mercury to the environment. As a result of these historical releases, mercury contamination is present in onsite soils, sediments and building structures, and in offsite surface water, sediments and biota. Because of the contaminant releases at Y-12 and other DOE facilities, the Oak Ridge Reservation was placed on the U. S. Environmental Protection Agency's (EPA's) National Priorities List established under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) [54 *Federal Register* 48184, November 21, 1989].

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, Oak Ridge, Tennessee* (DOE 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. The *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee* (DOE 2006a) (Phase II ROD) was issued in 2006 for the remediation of the balance of contaminated soil, scrap, and buried materials at the Y-12 site. Decisions regarding final land use and final goals for surface water, groundwater, and soil for the watershed will be addressed in future decision documents.

The NNSA is embarking on a significant facility and infrastructure modernization program at Y-12. The objectives for this program are to: consolidate operations to reduce footprint and maintenance costs; reuse and upgrade facilities and site infrastructure systems to be used in the future; replace facilities when it is the most effective alternative (new construction); and/or disposition surplus facilities and materials (infrastructure reduction). Construction activities for the modernization program have been initiated and are currently expected to be phased over a 20-year period. These activities will overlap the remediation actions under the UEFPC Phase I and Phase II RODs and the *Strategic Plan*, and these actions must be closely coordinated to minimize impact on Y-12's mission and modernization program.

More than 50% of the facilities currently in use at Y-12 were constructed before 1953, making them more than 60 years old. Many of these facilities were designed and built as temporary structures, expected to be used only until the end of World War II. Consequently, a significant recapitalization and rehabilitation program is necessary to ensure that Y-12 meets its national security mission. Rehabilitation alone cannot match the technological advances of the last half-century, and, therefore, a key component of modernizing Y-12 is decontamination/decommissioning and demolition (D&D) of outdated facilities and the design and construction of new facilities that are critical to its mission. These D&D activities are managed under the Integrated Facilities Disposition Program (IFDP).

1.1.1 Site Description

The ~34,000-acre ORR is located within and adjacent to the corporate limits of the city of Oak Ridge, Tennessee, in Roane and Anderson Counties. The ORR is bounded to the east and north by the developed portion of the city of Oak Ridge. The ORR hosts three major industrial research and production facilities originally constructed as part of the World War II-era Manhattan Project: East Tennessee Technology Park (ETTP), Oak Ridge National Laboratory (ORNL), and Y-12 (Figure 1.1).

The boundaries of the UEFPC watershed, which encompasses the industrialized area of Y-12, 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 property line to the east (Figure 1.1). The Phase I ROD addressed sources of contaminant releases to surface water within the UEFPC watershed, while the Phase II ROD addressed remediation of contaminated soils and scrapyards within the industrialized area of Y-12. Major features of UEFPC with respect to mercury contamination are summarized in Figure 1.2.

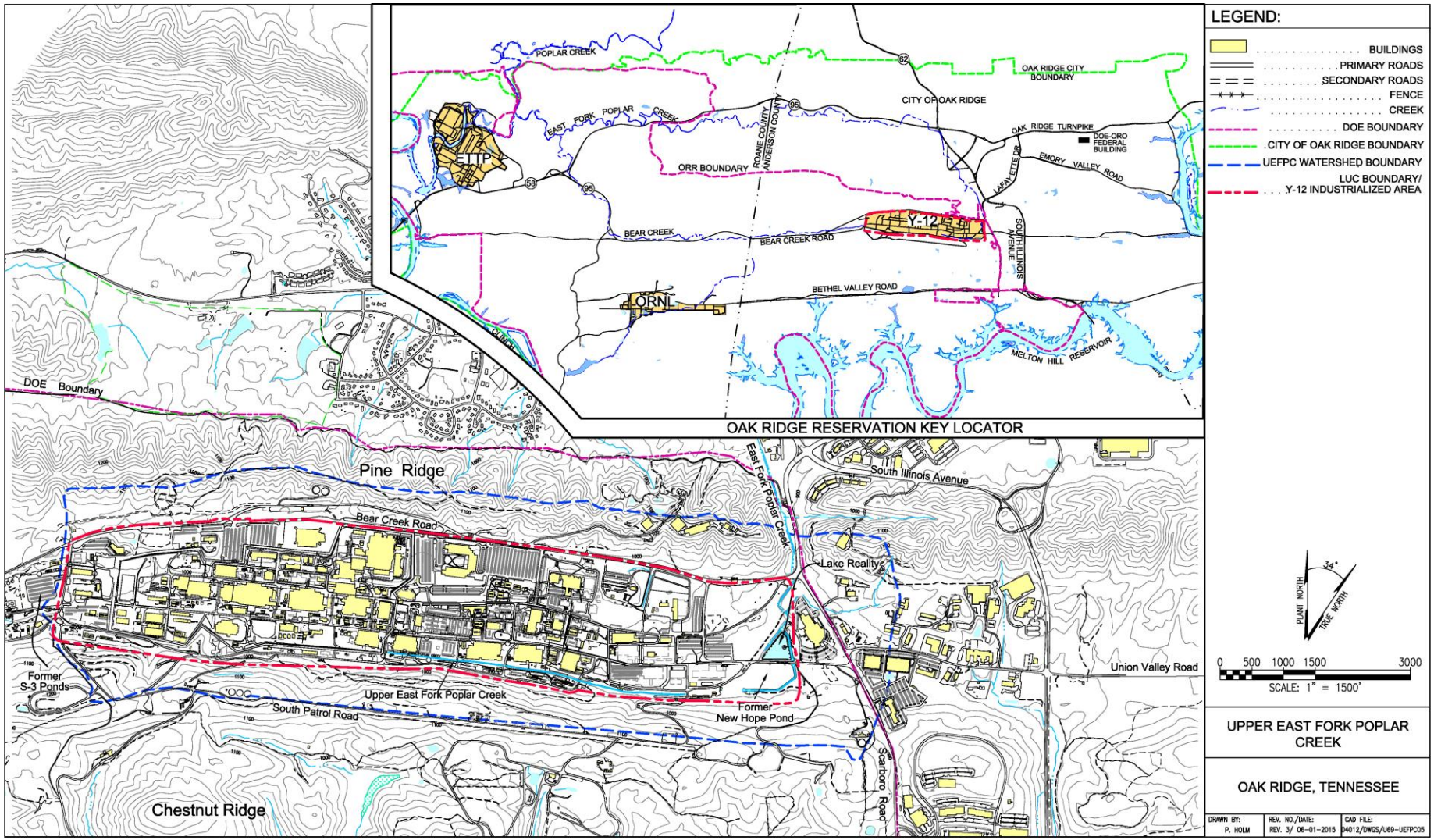

Figure 1.1 Location of the Upper East Fork Poplar Creek Watershed.

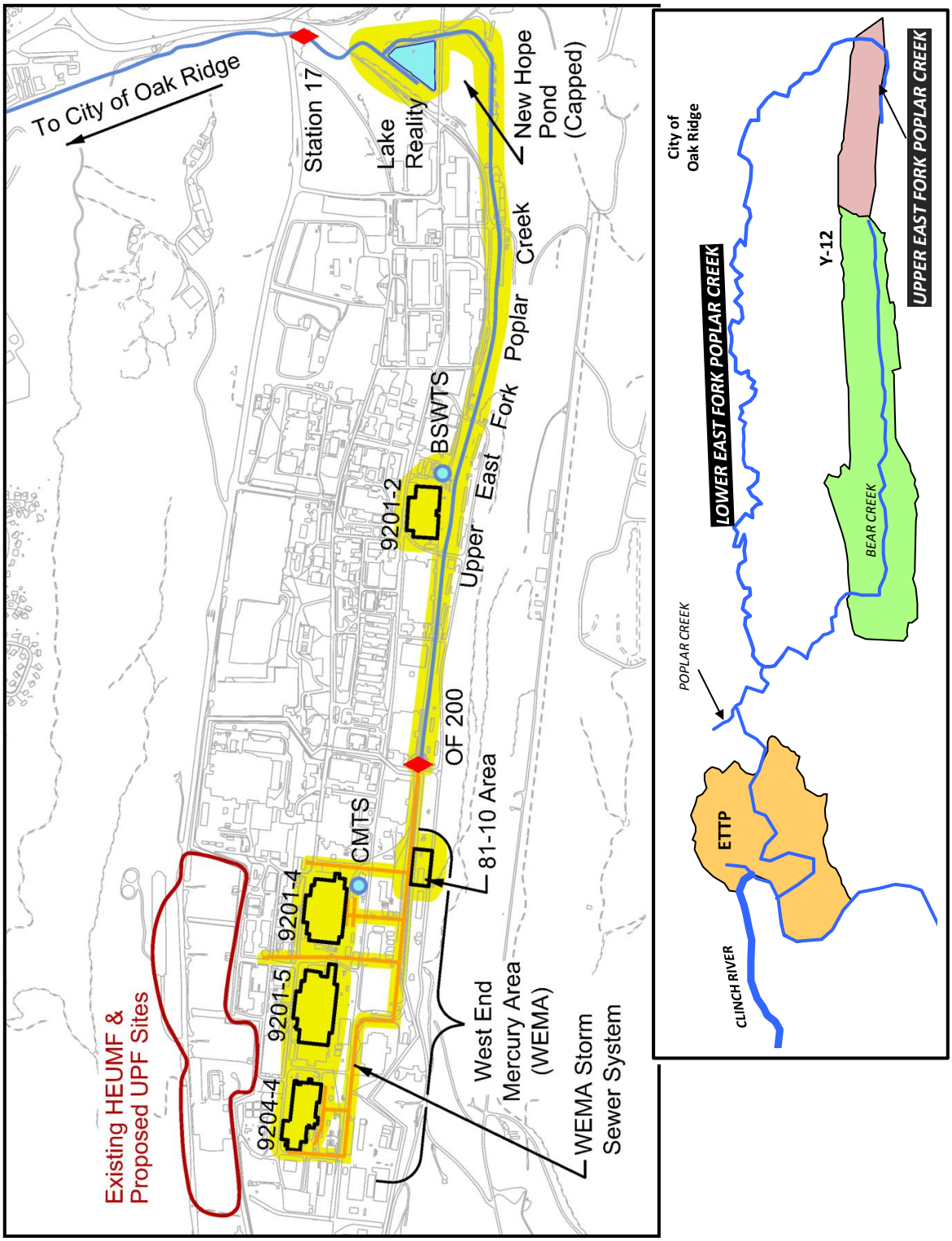

Figure 1.2. Suspected Areas of Mercury Contamination in UEFPC Watershed.

Historical operations at Y-12 have resulted in the release of mercury and other contaminants to the environment, resulting in the contamination of soil, groundwater, and surface water. As shown in Figure 1.2, UEFPC flows directly from Y-12 into the City of Oak Ridge. The storm sewer network servicing the former mercury processing buildings, designated the West End Mercury Area (WEMA) has become contaminated from mercury contamination in soil and groundwater. This contaminated storm drain network discharges through a series of outfalls into UEFPC surface water.

1.1.2 Soils/Geology/Hydrogeology

The Y-12 site is situated in the east Tennessee valley and ridge physiographic province, which is underlain by southeast-dipping sedimentary rocks of Cambrian through Mississippian age. Unconsolidated materials overlying bedrock in the UEFPC watershed include alluvium (stream-laid deposits), colluvium (material transported downslope), residuum (in situ residual material left after weathering of bedrock), weathered bedrock, and fill. Fill material consists of reworked natural materials mixed with construction debris. The unconsolidated materials are predominately clayey silts and silty clays. Very few areas within the watershed have a sequence of natural soil horizons because extensive cut-and-fill grading during construction of Y-12 reworked much of the preexisting unconsolidated material. In addition, the tributary system to UEFPC and a portion of the main channel in the central and western portions of the complex were captured in an extensive storm drain system. The thickness of fill material placed along former UEFPC tributaries is quite variable, ranging from a few feet to nearly 30 ft in the north-central portion of the complex. In most areas of the watershed, the water table lies within the unconsolidated zone or just beneath the bedrock-unconsolidated zone interface at depths ranging from less than 10 ft in the southern portion of the complex to more than 30 ft in the northern portion of the complex. Portions of the storm drain system flow continuously because they capture groundwater base-flow, as well as storm runoff.

The utility and infrastructure system in the UEFPC watershed includes an extensive network of sumps, storm drains, pipes, and outfalls. These features strongly influence the movement and discharge of shallow groundwater. In several large buildings (e.g., 9201-4, 9201-5, 9204-4, and 9201-2), basement-dewatering sumps collect shallow groundwater for discharge through outfalls to UEFPC, depressing the water table in some areas. The subsurface drainage system installed within the unconsolidated material influences groundwater flow and the water table. Within Y-12, infiltrating rainfall percolates through permeable zones in the unconsolidated materials to recharge groundwater where the ground surface is not covered by buildings or paving. Infiltrating groundwater can move downward and laterally quite rapidly within the unconsolidated zone through permeable zones to recharge the bedrock units beneath, or until intercepting a storm sewer or utility trace and discharging to UEFPC.

Underlying the unconsolidated zone, there are two fundamentally different hydrogeologic units within the UEFPC watershed: (1) shale-dominated (clastic) formations of the Conasauga Group that do not readily transmit groundwater (aquitard) and (2) the Maynardville Limestone and lowermost portions of the Copper Ridge Dolomite (Knox Group), fractured limestone and dolostone formations that readily transmit groundwater (aquifer). Groundwater flow within the aquitard formations is comparatively slow in relation to the aquifer formations and occurs primarily at shallow depths (< approximately 60 ft) via fractures and fracture zones. The general direction of groundwater flow within the aquitard formations is to the south–southeast toward UEFPC and the Maynardville Limestone. Vertical hydraulic gradients are predominantly upward within the aquitard formations.

The Maynardville Limestone is the primary groundwater exit pathway for the UEFPC watershed. Groundwater flow within the Maynardville Limestone is to the east along the strike of the valley. In addition, downward hydraulic gradients predominate within the Maynardville Limestone. In the upper 100 ft of the Maynardville Limestone, rapid groundwater flow occurs through an interconnected solution cavity network. The conduit network is connected to UEFPC, promoting a high degree of groundwater/surface

water interaction along the length of the watershed. At depths from about 100 to 500 ft in the Maynardville Limestone, groundwater flow occurs mostly through fractures and fracture zones that are, in part, isolated from the dilution and attenuation effects present in the upper 100 ft of the formation.

The high flow rates within active karst features and degree of groundwater-surface water interaction between the upper portions of the Maynardville Limestone and the open channel of UEFPC serve to dilute contaminant concentrations relative to the deeper portions of the aquifer. The groundwater-surface water connections provide a route for mass transfer of contaminants from shallow groundwater to UEFPC and vice-versa. The lack of dilution in the deeper intervals of the Maynardville Limestone results in contaminant concentrations that are typically higher than in the shallower interval, and which are sustained for longer distances. In addition, dissolved-phase contaminant concentrations indicate the presence of dense nonaqueous-phase liquid (DNAPL) in the Maynardville Limestone near the S-2 Site [tetrachloroethene (PCE), trichloroethene (TCE)] and at depths of 100 to 300 ft below ground surface in the eastern portion of the watershed (carbon tetrachloride). These DNAPL sources also contribute to higher dissolved-phase volatile organic compound (VOC) concentrations in the deeper intervals of the aquifer relative to the shallower intervals. In the eastern portion of Y-12 near Lake Reality, shallow groundwater flow deviates to the north following the surface water drainage pattern of UEFPC. A highly permeable underdrain system beneath the UEFPC distribution channel to Lake Reality captures shallow groundwater and functions to enhance the deviation of shallow groundwater flow to the north. Deeper groundwater flow in the Maynardville Limestone continues to the east through fracture flow zones along regional strike off the ORR until discharging as seeps, springs, and base-flow in the headwaters of Scarboro Creek in Union Valley. While groundwater discharged to UEFPC surface water may be treated under the interim actions evaluated in this FFS, a remedial action decision for groundwater is deferred to a future CERCLA decision.

1.1.3 Site Ecology

The ecology of the UEFPC watershed has been and continues to be strongly influenced by anthropogenic structures and industrial activities. Most of the UEFPC watershed is covered with concrete, gravel, asphalt, industrial structures, or grass. UEFPC provides very little habitat for terrestrial vertebrate animals. Woodchuck, opossum, raccoon, and striped skunk are among the largest and most abundant mammals. While surveys of protected vertebrates inhabiting the ORR are not comprehensive, the likelihood of federally or state-listed species is very low. Various birds nest and forage in the UEFPC watershed, including the belted kingfisher.

There are two dominant aquatic features in the area, UEFPC and Lake Reality. The UEFPC channel has been extensively modified over the years by installation of structures such as road crossings and weirs and through significant use of riprap and erosion controls. Much of the channel lacks riparian vegetation. Historically, mostly for security reasons, trees have not been permitted. The UEFPC channel aquatic habitat differs substantially from creeks in more natural settings. It lacks the “pool and riffle” morphology often associated with creeks in such settings. Lake Reality is a plastic-lined, flat-bottomed, steep-sided settling and spill-control basin. It is home to turtles and fish but does not support much vegetation.

Y-12 contains no designated habitat that could support threatened or endangered species of plants; however, most of the area was not directly surveyed. A small wetland was identified in 1997 just outside the complex in the area between New Hope Cemetery and Bear Creek Road. The area was dominated by jewelweed, cardinal flower, and microstegium as groundcover species and sycamore, red maple, ironwood, and green ash as woody species, none of which is threatened, endangered, or in need of special protection.

Several species of submersed macrophytes and emergent aquatic plants previously grew in and near the edge of the former New Hope Pond. None of these was considered to be rare or endangered.

1.1.4 Previous Cleanup Decisions and Actions

Cleanup actions that addressed a number of waste sources and contaminated media in the UEFPC watershed under CERCLA and other authorities have been completed or are ongoing. Figure 1.3 depicts the locations for the areas of concern addressed by previous actions. Principal actions within the watershed to date are summarized below.

<u>UEFPC Phase I and Phase II RODs</u>

- *ROD for Phase I Interim Source Control Actions (Ongoing)*. This FFS evaluates modifications to the Phase I ROD selected remedy. The Phase I ROD is described in more detail in Section 1.2, and only briefly summarized here. The interim source control actions selected in this decision address areas of contaminated soil and sediment that are principal-threat wastes with the potential to impact groundwater and surface water. The ROD sets an interim surface water goal. The scope of the interim actions include: (1) hydraulic isolation of soil in the WEMA (Buildings 9204-4, 9201-4, and 9201-5), (2) removal of contaminated sediments from UEFPC and Lake Reality, (3) treatment of groundwater discharge from the Building 9201-2 spring (Outfall 51), (4) administrative controls to prevent consumption of fish from UEFPC, and (5) monitoring of surface water. In addition, three short-term studies were identified to evaluate potential additional response actions [(1) the technical feasibility of a horizontal groundwater capture well as an additional component of hydraulic isolation of the WEMA, (2) the depth and mobility of contamination and alternative technologies for in situ treatment of mercury-contaminated soil at the Building 81-10 site, and (3) treatment and disposal options for soil and sediment that fail to meet the Waste Acceptance Criteria (WAC) for the Environmental Management Waste Management Facility (EMWMF)], and two long-term studies were identified to support future remedial actions [(1) evaluation of the viability of large-scale treatment of mercury-contaminated surface water in UEFPC, and (2) groundwater studies to facilitate a better understanding of the dynamics of the groundwater plumes underlying the UEFPC watershed]. Actions completed to date under the Phase I ROD include the following:

  - *Big Spring Water Treatment System (Completed)* – The Big Spring Water Treatment System (BSWTS) was constructed to treat discharge from Outfall 51 (including the large-volume spring and water from the Building 9201-2 sumps. Mercury contaminated water was rerouted from Building 9201-2 sumps and the East End Mercury Treatment System to the BSWTS in December 2006. The East End Mercury Treatment System and Outfall 550 are no longer in operation. (DOE 2005)

  - *WEMA Storm Sewer Cleanout/Relining (Completed)* - Clean up and repair of storm sewers in the West End Mercury Area was initiated in FY 2009. The initial phase included the videotaping of more than 20,000 linear ft of storm sewer to determine the condition of the sewers. During FY 2011, more than 8,000 linear ft of storm sewer were cleaned, and approximately 1,200 linear ft were lined. (DOE 2010b, 2012c)

  - *Explanation of Significant Differences* – An *Explanation of Significant Differences (ESD)* for the Phase I ROD was approved in 2012 (DOE 2012a) to modify some components of the Phase I selected remedy: (1) the construction of temporary asphalt caps over approximately 3.5 acres of unpaved areas at WEMA was eliminated; (2) the schedule for excavation of contaminated sediments from UEFPC and Lake Reality was revised to be consistent with the overall remediation strategy to conduct remedial action for UEFPC in a generally upgradient-to-downgradient sequence; and (3) two treatability studies that are no longer considered useful (evaluations of horizontal groundwater capture well, and in-situ treatment of soils at 81-10 area) were eliminated.

  The remaining Phase I remedial actions are scheduled for future implementation.

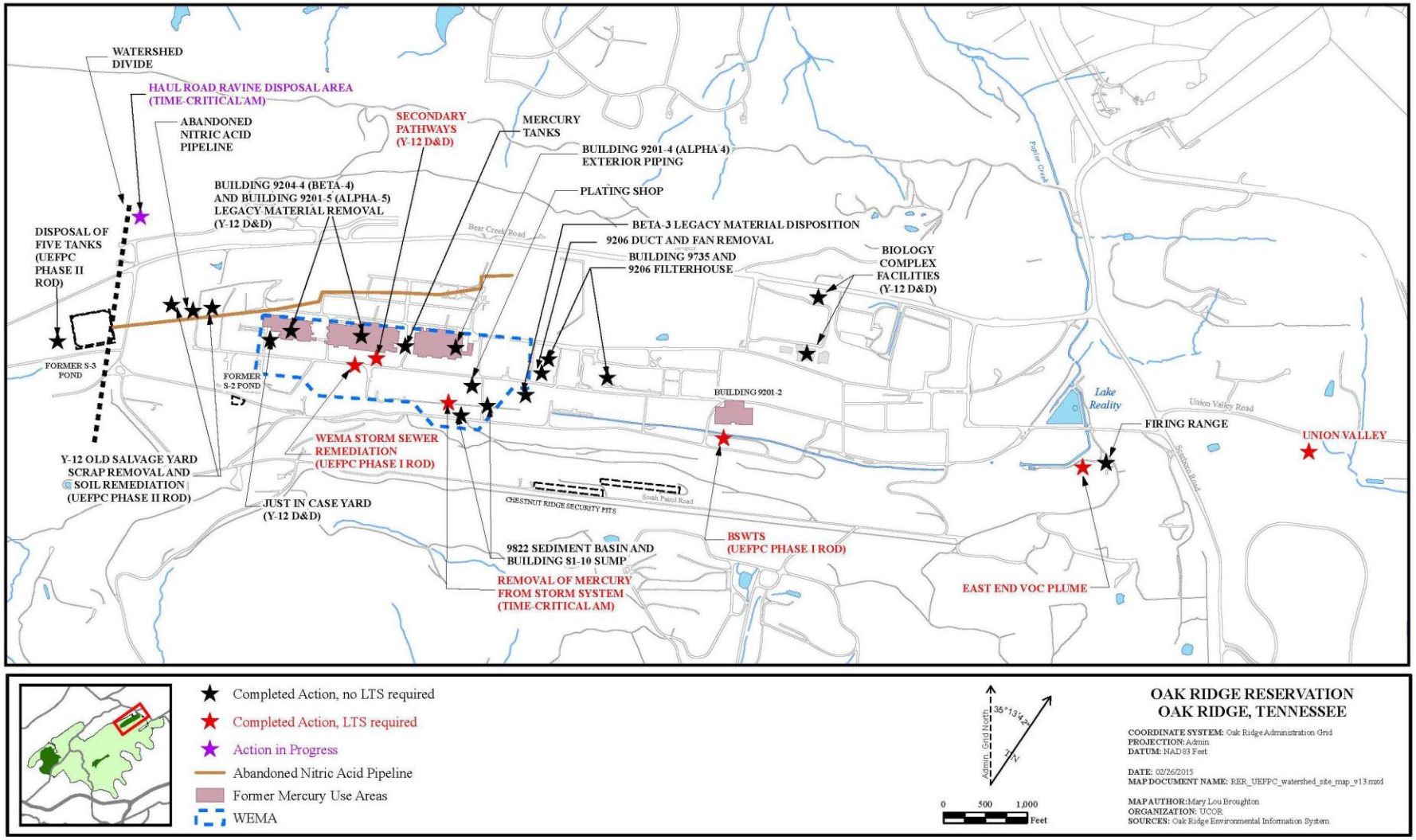

Figure 1.3. Completed/ongoing cleanup actions in UEFPC Watershed.

- *ROD for Phase II Interim Actions for Soils and Scrapyards (Ongoing)* - The Phase II ROD (DOE 2006a) was issued in 2006 for the remediation of the balance of contaminated soil, scrap, and buried materials in Y-12, the major contaminated area in the UEFPC watershed. Actions completed to date under the Phase II ROD include the following:

  - *Y-12 Old Scrapyard Cleanup (Completed)* - Cleanup of the 7-acre Y-12 Old Salvage Yard was initiated in May 2009 (DOE 2008; DOE 2009c). Removal of all scrap was completed in FY 2011 (DOE 2011a). Soil characterization in the Y-12 Old Salvage Yard was initiated in FY 2011, and removal of soil contaminated with VOCs contributing to future groundwater contamination was completed. Characterization and disposal of staged soil was completed in FY 2012 (DOE 2012d).

  - *EU-9 Characterization (Completed)* - An 11.7-acre Y-12 Exposure Unit 9 (EU-9) that includes the 81-10 Area, the former site of a mercury recovery process, was characterized in FY 2012. The characterization results indicated that future remedial action (soil excavation) is required in a portion of the 81-10 Area for protection of the industrial work force, but no action is required for groundwater and surface water protection. (DOE 2012i)

Response Actions Prior to Phase I and Phase II RODs

Additional cleanup actions undertaken to date in the UEFPC watershed, prior to the Phase I and Phase II RODs include the following:

- *National Pollutant Discharge Elimination System (NPDES) Permit Compliance Program Phase I Actions (Completed)* - Characterization of point sources of mercury discharge has been ongoing since 1982 under the Reduction of Mercury in Plant Effluent (RMPE) program, with comprehensive surveys conducted in the mid-1980s, 1990, and mid-1990s. These surveys have been the basis for numerous actions to eliminate sources of mercury to UEFPC. Estimated mercury loading from Y-12 to UEFPC in the early 1980s was calculated to be more than 150 g/d, with most of this loading coming from point sources (DOE 1998a). As a result, many of the point sources have been eliminated or reduced, and substantial reductions (>90%) in mercury loading have occurred since the early 1990s. Phase I actions were completed in the late 1980s and succeeded in reducing mercury loading to UEFPC. Phase I actions consisted of identifying major mercury sources and completing interim remediation, such as storm sewer inspection, cleaning, relining, and rerouting of process water flows [including the Mercury Tanks Interim Action at the West End Mercury Area (WEMA)]. A total of 5600 linear feet of storm sewer were cleaned, and 8400 linear feet were relined. Additionally, a 2000-ft section of the north-south pipe containing mercury-contaminated sediment was abandoned and replaced. The north-south pipe conveys UEFPC in the western area of the complex, and terminates at Outfall 200.

- *NPDES Permit Compliance Program Phase 2 Actions (Completed)* - Phase 2 actions focused on reducing continued migration of residual mercury and on meeting the mercury compliance schedule specified in the 1995 NPDES permit. Actions included the elimination of mercury sources and the rerouting of process pipe in Buildings 9201-2, 9201-4, 9201-5, and 9204-4 (Figure 1.3); the installation and operation of the Interim Mercury Treatment System and the subsequent East End Mercury Treatment System (EEMTS) at Building 9201-2; the installation and operation of the Central Mercury Treatment System treating contaminated sump water from Buildings 9201-4, 9201-5, and 9204-4; and the rerouting of UEFPC around Lake Reality to prevent formation of methylmercury-contaminated sediments.

- *UEFPC Stream Bank Stabilization Study (Completed)* - A treatability study was completed in 2000 to assess the impact of stabilization of portions of the UEFPC stream bank on the release of mercury to UEFPC. The results of the study indicated that stabilization of UEFPC banks has successfully reduced releases of contaminants during storm-flow events.

- *Flow Management (Completed)* - The 1995 NPDES permit for Y-12 indicated a need to manage flow in UEFPC to make it "stabilize at a value which will protect the stream water quality and the aquatic life now in recovery." A flow of 7 Mgd measured at Station 17 was determined to be acceptable, with flow to be maintained by pumping water from the Clinch River above Melton Hill Dam. Flow management began in 1996 and added approximately 4.5 Mgd. However, this flow augmentation was terminated in 2014.

- *Basin 9822 Removal Action (Completed)* - Basin 9822, adjacent to Building 81-10 was identified as a source of mercury and polychlorinated biphenyls (PCBs). An engineering evaluation/cost analysis (EE/CA) [DOE 1998b] was prepared, the action memorandum (DOE 1998c) approved, and the action completed in 1998. The removal action included pumping the basin and treating the water at an onsite facility, removing the sludge, disposing of the sludge in a disposal facility, demolishing the basin walls, and placing fill in the sediment basin. This action also included cleanout and closure of a mercury- and PCB-contaminated sump at the Building 81-10 Area.

- *Firing Range Removal Action (Completed)* - An EE/CA (DOE 1997a) was completed for the lead-contaminated Firing Range, the action memorandum (DOE 1997b) was approved, and the removal action was completed in 1998. The completed removal action for the Firing Range resulted in excavation and disposal of 864 yd^3 of lead-contaminated soil.

- *Union Valley Interim Action (Ongoing)* - An interim action was implemented for Union Valley to address the portion of the East End VOC Plume that has migrated beyond the boundary of Y-12. The approved ROD for this action (DOE 1997c) selected institutional controls (license agreements with property owners requiring them to notify DOE of any changes in groundwater and/or surface water use) to ensure protection of public health pending the development and implementation of final actions. In the interim-action ROD, an interim-action boundary was designated beyond the DOE boundary in impacted areas in Union Valley.

- *East End VOC Plume Removal Action (Ongoing)* - An EE/CA and action memorandum were completed for a removal action at the East End VOC Plume (DOE 1999b; DOE 1999c). The goal of the removal action is to mitigate future releases at the Y-12 boundary by taking actions at the east end of the complex to contain the VOC plume that is migrating offsite. The scope of this removal action includes VOC contamination; other contaminants, if detected in the future, will be addressed as part of a subsequent CERCLA action. The selected method of containing offsite releases is extraction of groundwater to intercept the plume near the ORR boundary with Union Valley, with subsequent treatment using filtration and air strippers. The treatment system has been in operation since 2000.

<u>UEFPC Deactivation/Decommissioning and Demolition Projects</u>

- *Y-12 Facilities Deactivation/Demolition Project (Ongoing)* – An EE/CA (DOE 2010c), Action Memorandum (DOE 2010d), and Removal Action Work Plan (DOE 2010e) were approved for the demolition of more than 100 buildings and facilities at Y-12 that are no longer needed for Y-12 operations, in support of the Y-12 modernization program and the IFDP. Supplemental documentation, such as Waste Handling Plans and Sampling and Analysis Plans, will be developed to supplement this work plan as needed.

- *Removal of Legacy Materials from Buildings 9201-5 and 9204-4 (Completed)* - A time-critical removal action was completed to remove legacy materials from Buildings 9201-5 (Alpha 5) and 9204-4 (Beta 4) in preparation for eventual decommissioning and demolition of these facilities. Legacy materials are defined as being easily removable items that involve minimal reconfiguration efforts. (DOE 2009d, 2012g)

- *Demolition of Y-12 Buildings 9211, 9220, 9224, 9769, 9735, and 9206 Bag House (Completed)* - Two time-critical removal actions were completed for the demolition of surplus contaminated facilities at the Y-12 site. The subject facilities included Building 9735, the Building 9206 Bag Filter House, and Buildings 9211, 9220, 9224, and 9769 of the ORNL Biology Complex. These facilities presented physical hazards to site employees due to their deteriorating physical conditions and had no identified future mission. The scope of activities under these removal actions included asbestos abatement, equipment removal, deactivation of utilities, and demolition of each facility to grade level. Demolition debris and other wastes generated from these demolition operations were characterized as required to meet waste acceptance criteria for disposal and transported for disposal at an approved onsite or offsite facility. (DOE 2009e, 2009f, 2011b, 2012h)

Mercury Reduction Project Actions

A number of projects were taken at UEFPC using funding from the American Recovery and Reinvestment Act of 2009 (ARRA), collectively labelled the Mercury Reduction Project, to facilitate reduction and lessened mobility of mercury at Y-12. These projects included the following:

- *Removal of Mercury from Storm Sewer System (Ongoing)* - A time-critical removal action was completed under ARRA funding to install mercury traps in WEMA storm drains and pipelines to collect and remove free mercury (DOE 2012j). A total of seven mercury traps were installed in the WEMA storm sewer system, primarily upstream from Outfalls 150, 160, 163, and 169, for collection of mercury (elemental mercury and associated contaminated sediments) from those locations and other locations within the storm sewer system as needed for appropriate waste storage, treatment and disposal.

- *Mercury Secondary Pathways Project (Completed)* - An interim action was completed to control and re-route stormwater runoff at WEMA buildings away from areas of known or suspected mercury contamination to storm drains and reduce percolation through contaminated soil. An evaluation was conducted of mercury source pathways that could impact the mobility of mercury in soils or actual discharge of mercury in the immediate vicinity of Buildings 9201-4, 9201-5, and 9204-4. Drains that could potentially discharge to soils were inspected. Designs were completed to retrofit selected building drains with mercury collection devices intended to remove mercury from building drain discharges prior to discharge to the storm sewer system. Impervious surfaces were constructed around each building and direct drainage to the storm sewer system was corrected.

- *Disposal of Five Tanks (Completed)* - A tank removal project was initiated under the UEFPC Phase II ROD to remove five tanks used for mercury-related activities at Y-12. These tanks were removed from service in the 1980s. Characterization was completed along with the necessary documentation needed for disposal of these tanks. Based on characterization results, two tanks were sent to the sanitary landfill at Y-12, and three tanks were transported for residual removals of tank contents, size reduction, and disposal. About 650 pounds of elemental mercury were removed from these tanks and disposed.

- *Mercury Soils Treatability Study (Completed)* - A treatability study was conducted under the UEFPC Phase I ROD to define a treatment option for Y-12 soils contaminated with mercury. Mercury

contaminated soil samples from EU-9 were successfully treated by three vendors using sulfur polymerization solidification/stabilization to meet required RCRA treatment standards. (DOE 2012i)

- *Outfall 200 Mercury Treatment Facility Conceptual Design (Ongoing)* - A treatability study and conceptual design of a water treatment system to reduce discharge of mercury at Outfall 200 were initiated in FY2012 under the UEFPC Phase I ROD. Collected samples of storm water effluent and grit from the bottom of the storm sewers were analyzed for constituents of concern and subjected to treatability analysis for removal of suspended solids and mercury. An alternatives analysis was performed for an Outfall 200 treatment system and a conceptual design based on the alternatives was developed. A Conceptual Design Report (UCOR 2014) and a Remedial Design Work Plan (DOE 2014b) were issued.

No-Further Action (NFA) Decisions

In addition, two no-further-action (NFA) decisions and one removal action with NFA after completion described below have been approved within the UEFPC watershed.

- *Plating Shop Container Areas NFA*. The Plating Shop Container Areas were collection and storage sites for spent plating solutions and sludges. A remedial investigation (RI) [DOE 1992a] was completed in 1992. The current and future industrial land-use exposure scenarios evaluated in the RI indicated that total cancer risks and noncarcinogenic health effects were well below the EPA-established ranges of concern. As a result, an NFA decision was approved in a September 1992 ROD (DOE 1992b).

- *Abandoned Nitric Acid Pipeline NFA*. The Abandoned Nitric Acid Pipeline carried waste (nitric acid, depleted and enriched uranium, various metal nitrates, salts, and lead skimmings) from uranium recovery processes in the central part of Y-12 to the S-3 Ponds. An RI (DOE 1994a) was conducted to address possible impacts to soil, surface water, and groundwater from the pipeline. The RI indicated that conditions related to the pipeline pose minimal threats to human health and the environment. Accordingly, an NFA decision was proposed, and the ROD (DOE 1994b) was approved in September 1994.

- *Building 9201-4 Exterior Process Piping Removal Action*. A removal action (DOE 1997d) was completed in June 1997 for exterior process piping remaining in place after the termination of Building 9201-4 operations. The removal action was limited to the mercury feed and hydrogen lines outside Building 9201-4, which were determined to be in poor condition and to have a high probability of containing mercury based on the field inspections. About 895 linear feet of pipe were cut into sections 20 ft or less in length, and all residual mercury was collected. Pipe sections were capped on both ends and consolidated inside Building 9201-4 pending disposition at the time the building undergoes decontamination and decommissioning (D&D).

An updated discussion of completed and ongoing actions within the UEFPC watershed is provided each year in the remediation effectiveness report (DOE 2014c).

1.1.5 Integrated Mercury Strategy for Y-12

The *Strategic Plan for Mercury Remediation at the Y-12 National Security Center* (DOE 2014a) describes DOE's integrated plan to remediate mercury contamination at Y-12 and impacted surface water downstream from Y-12. This *Strategic Plan* recognizes that the cleanup of mercury contamination and sources at Y-12 is a complex, multi-faceted problem that requires an equally multi-layered remediation approach. The Federal Facility Agreement (FFA) parties (i.e., DOE, EPA, and TDEC) have identified mercury contamination at Y-12 as the greatest environmental risk at the ORR, based on the on-going

releases of mercury in UEFPC to offsite, public waters and the lack of response in fish mercury concentrations to overall reductions of mercury in UEFPC from pre-1980 highs.

The interim actions proposed under this FFS to further reduce mercury releases to surface water in UEFPC (e.g., construction of a new water treatment system) are one component of this integrated multi-part strategy to reduce mercury contamination. This multi-faceted strategy will be pursued using an adaptive management approach. Adaptive management is an approach for natural resource management endorsed by the National Research Council and the U.S. Department of Interior, among others. It is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Adaptive management acknowledges uncertainty about how ecological and natural resource systems function and how they respond to management actions, and makes use of management interventions and follow-up monitoring to promote understanding and improve subsequent decision making through an iterative process. Major components of this approach (DOE 2014a) include:

- Completion of interim actions to reduce mercury releases from Y-12 at Station 17.

- Identification of desirable studies, technology development, and demonstrations to better understand the behavior of mercury in the local environment and the relationship between mercury concentrations in surface water and in fish.

- Prioritization and sequencing of these projects for maximum effectiveness and cost efficiency.

Key components of the integrated strategy for reducing potential risks from mercury are depicted in Figure 1.4, and include the following near-term elements (DOE 2014a):

- Response actions will continue to be implemented under the UEFPC Phase I and Phase II RODs, as well as the Mercury Reduction Project, D&D of the former-mercury-use buildings at WEMA, and other programs to achieve continuing reductions in mercury releases.

- Flow augmentation in UEFPC (i.e., release of 3 million gallons per day of water from the Clinch River to the UEFPC channel just below Outfall 200) was implemented in 1996 to maintain stream flow at higher levels to improve ecological conditions in the stream, but subsequently was terminated in 2014. The impact of this change on mercury flux dynamics in UEFPC will continue to be evaluated through ongoing monitoring.

- Construction of a new water treatment facility to treat discharges from Outfall 200 to reduce mercury loading in UEFPC will be completed (if selected in a ROD Amendment based on this FFS), thereby reducing the amount/flux of mercury leaving the site at Station 17, as well as providing potential treatment for contact stormwater and decontamination water from future demolition and remediation actions. The facility design will be optimized in terms of treatment method, secondary waste generation, throughput versus cost, and mercury removal efficiency. In addition, pre-design studies described in the Remedial Design Work Plan (DOE 2014b) have been conducted or are underway to provide data that will be used in the design of the water treatment facility and evaluate opportunities to reduce the volume of base-flow and storm water sewer contributions reaching the new treatment facility. Pre-design studies to evaluate potential diversion of stormwater (UCOR 2015a, 2015b) or non-contaminated process water (UCOR 2015c) from entering the WEMA storm sewer network did not identify significant opportunities for reducing the quantity of water requiring treatment. Storm-water characterization (UCOR 2105d) and mercury flux modeling (UCOR 2015e) studies also have been completed to provide improved understanding of mercury flux characteristics at Outfall 200.

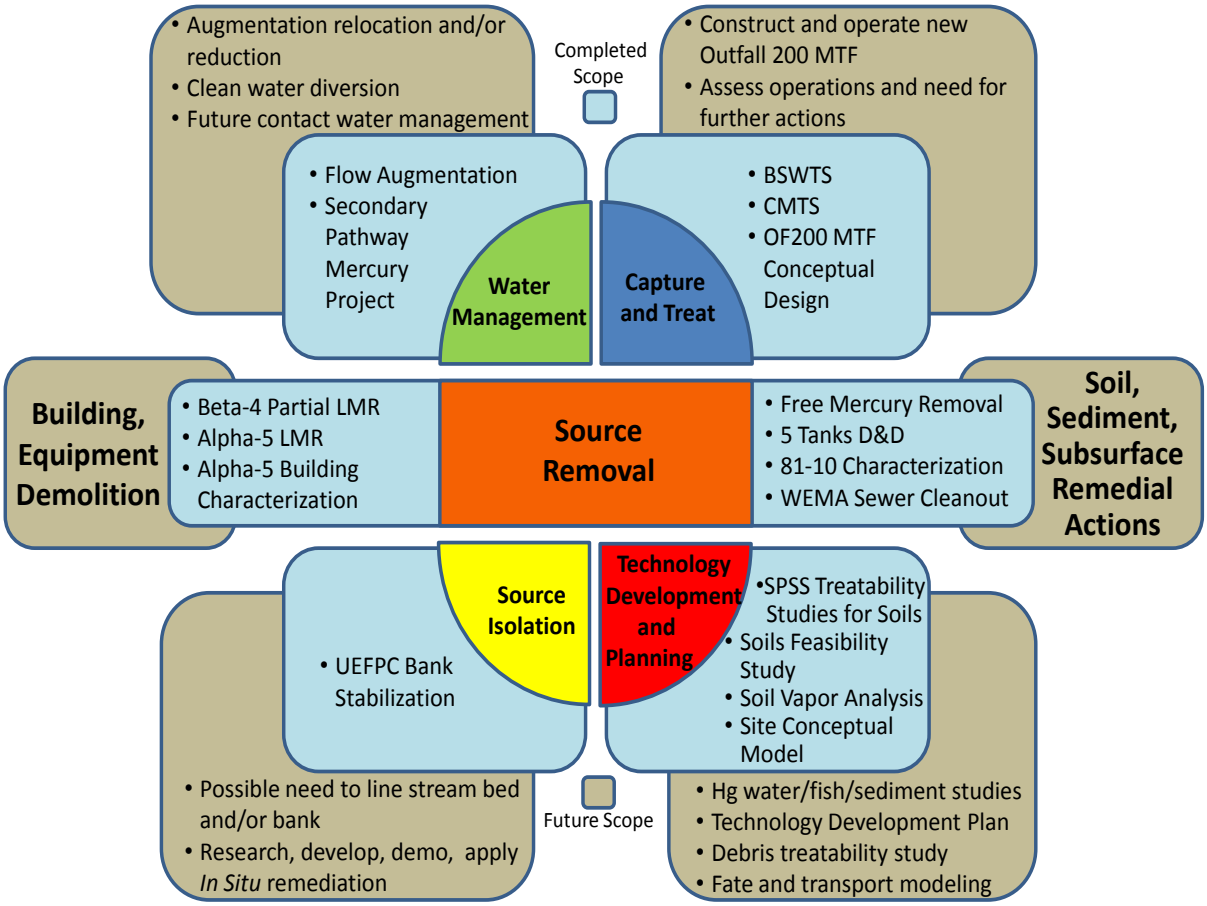

Figure 1.4 Multi-Layered Strategy for Mercury Remediation at Y-12 (DOE 2014a).

- Several studies with goals of reducing fish mercury concentrations, mercury flux, and surface water mercury concentrations will be conducted over the next several years. Field and laboratory studies will address areas including developing better understanding of mercury source contributions to UEPFC, mercury methylation processes, relationships between mercury in surface water and fish, ecological management and enhancement, water chemistry manipulation, sediment and bank soil stabilization, and potential stream reclassification.

- A FFA-party decision point to be evaluated in a CERCLA Alternatives Analysis in the FY 2021 timeframe will be the basis for agreement on any additional actions to be implemented in UEFPC or LEFPC, as needed.

- Large-scale, future mercury source removals (building demolitions followed by soil remediation) have been planned through a project-based approach. The approach involves many planning and pre-demolition activities prior to demolition and remediation. Key to the success of these large-scale demolition and remediation projects is a well-defined path for managing the expected waste debris and soil. Working with regulators, the path forward on managing the expected mercury-contaminated soils and debris will be defined and approved prior to the actual execution of these projects. Advance planning will allow efficiencies and cost reductions to be more successfully considered and implemented prior to, and in parallel, with the work.

- Building demolition and soil remediation have been sequenced in the OREM baseline to proceed west-to-east, to allow for ease of access in completing demolition and to reduce or eliminate issues of recontamination associated with groundwater flow that exhibits a west-to-east flow. Remediation of soil will follow directly after demolition for each facility. Implementation of the Phase I ROD actions to excavate contaminated sediments from UEFPC and Lake Reality is scheduled after completion of upstream D&D and remedial actions, for consistency with this sequencing strategy and reduce risk of recontamination of remediated areas.

As an adaptive plan, this strategy is expected to evolve as results of implemented actions are obtained and evaluated, and modifications are proposed as necessary. As on-going and planned studies continue to provide additional information to reduce uncertainties, and monitoring data are collected to determine impacts of completed response actions, response actions may be revised over time based on this collective information. The on-going and future mercury remediation at Y-12 is an extremely large and complex problem from all perspectives: chemical, geological, ecological, physical, regulatory, and economic. The *Strategic Plan* was developed to help guide future mercury remediation activities and support processes. Changes to schedules will likely occur over the extensive timeframe encompassed by this plan. The plan will be updated through FFA-party agreement, as necessary, to remain effective in organizing and focusing those efforts to define the work, reduce costs and increase efficiencies where possible, and to ultimately achieve the goal of cleaning up mercury from the Y-12 site and EFPC. While the interim actions considered in this FFS must be evaluated in the context of the comprehensive mercury remediation program outlined in the *Strategic Plan*, the scope of this FFS includes only the specific interim actions to further reduce mercury releases to UEFPC surface water, as described in the action alternatives evaluated in the following sections. Other response actions conducted under the *Strategic Plan* in the future will be documented under future CERCLA decisions.

1.2 SUMMARY OF UEFPC REMEDIAL INVESTIGATION FINDINGS AND PHASE I RECORD OF DECISION

The *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1998a) was completed in 1998 to evaluate the nature and extent of contamination at the site, and the fate and transport of contaminants within and from the characterization area. The *Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1999a)(FS) was issued in 1999, and the *Addendum to the Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 2000) (FS Addendum) was issued in 2000, to evaluate alternatives for potential remedial actions. Subsequently, the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE 2002) was issued in 2002. As reflected by the inclusion of "Phase I" in the title, this ROD was designed to be the first stage of a multi-stage remediation program.

1.2.1 Summary of UEFPC Remedial Investigation Findings

Extensive characterization of soil, groundwater, and surface water contamination in the UEFPC watershed was performed through several environmental initiatives and culminated in a final RI report in August 1998 (DOE 1998a). Data used in characterizing the UEFPC watershed included those collected under several regulatory and best management practice programs from 1985 to 1997: NPDES compliance program, Resource Conservation and Recovery Act of 1976 (RCRA) facility investigations, RCRA interim

status and post-closure monitoring, DOE Order 5400.1 compliance, RMPE program, Biological Monitoring and Abatement Program, and sampling conducted specifically to support the RI.

The original topography of Bear Creek Valley within the UEFPC CA has been altered substantially by grading activities during construction of the Y-12 Plant. Before plant construction, UEFPC surface water hydrology was similar to that of Bear Creek Valley, with tributaries flowing from Pine Ridge to UEFPC at the base of Chestnut Ridge to the south. During plant construction, the entire western half of the UEFPC system was captured in subsurface drains. The UEFPC CA affects three surface drainage basins: UEFPC Drainage Basin, West Union Valley Drainage Basin (Scarboro Creek Drainage Basin), and East Union Valley Drainage Basin. The UEFPC Drainage Basin originates in the subsurface storm-flow system in the western portion of the Y-12 site. UEFPC is underground from its westernmost point up to its emergence from a pipe (labelled the north-south pipe) at Outfall 200, where it then flows in an aboveground channel. After passing the Y-12 site boundary, it discharges into Lower East Fork Poplar Creek (LEFPC) and ultimately into the Clinch River. West Union Valley is drained by Scarboro Creek, which discharges into Melton Hill Lake. The East Union Valley Drainage Basin is drained by an unnamed creek that flows along the main length of Union Valley east of West Union Valley. It eventually empties into an embayment of Melton Hill Lake.

On a UEFPC watershed-wide scale, groundwater movement in the unconsolidated zone is generally towards UEFPC and is locally influenced by preferential pathways imposed by manmade and natural features. For example, an active zone of flow is usually present along the interface between the unconsolidated zone and bedrock. Water infiltrating bedrock moves mostly along strike, slowly in the sandstone and shale units, and quickly in the Maynardville Limestone. Some of the groundwater flow in the Maynardville Limestone discharges to UEFPC and Scarboro Creek through springs and seeps. The shallow groundwater divide between the UEFPC and West Union Valley (Scarboro Creek) prevents shallow contaminants from the Y-12 site from migrating into West Union Valley. Deep groundwater flow is mainly controlled by primary and secondary bedrock structures and can move into West Union Valley as indicated by tracer studies and contamination plumes.

1.2.1.1 Nature and Extent of Contamination

As discussed above, UEFPC and the Maynardville Limestone provide the conduits for offsite contaminant migration. The nature and extent of contamination is briefly summarized below:

- Mercury contamination is widespread at the Y-12 site and has been identified in soil, sediment, surface water, groundwater, buildings, drains, and sumps. Mercury continues to be released into UEFPC from point (discrete) and nonpoint (diffuse) sources within the Y-12 site. Mercury enters UEFPC from direct erosion of contaminated soil, migration of dissolved mercury through storm drains and outfalls, and through shallow groundwater. In addition to widespread mercury contamination throughout the UEFPC CA, several areas have been identified as significant sources of mercury releases. These areas include the WEMA (under and around Buildings 9201-4, 9201-5, and 9204-4), Building 81-10 Area, Building 9201-2 Area (Outfall 51), Lake Reality, and UEFPC streambed. These areas act as reservoirs for the release and migration of mercury contamination to shallow groundwater and surface water.

- Areas of contaminated soil are located throughout the UEFPC CA. In addition to mercury contamination, radiological contamination in shallow soil is widespread, primarily ^{238}U from historical uranium-processing operations. Areas of PCB contamination have also been identified.

- Surface water receives contamination through groundwater discharge, storm water runoff, and process outfall discharges, and is a route of contaminant migration off ORR via UEFPC. Mercury

concentrations in UEFPC have been decreasing as a result of response actions taken to date, but they are above ambient water quality criteria (AWQC) and are detected in fish in East Fork Poplar Creek (EFPC). PCB concentrations in UEFPC are below detection limits, but PCBs have been detected in the food chain within the creek. Sediments contribute mercury and PCBs to the food chain. The sediments in the storm drain system and UEFPC channel are contaminated as a result of historic releases from operations at the Y-12 site and continue to receive contaminant inputs from storm sewer discharges and nonpoint source runoff during storm events. The UEFPC streambed and Lake Reality contain sediments with elevated concentrations of multiple contaminants, primarily mercury and PCBs, which are subject to remobilization and/or downstream transport.

- Shallow (soil and other unconsolidated materials and uppermost bedrock <100 ft deep) and deeper (bedrock >100 ft deep) aquifers contain contaminants associated with the Y-12 site. Data indicate that dense nonaqueous-phase liquids (DNAPLs), such as organic solvents, may be present. VOCs in groundwater suggest the presence of DNAPL at several sites within the plant. The East End VOC Plume, a dissolved-phase carbon tetrachloride groundwater plume above maximum contaminant levels (MCLs) that extends eastward into Union Valley was addressed in a removal action to contain and treat contaminated groundwater.

Historically, the primary point sources of mercury to UEFPC at Y-12 have included mercury-contaminated water discharge from the basement sumps of former mercury-use buildings (i.e., Buildings 9201-2, 9202, 9201-4, 9201-5, and 9204-4), mercury-contaminated pipes (internal and external to buildings) and storm drains that discharge through Outfalls 169, 163, and 160, and the mercury-contaminated natural spring flow surfacing near the historic mercury-use area and discharging via Outfall 51. The point source at Outfall 51 is now treated by the BSWTS, while the potential treatment of the discharges from these other outfalls is the subject of this focused feasibility study. Important non-point sources of base-flow mercury identified in the RI included non-point inputs to the reach of stream between the termination of the north-south pipe (Outfall 200) and Outfall 109, which may be partially associated with scouring of streambed sediments. This latter source may have been impacted by the flow augmentation program, which was terminated in 2014 under the new NPDES permit for the Y-12 site; however, the impact of this recent change has yet to be determined. This cessation of the flow augmentation program had the effect of reducing base-flow rates at monitoring stations downstream from Outfall 200 (Stations 8 and 17) by a factor of approximately two-thirds.

The portion of the mercury loading that is associated with particulates tends to increase between Outfall 200 and Station 17, and stream flow increases significantly over this reach due to both facility discharges and groundwater influx to the stream. Mercury flux and concentration at Station 17 have generally trended lower over recent years, except for a temporary increase during 2011-13 that is thought to be associated with the storm drain cleanout program.

1.2.1.2 Conceptual Site Model

Most of the Y-12 site is underlain by anthropogenic fill (placed during plant construction) and shale-dominated units of the lower Conasauga Group. Most groundwater flow in these materials is south–southeast at depths of less than 70 ft toward the southern edge of Bear Creek Valley, which is underlain by the Maynardville Limestone (primary groundwater exit pathway). The storm sewer system and buried tributaries of UEFPC also play a significant role in transport of groundwater contaminants to UEFPC and the Maynardville Limestone.

Flow in the shallow interval of the Maynardville Limestone, which includes the water table interval and groundwater to a depth of about 100 ft, occurs through a maze of interconnected solution conduits

and cavities. Contaminants are easily flushed through this interval, and dilution effects that arise from rainfall/recharge mean that contaminant signatures tend to attenuate rapidly along strike.

Groundwater flow in the intermediate interval of the Maynardville Limestone occurs between 100 and 328 ft. Solution cavities and solutionally enlarged fractures exist in the Maynardville Limestone in this interval. In contrast to the shallow interval, this zone is isolated from dilution effects and constitutes an important transport pathway.

In the deep interval of the Maynardville Limestone (>328 ft), flow through fractures dominates groundwater movement, and as fracture spacing increases with depth, flow zones become less frequent.

UEFPC is the only surface water exit pathway. The natural flow path was altered during construction of the plant site, including rerouting of the natural streams, development of the underground utility system, and building of the dewatering sumps. In the late 1990s, flow augmentation measures significantly increased flow volumes and rates in UEFPC and altered flux trends of major contaminants, including mercury; the flow augmentation was terminated in 2014.

A new site conceptual model study conducted in 2008-2010 (ORNL 2011) to update the site conceptual model for mercury releases to UEFPC identified changes in key assumptions of the Phase I ROD:

- Of the known mercury inputs to UEFPC surface water, Outfall 200 (representing combined inputs from WEMA and other upstream areas) is the most important current source of mercury to the stream, representing up to 70-80% of the mercury flux at Station 17, particularly under low to average flow conditions. This is a significant change from the conditions when the Phase I ROD was issued (i.e., prior to the construction of the BSWTS and the resulting reduction in mercury flux from Outfall 51) when Outfall 200 was thought to represent approximately 20% of the flux at Station 17.

- Expected responsiveness of fish to reductions of mercury levels in surface water have not been observed – i.e., mercury concentrations in fish tissue have not declined at a rate similar to the mercury concentrations in surface water at Station 17 – indicating a more complex relationship than previously thought.

Figure 1.5 shows a simplified schematic of the major physical features affecting mercury processes and transport at Y-12. Contamination is introduced into groundwater through multiple paths including spills, pipeline leaks, and dissolution from contaminated soils and sediments. Due in part to the nonwetting properties and high density of liquid mercury, spills and leaks of mercury at the surface or within buildings may result in deposits of subsurface liquid mercury in both the unconsolidated and bedrock systems. Such deposits can provide a long-term source of mercury contamination in the groundwater that feeds UEFPC, as evidenced by the presence of mercury from Outfall 51, which drains a large spring adjacent to Building 9201-2. Basement sumps in Buildings 9201-2, 9201-4, and 9201-5 collect groundwater from the immediate area surrounding the former mercury processing buildings. These sumps historically fed groundwater into the storm drain system but have been rerouted to water treatment facilities. Sumps at Building 9201-5 are no longer in operation, allowing groundwater to accumulate in the basement of the building. (ORNL 2011)

Figure 1.6 shows the most recent version of the site conceptual model for mercury releases to UEFPC, from a conceptual model study conducted in 2008-2010 (ORNL 2011). As noted above, this study found that the combined inputs from WEMA and other upstream areas (as measured at Outfall 200) now represents the most important source of mercury inputs to UEFPC surface water – i.e., this source

now contributes up to 70-80% of the mercury flux at Station 17, particularly under low to average flow conditions, as opposed to an estimate of approximately 20% of the flux at Station 17 when the Phase I ROD was issued (i.e., prior to the construction of the BSWTS and the resulting reduction in mercury flux from Outfall 51). In addition, mercury concentrations in fish from UEFPC and downstream areas have not declined at a rate similar to the mercury concentrations in surface water at Station 17, indicating a more complex relationship than previously thought.

1.2.1.3 Summary of Site Risks

The baseline human health and ecological risk assessments developed as part of the UEFPC RI (1998a) identified unacceptable risks to human health in soil, sediment, surface water, and groundwater in the UEFPC CA. Unacceptable risks to the environment were identified in surface water and fish. If not addressed, actual or threatened releases of hazardous substances from the UEFPC CA may present a current or future unacceptable risk to human health or the environment.

Three human health exposure scenarios were evaluated for the baseline risk assessment: (1) a hypothetical unrestricted industrial worker exposure scenario, (2) a hypothetical recreational exposure scenario, and (3) a hypothetical residential exposure scenario. Risks to workers and other receptors under current conditions were not estimated and were assumed to be below levels of concern as a result of site controls. The baseline risk assessment quantified hypothetical future exposures based on the observed contaminant levels to estimate the reasonable maximum exposure to UEFPC contaminants under all future land-use scenarios.

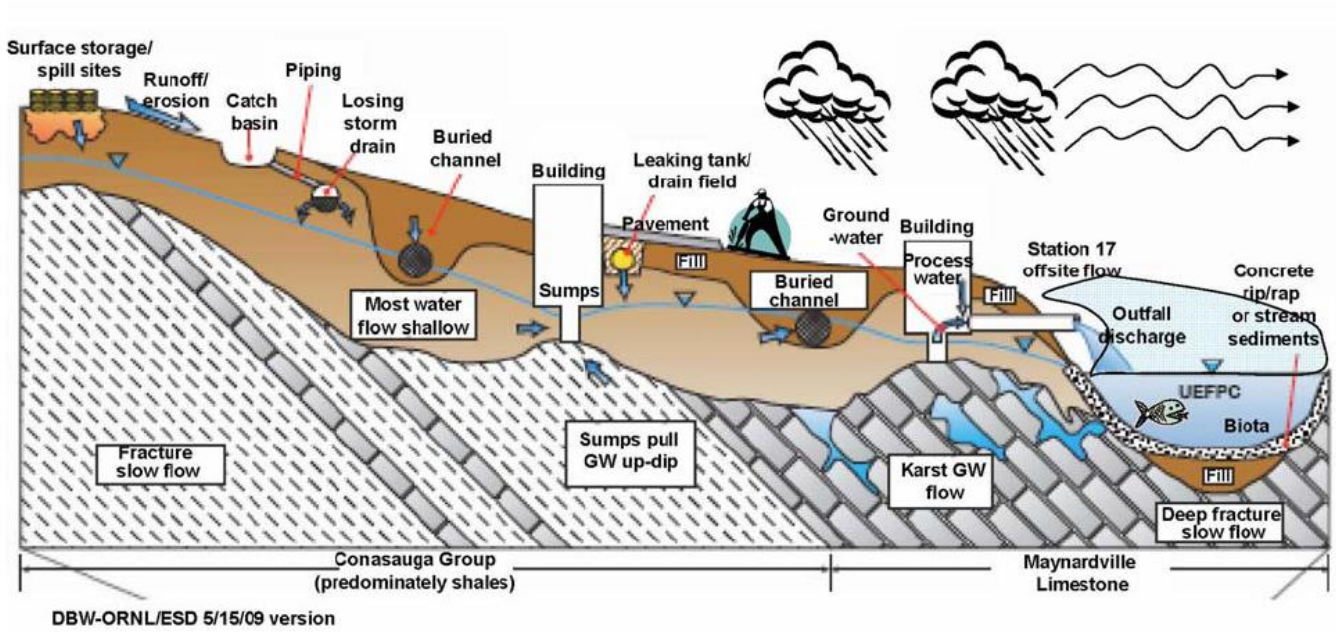

Figure 1.5 Major Physical Features Affecting Mercury Processes and Transport at Y-12 (ORNL 2011).

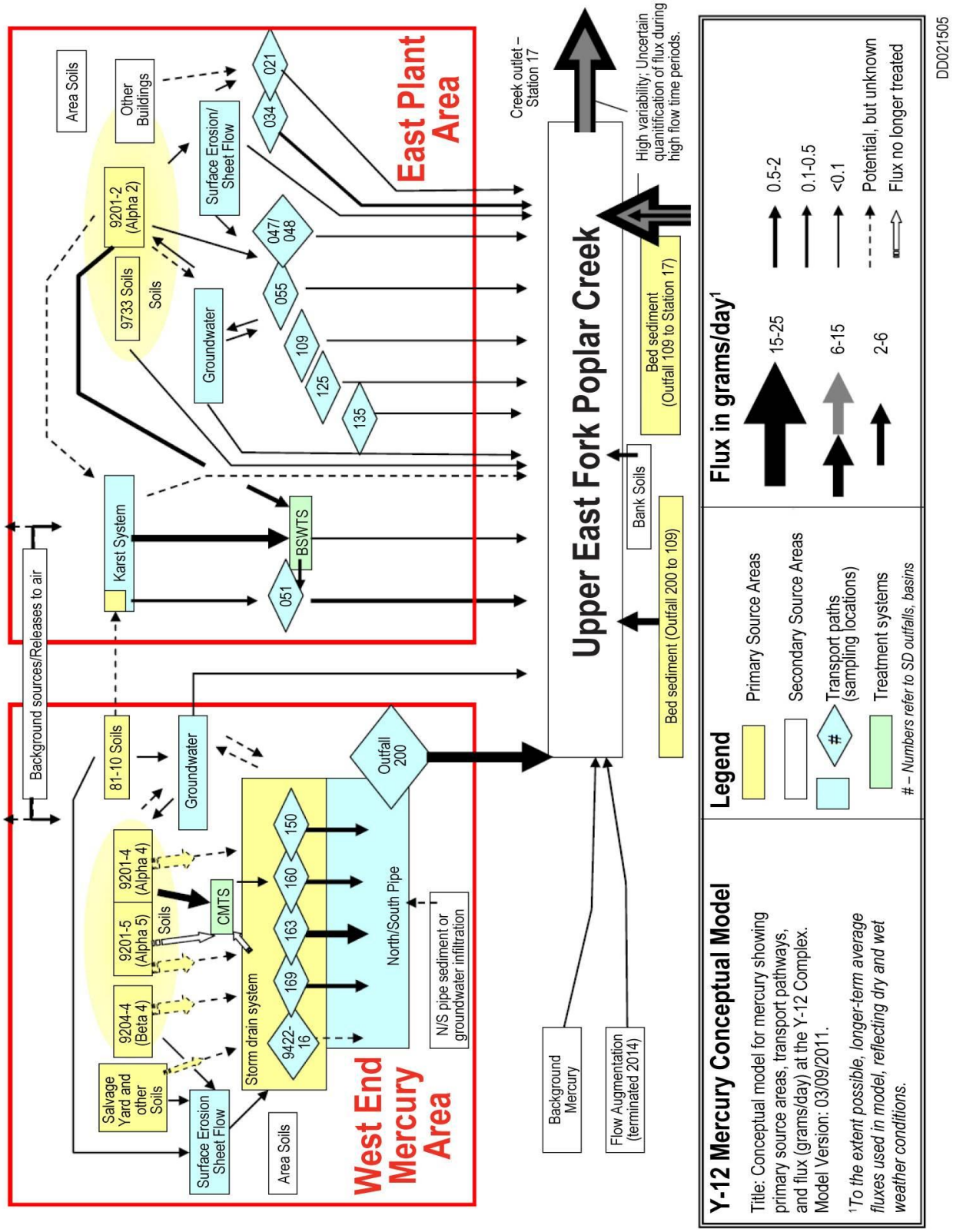

Figure 1.6 Conceptual Model for Contaminant Transport at the UEFPC (ORNL 2011).

The predominant COCs [defined as those COCs with total carcinogenic risks greater than 10^{-4} and or total noncarcinogenic hazards greater than a hazard index (HI) of 1] for the most likely expected future land uses, as well as those contaminants that could remobilize and/or transport downstream (into surface water and ultimately into fish), include the following:

- soil: $^{238/235}U$, $^{226/228}Ra$, ^{137}Cs, PCBs and dibenzo(a,h)anthracene;
- surface water (including fish): mercury and PCBs;
- sediments: benzo(a)pyrene, ^{226}Ra, cadmium, mercury, and PCBs; and
- groundwater: carbon tetrachloride (CCl_4), TCE, PCE, dichloroethene (DCE), benzene, chloroform, arsenic, beryllium, cadmium, manganese, and nitrate.

Since the purpose of this focused feasibility study is to evaluate alternatives for modification of the remedy selected in the Phase I ROD to include additional actions to reduce mercury releases to UEFPC surface water from the Y-12 site, only risks associated with the surface water pathway are pertinent to this study. The only unacceptable risk to potential human receptors was estimated to be that associated with the ingestion of fish from UEFPC (as well as LEFPC and EFPC) – i.e., UEFPC surface water exceeds the primary AWQC for mercury (51 ng/L) as well as the interim goal derived in the Phase I ROD for ingestion of fish by recreational receptors. However, this pathway is currently precluded by institutional controls, including postings and periodic patrols. Consequently there is no unacceptable risk to human health associated with UEFPC surface water, so long as the current institutional controls are maintained.

While the RI identified mercury and PCBs as COCs for the surface water pathway, more recent monitoring data indicate that only mercury exceeds any applicable or relevant and appropriate regulatory critieria (e.g., the AWQC of 51 ng/L) or risk-based goals (e.g., the interim goal of 200 ng/L). PCBs are rarely detected in UEFPC surface water and are well below regulatory criteria. The ongoing monitoring program for UEFPC surface water also includes uranium and zinc as COCs. The average uranium concentration measured at Station 17 was about 15 µg/L in FY2013 but four of the weekly composite samples exceeded the MCL of 30 µg/L (which is used only as a screening level for UEFPC). Zinc is measured in weekly grab samples and is well below the AWQC level of 120 µg/L (FY2013 average 18 µg/L, maximum 40 µg/L). The scope of this FFS is limited to interim measures to achieve further reductions in mercury concentrations in UEFPC surface water.

While the baseline risk assessment and the RI report were issued in 1998, it is useful to note that the methodology, assumptions, and key parameter values used in that analysis, are not significantly different than current EPA recommendations, with respect to evaluating potential risk from mercury. Specifically, the reference dose (RfD) for chronic oral toxicity has not changed; this is true both for inorganic forms of mercury (e.g., mercuric chloride was assumed for the RI) with a value of 3.0E-4 mg/kg-day and also for the more toxic methyl mercury (which was used for derivation of the interim goal specified in the FS Addendum, Proposed Plan, and Phase I ROD) with a value of 1.0E-4 mg/kg-day (EPA IRIS). Changes in the target concentration for mercury in fish tissue, as used in the derivation of the interim goal, are discussed in Section 2.2. Studies are ongoing to better understand the complex mercury methylation and bioaccumulation processes on mercury concentrations in fish.

Similarly, the RI identified potential current and future ecological risks to UEFPC biota. Potential current ecological risks from contaminants in UEFPC water, sediment, and/or fish were identified for fish and macroinvertebrates in UEFPC, aquatic biota in seeps and springs, and piscivorous wildlife. Levels of

mercury and PCBs in fish were identified to present a potentially unacceptable risk to fish and fish-eating birds. Potential unacceptable future risks were identified for fish and invertebrates in UEFPC and for aquatic biota in seeps and springs. The primary contaminants of concern that contribute most significantly to future ecological risk include mercury, carbon tetrachloride, chloroform, metals, and PCBs. Future risks to piscivorous biota were identified as significant, primarily due to mercury.

More recent data has indicated a potential concern regarding bioaccumulation of mercury in spiders along LEFPC, as identified in the FY2011 CERCLA Five-Year Review (DOE 2012a). Spiders found along EFPC were found to have unusually high ratios of methyl-mercury to total-mercury, which presents a potential hazard to predators that may ingest these spiders. Additional characterization is underway to reduce uncertainty and refine the conceptual model for mercury bioaccumulation to better evaluate this potential risk, and these activities will be documented in a protectiveness statement in the next CERCLA Five-Year Review in FY2016.

This FFS is focused solely on interim measures to achieve further reductions in mercury releases from the Y-12 site to UEFPC surface water and reductions in mercury concentrations in UEFPC surface water exiting the Y-12 site. Risks to human health or ecological receptors from other contaminants and other environmental media and pathways are not within the scope of this interim action.

1.2.2 Summary of UEFPC Feasibility Study and Phase I Record of Decision

The *Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE 1999a) developed and evaluated alternatives for potential remedial actions at UEFPC to address the site problems identified in the RI. Remedial alternatives in the FS were developed to include different combinations of the selected process options to achieve one or more of the following basic remediation strategies:

- Strategy 1 – Source control through containment – This strategy would use technologies such as capping and horizontal wells to hydraulically isolate waste and minimize its mobility. Capping would establish a protective cover to prevent infiltration of water into the contaminated area, while horizontal wells would be located upgradient of the contaminated area to divert uncontaminated shallow groundwater away from the contaminated area. This strategy would require knowledge of the approximate location of contamination source areas and would require long-term management. It would not directly address contamination that has migrated from the source prior to containment.

- Strategy 2 – Source control through removal and in-situ treatment – This strategy would involve: (1) the physical removal of contaminant sources (e.g., excavation of buried waste and contaminated soil) for ex situ treatment and/or disposal; and (2) chemical, physical, thermal, or biological treatment processes to destroy or immobilize contaminants in situ. This strategy would prevent or greatly reduce contaminant migration to environmental media, but would not directly address contamination that has migrated from the source prior to removal or treatment.

- Strategy 3 – Migration control– This strategy would allow mass transfer of contaminants from source areas to mobile media such as surface water or groundwater, but would control further migration with engineered systems for water collection and treatment at appropriate downgradient locations. This strategy would require very long operation and maintenance (O&M) periods, as some untreated sources could continue leaching for hundreds or thousands of years, but can be effective if primary or secondary sources cannot be sufficiently defined for source control strategies to be effective.

Five action remedial alternatives, in addition to the no-action alternative required under CERCLA, were initially developed and evaluated in the FS for screening to address site conditions throughout the UEFPC characterization area:

- Alternative 1, No Action
- Alternative 2, Source Control by Containment
- Alternative 3, Source Control by Removal and In-Situ Treatment
- Alternative 4, Migration Control
- Alternative 5, Migration Control and No Plume Growth
- Alternative 6, Migration Control with Source Control by Removal and In-Situ Treatment and No Plume Growth

In response to an EPA request for additional information on these source control and migration control strategies and associated actions, the FFA parties agreed to prepare an FS Addendum (DOE 2000) to provide additional detail regarding the application of general response actions (and their associated technologies and selected representative response actions) to individual release sites within the UEFPC characterization area. The specific release sites evaluated in the FS Addendum included the West End Mercury Area, UEFPC sediments, Lake Reality sediments, Outfall 51, and UEFPC surface water. For each of these release sites, the FS Addendum evaluated the nature and extent of contamination and identified GRAs and representative process options to address conditions at that release site. DOE also agreed to compare the source control and migration control strategies used to develop the FS alternatives for their effectiveness in meeting the surface water RAO. To facilitate comparison of these strategies, the FS Addendum developed three modified alternatives for evaluation in accordance with CERCLA criteria:

- Alternative 3a, Source Control – This alternative relied on source control actions to reduce risk and minimize costs. Component actions included hydraulic isolation of contaminated soils and cleanout/relining of contaminated sewer lines in the West End Mercury Area, excavation of contaminated sediments from UEFPC, excavation of contaminated sediments from Lake Reality, land use controls to protect potential human receptors, surface water monitoring to evaluate performance, and construction of a new 300 gallons-per-minute (gpm) water treatment facility at Building 9201-2 to treat water collected in the basement sumps in Building 9201-2 and the adjacent Outfall 51.

- Alternative 4a, Migration Control Using Water Treatment Plant at Station 17 – This alternative relied on a migration control strategy, based on construction of a new water treatment plant at Station 17, to achieve the RAO. A new water treatment plant with capacity to treat 15 million gallons per day (Mgd) would be constructed above Station 17 to treat UEFPC base-flow, a limited amount of storm flow, and groundwater extracted as part of the East End VOC containment action. Lake Reality would be renovated for use as a storm-flow retention basin. Additional component actions in this alternative included similar source control actions to those in Alternative 3a – i.e., hydraulic isolation of contaminated soils and cleanout/relining of contaminated sewer lines in the West End Mercury Area, excavation of contaminated sediments from UEFPC, excavation of contaminated sediments from Lake Reality, land use controls to protect potential human receptors, and surface water monitoring to evaluate performance.

- Alternative 6a, Migration and Source Control with Water Treatment Plant at Outfall 200 – This alternative relied on construction of a new water treatment plant at Outfall 200, in conjunction with

source control actions, to achieve the RAO. A new water treatment plant with capacity to treat 4.3 Mgd would be constructed at Outfall 200 to treat UEFPC base-flow, downstream outfalls, and groundwater extracted as part of the East End VOC containment action. Additional component actions in this alternative included similar source control actions to those in Alternative 3a – i.e., hydraulic isolation of contaminated soils and cleanout/relining of contaminated sewer lines in the West End Mercury Area, excavation of contaminated sediments from UEFPC, excavation of contaminated sediments from Lake Reality, land use controls to protect potential human receptors, and surface water monitoring to evaluate performance.

All of these alternatives included similar source control actions (e.g., hydraulic isolation of contaminated soils and cleanout/relining of contaminated sewer lines in the West End Mercury Area, excavation of contaminated sediments from UEFPC and Lake Reality), land use controls, and monitoring, but they differed primarily in the extent of water treatment operations proposed. That is, alternative 3a included construction of a new water treatment facility at Building 9201-2 (Big Spring Water Treatment System) to treat water from in-leakage of groundwater into the basement of this building and the adjacent Outfall 51, whereas the other alternatives called for construction of a much larger treatment system at Station 17 or at Outfall 200, respectively, instead of at Building 9201-2.

These three alternatives were carried forward into the Proposed Plan (DOE 2001) and the Phase I ROD (DOE 2002), which chose Alternative 3a as the selected remedy. Alternative 3a was determined to meet the threshold criteria of protectiveness and compliance with ARARs (with an interim waiver for the AWQC in-stream standard for mercury) and to provide the best balance of trade-offs among the other alternatives with respect to the balancing and modifying criteria. Alternative 3a was estimated to have the lowest cost of all alternatives at a present worth cost of $38 million, less than one-half the estimated cost of the other action alternatives, and to have the least uncertainties regarding implementability and long-term effectiveness. In particular, TDEC expressed concerns regarding the selection of a remedy that was dependent on the ability of a large-scale water treatment facility to consistently achieve the desired levels for mercury, and expressed a preference to proceed with source control actions and to defer decisions on large-scale water treatment to future decision documents. The State also expressed concerns about the need for surface water to bypass the treatment facility during storm flow conditions.

As reflected by the inclusion of "Phase I" in the title, the Phase I ROD was designed to be the first stage of a multi-stage remediation program. The Phase I ROD selected Alternative 3a, Source Control, as the response action that best met the CERCLA evaluation criteria to achieve the Remedial Action Objective (RAO): "Restore surface water to human health recreational risk-based values at Station 17". The selected alternative focused on a series of interim source control actions designed to reduce the release of mercury to the offsite environment. These actions were designed to address the most significant sources of mercury contamination in UEFPC for which sufficient data existed at that time to support appropriate remedy selection decisions through the CERLCA process. The interim source control actions selected in the Phase I ROD included:

- Hydraulic isolation of contaminated soils (subsequently modified in 2012 ESD) and cleanout/relining of contaminated sewer lines in the West End Mercury Area;

- Excavation of contaminated sediments from UEFPC and Lake Reality (implementation schedule subsequently modified in 2012 ESD);

- Construction and operation of a water treatment system at Building 9201-2 (designated the Big Spring Water Treatment System, BSWTS) to treat discharge from Outfall 51;

- Continued operation of the Central Mercury Treatment System (CMTS) and East End Mercury Treatment System (EEMTS) as needed;

- Land use controls to prevent fish consumption and to restrict access to contaminated areas; and

- Surface water monitoring to evaluate reductions in contaminant concentrations.

In addition to these source control actions, the selected remedy also included three short-term studies and two long-term studies to evaluate potential additional response actions:

- the technical feasibility of a horizontal groundwater capture well as an additional component of hydraulic isolation of the WEMA (subsequently modified in 2012 ESD);

- the depth and mobility of contamination and alternative technologies for in situ treatment of mercury-contaminated soil at the Building 81-10 site (subsequently modified in 2012 ESD);

- treatment and disposal options for soil and sediment that fail to meet the Waste Acceptance Criteria (WAC) for the Environmental Management Waste Management Facility (EMWMF);

- evaluation of the viability of large-scale treatment of mercury-contaminated surface water in UEFPC; and

- groundwater studies to facilitate a better understanding of the dynamics of the groundwater plumes underlying the UEFPC watershed.

Some of the actions selected in the Phase I ROD have been successfully completed while others are still scheduled for future implementation. While the actions completed to date have achieved significant reductions in the mercury releases from the site, the level of mercury in surface water and in biota (e.g., fish tissue) remain above the interim goal of 200 ppt established in the Phase I ROD.

The selected remedy included the continued operation of previously existing treatment systems for treatment of mercury contaminated waters as needed. These included the East End Mercury Treatment System (EEMTS), which continued operation only until the new BSWTS was constructed, and is no longer in operation; and the Central Mercury Treatment System (CMTS), which continues operation today. CMTS was designed to treat mercury contaminated water collected in sumps at the WEMA buildings, most notably Buildings 9201-4 and 9201-5, with a treatment capacity of 50 gpm. Treatment of water from the sumps in Building 9201-5 was discontinued following an accidental introduction of methanol from a leaking cooling system in 2005 that interfered with mercury treatment, but treatment of sump water from Building 9201-4 (a much larger source of mercury) continues. The total volume of water treated during FY2013 was approximately 2.2 million gallons; no effluent sample exceeded the goal of 200 ppt and the total mercury discharge was estimated at less than 2 mg (DOE 2014c).

The Phase I selected remedy also included construction of a new water treatment system (BSWTS) with a 300 gpm capacity to treat discharge from Outfall 51 (including the large-volume spring designated Big Spring located near the southeast corner of Building 9201-2) and water from the Building 9201-2 sumps. Mercury contamination within shallow groundwater beneath and adjacent to Building 9201-2 discharges at this spring. The source area extent that feeds Big Spring is not well understood and much of the flow and contamination is thought to originate from the source areas to the west in the WEMA. Following construction in FY2005, mercury contaminated water was rerouted from Outfall 51 and the

Building 9201-2 sumps to the BSWTS in December 2006. Influent previously treated at the East End Mercury Treatment System also was rerouted to the BSWTS at this time and the EEMTS operation was discontinued. During FY2013, the average concentration of mercury in BSWTS influent was 4.7 µg/L and 0.044 µg/L in system effluent, and none of the weekly composite samples exceed the performance goal of 200 ppt (0.2 µg/L) specified in the ROD. During FY2013, the volume of water treated at BSWTS was approximately 97 million gallons, and the total mercury flux discharged in the treated effluent was approximately 16 grams. In addition, water bypassing treatment during periods of high flow during FY2013 contributed an estimated mercury flux of approximately 75 grams. (DOE 2014c)

Also as required by the selected remedy, more than 20,000 linear ft of the storm sewer network at WEMA were inspected, more than 8,000 linear ft were cleaned, and approximately 1,200 linear ft were re-lined.

Previous modifications to the Phase I ROD have included three non-significant change (N-SC) notices and the *Explanation of Significant Differences for the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area* (DOE 2012)(ESD), which documented more significant changes:

- A non-significant change was documented in 2006 (DOE 2006c) to document changes in UEFPC surface water monitoring requirements to upgrade sampling equipment at Station 200A6 for collection of continuous mercury flux samples as 7-day composites and discontinue sampling at Outfalls 150, 160, 163, and 169 until one year prior to the WEMA remedial actions.

- A non-significant change was documented in 2006 (DOE 2007a) to discontinue treatment of water collected in sumps at Building 9201-5 (Alpha 5) at the CMTS due to the leakage of brine solution from cooling systems into the building sumps; methanol in the brine solution was found to contribute to enhanced bacterial growth at CMTS which negatively impacted the system treatment efficiency. Water is being allowed to accumulate in the basement of Building 9201-5.

- A non-significant change was documented in 2014 (DOE 2014d) to clarify that monitoring requirements and sampling protocols for UEFPC will be documented in the *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan* (DOE 2013b), rather than the UEFPC Remedial Design Work Plan (RDWP) as stated in the Phase I ROD.

- An ESD was approved in 2012 (DOE 2012b) to modify components of the Phase I selected remedy: (1) the construction of interim asphalt caps over approximately 3.5 acres of unpaved areas at WEMA was eliminated; (2) the schedule for excavation of contaminated sediments from UEFPC and Lake Reality was revised to be consistent with the overall remediation strategy to conduct remedial action for UEFPC in a generally upgradient-to-downgradient sequence; and (3) two treatability studies that are no longer considered useful (evaluations of horizontal groundwater capture well, and in-situ treatment of soils at 81-10 area) were eliminated.

While the Phase I ROD did not include large-scale water treatment operations as part of the selected remedy, it did include the study described above to evaluate the viability of long-term and large-scale treatment of mercury-contaminated surface water to support a future surface water decision. A treatability study and conceptual design study for a treatment system to reduce discharge of mercury from the WEMA storm sewer system was initiated in 2012 to fulfill this requirement. These studies led to the development of a conceptual design for a water treatment system to treat discharges at Outfall 200, which was documented in a conceptual design report (UCOR 2014) and a Remedial Design Work Plan (DOE

2014b). The successful performance of the existing water treatment systems (BSWTS, CMTS) for mercury reduction also suggest that additional water treatment facilities might achieve further reductions of mercury in UEFPC surface water. Therefore, this FFS evaluates additional water treatment actions that could be taken to supplement the actions already included in the Phase I selected remedy to achieve further reductions in mercury concentrations in UEFPC surface water and releases to the offsite environment.

1.2.3 Problem Summary

As a result of investigation activities that have occurred at Y-12, the following problems have been identified. The first group of problems was addressed in the Phase I decision, and the second group of problems was addressed in the Phase II decision. The third group of problems is addressed in the scope of this FFS. The last group of problems will be addressed in future decisions. Each of these sets of problems is summarized below.

Problems Addressed in the Phase I ROD

- Principal-threat mercury contamination in soil and sediment contributes to UEFPC surface water contamination;
- Shallow groundwater contaminated with mercury releasing to UEFPC surface water; and
- Mercury contamination in UEFPC surface water bioaccumulates in fish, contributing to risk to a recreational receptor from fish ingestion.

Problems Addressed in the Phase II ROD

- Contaminated soil contributing to a risk to a future industrial worker;
- Contaminated soil contributing to groundwater (VOC) and surface water (remaining lower levels of mercury) contamination;
- Buried waste and surface scrap metal; and
- Subsurface structures.

Problems Addressed in this FFS

- Concentrations of mercury in UEFPC surface water that exceed the interim goal of 200 ng/L at Station 17 established in the Phase I ROD and the long-term goal of attaining the AWQC in-stream standard of 51 ng/L for mercury.

Problems for Future Decisions

- Risk from exposure to groundwater;
- Final goals for surface water, groundwater, and soil; and
- Final land-use controls.

1.3 ORGANIZATION OF REPORT

This report consists of six chapters and supporting appendices:

- Chapter 1, "Introduction," describes the objectives of this report and summarizes the decision framework, site conditions, RI findings, and previous actions taken in the watershed.
- Chapter 2, "Remedial Action Objectives," presents the objectives of remedial action, the remediation approach, and remediation levels.
- Chapter 3, "Screening of Remedial Action Technologies and Development of Alternatives," summarizes the assemblage of representative process options into an alternative to meet the remedial action objectives (RAOs).
- Chapter 4, "Detailed Description of Alternatives," presents a description of each alternative.
- Chapter 5, "Analysis of Alternatives," evaluates the ability of the alternatives and no action to achieve CERCLA evaluation criteria and to meet the RAOs, and summarizes the alternative evaluation as compared to no (further) action.
- Chapter 6, "References," provides full citations for documents used in the preparation of this report and cited in the main text and appendices.

The appendices provide supporting data and additional information on remediation levels to protect groundwater and surface water, applicable or relevant and appropriate requirements (ARARs), and the cost estimate.

2. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAOs) are site-specific goals that are developed from the purpose and scope of remedial actions. This section summarizes land-use assumptions for UEFPC and presents RAOs for UEFPC surface water.

2.1 ANTICIPATED FUTURE LAND USE

Y-12 is located entirely within the DOE ORR "229 Boundary" established under the Atomic Energy Act of 1954 (AEA). Within the ORR, public access is subject to restrictions. Because Y-12 is an active production and special nuclear materials management facility, additional security and access limitations apply. The eastern portion of the complex is occupied by Lake Reality and the former New Hope Pond, maintenance facilities, office space, training facilities, and change houses. The far western portion of the complex houses primarily waste management facilities and construction contractor support areas. The central and west-central portions of the complex encompass the high-security portion, which supports core NNSA missions. Y-12 implements a variety of institutional measures to control access to surficial and subsurface contamination in all areas of the complex, such as radiological control areas and Occupational Safety and Health Act of 1970 (OSHA), 19 *Code of Federal Regulations* (*CFR*) 1910.120-regulated sites. The immediate areas surrounding Y-12 are not open for regulated hunting due to security issues.

Reasonably anticipated future uses of land in Y-12 are an important consideration in determining remediation levels and extent of remediation. Consistent with EPA guidance in *Land Use in the CERCLA Remedy Selection Process* (EPA 1995), DOE solicited input on potential future land use from other Federal Facility Agreement Parties (EPA and TDEC), local land-use planning authorities, and the public during the watershed-level RI and feasibility study development. The ORR Site-Specific Advisory Board recommended that the future land use of Y-12 be controlled industrial use within the western and south-central areas and unrestricted industrial in the eastern and north-central areas. Since that time, NNSA has recommended that because of security concerns and the current modernization program, the anticipated land use for the foreseeable future will be controlled industrial throughout the entire complex.

2.2 REMEDIAL ACTION OBJECTIVES

The UEFPC Phase I ROD specified the following RAO for the selected remedy: "to restore surface water to human health recreational risk-based values at Station 17."[1] This RAO was selected with the recognition

---

1 The "risk-based value" for mercury referenced in the RAO from the Phase I ROD was derived for the recreational use scenario using the adult recreational exposure parameters consistent with the EPA then-current AWQC methodology for ingestion of fish to determine an acceptable mercury concentration in fish. This analysis estimated the acceptable target concentration of mercury in fish to be 0.4 μg/g. A site-specific bioaccumulation factor for total mercury in EFPC (2000 L/kg) was then used to predict the associated acceptable interim mercury concentration in surface water of 200 ng/L (200 ppt). Therefore, the attainment of a concentration of 200 ng/L total mercury in UEFPC surface water was predicted to result in mercury concentrations in fish tissue below a hazard index of 1 and acceptable for human consumption. However, EPA now recommends the acceptable concentration limit for mercury in fish tissue at 0.3 μg/g, rather than the 0.4 μg/g used for the Phase I RAO calculation. Separately, in the NPDES Permit issued by the state of Tennessee in 2011, a target average mercury concentration of 87.5 ng/L in UEFPC surface water at Station 17 was predicted to allow mercury concentrations in fish to decrease to the target value of 0.3 μg/g. However, reductions in concentrations of mercury in UEFPC surface water achieved to date have not resulted in corresponding reductions in fish tissue; therefore, the simple linear relationship used to derive the interim goal appears to be suspect and the potential

that remediation of the UEFPC watershed would be conducted using a phased approach, and that an ultimate long-term goal would be the attainment of the Tennessee ambient water quality criteria (AWQC) standard for mercury.

The Phase I ROD selected remedy was designed to achieve the interim goal established by the FFA parties for surface water quality, and to make substantial progress toward attainment of the long-term water quality goal of meeting the AWQC in-stream standard for mercury. The source control actions selected in the Phase I ROD originally were scheduled for completion by 2016. While some actions have been successfully implemented, other actions have been rescheduled for future implementation under an ESD (DOE 2012).

The purpose of this FFS is to evaluate alternatives for modification of the Phase I ROD selected remedy to achieve further reductions in mercury releases from Y-12 to UEFPC surface water. Specifically, the action evaluated here includes the construction of a new water treatment facility designed to treat discharges from the WEMA storm sewer system at Outfall 200. This action would supplement the remedial actions already included in the selected remedy of the UEFPC Phase I ROD (as amended) to reduce the flux of mercury released from the WEMA sources to UEFPC surface water, to support attainment of the Phase I RAO, and to make substantial progress toward attainment of the long-term water quality goal of meeting the AWQC in-stream standard for mercury in UEFPC surface water. Sub-watershed RAOs specific to the new water treatment system, if selected, would be to:

- Capture discharges from the WEMA storm sewer system for treatment and/or storage under base-flow conditions and some degree of stormwater flow to mitigate uncontrolled releases of mercury (and other hazardous substances) into UEFPC surface water. Stormwater capture would be targeted to maximize mercury flux reduction.

- Store captured wastewater in excess of treatment capacity to minimize mercury flux bypassing the facility without treatment (i.e., the mercury flux contained in stream flow discharged at Outfall 200 that exceeds treatment capacity and stormwater storage capacity that would bypass the facility without treatment) to the extent practicable.

- Treat collected water to achieve reductions in mercury concentrations to meet the AWQC standard of 51 ng/L total mercury in the treated effluent.

- Discharge treated effluent in compliance with ARARs and at levels that are protective of the receiving water.

- Limit the total mercury flux discharged to UEFPC from Outfall 200. Mercury concentrations in UEFPC surface water, including any water bypassing the treatment facility, must meet a daily maximum concentration of 2000 ng/L total mercury and an annual rolling flux of 1 kg/year total mercury. To prevent acute toxicity to fish and aquatic life, mercury concentrations in UEFPC stream flow, including any water bypassing the treatment facility, must not exceed 1400 ng/L dissolved mercury.

Various treatment capacity and stormwater storage capacity levels are evaluated in the FFS, and may be further optimized during the remedial design process. Design configurations that include stormwater storage allow the collection of flow exceeding treatment capacity for future treatment, and reduce the frequency with which Outfall 200 discharges would bypass the facility without treatment. The resulting mercury removal would contribute towards attainment of the interim goal established in the Phase I ROD and the long-term goal

---

effectiveness of reductions in water concentrations to achieve reductions in fish tissue concentrations is uncertain. In any case, the interim goal of 200 ng/L at Station 17 is not directly relevant to the action being evaluated under this FFS.

of meeting the AWQC in-stream standard for mercury. The interim waiver of the in-stream AWQC standard for mercury approved under the Phase I ROD would not be affected by any modification of the selected remedy as a result of this FFS and would remain in effect.

In addition to achieving reductions in the ongoing mercury releases from Outfall 200 to UEFPC, the proposed water treatment facility also would provide potential benefits for treatment of wastewater from other sources. For example, this facility could provide additional protection from increased mercury releases during future demolition actions at the major mercury process buildings at WEMA and remediation of underlying soils. However, these future sources remain to be fully characterized.

The interim action to further reduce mercury flux to UEFPC surface water considered in this FFS is one component of a series of response actions planned for the UEFPC watershed. Some response actions conducted under the Phase I ROD, Phase II ROD and other CERCLA decisions (e.g., multiple removal actions) have already been implemented or scheduled for future implementation, while other response actions will be identified and documented in future CERCLA decision documents. Such future actions will be documented and scheduled for implementation in accordance with FFA protocols and requirements.

2.3 PERFORMANCE MONITORING FOR UEFPC PHASE I ROD RAO

Performance in achieving the Phase I RAO is monitored and reported in the annual remediation effectiveness report (DOE 2014c). Surface water quality metrics utilized to evaluate progress toward attainment of Phase I ROD goals include a 200 ng/L (200 ppt) performance metric for mercury in surface water at Station 17, derived to limit the risk to an adult recreational user consuming fish as described above. Surface water monitoring at Station 17 is conducted to gauge the cumulative effects of the various actions as they are completed with regard to the contaminants of concern (mercury, uranium, and zinc). Biological monitoring is performed to assess levels of mercury in fish tissue at EFK 23.4. In addition to the watershed-wide mercury reduction objectives of the Phase I remedy, additional action-specific requirements would be established for the new water treatment facility if selected. The effluent from a new water treatment system selected under a modification to the Phase I ROD would be required to meet the AWQC standard of 51 ng/L total mercury in the treated effluent. Additional requirements would be established to limit the concentration of total and dissolved mercury in UEFPC surface water, including any water that bypasses the treatment facility, not to exceed 2000 ng/L and 1400 ng/L, respectively.

Figure 2.1 depicts the annual average mercury concentration in surface water at Station 17 and in fish tissue. Figure 2.2 shows the annual mercury flux at Station 17 and the annual rainfall. The temporary increase in mercury discharges at Station 17 during 2011-2012 may be partially attributed to the continuing discharge of mercury on sediment that was disturbed during the 2011 West End storm drain cleanout project, as well as the relatively high rainfall levels during this period. Higher mercury flux at Station 17 relative to upstream monitoring locations is thought to be partially attributable to entrainment of contaminated sediment from the UEFPC streambed in this reach. Approximately 3 million gallons per day of water from the Clinch River was released to the UEFPC channel just below Outfall 200 beginning in 1996 to improve stream conditions for aquatic biota, but this flow augmentation program was discontinued in 2014. Monitoring data to date indicate that cessation of the flow augmentation has resulted in a reduction of the base-flow at Station 17 by a factor of approximately two-thirds. The impact of this change on the dynamics of mercury flux in UEFPC will continue to be evaluated through ongoing monitoring. As described in the previous section, monitoring data to date do not support a direct relationship between mercury concentrations in surface water and in fish tissue, suggesting a more complex relationship than previously suspected.

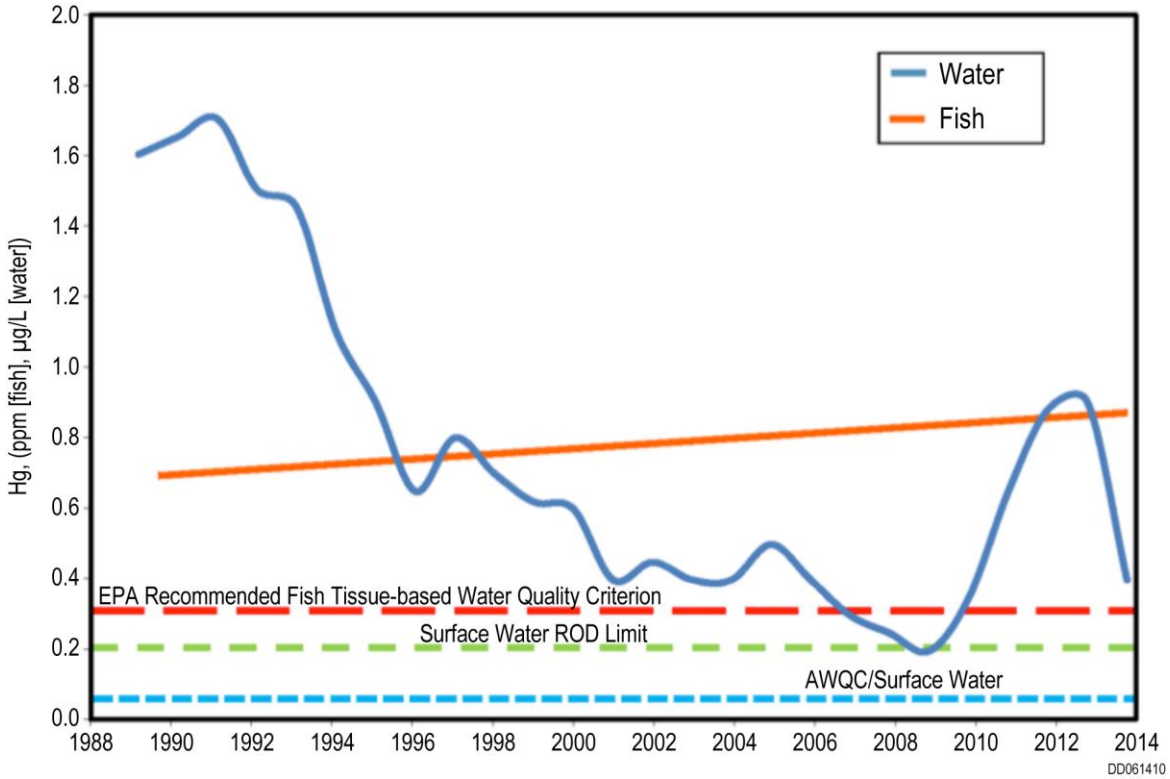

Figure 2.1 Mercury Concentration/Flux in UEFPC Surface Water at Station 17 and in Fish (DOE 2014b).

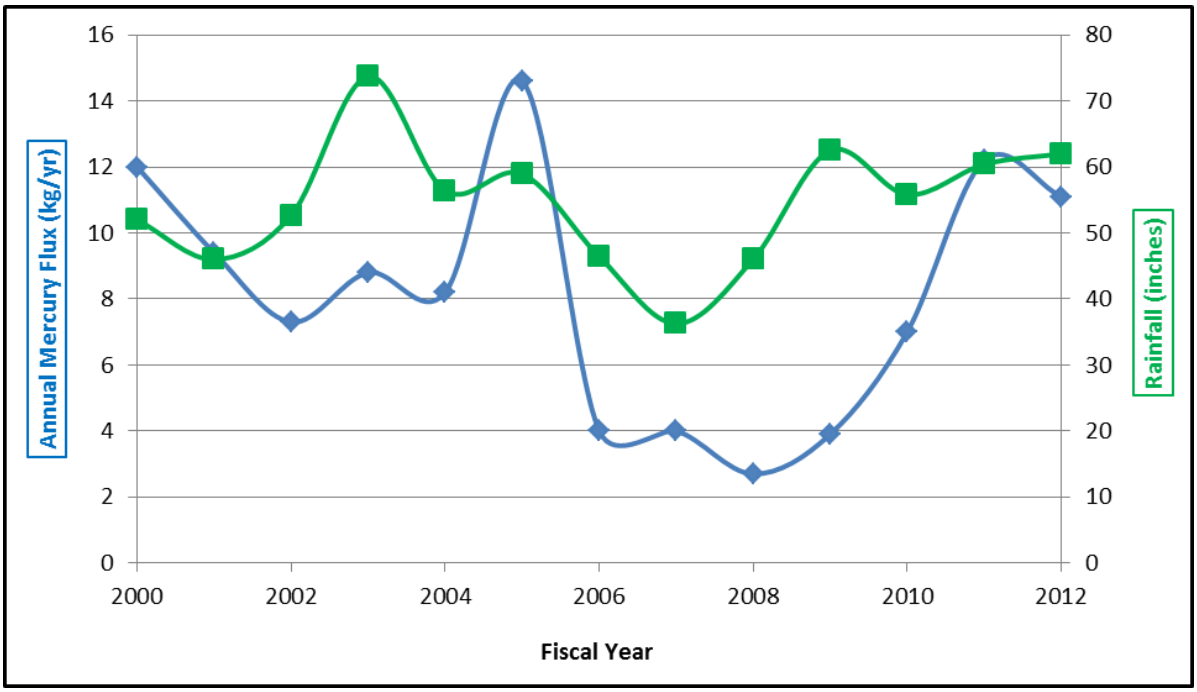

Figure 2.2 Annual Mercury Flux at Station 17 (DOE 2014a).

3. SCREENING OF REMEDIAL ACTION TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This chapter summarizes the screening of remediation technologies and process options and the development of remedial alternatives for potential modification of the UEFPC Phase I remedy to include additional actions to reduce mercury releases to UEFPC surface water. In accordance with CERCLA [40 *CFR* 300.430(1)], the goal of this FFS is to develop and evaluate remedial alternatives that eliminate, reduce, or control risks to human health and the environment. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) defines the preferences below in developing remedial action alternatives.

- Use of treatment to address the principal threats posted by a site, wherever practical.
- Use of engineering controls (e.g., containment) for waste that poses a relatively low, long-term threat and for which treatment is not practical.
- Implementation of a combination of actions, as appropriate, to achieve protection of human health and the environment. For example, in appropriate site situations, treatment of principal threats is combined with engineering and institutional controls for treatment of residuals and untreated waste.
- Use of institutional controls to supplement engineering controls for short- and long-term management to prevent or limit exposures to hazardous substances.
- Selection of an innovative technology when the technology offers the potential for comparable or better treatment performance or implementability than other technologies, fewer adverse impacts than other technologies, or lower costs than demonstrated technologies for similar levels of performance.
- Restoration of environmental media (e.g., groundwater) to their beneficial uses whenever practicable and within a reasonable time frame. When restoration of groundwater to beneficial uses is not practical, EPA expects remedial action to prevent further migration of the contaminant plume, prevent human and environmental exposures to contaminated groundwater, and evaluate further risk reduction.

Because this FFS is focused on the potential modification of the UEFPC Phase I remedy to include additional actions to reduce mercury releases to surface water and is only one part of an integrated multi-part strategy to reduce mercury contamination at Y-12, the range of alternatives is focused on additional water treatment actions. Therefore, the range of technology types and process options applicable to this study is limited to those pertinent to the removal of mercury from surface water.

The primary problem addressed in this FFS is the release of mercury from the WEMA storm sewer system to UEFPC surface water at levels that exceed the interim goal of 200 ng/L established in the Phase I ROD and the AWQC in-stream standard of 51 ng/L, and which may contribute to unacceptable levels of mercury in fish tissue. While existing institutional controls are effective in preventing unacceptable risks to current receptors from ingestion of fish containing unacceptable levels of mercury, mercury contamination at Y-12 has been identified as the greatest environmental risk at the DOE ORR due to the ongoing releases of mercury to the offsite environment and the elevated concentrations of mercury in fish.

The UEFPC watershed, which contains the Y-12 National Security Complex, is expected to remain under DOE control in perpetuity. Therefore, institutional controls, including those already selected in the

Phase I ROD, are expected to be useful tools to be used in conjunction with other technology options, for consideration in the technology screening.

3.1 KEY SITE PROBLEMS

The UEFPC RI report and the UEFPC Phase I ROD identified several key problems relating to contamination in UEFPC. Key conclusions from the RI report regarding the problems and site conditions at the UEFPC include the following:

- Mercury contamination is widespread at theY-12 site as a result of past operations and has been identified in soil, sediment, surface water, groundwater, buildings, drains, and sumps. Mercury continues to be released into UEFPC from point and nonpoint sources within the Y-12 site, including direct erosion of contaminated soil, migration of dissolved mercury through storm drains and outfalls, and through shallow groundwater. Major source areas (e.g., WEMA, Building 81-10 Area, Outfall 51, Lake Reality, and UEFPC streambed) act as reservoirs for the release and migration of mercury and other contaminants to shallow groundwater and surface water.

- In addition to mercury contamination, UEFPC has widespread radiological contamination in soil, primarily ^{238}U from historical uranium-processing operations, and areas of PCB contamination.

- Groundwater contamination is present in shallow and deeper aquifers at the Y-12 site, including organic solvents and DNAPLs.

- Surface water receives contamination through groundwater discharge, storm water runoff, and process outfall discharges, and is a route of contaminant migration off ORR via UEFPC. Mercury concentrations in UEFPC have been reduced as a result of response actions taken to date, but remain above the interim goal of 200 ng/L and the AWQC in-stream standard of 51 ng/L.

- Institutional controls are currently in place to prevent unacceptable risks to human populations from exposure to UEFPC contaminants.

Remedial actions selected in the UEFPC Phase I ROD focused on a series of interim source control actions designed to reduce the release of mercury to the offsite environment and to address the most significant sources of mercury contamination in UEFPC for which sufficient data existed at that time to support appropriate remedy selection decisions through the CERLCA process. The interim source control actions selected in the Phase I ROD included:

- Hydraulic isolation of contaminated soils [subsequently modified in ESD (DOE 2012b)] and cleanout/relining of contaminated sewer lines in the West End Mercury Area;

- Excavation of contaminated sediments from UEFPC and Lake Reality [implementation schedule subsequently modified in ESD (DOE 2012b)];

- Construction and operation of a water treatment system at Building 9201-2 to treat discharge from Outfall 51 and Building 9201-2 sumps (BSWTS);

- Continued operation of the Central Mercury Treatment System (CMTS) and East End Mercury Treatment System (EEMTS) as needed;

- Three short-term and two long-term studies to address uncertainties identified with potential additional components of the selected remedy;

- Land use controls to prevent fish consumption and to restrict access to contaminated areas; and

- Surface water monitoring to evaluate reductions in contaminant concentrations.

Additional remedial actions considered in this FFS are intended to address the following additional problems:

- While considerable progress has been made in reducing mercury releases from the Y-12 site to the UEFPC surface water, mercury concentrations in surface water at Station 17 continue to exceed both the interim goal of 200 ng/L established in the Phase I ROD and the AWQC in-stream standard of 51 ng/L. As a result of the continued mercury concentrations measured at Station 17, the most recent CERCLA Five-Year Review concluded that the Phase I ROD is not currently protective for ecological receptors (DOE 2012a).

- While the Phase I ROD did not include large-scale water treatment operations as part of the selected remedy, it did include studies to evaluate the viability of long-term and large-scale treatment of mercury-contaminated surface water to support a future surface water decision. A treatability study and conceptual design study for a treatment system to reduce discharge of mercury from the WEMA storm sewer system was initiated in 2012 to fulfill this requirement. These studies led to the development of a conceptual design for a water treatment system to treat discharges at Outfall 200, which was documented in a conceptual design report (UCOR 2014) and a Remedial Design Work Plan (DOE 2014b). The successful performance of the existing water treatment systems (BSWTS, CMTS) for mercury reduction also suggest that additional water treatment facilities might achieve further reductions of mercury in UEFPC surface water. Therefore, this FFS evaluates additional water treatment actions that could be taken to supplement the actions already included in the Phase I selected remedy to achieve further reductions in mercury concentrations in UEFPC surface water and releases to the offsite environment.

Remedial actions for UEFPC groundwater, as well as final goals for surface water, groundwater, and soil, and final land use controls, are deferred to a future decision.

3.2 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

Initially, process options, subsets of general response actions (GRAs), and technology types are identified for each problem. These process options are screened based on applicability to site contaminants and conditions. Then, remaining process options are evaluated with respect to effectiveness, implementability, and cost to select options to carry forward into the alternative development phase.

3.2.1 Identification of Process Options

GRAs are broad categories of technologies that, by themselves or in combination with other GRAs, are used to satisfy the RAOs. GRAs include no action, institutional controls, containment, removal, in situ treatment, ex situ treatment, and disposal. The GRAs may be combined to form remediation alternatives to meet the RAOs. Descriptions of these GRAs and their applicability to the very focused scope of this FFS are summarized below:

- *No (further) action*. The no-action GRA is retained throughout the CERCLA process as required by the NCP. The no-action alternative provides a baseline against which other alternatives can be evaluated. However, a true no-action alternative is not relevant for this FFS, since some remedial actions have already been performed under the Phase I ROD selected remedy, and other actions are ongoing and planned. For the purpose of this FFS, this "no further action" GRA would be defined to mean no change to the existing Phase I selected remedy.

- *Institutional controls*. Institutional controls include access controls to reduce or eliminate access to the site and monitoring to assess the integrity of remedial actions. The volume, mobility, and toxicity of the contaminants are not reduced through the application of institutional controls. The Phase I ROD selected remedy already includes an extensive set of institutional controls to restrict access to contaminated areas and to prohibit human consumption of fish. While existing institutional controls would be maintained, no additional institutional controls are evaluated under this FFS.

- *Containment*. Containment technologies reduce access to the waste or migration potential from the waste. Waste media are isolated from the primary transport mechanisms (e.g., wind, surface water, or groundwater) through the installation of surface or subsurface barriers. Containment does not reduce the volume, mobility, or toxicity of the contamination. Containment actions already included within the scope of the Phase I ROD selected remedy would not be impacted by this FFS. Containment technologies generally are not applicable to the limited scope of this FFS.

- *Removal*. Removal technologies excavate waste or contaminated media from their present location and move the waste to an alternate location for treatment and/or disposal. These removal technologies can be selected to reduce exposure to workers and be amenable to treatment processes. Removal activities already included within the scope of the Phase I ROD selected remedy (e.g., excavation of contaminated sediment from UEFPC and Lake Reality) would not be impacted by this FFS. Removal technologies generally are not applicable to the limited scope of this FFS, with the exception of surface water collection operations.

- *In situ treatment*. In situ treatment technologies or process options reduce the toxicity, mobility, or volume of the waste in place. Chemicals are added, physical properties are changed, or biological activity of the media is modified without excavation or removal. In situ treatment technologies are not applicable to the scope of this FFS (i.e., not applicable for removal of mercury from surface water).

- *Ex situ treatment*. Ex situ treatment process options involve the reduction of toxicity, mobility, or volume of soil/sediment, groundwater, and surface water. Ex situ treatment technologies may be combined with removal and disposal process options (e.g., disposal of treatment residuals). The scope of this FFS includes consideration of potential new ex situ treatment systems for removal of mercury from UEFPC surface water. Treatment systems already included within the Phase I ROD selected remedy (e.g., BSWTS) would continue operation and would not be impacted by this FFS.

- *Disposal*. Disposal technologies include onsite and offsite disposal. Disposal can occur at existing, permitted disposal facilities or at new facilities. Disposal technologies may be coupled with removal and treatment technologies. Disposal activities included within the scope of the Phase I ROD selected remedy would not be impacted by this FFS. New disposal operations under the scope of this FFS includes disposal of construction waste and residuals from water treatment operations.

Technologies and process options for each GRA are initially screened for technical applicability to identify those to carry forward for further evaluation. This screening reduces the possible process options that can be considered for the limited scope of this FFS – i.e., potential water treatment operations to achieve further reductions in mercury concentrations in UEFPC surface water. The two general criteria

used to determine whether a technology or process option should be retained for further evaluation are: its applicability to the type and combination of contaminants present at the site, and its applicability to the physical conditions of the site.

A screening of potential treatment technologies for applicability to the removal of mercury from UEFPC surface water was conducted as part of the treatability and conceptual design studies initiated in 2012 to evaluate additional water treatment operations to reduce discharge of mercury from the WEMA storm sewer network at Outfall 200 to UEFPC surface water. This technology screening is presented in detail in Appendix A of the Conceptual Design Report (UCOR 2014), and is only briefly summarized in the following section.

3.2.2 Screening of Treatment Technologies for Reduction of Mercury in Surface Water

Treatment technologies were screened for potential applicability to the treatment of discharges from the WEMA storm sewer system at Outfall 200 as part of a treatability and conceptual design study (UCOR 2014). Treatment technologies that were eliminated from further consideration during the initial screening included:

- Biological treatment – Biological treatment operations would use bacteria in a biological reactor to convert soluble mercury to elemental mercury which would be retained in the biomass or to other less soluble forms that would be removed by other processes. This technology was eliminated from further consideration because it has not been demonstrated to achieve the desired mercury removal effectiveness.

- Zero-valent iron treatment – Zero-valent iron (ZVI) can be used to reduce oxidized forms of mercury and the reduced forms of mercury would be retained with the iron solids. This technology was eliminated from further consideration because it has not been demonstrated to achieve the desired mercury removal effectiveness.

Based on the results of the technology screening process, the following treatment technologies were retained for detailed evaluation and development of treatment alternatives:

- Granular activated carbon (GAC) adsorption – GAC and sulfur-impregnated activated carbon have been demonstrated to be very effective media for adsorption of aqueous mercury.

- Enhanced alumina adsorption – This process uses various granular, porous oxides and hydroxides of aluminum that have been enhanced by exposure to sodium hydroxide at high temperatures as the media for mercury adsorption. Otherwise similar to GAC adsorption.

- Chemical precipitation – Chemical precipitation is a process in which a chemical precipitant or coagulant, or both, is added to water for the purpose of precipitating, adsorbing or binding contaminants to a solid or insoluble floc. For mercury removal, typically a ferric coagulant is used with a sulfide functional polymer to produce mercury-sulfide bound solids and ferric oxyhydroxides that adsorp or coprecipitate mercury with other suspended solids. Dissolved mercury can be precipitated to low concentrations by the sulfide groups on the sulfide functional polymer and adsorbed onto other species formed during the precipitation process.

- Ion exchange – Ion exchange involves the passage of water through a bed of ion exchange resins to exchange undesirable ions in the water for desired ions. Specialty thiol functional ion exchange resins can be used to remove mercury from water.

- Membrane filtration with reverse osmosis, followed by chemical precipitation and/or adsorption for reject treatment – Reverse osmosis is a membrane separation process that uses high pressure to force a solution through a semi-permeable microporous membrane that retains the soluble mercury and other dissolved salts on the reject side of the membrane and allows the purified water to pass to the permeate side.

- Chemical reduction followed by air stripping and vapor-phase mercury adsorption – This process uses chemical reduction to convert inorganic mercury [Hg(2)] in aqueous phase to dissolved elemental mercury [Hg(0)], which is then removed from the water by air stripping. For mercury removal, stannous chloride is generally used to reduce the inorganic dissolved mercury to elemental mercury, which is volatile and removed using a sparge air-stripping system. Treatment of the air-stripper off-gas also may be required.

Additional unit operations for removal of solids that may be present in the treatment system influent would be required for all of these treatment technologies and would include:

- Grit removal - removal of large solids and grit that can interfere with treatment processes or cause excessive mechanical wear and increased maintenance requirements for wastewater treatment equipment

- Multi-media filtration - pre-treatment for suspended solids removal prior to effluent polishing operations using GAC adsorption or ion exchange

These treatment technologies were used in various combinations to construct alternatives for potential treatment system configurations to treat discharges from Outfall 200 for mercury reduction. These preliminary alternatives for unit operation trains for treatment of UEFPC surface water included the following:

- Alternative 1 - Grit removal + multi-media filtration + GAC adsorption

- Alternative 2 - Grit removal + chemical precipitation + multi-media filtration + GAC adsorption

- Alternative 3 - Grit removal + chemical precipitation + multi-media filtration + enhanced alumina adsorption

- Alternative 4 - Grit removal + chemical precipitation + multi-media filtration + ion exchange

- Alternative 5 - Grit removal + chemical precipitation + reverse osmosis + multi-media filtration + GAC adsorption

- Alternative 6 - Grit removal + chemical precipitation + chemical reduction + air stripping + multi-media filtration + GAC adsorption

Grit removal is common to all alternatives and would be required for removal of coarse solids prior to other treatment processes. With only one exception, all alternatives also involve chemical precipitation

followed by various effluent polishing operations. Alternative 1, which would rely entirely on GAC adsorption was deemed to have high process risk due to the lack of an adequate solids management system to handle the high variability in suspended solids loading in UEFPC surface water during storm events. Alternative 2 was evaluated to be the lowest risk and most cost-effective process configuration since it is a well demonstrated technology for mercury treatment. This Alternative was recommended as the basis for subsequent treatability testing and was carried forward to the conceptual design report. Based on bench-scale treatability testing that indicates that effluent polishing using GAC adsorption may not be required to achieve the desired mercury removal goals, the conceptual design report evaluates multiple sub-options that include different treatment capacity, stormwater storage capacity, and inclusion or exclusion of effluent polishing using GAC adsorption.

3.3 DEVELOPMENT AND DESCRIPTION OF ALTERNATIVES

The GRAs and representative process options selected in the preceding section based on the criteria of effectiveness, implementability, and cost were used to develop a series of remedial alternatives to achieve further reductions of mercury releases to UEFPC surface water. While the representative process options provide a basis for developing alternatives in this FFS, the specific process options used to implement the remedial action could change and would be finalized during until the remedial design phase.

This FFS evaluates remedial alternatives for potential modification of the selected remedy in the Phase I ROD to include additional actions to reduce mercury releases to UEFPC surface water. Such actions would be designed to supplement response actions previously included in the selected remedy under the Phase I ROD, as well as other response actions undertaken and planned to reduce mercury releases from the Y-12 site, and must be considered in the context of the comprehensive mercury remediation program.

As discussed previously, considerable progress has been made in reducing mercury releases from the Y-12 site to the UEFPC surface water. However, mercury concentrations in surface water at Station 17 continue to exceed both the interim goal of 200 ng/L established in the Phase I ROD and the ultimate goal of meeting the AWQC in-stream standard for mercury of 51 ng/L. In addition, mercury concentrations in fish tissue remain above the target concentration of 0.3 µg/g. As a result of the continued mercury flux/concentration measured at Station 17 in excess of these target levels, the most recent CERCLA Five-Year Review concluded that the Phase I ROD currently is not protective for ecological receptors (DOE 2012a).

For this FFS, additional remedial alternatives have been developed to help achieve the RAO using process options identified in Section 3.2 and the water treatment system alternatives analysis presented in the Conceptual Design Report (UCOR 2014). These remedial alternatives include additional actions that could be taken to supplement the actions already included in the Phase I selected remedy to achieve further reductions in mercury concentrations in UEFPC surface water and mercury releases to the offsite environment. Some of the component actions selected in the Phase I ROD have been successfully completed while other actions are still scheduled for future implementation, as summarized in Table 3.1.

Each of the action alternatives considered in this FFS incorporates remediation strategies that can be applied to address the key site problem of mercury concentrations in UEFPC surface water that exceed the interim goal of 200 ppt and the long-term goal of attaining the AWQC in-stream standard for mercury. Since the component actions included in the Phase I selected remedy, as well as planned D&D and soil remediation actions at the primary mercury use buildings and other mercury reduction actions under the

Table 3.1 Implementation Status of Component Actions of the Selected Remedy (Alternative 3a) in the Phase I ROD for the UEFPC CA (DOE 2002).

Component of Selected Remedy (Alternative 3a) in Phase I ROD	Implementation Status
Hydraulic isolation at WEMA • Construction of asphalt caps over approximately 3.5 acres of unpaved areas with mercury contaminated soil and gravel. • Clean and reline contaminated storm sewers.	Eliminated by ESD (DOE 2012b). This component of hydraulic isolation for WEMA soils is no longer needed, as the schedule for demolition of WEMA buildings has been accelerated, making contaminated soils in these areas accessible for excavation, where appropriate, under the Phase II ROD. Complete. Approximately 20,000 linear ft of storm sewers were inspected using a remote video camera, ~ 8,000 linear ft were cleaned, and ~ 1,200 linear ft were relined (DOE 2012c).
Building 9201-2 Water Treatment System – Construct a 300 gpm water treatment system to remove mercury from the discharge from Outfall 51 and groundwater collected in dewatering sumps at Building 9201-2.	Construction complete and operation ongoing. The Building 9201-2 water treatment system (BSWTS) completed construction and began operations in 2005 (DOE 2005), and has been very successful in reducing mercury concentrations from these sources well below the design goal of 200 ppt in the system effluent.
Continue temporary water treatment at CMTS and EEMTS as needed.	Treatment of mercury-contaminated storm water and groundwater at CMTS is continuing. Operation of EEMTS was terminated in 2006 and its influent was rerouted to BSWTS for treatment.
UEFPC sediment/soil removal – Remove mercury-contaminated sediment/soil from approximately 4,750 ft of UEFPC stream bed (~7,900 yd3) for treatment and disposal.	ESD (DOE 2012b) revised the implementation schedule and construction logic for consistency with UEFPC upgradient-to-downgradient remediation strategy. Planned for ~ 2040.
Lake Reality sediment removal – Remove approximately 1 ft (~4,035 yd^3) of contaminated sediment for treatment and disposal.	ESD (DOE 2012b) revised the implementation schedule and construction logic for consistency with UEFPC upgradient-to-downgradient remediation strategy. Planned for ~ 2040.
Short-Term Studies • Technical feasibility of horizontal groundwater capture well for hydraulic isolation at WEMA • Characterization study and treatability study for 81-10 area soils. • Treatment and disposal options for mercury-contaminated excavated soil	ESD (DOE 2012b) eliminated feasibility study for horizontal well. This component of hydraulic isolation for WEMA soils is no longer needed, as the schedule for demolition of WEMA buildings has been accelerated, making contaminated soils in these areas accessible for excavation, where appropriate, under the Phase II ROD. ESD (DOE 2012b) eliminated treatability study, which is no longer needed based on results of the characterization study (DOE 2010). Ongoing. Treatability study for Y-12 mercury-contaminated soil has been completed (DOE 2012k).
Long-Term Studies • Groundwater studies • Viability of large-scale (4-7 Mgd) treatment of mercury-contaminated surface water	Ongoing. Studies are ongoing to improve understanding of the dynamics of groundwater plumes at UEFPC. UEFPC groundwater ROD planned for ~2028. Treatability study and conceptual design study for a new water treatment system at Outfall 200 was developed under the ARRA (UCOR 2014).
Surface Water Monitoring	Ongoing. Surface water monitoring is ongoing to evaluate the effectiveness of source control and removal actions in reducing contaminant concentrations and flux, relative to the goal of reducing mercury to 200 ppt or less at Station 17.
Land Use Controls	Ongoing. Land use controls are implemented to limit the use of and/or exposure to areas of the UEFPC area to insure protectiveness.

BSWTS = Big Spring Water Treatment System
CMTS = Central Mercury Treatment System
EEMTS = East End Mercury Treatment System
NPDES = National Pollutant Discharge Elimination System
ppt = parts per trillion (ng/L)
RCRA = Resource Conservation and Recovery Act
UEFPC = Upper East Fork Poplar Creek
WEMA = West End Mercury Area

Strategic Plan, already will achieve extensive reductions in the known primary source areas of mercury contamination at the Y-12 site, the remediation strategy for the alternatives considered in this FFS focuses on ex situ treatment of surface water for mercury removal.

While the Phase I ROD did not include large-scale water treatment operations as part of the selected remedy, it did include studies to evaluate the viability of long-term and large-scale treatment of mercury-contaminated surface water to support a future surface water decision. A treatability study and conceptual design of a treatment system to reduce discharge of mercury at Outfall 200 were initiated in 2012 using ARRA funding in support of this Phase I ROD requirement. These studies led to the development of a conceptual design for a water treatment system to treat discharges at Outfall 200, which was documented in a conceptual design report (UCOR 2014) and a Remedial Design Work Plan (DOE 2014b). The successful performance of the existing water treatment systems (BSWTS, CMTS) for mercury reduction also suggest that additional water treatment facilities might achieve further reductions of mercury in UEFPC surface water. Therefore, this FFS evaluates additional water treatment actions that could be taken to supplement the actions already included in the Phase I selected remedy to achieve further reductions in mercury concentrations in UEFPC surface water and releases to the offsite environment.

The remedial alternatives evaluated in this FFS are informed by the alternatives evaluation conducted under the conceptual design report (UCOR 2014), as described in the preceding section. That alternatives evaluation determined chemical precipitation to be the preferred treatment technology for mercury removal from UEFPC surface water, as a proven water treatment technology with high effectiveness for mercury and solids removal. Therefore, the alternatives developed below are based on chemical precipitation, and differ only with respect to treatment capacity and stormwater storage capacity. Bench-scale treatability testing indicates that effluent polishing using GAC adsorption may not be required to achieve the desired mercury removal goals; however, all alternatives are designed such that effluent polishing by GAC adsorption can be added in the future if the operational performance monitoring of the treatment system indicates the need and if determined by the FFA parties to be the appropriate course of action relative to other available response actions to reduce mercury releases.

The treatment capacity and stormwater storage capacity specified in each of the action alternatives are considered nominal values for the purpose of analysis of these alternatives. However, the optimal treatment and storage capacity, as well as the optimal configuration of unit operations, would continue to be further evaluated during the remedial design process, and ultimately would be approved by all FFA parties in the remedial design report.

3.3.1 Alternative 1 – No (Further) Action

The no-action alternative is required by the NCP and serves as a baseline for comparison for the other alternatives. The no-action alternative does not initiate action, and normally assumes that present security measures limiting access and use are not maintained, and that short- and long-term monitoring is eliminated. No implementation is required. There would be no costs associated with this alternative.

However, a true no-action alternative is not relevant for this FFS, since some remedial actions have already been performed under the Phase I ROD selected remedy, and other actions are ongoing and planned. For the purpose of this FFS, this “no further action” alternative would be defined to mean no change to the existing Phase I selected remedy (as modified to date).

3.3.2 Alternative 2 – Water Treatment at Outfall 200

This alternative includes construction of a new water treatment facility to capture and treat discharges from Outfall 200 designed to reduce mercury releases to UEFPC surface water. Multiple treatment facility configurations are evaluated under this alternative with different levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water. In each case, storm flow above the facility treatment and storage capacity would bypass the facility and be released to UEFPC without treatment. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L in the treated effluent. The resulting mercury removal would be expected to contribute substantially towards reducing the mercury concentration in UEFPC surface water at Station 17 to meet the interim goal of 200 ng/L established in the Phase I ROD and the long-term goal of attaining the AWQC in-stream standard of 51 ng/L for total mercury.

As discussed in previous sections, Outfall 200 is the integration point for the Y-12 storm sewer effluent entering UEFPC, which constitutes the largest source of mercury releases to UEFPC under base-flow conditions. The storm sewer system adjacent to former mercury-use Buildings 9201-4, 9201-5, and 9204-4 is drained by Outfalls 150, 160, 163 and 169 (Figure 3.1). This storm sewer system is badly deteriorated and has numerous leaks, despite previous attempts to reline the system, that result in infiltration of mercury-contaminated groundwater and accumulation of mercury-contaminated sediment in the storm sewer that is a source for base-flow discharges of mercury to UEFPC. Stormwater runoff through mercury-contaminated soils into the storm sewers and catch basins also results in the release of mercury-contaminated sediments to UEFPC during storm events. These various outfalls converge at Outfall 200.

The FS Addendum (DOE 2000) identified this discharge from the WEMA storm sewer system at Outfall 200 as one of the three primary sources of mercury releases to UEFPC under base-flow conditions. The other primary sources included: discharge of mercury-contaminated groundwater from Outfall 51 and the Building 9201-2 sumps, which are now treated by the BSWTS; and non-point source releases between Outfall 200 and Outfall 109, that may be associated with scouring of streambed sediments. The relative magnitude of this latter source may be impacted by the termination of the flow augmentation program in 2014, but these impacts are yet to be determined. Discharge from the WEMA storm sewer system at Outfall 200 is thought to be the predominant source of mercury releases to UEFPC under base-flow conditions (ORNL 2011).

As discussed previously, a treatability study and conceptual design study were initiated in 2012 for a treatment system to reduce discharge of mercury at Outfall 200 using available ARRA funding, in support of the Phase I ROD requirement to investigate the viability of large-scale treatment of mercury-contaminated surface water at UEFPC. The resulting Conceptual Design Report (UCOR 2014) and Remedial Design Work Plan (DOE 2014b) provide much greater detail in the system design than is typically available for an FS, and that information is used to develop remedial alternatives for this FFS. While the final facility design would be determined during the remedial design process if this alternative is selected for implementation, the recommended conceptual design for the treatment system would include: grit removal; sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification; and multi-media filtration. The system design also would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed and if warranted by future conditions. Effluent polishing using granular activated carbon is not included in the basic system configurations because treatability testing indicates that the planned unit operations may achieve the performance objectives without polishing, but the modular facility design will facilitate this addition in the future if needed; system performance would

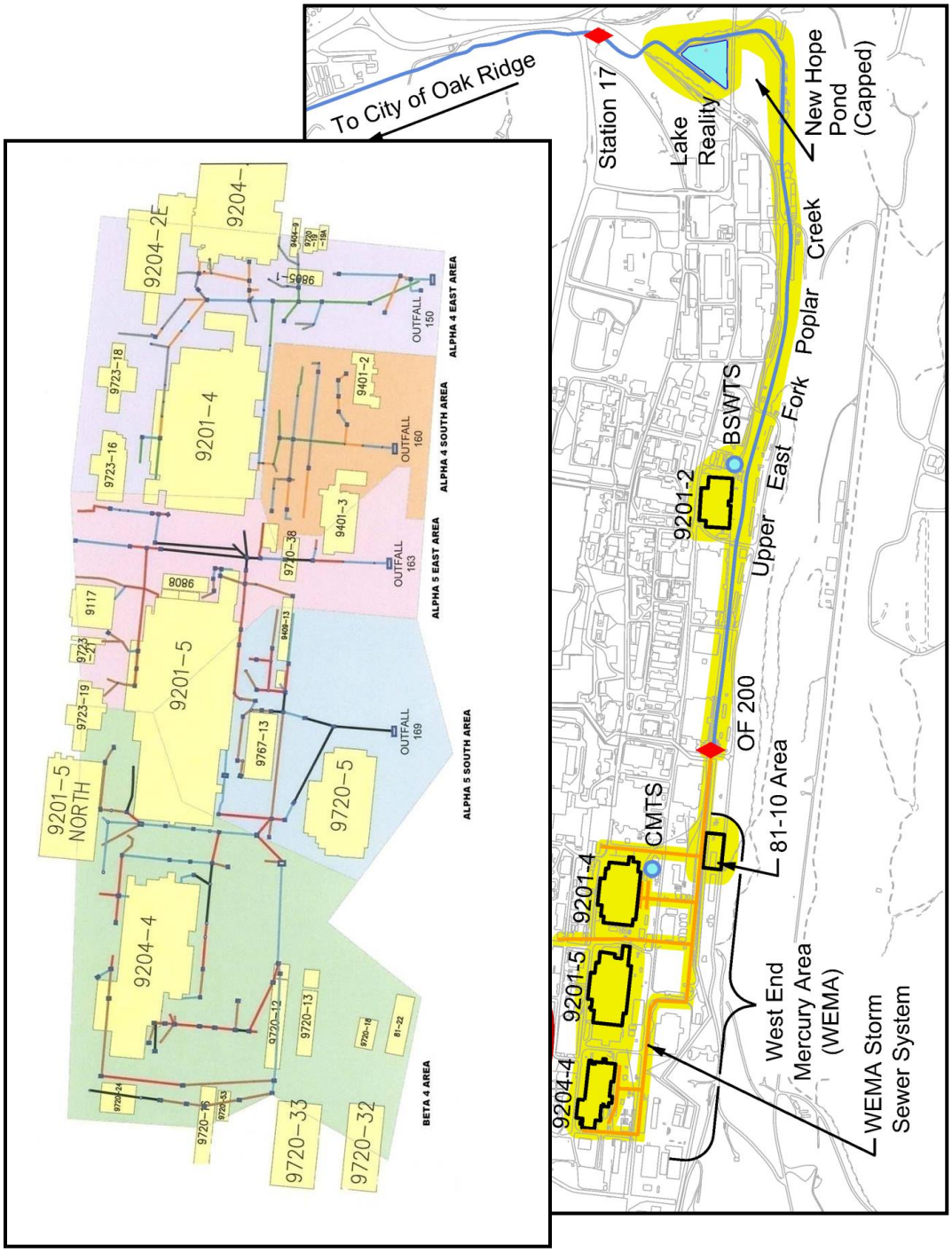

Figure 3.1 Locations of WEMA Former Mercury-Use Buildings and Outfalls.

be evaluated after one year of operation, and any potential modifications to improve performance would be evaluated by the FFA parties.

The large variability in stream flow is one of the primary challenges in designing a water treatment facility for UEFPC. Stream flow in UEFPC is characterized by a relatively low base-flow of approximately 1000 gpm during dry conditions, with significantly increased flow during storm events, peaking as high as 40,000 gpm or more (UCOR 2014). The annual discharge at Outfall 200 is estimated at approximately 722 million gallons during a year of average precipitation (e.g., 2010); approximately 74% of this discharge was estimated to occur during dry weather (base-flow) conditions (UCOR 2015d). Stream flow measurements are recorded at Outfall 200A6, just upstream of Outfall 200 under the ORR Water Resources Restoration Program. These data were evaluated in the conceptual design report (UCOR 2014) to support the development of treatment system alternatives. Stream flow measurements also are documented annually in the Remediation Effectiveness Report (DOE 2014c).

Sub-alternatives have been developed, generally based on the options evaluated in the Conceptual Design Report (UCOR 2014), to evaluate different levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water:

- Alternative 2a – A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 1500 gpm (2.2 Mgd) of influent surface water. This capacity would be sufficient to treat the base-flow conditions in UEFPC, but most storm events would exceed this capacity. Historical records indicate that approximately 19-24% of flow records exceed 1500 gpm. Treatment operations would include 3000 gpm capacity for grit removal, followed by chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification), and dewatering (multi-media filtration) for influent surface water flows up to 1500 gpm plus up to 500 gpm of recycle flows (e.g., backwash water, filter press filtrate). Influent flows greater than 1500 gpm but less than 3000 gpm would flow through the grit removal system and then discharged to UEFPC without further treatment, and flows above 3000 gpm would bypass all treatment operations.

- Alternative 2b – A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water. This capacity is approximately equivalent to the 95th percentile flow in UEPFC – i.e., 95% of stream flow records for UEFPC do not exceed 3000 gpm. This capacity would address baseline flow conditions and small rain events. Unit operations of grit removal, chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification) and dewatering (multi-media filtration) all would have design capacity for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) up to 1000 gpm. Influent flows greater than 3000 gpm would bypass the facility to UEFPC without treatment.

- Alternative 2c – A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water, with stormwater storage up to 2 million gallons to manage flows up to 40,000 gpm. Treatment operations would include 40,000 gpm capacity for grit removal, followed by chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification) and dewatering (multi-media filtration) for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater up to 1000 gpm. Stormwater storage of up to 2 million gallons would be provided using above-ground tanks or lined stormwater retention basins. Peak flows from larger storm events would bypass the treatment facility, although the initial runoff flow from these larger storm events (i.e., the "first flush") would be captured.

Stormwater flows that exceed the treatment and storage capacity would bypass the facility to UEFPC without treatment.

- Alternative 2d – A new water treatment facility would be constructed to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water, with stormwater storage up to 10 million gallons to manage flows up to 40,000 gpm. Treatment operations would include 40,000 gpm capacity for grit removal, followed by chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification) and dewatering (multi-media filtration) for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater up to 1000 gpm. Stormwater storage of up to 10 million gallons would be provided using above-ground tanks or lined stormwater retention basins. Peak flows from larger storm events would bypass the treatment facility, although the initial runoff flow from these larger storm events (i.e., the "first flush") would be captured. Stormwater flows exceeding the treatment and storage capacity would bypass the facility to UEFPC without treatment.

Each of these Alternatives is described in greater detail in Section 4, and evaluated with respect to the prescribed CERCLA evaluation criteria in Section 5.

Under all action alternatives, stream flow in excess of treatment and storage capacity would be bypass the treatment system. Alternatives 2a and 2b are comparable to Scalability Options 2 and 4 from the Conceptual Design Report (UCOR 2014) and represent the two highest rated alternatives evaluated in that study. These alternatives were highly rated due to the combination of relatively low capital costs, demonstrated effectiveness in mercury reduction, and operational flexibility for a range of flow conditions and influent water characteristics. Alternative 2d is comparable to Scalability Option 7 from the Conceptual Design Report, and differs from Alternative 2b primarily in the inclusion of a larger headworks system to manage much larger storm-flow levels and 10-million gallons of stormwater storage capacity; this option has greater flexibility to manage a wider range of flow conditions and therefore achieves greater effectiveness in mercury removal, but also has a significantly higher cost. Alternative 2c is not directly comparable to a Scalability Option from the Conceptual Design Report, but essentially represents an option intermediate between Alternatives 2b and 2d and is included to provide a more complete range of alternatives. Alternative 2c differs from Alternative 2b in the larger headworks system to manage much larger storm-flow levels and 2-million gallons of stormwater storage capacity; like Alternative 2d, this option has more flexibility to manage a wider range of flow conditions and achieves greater effectiveness in mercury removal, but also has a higher cost.

Under all action alternatives, the new water treatment facility would be constructed using a modular design that would be conducive to future modifications that might be needed. Such future modifications could include construction of additional unit operations to improve treatment system performance to achieve greater mercury reductions in system effluents (e.g., addition of granular activated carbon adsorption or other unit operations for effluent polishing), construction of storage capacity to address greater amounts of storm flow, or other changes. For example, Alternative 2a could be modified in the future to increase treatment capacity equivalent to that of Alternatives 2b-2d, or Alternative 2a or 2b could be modified in the future to add stormwater storage facilities comparable to those in Alternatives 2c or 2d. And all Alternatives would be constructed to in a manner to allow future construction of additional treatment operations, such as effluent polishing using granular activated carbon adsorption, if determined to be necessary to meet system performance objectives and if determined by the FFA parties to be the appropriate action relative to other available response actions to reduce mercury releases. Performance of the treatment system with respect to reduction of mercury releases to UEFPC would be evaluated after

two years of operation, and any potential modifications to improve performance would be evaluated by the FFA parties along with other potential response actions to achieve further mercury reductions.

Alternatives 2c and 2d include operations for capture and storage of stormwater in excess of the system treatment capacity, with storage capacity of 2 million gallons and 10 million gallons, respectively. While the total stormwater volume associated with major storm events would exceed these storage capacities and would still require bypass without treatment, these Alternatives would capture the initial rainfall, or "first flush" from even the largest storm events (defined as the runoff from the 60-minute period surrounding the hydrograph peak). Stormwater characterization studies (UCOR 2015d) have observed that this initial runoff from storm events contains an elevated loading of both total mercury and total suspended solids, and that these concentrations drop off rapidly after peaking as the flow subsides to pre-storm levels. During the early phase of a storm event, the concentration of dissolved mercury was observed to decrease (presumably due to dilution by the increase in stream flow) while the concentrations of total suspended solids and total mercury (presumably due to an increase in particle-associated mercury) were observed to increase similar to the peak in stream flow; after the peak in stream flow, the concentration of dissolved mercury increases, while the concentrations of total mercury and total suspended solids decrease as the flow subsides to pre-storm levels. This analysis estimated that approximately 65% of the total mercury and 69% of the total suspended solids mass released during a storm event occurs during this 60-minute period during the early phase of the storm. This effect is thought to be due to the sudden increase in turbulent flow in the storm drain piping that mobilizes mercury-laden sediment residing in the system (UCOR 2015e).

Studies also have been conducted to evaluate opportunities for diversion of up-gradient non-contaminated precipitation runoff during storm events (UCOR 2015a, 2015b) and/or diversion of non-stormwater influent sources (e.g., once-through cooling water, condensate) (UCOR 2015c) to the WEMA storm drain network. These studies evaluated potential improvements in the management of non-contaminated stormwater and process water prior to entering the WEMA storm drain network to prevent contamination and reduce the quantity of water requiring treatment at the proposed water treatment facility. The watershed diversion studies evaluated both a passive design and an active pumping design (UCOR 2105b); however, both alternatives were estimated to reduce the annual discharge at Outfall 200 by only 0.5 to 1% and to reduce peak flow during storm events less than 5%, and would not significantly impact the design capacity requirements for the proposed water treatment facility. Similarly, the study of non-stormwater diversion opportunities (UCOR 2015c) concluded that Y-12 facility discharges to the WEMA storm drain network already have been reduced from 855 gpm to 516 gpm. While additional reductions up to 296 gpm may be possible, these further reductions would be expensive to implement and would not impact the design capacity requirements for the proposed water treatment facility.

Stormwater characterization (UCOR 2015d) and mercury flux modeling (UCOR 2015e) studies provide a better understanding of flow dynamics in UEFPC and the flux of mercury and total suspended solids during base-flow conditions and storm events. Approximately 68% of the mercury flux but only 18% of the total suspended solids flux were estimated to occur during dry weather (base-flow) conditions (UCOR 2015e), with the remainder associated with storm events.

Alternative Siting Locations. Outfall 200 has been identified as the proposed location for a new water treatment facility because it is the integration point for the WEMA storm sewer effluent entering UEFPC, and this storm sewer effluent constitutes the largest source of mercury releases to UEFPC under base-flow conditions. In addition, preliminary siting studies conducted under the Conceptual Design Report (UCOR 2014) have identified feasible construction sites to support treatment of discharges from Outfall 200. Alternative locations that could be considered for a new water treatment facility, including the

individual WEMA outfalls (Outfalls 150, 160, 163 or 169) or Station 17 are evaluated qualitatively for the purpose of this FFS, and may be further evaluated during remedial design.

Figure 3.1 shows the WEMA storm drain network that discharges to UEFPC at Outfall 200. Continuous flow-paced monitoring for mercury has been collected for Outfall 200 since 2007, and for Outfalls 150, 160, 163, and 169 since 2010. The mercury flux from each outfall is highly variable over time, as is the relative magnitude of the flux from each outfall with respect to the others. While Outfall 163 appears to be contributing the largest portion of the mercury flux in recent years, mercury releases from these individual outfalls have changed in their relative magnitude over time. Since Outfall 200 serves as an integration point for all discharges from the WEMA storm drain network, and therefore for contamination exiting WEMA, it is considered a preferable location for a new water treatment facility, relative to the individual WEMA outfalls. Station 17 is the surface water monitoring location near where UEFPC exits the Y-12 site and the ORR. This location would require treatment of a higher stream flow rate, which includes drainage from non-contaminated areas, relative to locations closer to the contaminant source.

Relationship to Previously Selected Phase I ROD Actions. As described previously, the new water treatment system constructed under this alternative would be designed to supplement other response actions already underway or planned for future implementation under the Phase I ROD, and would not modify or replace any of those actions. Specifically, the following Phase I ROD actions would not be impacted by this alternative:

- Phase I ROD Interim Source Control Actions – The interim source control actions previously selected in the Phase I ROD would be unaffected by this alternative – that is, operation of the BSWTS would continue and the sediment/soil removal at UEFPC and Lake Reality would be implemented in the future as planned. The ESD for the Phase I ROD (DOE 2102b) revised the planned implementation schedule for excavation of contaminated sediments from UEFPC and Lake Reality to follow completion of upstream D&D and remedial actions, for consistency with the Y-12 west-to-east sequencing strategy and reduce risk of recontamination of remediated areas.

- Surface Water Monitoring - Surface water monitoring requirements already established under the Phase I ROD would be maintained under this alternative. Additional monitoring of the water treatment system effluent would be implemented to evaluate the effectiveness of this action.

- Land Use Controls - Land use controls already established under the Phase I ROD would be maintained under this alternative. No new land use controls would be required.

Relationship to Mercury Strategic Plan Actions. Also as discussed under Sections 1.1.4 and 1.1.5, numerous additional actions and studies are planned under the Y-12 Mercury Reduction Project and the *Strategic Plan for Mercury Remediation* (DOE 2014a) which are separate from the actions being conducted under the Phase I ROD and outside the scope of this FFS. These actions would continue and would not be impacted by this alternative, including:

- Removal of Mercury from Storm Sewer System – The ongoing collection and disposal of mercury (elemental mercury and associated contaminated sediments) from mercury traps installed in the WEMA storm sewer system would continue but are outside the scope of this FFS.

- Field and Laboratory Studies - Several studies with goals of reducing fish mercury concentrations, mercury flux, and surface water mercury concentrations will be conducted over the next several years, addressing areas including developing better understanding of mercury source contributions to

UEPFC, mercury methylation processes, relationships between mercury in surface water and fish, ecological management and enhancement, water chemistry manipulation, sediment and bank soil stabilization, and potential stream reclassification. While these studies may provide important information to better understand the complex behavior of mercury in the UEFPC and EFPC ecosystem and to ultimately support the desired reduction of mercury in fish tissue, they are outside the scope of this FFS.

- Mercury-Use Building Demolition – The WEMA former mercury-use buildings are planned for demolition followed by remediation of underlying soils to remove major sources of mercury contamination. Building demolition and soil remediation are planned to proceed in a generally west-to-east sequence, to reduce potential for recontamination associated with groundwater flow that exhibits a west-to-east flow. Remediation of soil will follow directly after demolition for each facility. These future demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water. The proposed water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. However, this source has not been specifically evaluated in the conceptual design of the treatment system, but would be evaluated during the planning for these future demolition/remediation projects as additional characterization data become available to better define potential contaminants of concern. The modular design of the water treatment system would facilitate any changes that might be needed.

A CERCLA Alternatives Analysis is planned for the ~2021 timeframe which will be the basis for a future FFA-party agreement on any additional actions to be implemented in UEFPC or LEFPC. Completion of all response actions to reduce mercury in UEFPC surface will require many years.

Management of Uncertainties. There are numerous uncertainties regarding the site conditions and the technology performance associated with the new water treatment system which would be constructed under these alternatives. These uncertainties will be managed in this alternative using an adaptive management approach under the overall *Strategic Plan for Mercury Remediation at Y-12* (DOE 2014a), as described in Section 1.1.5. That is, as data is collected regarding the performance of this treatment system, and as results of other implemented remediation actions and studies are obtained and evaluated, modifications to response actions may be proposed as necessary. For example, additional unit operations for treatment could be added to this water treatment system to obtain greater reductions in mercury concentrations or additional storage capacity could be constructed to reduce storm-flow bypass requirements if monitoring data from initial system operations indicate that such changes may be beneficial and cost-effective relative to other potential response actions. Such modifications would be made through FFA-party agreement, to achieve the goal of reducing mercury levels in UEFPC.

4. DETAILED DESCRIPTION OF ALTERNATIVES

This chapter presents detailed descriptions of the remedial alternatives for additional mercury abatement actions at UEFPC. The level of detail presented here supports the comparative evaluation of alternatives in Section 5. Design details (e.g., treatment capacity, storage capacity, final configuration of unit operations) may be modified as needed during remedial design after selection of the preferred remedy.

Since the component actions included in the Phase I selected remedy, in conjunction with the planned demolition and soil remediation actions at the primary mercury use buildings, already will achieve extensive reductions in the known primary source areas of mercury contamination at the Y-12 site, the remediation strategy for the alternatives considered in this FFS focuses on ex situ treatment of surface water for mercury removal. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. the AWQC standard for mercury) or less in system effluents. The resulting mercury removal would be expected to contribute substantially towards reducing the mercury concentration in UEFPC surface water at Station 17 to meet the interim goal of 200 ng/L established in the Phase I ROD and the long-term goal of attaining the AWQC in-stream standard of 51 ng/L for total mercury.

4.1 ALTERNATIVE 1: NO (FURTHER) ACTION

As required by the NCP, the no-action alternative provides a comparative baseline against which other alternatives can be evaluated. The no-action alternative does not initiate any remedial action, and normally assumes that existing security measures and institutional controls to limit access and use are not maintained, and that short- and long-term monitoring is eliminated. No implementation is required and there would be no costs associated with this alternative.

However, a true no-action alternative is not relevant for this FFS, since some remedial actions have already been performed under the Phase I ROD selected remedy, and other actions are ongoing and planned. Since the purpose of this FFS is only to evaluate potential modification of the selected remedy in the Phase I ROD to include additional actions to reduce mercury releases to UEFPC surface water, this "no further action" alternative is defined to mean the existing Phase I selected remedy (as modified to date) would continue implementation without further changes.

4.2 ALTERNATIVE 2: WATER TREATMENT AT OUTFALL 200

Alternative 2 involves the construction of a new water treatment facility designed to treat discharges from Outfall 200 to reduce mercury releases to UEFPC surface water. Multiple treatment facility configurations are evaluated under this alternative with different levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water. In each case, storm flow above the facility treatment and storage capacity would be bypassed around the facility and released to UEFPC without treatment. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. the AWQC standard for mercury) or less in system effluents. The resulting mercury removal would be expected to contribute substantially towards reducing the mercury concentration in UEFPC surface water at Station 17 to meet the interim goal of 200 ng/L established in the Phase I ROD and the long-term goal of attaining the AWQC in-stream standard of 51 ng/L for total mercury.

As discussed previously, a treatability study and conceptual design study were initiated in 2012 for a treatment system to reduce discharge of mercury from Outfall 200 using available ARRA funding, in support of the Phase I ROD requirement to investigate the viability of large-scale treatment of mercury-contaminated surface water at UEFPC. The resulting Conceptual Design Report (UCOR 2014) and Remedial Design Work Plan (DOE 2014b) provide much greater detail in the system design than is typically available in an FS. While the final facility design would be determined during the remedial design process if this alternative is selected for implementation, the recommended conceptual design for the treatment system would include: grit removal; chemical co-precipitation/clarification; and multimedia filtration. The system design also would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed and if warranted by future conditions, consistent with the adaptive management approach and the *Strategic Plan* (DOE 2014a).

The new water treatment facility would be constructed using a modular design that would be conducive to future modifications that might be needed. Such future modifications could include construction of additional unit operations to improve treatment system performance to achieve greater mercury reductions in system effluents (e.g., addition of granular activated carbon adsorption or other unit operations for effluent polishing, if needed to achieve system performance objectives), construction of storage capacity to address greater amounts of storm flow, or other changes. Effluent polishing using granular activated carbon is not included in the basic system configurations because treatability testing indicates that the planned unit operations may achieve the performance objectives without polishing, but the modular facility design will facilitate this addition in the future if needed. The new water treatment facility would benefit from ongoing studies to evaluate improvements in management of clean stormwater and non-contaminated process water (e.g., once-through cooling water, condensate) to prevent contamination and reduce the quantity of water requiring treatment.

The current Conceptual Design Report (UCOR 2014) and Remedial Design Work Plan (DOE 2014b) anticipate influent and effluent monitoring to include total and soluble (dissolved) mercury. This data will be integrated with the on-going monitoring program at Outfall 200 to determine the annual mercury flux removed and annual flux that bypasses the treatment facility. Other parameters are anticipated to be monitored to a varying degree as appropriate to support the treatment process and plant operation and may include parameters such as: temperature, pH, oxidation reduction potential, conductivity, turbidity, TSS, other metals, methanol, PCBs, oil and grease, free chlorine, common salts, and whole effluent toxicity testing. However, the specific details of the monitoring requirements for the treatment system effluent will be determined by the FFA parties in the Remedial Action Work Plan that would follow the decision to construct this facility.

Outfall 200 has been identified as the nominal location for a new water treatment facility because it is the integration point for the WEMA storm sewer effluent entering UEFPC, and this storm sewer effluent constitutes the largest source of mercury releases to UEFPC under base-flow conditions. In addition, preliminary siting studies conducted under the Conceptual Design Report (UCOR 2014) have identified feasible construction sites near Outfall 200. However, siting studies are still underway and may ultimately select a preferred location for a new water treatment facility to treat discharges from Outfall 200 at some distance downstream from Outfall 200. However, treatment of discharge from Outfall 200 instead of other discharge or water collection locations [e.g., the individual WEMA (Outfalls 150, 160, 163 or 169) or Station 17] is considered to be preferable due to the following considerations:

- Construction of a new facility at the individual WEMA outfalls would be much more severely constrained by ongoing Y-12 operations and security requirements, and would require construction within the high security area. Site topography likely would constrain the facility to a much smaller footprint which may not be adequate for the planned facility operations. While Outfall 163 has been

contributing the largest portion of the mercury flux in recent years, mercury releases from these individual outfalls have changed in their relative magnitude over time. More construction of new piping infrastructure would be required to reroute effluents from the individual outfalls to a treatment facility constructed at one of these locations relative to construction at Outfall 200.

- Station 17 is the surface water monitoring location near where UEFPC exits the Y-12 site and the ORR, prior to running through the City of Oak Ridge. As described previously, construction of a water treatment facility at Station 17 was considered in Alternative 4a in the Phase I ROD. This location would offer advantages in terms of the physical topography of the site and the availability of feasible construction sites. The primary disadvantage of this location would be the higher stream flow rate, which includes surface runoff from a much larger and largely non-contaminated area, whereas the other locations would allow more focused treatment closer to the contaminant source.

Sub-alternatives which have been developed to evaluate different levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water, are described in the following sections. All alternatives would bypass stream flows in excess of treatment and storage capacity to UEFPC without treatment.

Under all sub-alternatives, decontamination facilities and staging areas would need to be developed during construction of the new water treatment facility. These areas would have containment to prevent decontamination water or rainwater from leaving the area without appropriate sampling. Any water that cannot be discharged directly to a storm drain would be treated, as needed. The size of these areas would depend on the scope covered by an activity. Some modification/relocation of roads and other infrastructure construction may be needed to implement this alternative, depending on the final location.

The new water treatment system constructed under this alternative would be designed to supplement other response actions already underway or planned for future implementation under the Phase I ROD, and would not modify or replace any of those actions. Similarly, construction of this new facility would not impact the additional actions and studies are planned under the Y-12 Mercury Reduction Project and the *Strategic Plan for Mercury Remediation* (DOE 2014a) which are separate from the actions being conducted under the Phase I ROD.

4.2.1 Alternative 2a: Water Treatment at Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity of 1500 gpm (2.2 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration with treatment capacity for up to 1500 gpm of influent surface water plus up to 500 gpm of recycle flows (e.g., backwash water, filter press filtrate). The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Conceptual process flow diagrams for Alternative 2a are shown in Figures 4.1 and 4.2. A nominal facility location and layout is depicted in Figure 4.3. Alternative 2a is comparable to Scalability Option 2 described in the Conceptual Design Report (UCOR 2014), and the conceptual design information presented below is summarized from that document. This alternative is intended to represent a minimal system capable of treating UEFPC surface water under base-flow conditions and only minimal rainfall events.

The headworks for this facility would be constructed to manage a maximum flow of 3000 gpm, which is based on the 95th percentile stream flow estimate for UEFPC at this location – i.e., 95% of

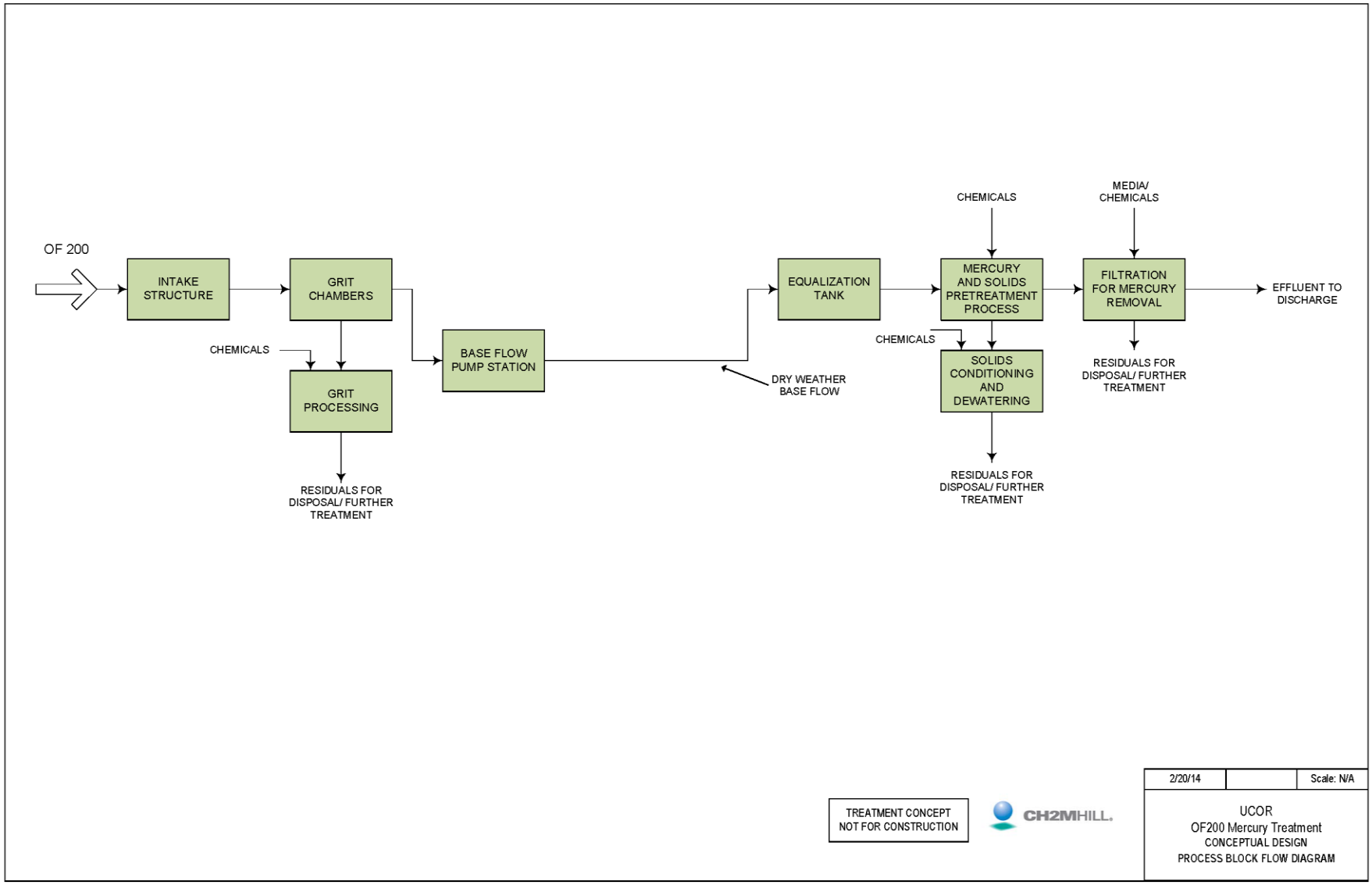

Figure 4.1 Conceptual Process Block Flow Diagram for Outfall 200 Water Treatment System Alternative 2a/2b (UCOR 2014).

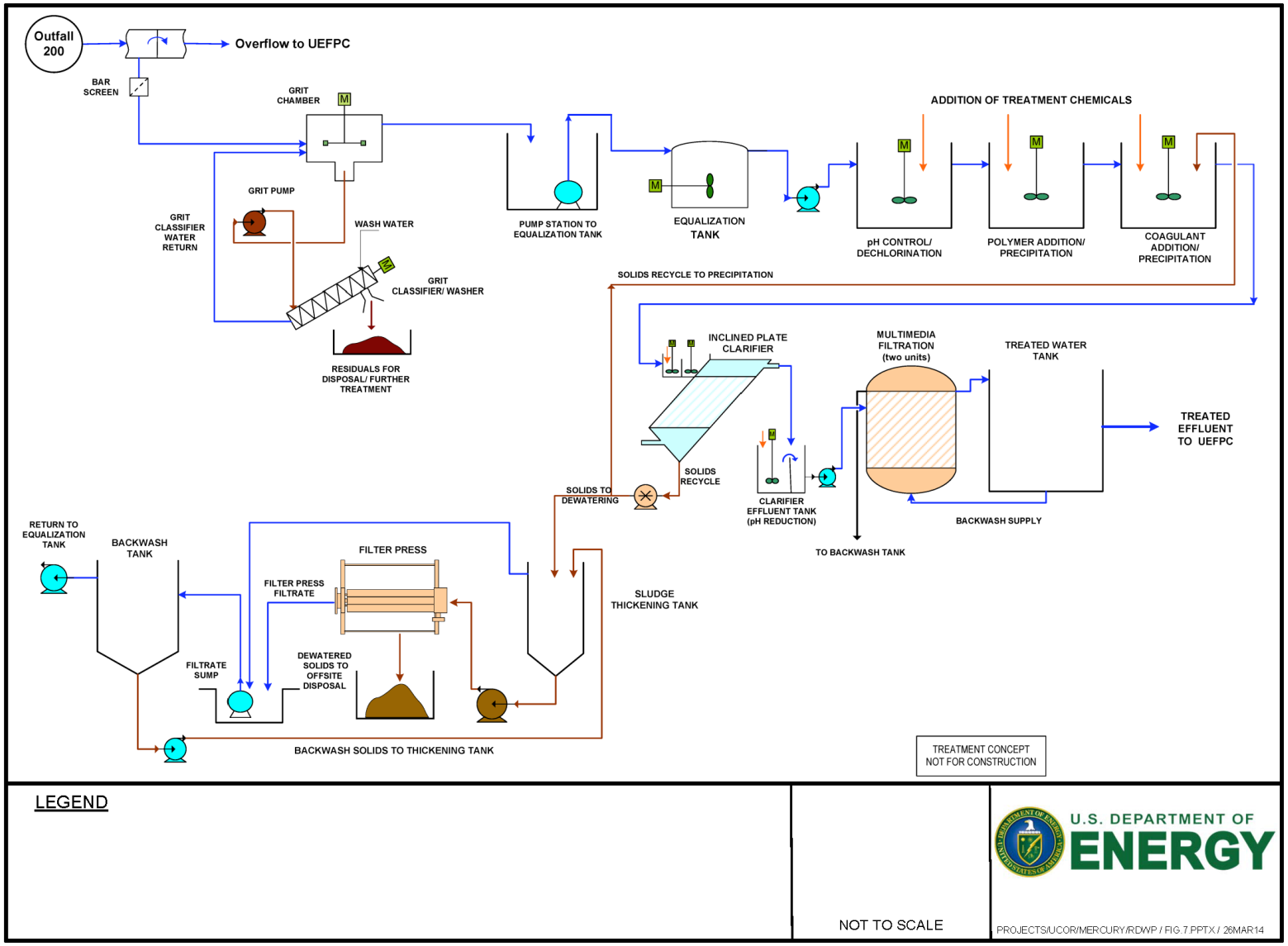

Figure 4.2 Alternative 2a/2b, Outfall 200 Water Treatment System, Preliminary System Process Flow Diagram (DOE 2014b).

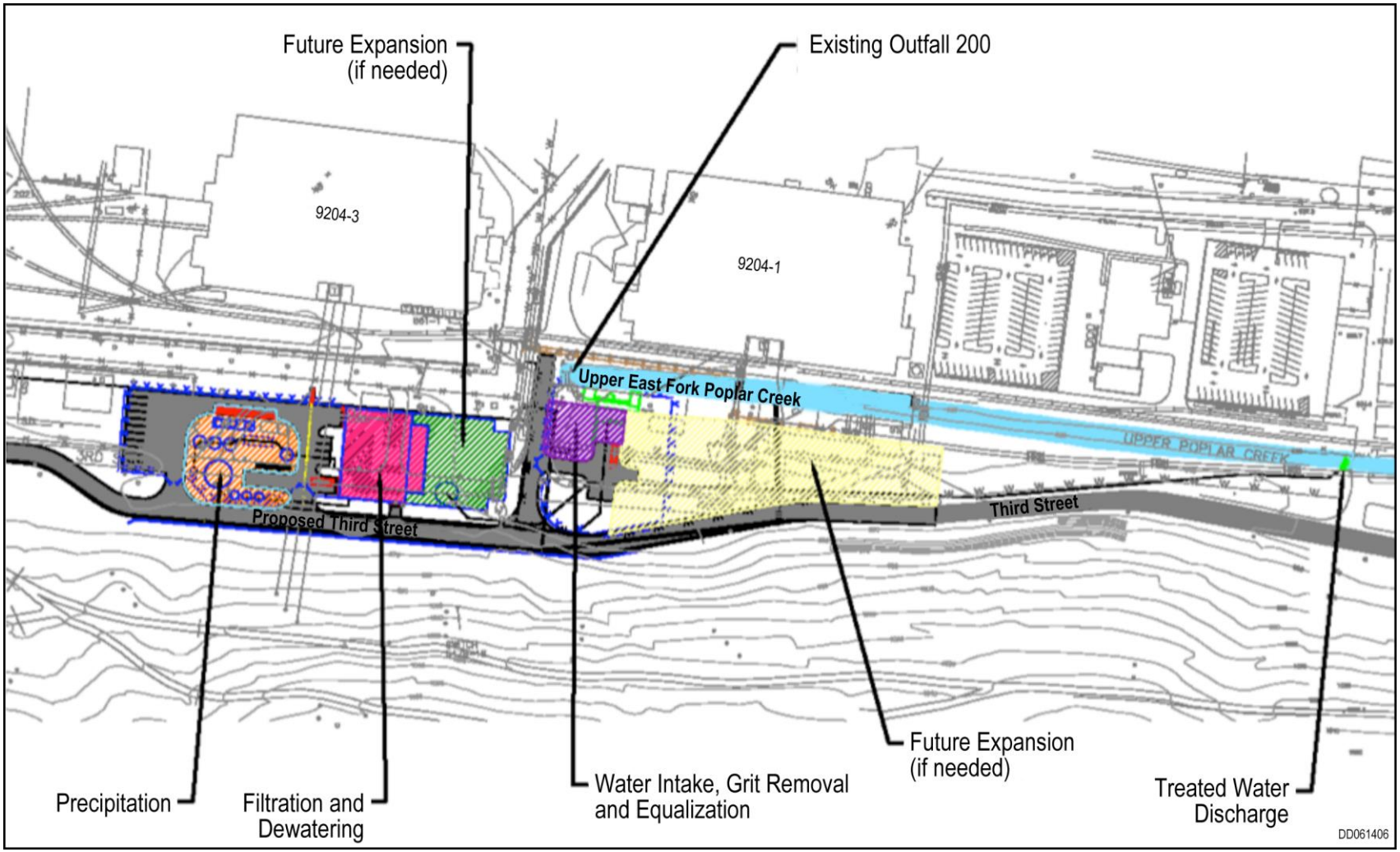

Figure 4.3 Alternative 2a/2b, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout (DOE 2014b).

stream flow records for UEFPC do not exceed 3000 gpm. Stream flow in UEFPC is characterized by a relatively low base-flow of approximately 1000 gpm during dry conditions, with significantly increased flow during storm events, peaking as high as 40,000 gpm or more (UCOR 2014). This large variability in stream flow is one of the primary challenges in constructing a water treatment facility for UEFPC.

Water flowing from Outfall 200 would be diverted into the inlet channel of the headworks through an intake structure with an adjustable weir. The inlet channel would contain bar racks or other coarse screen to remove oversize material from entering the grit removal chambers. Flows in excess of the headworks design capacity (3000 gpm for this Alternative) would overflow the weir and continue to flow down UEFPC without treatment.

The headworks system would include a manual bar screen, grit removal, grit classification and dewatering, and a pump station. Grit removal refers to the process of removing larger solids prior to the treatment processes that target removal of colloidal and dissolved mercury. Grit removal would be accomplished using vortex-grit chambers, which would remove grit particles larger than about 50 µm diameter and other high-density materials, potentially including any droplets of elemental mercury of sufficient size. Grit and any associated mercury would be periodically removed from the system using a grit pump for dewatering and disposal.

Water that has completed the grit removal process would be pumped through the base-flow pump station to an equalization tank prior to further treatment. The equalization tank would be designed to provide a hydraulic retention time of approximately 1 hour. Effluent from the equalization tank would be pumped to a pH control and dechlorination tank, where acid or caustic reagents would be added to adjust pH to the required range (typically 7 to 9 for chemical precipitation of mercury), and agents would be added for dechlorination as required, before the effluent is released to chemical precipitation tanks.

The effluent from the pH control/dechlorination tank would be pumped to a tank where a sulfide functional polymer would be introduced and then to another tank where ferric chloride coagulant would be added in order to produce mercury-sulfide bound solids and ferric oxyhydroxides that adsorb or co-precipitate mercury with other suspended solids. Dissolved mercury would be precipitated by the sulfide groups on the sulfide functional polymer and adsorbed onto other species formed during the precipitation process. Solids formed during the coagulation and flocculation process, enhanced by the use of ferric iron and organic polymers, would include colloidal and suspended mercury. The effluent from the chemical precipitation process would then go to inclined-plate clarifiers to remove the solids. A portion of the clarifier sludge would be recycled back to the coagulant addition tank to promote growth of denser precipitate solids, settling, fines capture, and drive the precipitation process toward equilibrium. A portion of the clarifier sludge would be sent to a sludge thickening tank to increase the solids concentration to at least 5% prior to dewatering. The thickened solids from the sludge thickening tank would be pumped to a filter press for dewatering. The filter cake generated from the filter press would be sent for disposal, while the filtrate would be pumped to a backwash tank and then recycled back into the untreated influent in the pH control/dechlorination tank.

Clarifier effluent would be pumped to a clarified water tank for pH adjustment prior to multi-media filtration. The multi-media filtration system would consist of a series of vessels containing appropriate filter media that would be operated in parallel with individual units being backwashed or taken offline as needed. At least one unit typically would be inactive at any time, so that it can be put into use when another unit reaches capacity and requires backwashing. Effluent from the multi-media filtration tanks would go to a holding tank and then would be discharged back to UEFPC. A portion of the clean effluent from the holding tank also would be used for backwashing of the multi-media filtration tanks as needed.

Solid and liquid waste materials generated during facility construction and during treatment operations would be appropriately characterized and disposed. Waste generated during facility construction may include noncontaminated construction debris and asbestos-contaminated debris, as well as soil and debris that may contain mercury or other hazardous materials. Solid waste streams generated during treatment operations would include coarse debris from the bar screen, grit material from the grit removal system, filter cake from the filter press, spent media from the multi-media filters, laboratory sampling materials, personal protective equipment, and universal waste items. The predominant solid waste streams are assumed to be grit material from the grit removal system (estimated at 300,000 lbs/year), filter cake from the filter press (estimated at 400,000 lbs/year), and spent media from the multi-media filters (estimated at 22,000 lbs/year)(UCOR 2014). Liquid waste streams would include liquids from dewatering operations, spent laboratory chemicals, and equipment cleaning materials. Some liquid residuals, such as those generated during backwash operations and solids handling, would be pumped back into the equalization tank and reused in treatment system operations. Solid wastes meeting appropriate waste acceptance criteria would be disposed onsite at the ORR Solid Waste Landfills or the EMWMF, as appropriate; while wastes not meeting waste acceptance criteria for onsite disposal would be sent for disposal at an appropriately licensed offsite facility. Wastes generated during facility operations are expected to include sanitary/industrial waste, RCRA-regulated hazardous waste, low-level radioactive waste, and mixed waste. All wastes would be characterized in accordance with the Sampling and Analysis Plan and Waste Handling Plan requirements developed during remedial design to determine the appropriate disposition path.

Alternative 2a would have capacity for grit removal from influent surface water flows up to 3000 gpm capacity, and capacity for other treatment operations for influent surface water flow up to 1500 gpm plus 500 gpm of recycle flows (recycle of backwash water and filter press filtrate). Influent flow greater than 1500 gpm but less than 3000 gpm would flow through the grit removal system and then be released to UEFPC without further treatment, while stream flow greater than 3000 gpm would overflow the weir and continue to flow down UEFPC without either grit removal or chemical treatment.

Preliminary performance modeling (UCOR 2015e) estimates that this treatment system could remove approximately 1600 g/year of mercury or approximately 52% of the mercury flux at Outfall 200 during a typical year, based on rainfall data from 2010 which is considered a year of average precipitation and stream flow. Additional mercury reduction potentially may be achieved for stream flows between 1500 and 3000 gpm, which would be processed through the grit removal system only, but data are not currently available to quantify any such reduction.

Operation of the new water treatment system would continue until mercury levels in discharges from Outfall 200 have declined to levels that no longer require treatment – i.e., planned remediation of mercury source areas at WEMA may result in reduction of mercury releases to UEFPC to levels that no longer require treatment. Remediation of the former mercury-use buildings is currently scheduled to extend at least to FY2039. A period of operations of 30 years is assumed for this analysis.

Costs for Alternative 2a are estimated at approximately $115 million capital cost, and operations and maintenance cost of approximately $ 2.2 million per year. The present value cost for construction and 30 years of operation is estimated at approximately $142 million.

Surface water monitoring would be conducted to evaluate the effectiveness of the treatment system operations. Monitoring would include influent stream water entering the treatment facility and the effluent stream following treatment, in order to evaluate the effectiveness of the treatment operations in reducing mercury concentrations to 51 ng/L total mercury in the treated effluent. This effluent monitoring would be in addition to the monitoring currently required by the Phase I ROD, which would continue to

measure progress toward attaining the interim goal of 200 ng/L and the ultimate goal of attaining the AWQC standard of 51 ng/L in-stream at Station 17.

The new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed, based on an adaptive management approach. Such future modifications could include construction of additional unit operations to improve treatment system performance to achieve greater mercury reductions in system effluents, construction of storage capacity for storm flow, or other changes. In particular, the facility footprint would be designed to accommodate future addition of additional treatment operations for effluent polishing and/or stormwater storage. Similarly, the headworks and diversion structure of the facility would be constructed in a manner to allow future expansion to accommodate flow up to 40,000 gpm, if warranted by performance monitoring data and/or any future changed conditions, consistent with the adaptive management approach. Such potential modifications of the treatment system would be evaluated by the FFA parties based upon monitoring of the treatment system performance for a period of two years, and would be evaluated by the FFA parties relative to other potential response actions to achieve further mercury reductions under the adaptive management approach.

4.2.2 Alternative 2b: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration with treatment capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate). The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Process flow diagrams for Alternative 2b are shown in Figures 4.1 and 4.2, and a nominal facility location and layout is depicted in Figure 4.3 (i.e., same process flow and layout as Alternative 2a). Alternative 2b is comparable to Scalability Option 4 described in the Conceptual Design Report (UCOR 2014), and the conceptual design information presented below is summarized from that document. This alternative is intended to represent a system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200 (i.e. 95% of stream flow records for UEFPC do not exceed 3000 gpm).

The headworks and grit removal chamber for this facility would be identical to those in Alternative 2a, and would be constructed to manage a maximum flow of 3000 gpm. However, this facility differs from Alternative 2a in that the subsequent treatment operations following grit removal also would be designed to treat flow rates up to 3000 gpm, which is approximately equivalent to the 95th percentile stream flow estimate for UEFPC at Outfall 200. Influent flows greater than 3000 gpm would overflow the weir and continue to flow down UEFPC without either grit removal or further treatment.

Water flowing from Outfall 200 would be diverted into the inlet channel of the headworks through an intake structure with an adjustable weir, and continue through a manual bar screen, grit removal, grit classification and dewatering, and pump station. Water that has completed the grit removal process would be pumped through the base-flow pump station to an equalization tank prior to further treatment. The remainder of the treatment system would include the same sequence of unit operations as described for Alternative 2a, but would include two parallel treatment trains to provide twice the treatment capacity, i.e., treatment capacity for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash

water, filter press filtrate) up to 1000 gpm for all treatment operations. As described for Alternative 2a, the treatment process would include the following sequential unit operations:

- Headworks/Intake structure, with manually cleaned bar screen, and overflow diversion to UEFPC
- Vortex-grit chamber for grit removal under base-flow conditions (up to 3000 gpm), and grit classifier/washer.
- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed.
- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank.
- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers.
- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream.
- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC.
- Equalization, effluent and backwash holding tanks.

Solid and liquid waste materials generated during facility construction and treatment operations would be similar to those described previously for Alternative 2a. However, the residuals generated during facility operations would include larger quantities due to the greater treatment capacity. The predominant solid waste streams generated by the treatment operations are estimated to include grit material from the grit removal system (estimated at 300,000 lbs/year), filter cake from the filter press (estimated at 400,000 lbs/year), and spent media from the multi-media filters (estimated at 22,000 lbs/year) (UCOR 2014). All wastes would be appropriately characterized in accordance with the Sampling and Analysis Plan and Waste Handling Plan requirements developed during remedial design, and sent for appropriate onsite or offsite disposal as sanitary/industrial waste, RCRA-regulated hazardous waste, low-level radioactive waste, or mixed waste, as appropriate.

Alternative 2b would have capacity for grit removal and chemical treatment of influent surface water flows up to 3000 gpm capacity. Influent flows greater than greater than 3000 gpm would overflow the weir and continue to flow down UEFPC without either grit removal or chemical treatment.

Preliminary performance modeling (UCOR 2015e) estimates that this treatment system could remove approximately 2100 g/year of mercury or approximately 68% of the mercury flux at Outfall 200 during a typical year.

Operation of the new water treatment system would continue until mercury levels in discharges from Outfall 200 have declined to levels that no longer require treatment – i.e., planned remediation of mercury source areas at WEMA may result in reduction of mercury releases to UEFPC to levels that no longer require treatment. An operational period of 30 years is assumed for this analysis.

Costs for Alternative 2b are estimated at approximately $125 million capital cost, and approximately $2.7 million per year for operation and maintenance. The present value cost for construction and 30 years of operation is estimated at approximately $158 million.

New surface water monitoring requirements would be similar to that described for Alternative 2a to evaluate the effectiveness of the treatment system operations. This effluent monitoring would be additional to the monitoring currently required by the Phase I ROD.

The new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed, based on an adaptive management approach. Such future modifications could include construction of additional unit operations to improve treatment system performance to achieve greater mercury reductions in system effluents, construction of storage capacity for storm flow, or other changes. In particular, the facility footprint would be designed to accommodate future addition of additional treatment operations for effluent polishing and/or stormwater storage. Similarly, the headworks and diversion structure of the facility would be constructed in a manner to allow future expansion to accommodate flow up to 40,000 gpm, if warranted by performance monitoring data and/or any future changed conditions, consistent with the adaptive management approach. Such potential modifications of the treatment system would be evaluated by the FFA parties based upon monitoring of the treatment system performance for a period of two years, and would be evaluated by the FFA parties relative to other potential response actions to achieve further mercury reductions under with the adaptive management approach.

4.2.3 Alternative 2c: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity for 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 2 million gallons to manage flows up to 40,000 gpm. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. The system design would be configured to maintain flexibility and expandability to accommodate modification of treatment processes, as needed in the future. Alternative 2c is not directly comparable to a Scalability Option described in the Conceptual Design Report (UCOR 2014), but is similar to Scalability Option 4 with the addition of the 2 million gallon storage capacity; this Alternative is intended to represent a treatment system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200, and capable of capturing stormwater in excess of these flow rates for future treatment. The 2 million gallon storage capacity is estimated to be sufficient to capture the initial runoff from most storm events (i.e., the "first flush"). Stormwater flows in excess of this storage capacity would bypass the treatment facility. Process flow diagrams for Alternative 2c are shown in Figures 4.4 and 4.5, and a nominal facility location and layout is depicted in Figure 4.6.

The headworks for this facility would differ from that for Alternatives 2a and 2b, in that it would be constructed to manage a maximum flow of 40,000 gpm, using a two-stage weir system. Water flowing from Outfall 200 would be diverted into the inlet channel of the headworks through an intake structure with an adjustable weir as in the previous alternatives. Again, the inlet channel would contain manual bar screens or other coarse screens to remove oversize material from entering the grit removal chambers. Under normal flow conditions, all influent water would be directed to the base-flow grit removal chamber, as described for Alternatives 2a and 2b. However, unlike Alternatives 2a and 2b, this system would also contain a much larger grit removal chamber for stormwater flows, capable of treating influent

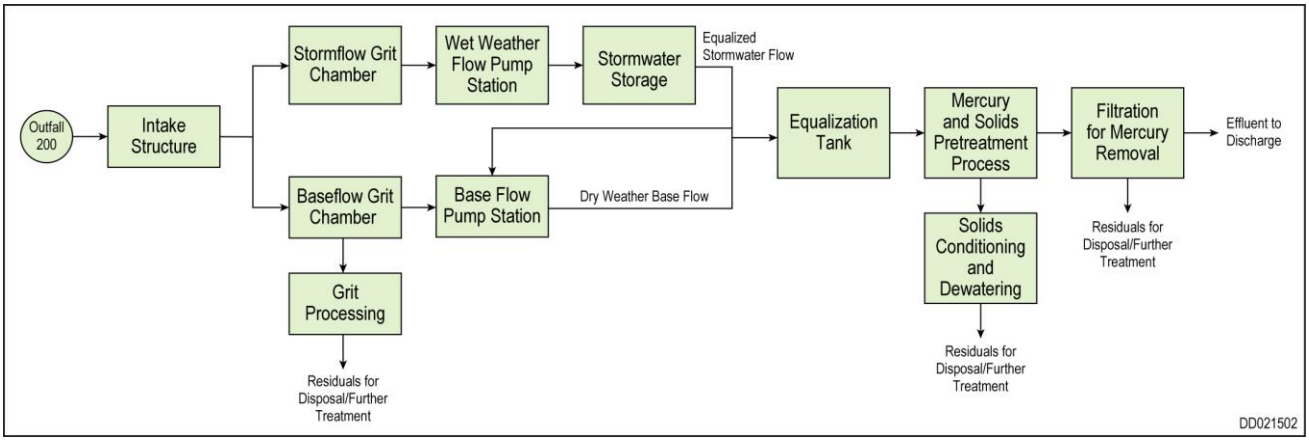

Figure 4.4 Conceptual Process Block Flow Diagram for Outfall 200 Water Treatment System Alternative 2c/2d.

flows up to 37,000 gpm (52 Mgd). When stream flow does not exceed the capacity of the smaller base-flow unit, all influent water would be processed for grit removal in the base-flow unit. The larger wet-weather unit would operate only during storm events or when flows exceed base-flow conditions, and the stormwater treated in that unit would be pumped to the stormwater storage tanks following grit removal. Influent flows exceeding the headworks capacity of 40,000 gpm or the storage capacity would overflow the weir system and bypass the facility and continue to flow down UEFPC without treatment.

Stormwater storage would consist of an above-ground steel tank with a capacity of 2 million gallons. The tank would be equipped with mixers to keep in suspension any solids that remain after the grit removal processing. Stormwater stored in the tank would be pumped to the equalization tank for treatment during non-storm conditions at a flow rate up to 1000 gpm. During remedial design, alternative storage configurations may be evaluated, including use of concrete retention basins versus above-ground tank.

The remainder of the treatment system would be equivalent to that in Alternative 2b, with two parallel treatment trains to provide a total treatment capacity for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) up to 1000 gpm for all treatment operations, and would include the following sequence of unit operations:

- Headworks/Intake structure, with manually cleaned bar screen, and overflow diversion to UEFPC
- Vortex-grit chamber for grit removal under base-flow conditions (up to 3000 gpm), and grit classifier/washer.
- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed.
- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank.
- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers.

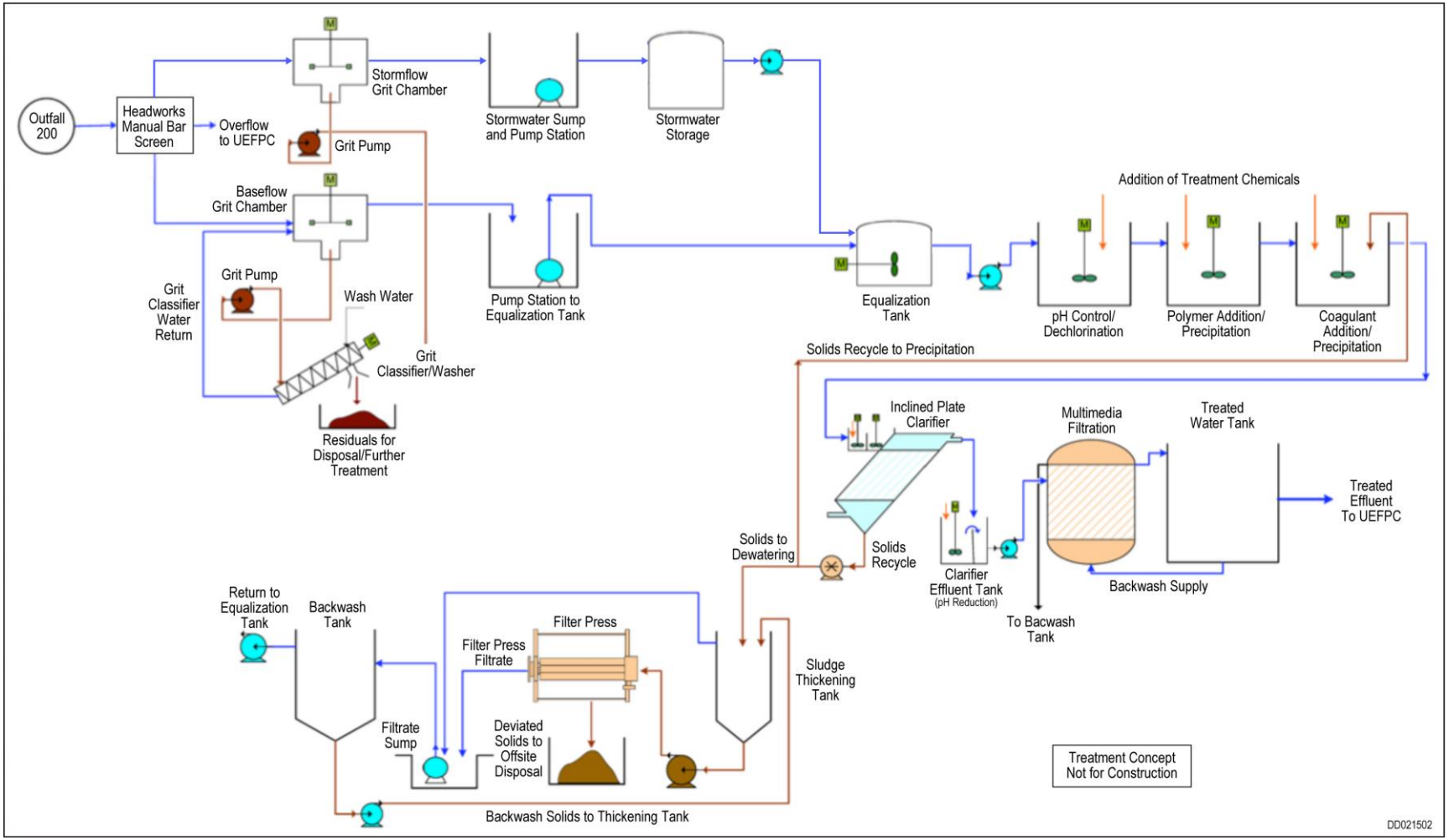

Figure 4.5 Alternative 2c/2d, Outfall 200 Water Treatment System, Preliminary System Process Flow Diagram.

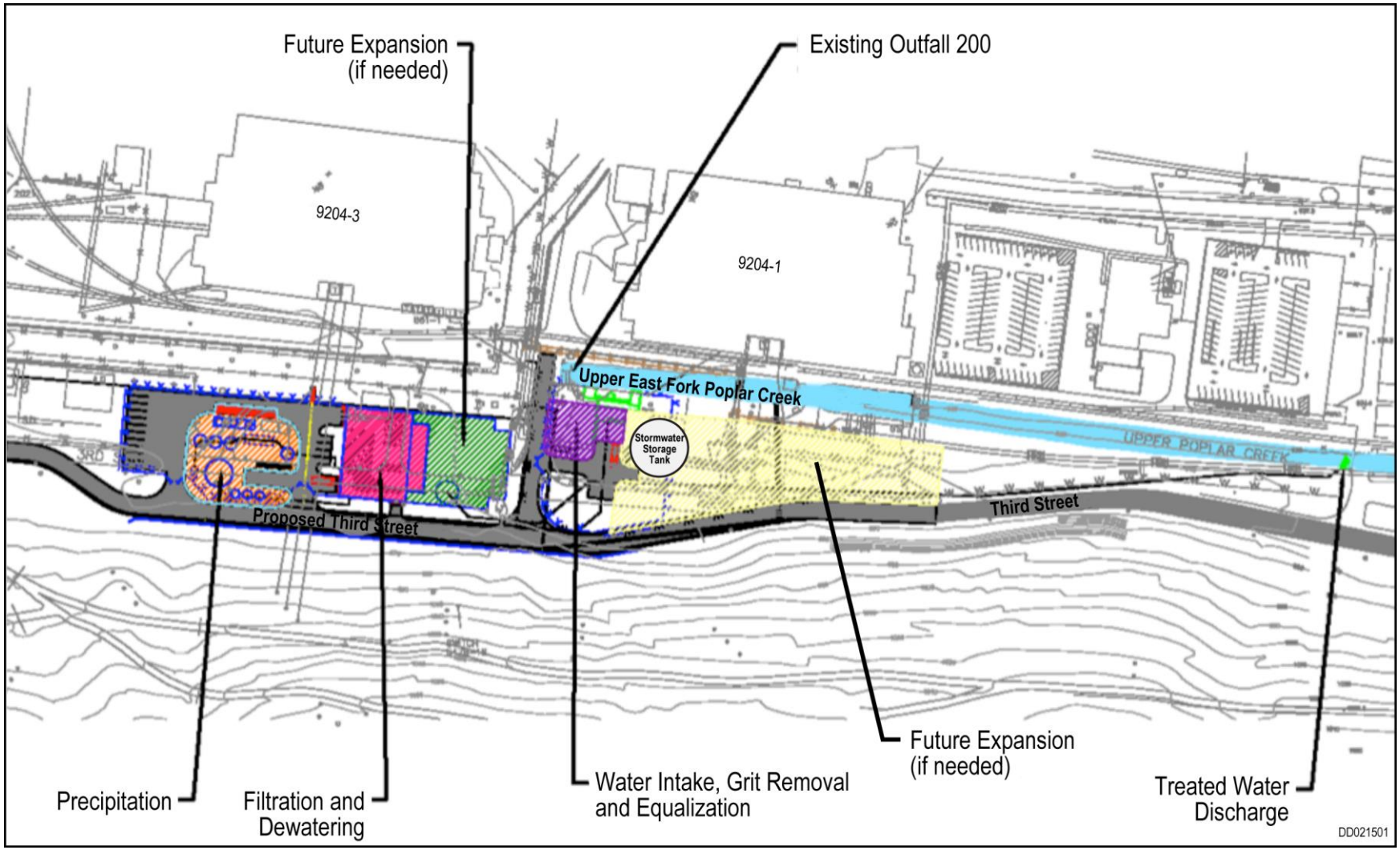

Figure 4.6 Alternative 2c, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout.

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream.

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC.

- Equalization, effluent and backwash holding tanks.

Solid and liquid waste materials generated during facility construction and treatment operations would be similar to those described previously for Alternative 2b. However, the residuals generated during facility operations would include larger quantities due to the greater treatment capacity. The predominant solid waste streams generated by the treatment operations are estimated to include grit material from the grit removal system (estimated at 1,300,000 lbs/year), filter cake from the filter press (estimated at 440,000 lbs/year), and spent media from the multi-media filters (estimated at 44,000 lbs/year) (UCOR 2014). All wastes would be appropriately characterized in accordance with the Sampling and Analysis Plan and Waste Handling Plan requirements developed during remedial design, and sent for appropriate onsite or offsite disposal as sanitary/industrial waste, RCRA-regulated hazardous waste, low-level radioactive waste, or mixed waste, as appropriate.

Alternative 2c would have capacity for grit removal and chemical treatment of influent surface water flows up to 3000 gpm capacity. Influent flows greater than greater than 40,000 gpm would overflow the weir and continue to flow down UEFPC without either grit removal or chemical treatment.

Preliminary performance modeling (UCOR 2015e) estimates that this treatment system could remove approximately 2600 g/year of mercury or approximately 84% of the mercury flux at Outfall 200 during a typical year.

Operation of the new water treatment system would continue until mercury levels in discharges from Outfall 200 have declined to levels that no longer require treatment – i.e., planned remediation of mercury source areas at WEMA may result in reduction of mercury releases to UEFPC to levels that no longer require treatment. An operational period of 30 years is assumed for this analysis.

Costs for Alternative 2c are estimated at approximately $146 million capital cost, and approximately $3.1 million per year for operation and maintenance. The present value cost for construction and 30 years of operation is estimated at approximately $185 million.

New surface water monitoring requirements would be similar to that described for Alternative 2a to evaluate the effectiveness of the treatment system operations. This effluent monitoring would be additional to the monitoring currently required by the Phase I ROD.

The new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed, based on an adaptive management approach. Such future modifications could include construction of additional unit operations to improve treatment system performance to achieve greater mercury reductions in system effluents, construction of storage capacity for storm flow, or other changes. In particular, the facility footprint would be designed to accommodate future addition of additional treatment operations for effluent polishing and/or stormwater storage, if warranted by performance monitoring data and/or any future changed conditions, consistent with the adaptive management approach. Such potential modifications of the treatment system would be evaluated by the FFA parties based upon monitoring of the treatment system performance for a period of

two years, and would be evaluated by the FFA parties relative to other potential response actions to achieve further mercury reductions under the adaptive management approach.

4.2.4 Alternative 2d: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 10 Million Gallons Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity for 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 10 million gallons to manage flows up to 40,000 gpm. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. The system design would be configured to maintain flexibility and expandability to accommodate modification of treatment processes, as needed in the future. Alternative 2d is comparable to Scalability Option 7 described in the Conceptual Design Report (UCOR 2014), and is intended to represent a treatment system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200, and capable of capturing stormwater in excess of these flow rates for future treatment. The 10 million gallon storage capacity is approximately equivalent to water volume generated by the 1-year 24-hour storm event (UCOR 2014). Peak flows from larger storm events would bypass the treatment facility, although the initial runoff flow from these storm events (i.e., the "first flush") would be captured. Process flow diagrams for Alternative 2d are shown in Figures 4.4 and 4.5, and the general facility location and layout is depicted in Figure 4.7.

The headworks for this facility would be constructed to manage a maximum flow of 40,000 gpm, using a two-stage weir system, as described above for Alternative 2c. Water flowing from Outfall 200 would be diverted into the inlet channel of the headworks through an intake structure with an adjustable weir as in the previous alternatives. Again, the inlet channel would contain manual bar screens or other coarse screens to remove oversize material from entering the grit removal chambers. Under normal flow conditions, all influent water would be directed to the base-flow grit removal chamber, as described for Alternatives 2a and 2b. However, unlike Alternatives 2a and 2b, this system would also contain the much larger grit removal chamber for stormwater flows like Alternative 2c, capable of treating influent flows up to 37,000 gpm (52 Mgd). When stream flow does not exceed the capacity of the smaller base-flow unit, all influent water would be processed for grit removal in the base-flow unit. The larger wet-weather unit would operate only during storm events or when flows exceed base-flow conditions, and the stormwater treated in that unit would be pumped to the stormwater storage tanks following grit removal. Influent flows exceeding the headworks capacity of 40,000 gpm or the storage capacity would overflow the weir system and bypass the facility and continue to flow down UEFPC without treatment.

Stormwater storage would consist of five above-ground steel tanks with a capacity of 2 million gallons each, for a total storage capacity of 10 million gallons. Each tank would be equipped with mixers to keep in suspension any solids that remain after the grit removal processing. Stormwater stored in these tanks would be pumped to the equalization tank for treatment during non-storm conditions at a flow rate up to 1000 gpm. During remedial design, alternative storage configurations may be evaluated, including use of concrete retention basins versus above-ground tanks.

The remainder of the treatment system would be equivalent to that in Alternative 2b and 2c, with two parallel treatment trains to provide a total treatment capacity for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) up to 1000 gpm for all treatment operations, and would include the following sequence of unit operations:

- Equalization tank (minimum 1 hour holding time).

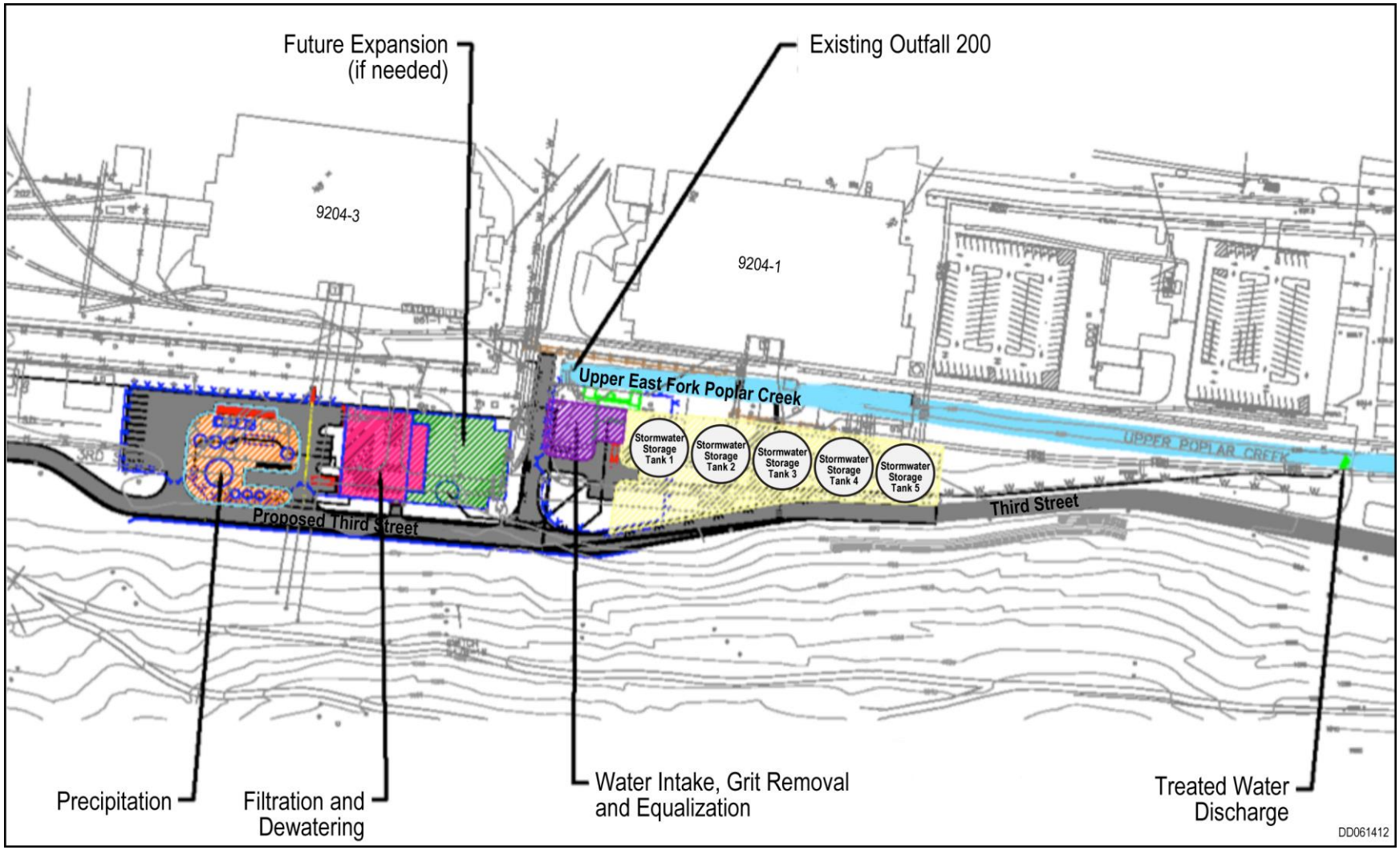

Figure 4.7 Alternative 2d, Outfall 200 Water Treatment System, Preliminary Facility Location and Layout.

- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed.

- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank.

- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers.

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream.

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC.

- Equalization, effluent and backwash holding tanks.

Alternative 2d differs from Alternative 2c primarily in the larger storage capacity for up to 10 million gallons of stormwater flow. The remaining unit operations of the treatment system are equivalent to those under Alternatives 2b and 2c, and double that of Alternative 2a – that is two parallel treatment trains would provide a total treatment capacity of 3000 gpm for influent surface water plus 1000 gpm for recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater.

Solid and liquid waste materials generated during facility construction and treatment operations would be similar to those described previously for Alternative 2c. The predominant solid waste streams generated by the treatment operations are estimated to include grit material from the grit removal system (estimated at 1,300,000 lbs/year), filter cake from the filter press (estimated at 440,000 lbs/year), and spent media from the multi-media filters (estimated at 44,000 lbs/year) (UCOR 2014). All wastes would be appropriately characterized in accordance with the Sampling and Analysis Plan and Waste Handling Plan requirements developed during remedial design, and sent for appropriate onsite or offsite disposal as sanitary/industrial waste, RCRA-regulated hazardous waste, low-level radioactive waste, or mixed waste, as appropriate.

Alternative 2d would have capacity for grit removal from influent surface water flows up to 40,000 gpm capacity, and capacity for other treatment operations for influent surface water flows up to 3000 gpm plus recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater up to 1000 gpm. Stormwater flows greater than 3000 but less than 40,000 gpm would be processed for grit removal and then pumped to a series of storage tanks with a maximum capacity of 10 million gallons. Influent flows exceeding the headworks capacity of 40,000 gpm or the storage capacity would overflow the weir system and bypass the facility and continue to flow down UEFPC without treatment.

Mass balance modeling predicts capture rates of water above 92% for both average and heavy rainfall years for the system configuration in Alternative 2d, with 10 million gallons of storage capacity and maximum flow rates of 3000 gpm pumping capacity to the treatment facility directly and 37,000 gpm pumping capacity to the storage tanks. This capacity also would be sufficient to capture the first flush rainfall (defined as the runoff from the 60-minute period surrounding the hydrograph peak) even from larger storm events for which the total volume exceeds the 10 million gallon storage capacity.

Preliminary performance modeling (UCOR 2015e) estimates that this treatment system could remove approximately 2800 g/year of mercury or approximately 91% of the mercury flux at Outfall 200 during a typical year.

Operation of the new water treatment system would continue until mercury levels in discharges from Outfall 200 have declined to levels that no longer require treatment – i.e., planned remediation of mercury source areas at WEMA may result in reduction of mercury releases to UEFPC to levels that no longer require treatment. An operational period of 30 years is assumed for this analysis.

Costs for Alternative 2d are estimated at approximately $179 million capital cost, and approximately $ 3.4 million per year for operation and maintenance. The present value cost for construction and 30 years of operation is estimated at approximately $221 million.

New surface water monitoring requirements would be similar to that described for Alternative 2a to evaluate the effectiveness of the treatment system operations. This effluent monitoring would be additional to the monitoring currently required by the Phase I ROD.

The new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed, based on an adaptive management approach. In particular, the facility footprint would be designed to accommodate future addition of additional treatment operations for effluent polishing, if warranted by performance monitoring data and/or any future changed conditions, consistent with the adaptive management approach. Such potential modifications of the treatment system would be evaluated by the FFA parties based upon monitoring of the treatment system performance for a period of two years, and would be evaluated by the FFA parties relative to other potential response actions to achieve further mercury reductions under the adaptive management approach.

This page intentionally left blank.

5. ANALYSIS OF ALTERNATIVES

This chapter presents the detailed analyses of the remedial alternatives for additional mercury abatement actions at UEFPC. Section 5.1 presents the evaluation criteria, while Section 5.2 presents the in-depth analysis for each alternative that forms the basis of alternative selection and Section 5.3 presents a comparative analysis of all alternatives.

5.1 EVALUATION CRITERIA

CERCLA Sect. 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. EPA has identified the following nine criteria (EPA 1988a) for use in evaluating each alternative [40 *CFR* 300.430(e)(9)(iii)]:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume through treatment;
- short-term effectiveness;
- implementability;
- cost;
- state acceptance; and
- community acceptance.

The first two criteria, overall protection of human health and the environment and compliance with ARARs, are the threshold criteria that relate directly to statutory findings that must be documented in the ROD. The next five criteria, the primary balancing criteria, address the performance of the remedial alternative and verify that the alternative is realistic. The last two criteria, the modifying criteria of state acceptance and community acceptance, are not addressed in the current analyses because they rely on stakeholder participation and feedback on the preferred alternative identified in the proposed plan.

In addition to these evaluation criteria prescribed under CERCLA, DOE policy directs that the substantive elements of analysis required under NEPA should be incorporated into CERCLA decision documents (DOE 1994c). Elements common to both CERCLA and NEPA include protectiveness, compliance with ARARs, long-term effectiveness and permanence, short-term effectiveness, and cost. Additional NEPA values that are not specifically included in the CERCLA criteria include socioeconomic impacts, environmental justice, irreversible and irretrievable commitment of resources, and cumulative impacts. Additionally, EPA (EPA 2012) and DOE (DOE 2013c) policies to incorporate sustainability principles into the remedial decision-making process by considering all environmental effects of remedy implementation is consistent with and incorporated into the CERCLA and NEPA evaluation criteria. All action alternatives considered for this interim action include very similar unit operations and construction footprints and would not differ significantly with respect to these requirements – that is, all alternatives would incorporate appropriate measures to reduce energy usage, reduce air pollutant and greenhouse gas emissions, reduce water use and negative impacts on water resources, incorporate responsible waste reduction and materials management practices, and protect ecosystem services.

5.1.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses whether the alternative would achieve and maintain adequate protection of human health and the environment in accordance with RAOs. All alternatives considered for selection must satisfy this criterion. Because the scope of this criterion is broad, it also reflects discussions of the subsequent criteria, including long-term effectiveness and permanence as well as short-term effectiveness. This criterion evaluates how site risks associated with each exposure pathway would be eliminated, reduced, or mitigated through treatment, engineering, or institutional controls. This criterion also evaluates impacts to the site environment resulting from the action itself.

5.1.2 Compliance with ARARs

This criterion addresses compliance with promulgated federal and state environmental regulations that are legally applicable or relevant and appropriate. If an alternative could not meet a requirement, a waiver under CERCLA might be justified. ARARs consist of two sets of requirements—those that are applicable and those that are relevant and appropriate. If there are no standards that address the proposed action or the COC, nonpromulgated advisories, criteria, or guidance developed by EPA, other federal agencies, or states may be designated as to-be-considered (TBC) guidance.

Requirements that do not fall within established criteria for ARARs include DOE Orders that pertain only to DOE facilities. AEA requirements for DOE waste management are incorporated into DOE Orders developed under AEA authority. EPA's *CERCLA Compliance with Other Laws Manual* states that "…DOE Orders are not promulgated requirements and are not potential ARARs" (EPA 1988b). The manual further states that "…to the extent that DOE Orders are more stringent or cover areas not addressed by existing ARARs, they should be considered when necessary to develop a protective remedy." Substantive requirements of DOE Orders serve as TBC requirements that, when specifically incorporated into a CERCLA ROD, become enforceable standards.

Appendix A presents potential ARARs for the scope of this FFS.

5.1.3 Long-Term Effectiveness and Permanence

This criterion evaluates the extent to which an alternative would reduce overall risk to human health and the environment after the RAOs had been met. It also considers the degree to which an alternative would provide sufficient long-term controls and reliability to prevent exposures that exceed levels protective of human and environmental receptors. The principal factors addressed by this criterion include magnitude of residual risk and adequacy and reliability of controls to address such risk. This criterion also evaluates the potential long-term environmental effects of the alternative.

The evaluation of adequacy and reliability of controls assesses the effectiveness of any treatment, containment, or institutional measures that are part of the alternative. Factors considered include performance characteristics, maintenance requirements, and expected durability. Information and data from past performance and similar technology applications may be appropriately incorporated into the evaluation.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion reflects the statutory preference for remedial alternatives containing a treatment component that substantially reduces toxicity, mobility, or volume of hazardous substances through treatment. The evaluation of alternatives against this criterion considers the extent to which alternative technologies could effectively and permanently fix, transform, immobilize, or reduce the volume of waste materials and contaminated media.

5.1.5 Short-Term Effectiveness

Short-term effectiveness addresses the effects on human health and the environment posed by construction and implementation of the alternative. The potential impacts and associated mitigative measures are examined for protectiveness of the community, remediation workers, and environmental receptors during remedial activities.

Potential short-term risks to the public include inhalation of contaminants that might be released during waste removal and treatment operations. Potential short-term risks to workers include direct contact and exposure to contaminants during construction, waste handling, and transportation; physical injury or death during construction and transportation activities; and worker exposures to airborne contamination during waste and soil-removal operations. Alternative analyses also include a description of mitigative measures, such as engineering and institutional controls, expected to minimize potential risks to the public and workers.

Short-term environmental effects and mitigation measures are qualitatively assessed. This assessment includes impacts on environmental media and potentially sensitive resources.

5.1.6 Implementability

This criterion examines the technical and administrative factors affecting implementation of an alternative and considers the availability of services and materials required during implementation. Technical factors assessed include ease and reliability of initiating construction and operations, prospects for implementing any additional future actions, and adequacy of monitoring systems to detect failures. Administrative factors include permitting and the need for coordination among the lead agency (DOE) and regulatory agencies (EPA and TDEC). Service and material considerations include treatment, storage, and disposal capacities; equipment and operator availability; and applicability or development requirements for prospective technologies.

Technical feasibility considers the performance history of the technologies in direct applications or the expected performance for similar applications. Also addressed are uncertainties associated with construction, operation, and performance monitoring.

The evaluation of administrative feasibility addresses actions required to coordinate with regulatory agencies in establishing the framework for compliance with substantive technical requirements. The NCP requires that each alternative's relative administrative feasibility be evaluated to include "…activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions). CERCLA Sect. 121(e) stipulates that no federal, state, or local permit shall be required for the portion of any removal or remedial action conducted entirely on-site." An action must satisfy the substantive requirements of any permits that would otherwise be required.

The availability of services and materials is addressed by analyzing the material components of the proposed technologies and then determining the locations and quantities of those materials. Process operations are reviewed to identify any special services, operator skills, or training needed to readily implement the process.

5.1.7 Cost

Cost estimates are included for each action alternative. The estimate is based on feasibility-level scoping and is intended to facilitate evaluation of the alternative. The estimate has an expected accuracy of +50 to –30% for the scope of action. All estimates have been escalated using DOE-approved annual

rates and a schedule for the various activities based on similar project experience. Typical cost estimating contingencies are not included in the estimate.

The cost estimate has been divided into capital and operations and maintenance (O&M) costs. Capital costs are defined as those expenditures required to initiate and construct an alternative. These are short-term costs and exclude costs required to maintain the action throughout the project's lifetime.

Appendix B presents additional information on the cost estimates and the major assumptions used to develop those estimates.

5.1.8 State Acceptance

State acceptance of alternatives will be evaluated in the proposed plan issued for public comment, and feedback received on the preferred alternative identified in the proposed plan will be documented in the record of decision. Therefore, this criterion is not considered in this FFS.

5.1.9 Community Acceptance

Community acceptance of alternatives will be evaluated in the proposed plan issued for public comment, and feedback received on the preferred alternative identified in the proposed plan will be documented in the record of decision. Therefore, this criterion is not considered in this FFS.

5.1.10 Additional Considerations – NEPA Criteria

DOE policy (DOE 1994c) directs that the substantive elements of analysis required under NEPA should be incorporated into CERCLA decision documents. This process provides decision makers with a wider range of environmental and socio-economic concerns than those specifically delineated under CERCLA. While this FFS incorporates NEPA values throughout, the evaluation of alternatives that follows highlights in a separate section considerations for NEPA values that are not specifically included in the CERCLA criteria: socioeconomic impacts, environmental justice, irreversible and irretrievable commitment of resources, and cumulative impacts.

5.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

5.2.1 Alternative 1: No (Further) Action

Evaluation of the no-action alternative is required under CERCLA [40 *CFR* 300.430(e)(6)] to provide a basis for comparison with the action alternatives. Under this no-further-action alternative, no additional response actions would be selected for modification of the Phase I ROD selected remedy to further reduce mercury releases to UEFPC surface water. Unlike a traditional no-action alternative, however, the response actions previously selected under the Phase I ROD, as modified to date, would continue to be implemented, but a new water treatment facility to further reduce mercury releases to UEFPC would not be constructed.

A no-action decision may be reached only if no action is deemed necessary to reduce, control, or mitigate exposure; if the site does not present a threat to human health and the environment; or if any action taken would worsen the negative effects on human health and the environment.

5.2.1.1 Overall Protection of Human Health and the Environment (Alternative 1)

The no-further-action alternative would not be protective of human health. The baseline human health risk assessment (BHHRA) for UEFPC identified potential future risks that exceeded the EPA threshold for acceptable carcinogenic risk of 1×10^{-4} for carcinogens or a hazard index (HI) of 1 for noncarcinogens. While releases of mercury to UEFPC have decreased significantly since the RI was issued, partly as a result of implementation of the remedial actions under the Phase I ROD and Phase II ROD, as well as the Mercury Reduction Project and other actions, mercury concentrations in surface water at Station 17 continue to exceed both the interim goal of 200 ng/L established in the Phase I ROD and the AWQC. As a result of the continued concentrations measured at Station 17 in excess of the interim goal, the no-further-action alternative is not considered protective.

The no-further-action alternative also would not be protective of the environment. No additional remedial actions would be taken to attain AWQC levels in surface waters, and contaminant releases in excess of target levels would continue unabated.

5.2.1.2 Compliance with ARARs (Alternative 1)

Compliance with ARARs applies only to actions taken under CERCLA authority. Since the no-further-action alternative includes no new actions to reduce, control, or mitigate potential exposure to hazardous substances, there are no ARARs associated with this alternative.

5.2.1.3 Long-Term Effectiveness and Permanence (Alternative 1)

Residual risk under the no-further-action alternative would be unacceptable. Under this alternative, no new institutional or engineering controls to mitigate contaminant exposure would be implemented. Contaminant releases to surface water and groundwater would continue and could increase in the future. The no-further-action alternative is not considered effective in the long term.

5.2.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 1)

Implementation of the no-further-action alternative would not meet the CERCLA preference for treatment to reduce toxicity, mobility, or volume of contaminants.

5.2.1.5 Short-Term Effectiveness (Alternative 1)

Because no remedial actions would be taken under the no-further-action alternative, there would be no short-term risks to workers or the community and no short-term environmental impacts.

5.2.1.6 Implementability (Alternative 1)

No implementation of activities would be required for the no-further-action alternative. Therefore, this alternative is considered inherently implementable.

5.2.1.7 Cost (Alternative 1)

No costs would be associated with implementation of the no-further-action alternative.

5.2.1.8 Additional Considerations (Alternative 1)

Additional CERCLA evaluation criteria of State Acceptance and Community Acceptance will be addressed in the Proposed Plan and ROD, following public comment, and are not discussed in this FFS. NEPA criteria are discussed below.

Socioeconomic Impacts and Land Use – Because the no-further-action alternative is the baseline condition, the socioeconomic conditions of this alternative are those against which other alternatives will be compared. Land use under the no-action alternative normally is assumed to be unrestricted; however, the presence of the Y-12 National Security Complex and its ongoing national security mission renders the future use of the UEFPC site for any activities other than DOE-controlled industrial use completely implausible, and the DOE-controlled land-use designation for the UEFPC would continue.

Environmental Justice – No environmental justice impacts have been identified for the no-further-action alternative. The Scarboro community is the only formally identified environmental justice community near the ORR, and is located on the opposite side of Pine Ridge from Y-12 and the UEFPC. Upon exiting the Y-12 site, UEFPC flows into Lower East Fork Poplar Creek, which passes near this community as it flows through the City of Oak Ridge.

Irreversible and Irretrievable Commitment of Resources – No irretrievable commitment of resources would result directly from implementation of the no-further-action alternative.

Cumulative Impacts – Because the no-further-action alternative is the baseline condition, there would be no cumulative impacts for this action. Because no additional response actions would be selected for modification of the Phase I ROD selected remedy to further reduce mercury releases to UEFPC surface water, releases of mercury in excess of the interim goal and water quality criteria may continue.

5.2.2 Alternative 2a: Water Treatment at Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage

Alternative 2a would include construction of a new water treatment facility to treat discharges from Outfall 200 with a treatment capacity of 1500 gpm (2.2 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration. The system design capacity of 1500 gpm would be sufficient to treat the average discharge from Outfall 200 to UEFPC (nominally1000 gpm), but most storm events would exceed this capacity. Treatment operations would include 3000 gpm capacity for grit removal, followed by chemical co-precipitation/clarification (sulfide-functional polymer precipitation, and ferric chloride co-precipitation with clarification), and dewatering (multi-media filtration) of influent surface water flows up to 1500 gpm plus 500 gpm of recycle flows (recycle of backwash water and filter press filtrate). Influent surface water flow greater than 1500 gpm but less than 3000 gpm would flow through the grit removal system and then bypass the treatment facility to UEFPC. Influent flows greater than 3000 gpm would bypass all operations. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future.

Technologies implemented by this alternative include surface water collection and treatment, disposal of treatment residuals, institutional controls, and monitoring. A representative conceptual design for this alternative is presented in this FFS for purposes of comparative evaluation and cost estimation. If this alternative is selected, a more detailed implementation plan will be presented in the ROD, and substantive components of the design, consistent with the ROD, will be finalized during remedial design.

5.2.2.1 Overall Protection of Human Health and the Environment (Alternative 2a)

Alternative 2a would achieve protection of human health and the environment through treatment of UEFPC surface water at a new water treatment facility near Outfall 200 to reduce mercury contamination. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. AWQC in-stream standard for recreational use) or less in system effluents, to support the goal of reducing mercury concentrations in UEFPC surface water at Station 17 to the interim goal of 200 ng/L and ultimately to the AWQC in-stream standard of 51 ng/L. This action would result in permanent reduction of mercury in surface water and reduction of future contaminant releases from the Y-12 site to the offsite environment. However, UEFPC surface water would bypass treatment when stream flow levels exceed 1500 gpm. Alternative 2a would be expected to remove approximately 1600 g/year of mercury from UEFPC surface water or approximately 52% of the estimated mercury flux of 3100 g discharged at Outfall 200 during a typical year.

In addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC, the new water treatment facility also could provide benefits for treatment of wastewater from other sources, such as wastewaters from future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings. While the future WEMA demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water, the water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. However, this source has not been specifically evaluated in the conceptual design of the treatment system, but would be evaluated during the planning for these future projects as additional characterization data become available to better define potential contaminants of concern. The modular design of the water treatment system would facilitate any change that might be needed.

Risks to remediation workers and facility operations workers during implementation of this alternative would be low and would be maintained as low as reasonably achievable through implementation of the health and safety plan. Increased protection of aquatic populations in surface water would be achieved by removing contaminants known to bioaccumulate in biota. Land use controls, including posting and periodic patrols, established under the Phase I ROD would continue as long as necessary for protection of human health and the environment.

Because contaminants would remain onsite above levels for unrestricted release, institutional controls would include continuing federal ownership of this site, and access and use restrictions to preclude future residential, agricultural, or recreational use of this site that could result in completed exposure pathways. Groundwater use restrictions would continue, pending a future remedy decision for groundwater.

5.2.2.2 Compliance with ARARs (Alternative 2a)

Appendix A summarizes the chemical-specific, location-specific, and action-specific ARARs for the remedial actions considered in this FFS. All ARARs would be met or waived.

Alternative 2a is not expected to attain the recreational (organisms only) AWQC in-stream standard for mercury of 51 ng/L. No new waiver of any ARAR would be requested, but the interim waiver of this chemical-specific requirement previously approved in the Phase I ROD would remain in effect. Effluent from the treatment facility would contain reduced concentrations of mercury not to exceed 51 ng/L, which would contribute toward attainment of the interim goal of 200 ng/L at Station 17 as specified in the Phase I ROD and toward the long-term goal of meeting the AWQC in-stream standard.

TDEC and DOE criteria for acceptable levels of radiation dose and as low as reasonably achievable (ALARA) considerations would be met. DOE Orders are TBC for protection of the general public during all activities. Occupational worker protection will be addressed by compliance with 29 CFR 1910 and 10 CFR 835 requirements.

Because the alternative is an interim action that would not address groundwater remediation, groundwater ARARs are not considered. The primary goal for actions at UEFPC is to protect surface water in accordance with the goal presented in the UEFPC Phase I ROD.

Location-specific ARARs, as described in Appendix A, would be achieved under this alternative. All construction activities with the potential to impact UEFPC or its floodplain would be designed using best management practices and erosion/siltation controls to meet requirements for aquatic resource alteration activities. Actions under this alternative are not expected to impact wetlands to a significant extent. No federal- or state-listed threatened or endangered species are present at the impacted area, nor are there any known historical or archaeological resources that would be impacted by this action.

Action-specific ARARs, as listed in Appendix A, would be met by this alternative. Compliance with general construction/remedial action ARARs would be ensured for all base actions by control of fugitive emissions, best management practices for storm water runoff, and proper management of all waste streams generated. All ARARs for transportation and disposal would be met.

5.2.2.3 Long-Term Effectiveness and Permanence (Alternative 2a)

Alternative 2a would be effective in controlling the offsite migration of contaminated surface water using treatment technologies. Migration would be controlled by intercepting the storm sewer system discharges to UEFPC and treating the water to meet risk-based criteria. Long-term environmental impacts would be reduced by limiting potential releases of mercury and other contaminants under base-flow conditions and minimal storm events. Mercury removed from UEFPC surface water through the operation of this treatment system would be permanently removed for disposal. This alternative is expected to remove approximately 52% of the annual mercury flux discharged at Outfall 200 during a typical year.

This alternative would rely on continuation of the land use controls, including posting and periodic patrols, established under the Phase I ROD to prevent fish consumption from UEFPC as long as mercury levels in fish remain above the target concentration of 0.3 µg/g. This alternative would require the commitment to operation of the water treatment facility until other response actions are implemented to reduce mercury releases to UEFPC. The new water treatment facility would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water, and might be retired following implementation of other response actions to remove mercury source areas and reduce releases to UEFPC surface water. Remedial actions under this alternative would not adversely impact wetland areas. Construction activities would impact the floodplain of UEFPC, but areas disturbed during implementation would be regraded and revegetated to prevent erosion.

While removal of mercury from UEFPC surface water for permanent disposal through treatment operations under this alternative would contribute to risk reduction, this interim action is only one component of a comprehensive remedial action program for UEFPC, and is not intended to address all site risks. CERCLA five-year reviews would be conducted to evaluate the protectiveness of the remedial actions and the effectiveness of the engineering and institutional controls. Compliance with the remedial action objectives would be monitored and the action modified, if necessary, to ensure protectiveness. Periodic surveillance and maintenance activities and environmental monitoring would be conducted on a regular basis, and any required maintenance performed as necessary. Actions taken under this alternative

are consistent with actions taken previously at LEFPC and would not cause recontamination above LEFPC remediation levels. Surface water quality at UEFPC would be expected to improve following implementation of this alternative.

5.2.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 2a)

Treatment of UEFPC surface water would concentrate mercury and other contaminants in residual waste streams and reduce the volume, toxicity, and mobility of contaminated surface water. Alternative 2a is estimated to remove approximately 1600 g/year of mercury from UEFPC surface water or approximately 52% of the mercury flux at Outfall 200 during a typical year (UCOR 2014). Residual waste from the treatment system will be managed in accordance with all pertinent requirements.

5.2.2.5 Short-Term Effectiveness (Alternative 2a)

Alternative 2a would protect the community during implementation of remedial actions through the use of engineering and institutional controls. Storm-flow runoff controls would be implemented throughout all excavation and construction activities to prevent impacts to surface waters. Dust emission controls also would be implemented during all construction activities to minimize airborne releases. All activities would occur on DOE property and DOE roads that are currently inaccessible to the public. Access controls already in place at the Y-12 site prevent public access to the UEFPC area.

There would be some increase in traffic on the local roads as equipment (e.g., bulldozers, excavators, etc.) and trucks were brought to the site for remediation. No new construction of paved roads would be expected to be required, but existing roads at Y-12 may need to be rerouted or extended as needed. The increase in vehicle traffic would not be excessive.

By planning construction activities and staging in accordance with ALARA principles, industry and OSHA codes and requirements, and DOE Orders, exposure and accidental risks associated with remedial activities would be controlled to acceptable levels. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, environmental monitoring (e.g., ambient air for external gamma radiation and airborne radioactivity), and restrictions on access to contaminated areas. All machinery and equipment would be inspected regularly, surveyed for radioactive and chemical contamination, and decontaminated if necessary. Dust-control measures would limit the release of and exposure to contaminated particulate matter.

Short-term disturbance of the vegetation and wildlife habitat under Alternative 2a would be minimal. Remediation activities under this alternative would be limited to areas that have been previously disturbed and do not present significant habitat. Some grass and trees would potentially be eliminated, but the wildlife and their habitats should not be affected. Storm-flow controls would prevent soil from moving into the aquatic environment during excavation.

The duration of implementation of Alternative 2a is estimated at approximately 5 years for construction, followed by 30 years of treatment operations. The new treatment system would be expected to achieve an immediate reduction in mercury releases from the WEMA storm sewer network to UEFPC surface water. Other site risks to be addressed by other response actions are outside the scope of this interim action.

5.2.2.6 Implementability (Alternative 2a)

Overall, Alternative 2a would be technically and administratively easy to implement.

Technical Feasibility. All of the proposed remedial actions would be performed using standard construction equipment and techniques.

Administrative Feasibility. All actions would be conducted onsite and thus would not require permits; however, substantive provisions of any permits that otherwise would be required would be considered to be ARARs. This alternative is expected to comply with all identified ARARs, with the exception of the recreational AWQC in-stream standard for mercury, for which the waiver previously approved in the Phase I ROD would remain in effect. No administrative barriers to implementation have been identified.

Availability of Services and Materials. All services and materials required for implementation of Alternative 2a are readily available. Only standard construction equipment, trades, and materials are required for this alternative.

5.2.2.7 Cost (Alternative 2a)

The total capital cost for Alternative 2a is estimated at approximately $115 million, including direct and indirect costs. No contingent actions are identified for this alternative; rather, an adaptive management approach will be followed to identify any changes that may be needed in the future based on accumulated information – that is, after implementation of this alternative, monitoring data will be collected over time to evaluate the performance of the treatment facility and the attainment of downstream goals, and modifications of the facility may be proposed for FFA party consideration based on these data and all accumulated information.

O&M costs are estimated at approximately $2.2 million annually and include costs for operation of the treatment facility, purchase of process chemicals, disposal of treatment residuals, and environmental monitoring. While much of the environmental monitoring at UEFPC would continue to be conducted under the ongoing ORR-wide surveillance program, additional monitoring would be conducted to verify effectiveness of the treatment facility operations. O&M cost associated with implementation of institutional controls is already part of the Y-12 security mission. Similarly, costs for the required CERCLA five-year reviews for ORR remediation projects are already included in the OREM program budget.

The present worth of Alternative 2a is estimated at $142 million. Additional information regarding the cost estimate for Alternative 2a is presented in Appendix B.

5.2.2.8 Additional Considerations (Alternative 2a)

The additional CERCLA evaluation criteria of State Acceptance and Community Acceptance will be addressed in the Proposed Plan and ROD, following public comment on the preferred remedy, and are not discussed in this FFS.

Socioeconomic Impacts and Land Use – Implementation of this alternative would not result in any long-term change in the local economy or socioeconomic impacts. The DOE-controlled land-use designation for the UEFPC would continue.

Environmental Justice – No environmental justice impacts have been identified for this alternative. The Scarboro community is the only formally identified environmental justice community near the ORR. This community is located on the opposite side of Pine Ridge from the Y-12 site and UEFPC, and it would not be adversely impacted by the construction of the new water treatment facility. No short-term impacts would be expected during implementation.

Irreversible and Irretrievable Commitment of Resources – Implementation of this alternative would require an irretrievable commitment of the construction site for the new water treatment facility which would not be available for other uses, and the consumption of fuel and other nonrenewable resources during implementation of remediation activities.

Cumulative Impacts – The potential for cumulative impacts related to the remedial actions implemented at UEFPC under this alternative is not considered significant due to the limit scope of this action. Numerous additional remedial actions as well as other construction activities will occur at Y-12 and throughout the ORR that could have cumulative impacts such as increases in vehicle traffic, degradation of habitat, etc. However, the likelihood of significant cumulative impacts is considered very remote.

5.2.3 Alternative 2b: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage

Alternative 2b would include construction of a new water treatment facility to treat discharges from Outfall 200 with a treatment capacity of 3000 gpm (4.3 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration, all with a design capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate). The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. The design capacity of 3000 gpm is approximately equivalent to the 95th percentile stream flow in UEPFC. Influent flows greater than 3000 gpm would bypass the treatment facility to UEFPC without treatment.

Technologies implemented by this alternative include surface water collection and treatment, disposal of treatment residuals, institutional controls, and monitoring. A representative conceptual design for this alternative is presented in this FFS for purposes of comparative evaluation and cost estimation. If this alternative is selected, a more detailed implementation plan will be presented in the ROD, and substantive components of the design, consistent with the ROD, will be finalized during remedial design.

5.2.3.1 Overall Protection of Human Health and the Environment (Alternative 2b)

Alternative 2b would achieve protection of human health and the environment through treatment of UEFPC surface water to reduce mercury contamination. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. AWQC in-stream standard for recreational use) or less in system effluents, to support the goal of reducing mercury concentrations in UEFPC surface water at Station 17 to the interim goal of 200 ng/L and ultimately to the AWQC standard of 51 ng/L at Station 17. This action would result in permanent reduction of mercury in surface water and reduction of future contaminant releases from the Y-12 site to the offsite environment. Alternative 2b provides sufficient treatment capacity that UEFPC surface water would bypass treatment only 5% of the time under high flow conditions when stream flow levels exceed 3000 gpm. Alternative 2b would be expected to remove approximately 2100 g/year of mercury from UEFPC surface water or approximately 68% of the mercury flux at Outfall 200 during a typical year.

As described for Alternative 2a, the new water treatment facility could provide benefits for treatment of wastewater from sources such as the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. While the future WEMA demolition and remediation actions will include comprehensive contamination control measures and best

management practices to minimize any release of contaminants to UEFPC surface water, the water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC.

Risks to remediation workers and facility operations workers during implementation of this alternative would be low and would be maintained as low as reasonably achievable through implementation of the health and safety plan. Increased protection of aquatic populations in surface water would be achieved by removing contaminants known to bioaccumulate in biota. Land use controls, including posting and periodic patrols, established under the Phase I ROD would continue as long as necessary for protection of human health and the environment.

Because contaminants would remain onsite above levels for unrestricted release, institutional controls would include continuing federal ownership of the Y-12 site, and access and use restrictions to preclude future residential, agricultural, or recreational use of this site that could result in completed exposure pathways. Groundwater use restrictions would continue, pending a future remedy decision for groundwater.

5.2.3.2 Compliance with ARARs (Alternative 2b)

Alternative 2b is expected to comply with all location-specific and action-specific ARARs in a manner similar to that discussed previously for Alternative 2a. In addition, all chemical-specific ARARs also would be achieved, with the exception of the recreational (organisms only) AWQC in-stream standard for mercury of 51 ng/L. No new waiver of any ARAR would be requested, but the interim waiver of this chemical-specific requirement previously approved in the Phase I ROD would remain in effect. Effluent from the treatment facility would contain reduced concentrations of mercury not to exceed 51 ng/L, which would contribute toward attainment of the interim goal of 200 ng/L at Station 17 as specified in the Phase I ROD and toward the long-term goal of meeting the AWQC in-stream standard. Because this is an interim action that would not address groundwater remediation, groundwater ARARs are not considered.

5.2.3.3 Long-Term Effectiveness and Permanence (Alternative 2b)

Alternative 2b would be effective in controlling the offsite migration of contaminated surface water using treatment technologies. Migration would be controlled by intercepting the storm sewer system discharges to UEFPC and treating the water to meet risk-based criteria. Long-term environmental impacts would be reduced by limiting potential releases of mercury and other contaminants under base-flow conditions and some small storm events. Mercury removed from UEFPC surface water through the operation of this treatment system would be permanently removed for disposal. This alternative is expected to remove approximately 68% of the annual mercury flux discharged at Outfall 200 during a typical year.

This alternative would rely on continuation of the land use controls, including posting and periodic patrols, established under the Phase I ROD to prevent fish consumption from UEFPC as long as mercury levels in fish remain above the target concentration of 0.3 µg/g. This alternative would require the commitment to operation of the water treatment facility until other response actions are implemented to reduce mercury releases to UEFPC. The new water treatment facility would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water, and might be retired following implementation of other response actions to remove mercury source areas and reduce releases to UEFPC surface water. Remedial actions under this alternative would not adversely impact wetland areas. Construction activities would impact the floodplain of UEFPC, but areas disturbed during implementation would be regraded and revegetated to prevent erosion.

While removal of mercury from UEFPC surface water for permanent disposal through treatment operations under this alternative would contribute to risk reduction, this interim action is only one component of a comprehensive remedial action program for UEFPC, and is not intended to address all site risks. CERCLA five-year reviews would be conducted to evaluate the protectiveness of the remedial actions and the effectiveness of the engineering and institutional controls. Compliance with the remedial action objectives would be monitored and the action modified, if necessary, to ensure protectiveness. Periodic surveillance and maintenance activities and environmental monitoring would be conducted on a regular basis, and any required maintenance performed as necessary. Actions taken under this alternative are consistent with actions taken previously at LEFPC and would not cause recontamination above LEFPC remediation levels. Surface water quality at UEFPC would be expected to improve following implementation of this alternative.

5.2.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 2b)

Treatment of UEFPC surface water would concentrate mercury and other contaminants in residual waste streams and reduce the volume, toxicity, and mobility of contaminated surface water. Alternative 2b is estimated to remove approximately 2100 g/year of mercury from UEFPC surface water or approximately 68% of the mercury flux at Outfall 200 during a typical year (UCOR 2014). Residual waste from the treatment system will be managed in accordance with all pertinent requirements.

5.2.3.5 Short-Term Effectiveness (Alternative 2b)

Alternative 2b would protect the community during implementation of remedial actions through the use of engineering and institutional controls. Storm-flow runoff controls would be implemented throughout all excavation and construction activities to prevent impacts to surface waters. Dust emission controls also would be implemented during all construction activities to minimize airborne releases. All activities would occur on DOE property and DOE roads that are currently inaccessible to the public. Access controls already in place at the Y-12 site prevent public access to the UEFPC area.

There would be some increase in traffic on the local roads as equipment (e.g., bulldozers, excavators, etc.) and trucks were brought to the site for remediation. No new construction of paved roads would be expected to be required, but existing roads at Y-12 may need to be rerouted or extended as needed. The increase in vehicle traffic would not be excessive.

By planning construction activities and staging in accordance with ALARA principles, industry and OSHA codes and requirements, and DOE Orders, exposure and accidental risks associated with remedial activities would be controlled to acceptable levels. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, environmental monitoring (e.g., ambient air for external gamma radiation and airborne radioactivity), and restrictions on access to contaminated areas. All machinery and equipment would be inspected regularly, surveyed for radioactive contamination, and decontaminated if necessary. Dust-control measures would limit the release of and exposure to contaminated particulate matter.

Short-term disturbance of the vegetation and wildlife habitat under Alternative 2b would be minimal. Remediation activities under this alternative would be limited to areas that have been previously disturbed and do not present significant habitat. Some grass and trees would potentially be eliminated, but the wildlife and their habitats should not be affected. Storm-flow controls would prevent soil from moving into the aquatic environment during excavation.

The duration of implementation of Alternative 2b is estimated at approximately 5 years for construction, followed by 30 years of treatment operations. The new treatment system would be expected

to achieve an immediate reduction in mercury releases from the WEMA storm sewer network to UEFPC surface water. Other site risks to be addressed by other response actions are outside the scope of this interim action.

5.2.3.6 Implementability (Alternative 2b)

Alternative 2b would be technically and administratively feasible to implement.

Technical Feasibility. Technical feasibility for Alternative 2b will be similar to that described previously for Alternative 2a. All of the proposed remedial actions would be performed using standard construction equipment and techniques.

Administrative Feasibility. Administrative feasibility for Alternative 2b will be similar to that described previously for Alternative 2a. No administrative barriers to implementation have been identified.

Availability of Services and Materials. All services and materials required for implementation of Alternative 2b are readily available, similar to that described previously for Alternative 2a.

5.2.3.7 Cost (Alternative 2b)

The total capital cost for Alternative 2b is estimated at approximately $125 million, including direct and indirect costs. No contingent actions are identified for this alternative; rather, an adaptive management approach will be followed to identify any changes that may be needed in the future based on accumulated information – that is, after implementation of this alternative, monitoring data will be collected over time to evaluate the performance of the treatment facility and the attainment of downstream goals, and modifications of the facility may be proposed for FFA party consideration based on these data and all accumulated information.

O&M costs are estimated at approximately $2.7 million annually and include costs for operation of the treatment facility, purchase of process chemicals, disposal of treatment residuals, and environmental monitoring. While much of the environmental monitoring at UEFPC would continue to be conducted under the ongoing ORR-wide surveillance program, additional monitoring would be conducted to verify effectiveness of the treatment facility operations. O&M cost associated with implementation of institutional controls is already part of the Y-12 security mission. Similarly, costs for the required CERCLA five-year reviews for ORR remediation projects are already included in the OREM program budget.

The present worth of Alternative 2b is estimated at $158 million. Additional information regarding the cost estimate for Alternative 2b is presented in Appendix B.

5.2.3.8 Additional Considerations (Alternative 2b)

The additional CERCLA evaluation criteria of State Acceptance and Community Acceptance will be addressed in the Proposed Plan and ROD, following public comment on the preferred remedy, and are not discussed in this FFS.

Socioeconomic Impacts and Land Use – Socioeconomic and land use impacts for this alternative would be equivalent to those described for Alternative 2a – i.e., implementation of this alternative would not result in any long-term change in the local economy or land use.

Environmental Justice – Environmental justice impacts for this alternative would be equivalent to those described for Alternative 2a – i.e., no environmental justice impacts have been identified for this alternative.

Irreversible and Irretrievable Commitment of Resources – These impacts would be similar to those described for Alternative 2a – i.e., the commitment of the construction site for the new water treatment facility which would not be available for other uses, and the consumption of fuel and nonrenewable resources and materials during implementation.

Cumulative Impacts – Cumulative impacts for this alternative would be equivalent to those described for Alternative 2a – i.e., no potential for significant cumulative impacts has been identified.

5.2.4 Alternative 2c: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage

Alternative 2c would include construction of a new water treatment facility to treat discharges from Outfall 200 with a treatment capacity for 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 2 million gallons. The headworks for this new treatment facility would be constructed to manage a maximum flow of 40,000 gpm, which would be directed to treatment or storage through a two-stage weir system. The conceptual design for the treatment system would include the general process operations of grit removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. The 2 million gallon storage capacity is intended to capture the initial runoff flow from most storm events (i.e., the "first flush"). Stormwater flows in excess of this storage capacity would bypass the treatment facility. The system design would be configured to maintain flexibility and expandability to accommodate additional unit operations, as needed in the future.

Technologies implemented by this alternative include surface water collection, storage, and treatment; disposal of treatment residuals; institutional controls; and monitoring. A representative conceptual design for this alternative is presented in this FFS for purposes of comparative evaluation and cost estimation. If this alternative is selected, a more detailed implementation plan will be presented in the ROD, and substantive components of the design, consistent with the ROD, will be finalized during remedial design.

5.2.4.1 Overall Protection of Human Health and the Environment (Alternative 2c)

Alternative 2c would achieve protection of human health and the environment through treatment of UEFPC surface water to reduce mercury contamination. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. AWQC in-stream standard for recreational use) or less in system effluents, to support the goal of reducing mercury concentrations in UEFPC surface water at Station 17 to the interim goal of 200 ng/L and ultimately to the AWQC in-stream standard of 51 ng/L. This action would result in permanent reduction of mercury in surface water and reduction of future contaminant releases from the Y-12 site to the offsite environment. Alternative 2c provides sufficient treatment capacity that UEFPC surface water would bypass treatment only 5% of the time under high flow conditions when stream flow levels exceed 3000 gpm, and initial 2 million gallons of storm flow above 3,000 gpm would be stored for future treatment. This storage capacity is estimated to capture the first flush rainfall from most storm events. Alternative 2c would be expected to remove approximately 2600 g/year of mercury from UEFPC surface water or approximately 84% of the mercury flux at Outfall 200 during a typical year.

As described for Alternative 2a, the new water treatment facility could provide benefits for treatment of wastewater from sources such as the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. While the future WEMA demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water, the water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. Alternative 2c would offer significant advantages over Alternatives 2a or 2b in this regard, due to the presence of stormwater storage capacity which could allow more flexible wastewater inputs.

Risks to remediation workers and facility operations workers during implementation of this alternative would be low and would be maintained as low as reasonably achievable through implementation of the health and safety plan. Increased protection of aquatic populations in surface water would be achieved by removing contaminants known to bioaccumulate in biota. Land use controls, including posting and periodic patrols, established under the Phase I ROD would continue as long as necessary for protection of human health and the environment.

Because contaminants would remain onsite above levels for unrestricted release, institutional controls would include continuing federal ownership of the Y-12 site, and access and use restrictions to preclude future residential, agricultural, or recreational use of this site that could result in completed exposure pathways. Groundwater use restrictions would continue, pending a future remedy decision for groundwater.

5.2.4.2 Compliance with ARARs (Alternative 2c)

Alternative 2c is expected to comply with all location-specific and action-specific ARARs in a manner similar to that discussed previously for Alternatives 2a and 2b. In addition, all chemical-specific ARARs also would be achieved, with the exception of the recreational (organisms only) AWQC in-stream standard for mercury of 51 ng/L. No new waiver of any ARAR would be requested, but the interim waiver of this chemical-specific requirement previously approved in the Phase I ROD would remain in effect. Effluent from the treatment facility would contain reduced concentrations of mercury not to exceed 51 ng/L, which would contribute toward attainment of the interim goal of 200 ng/L at Station 17 as specified in the Phase I ROD and toward the long-term goal of meeting the AWQC in-stream standard. Because this is an interim action that would not address groundwater remediation, groundwater ARARs are not considered.

5.2.4.3 Long-Term Effectiveness and Permanence (Alternative 2c)

Alternative 2c would be effective in controlling the offsite migration of contaminated surface water using treatment technologies. Migration would be controlled by intercepting the storm sewer system discharges to UEFPC and treating the water to meet risk-based criteria. Long-term environmental impacts would be reduced by limiting potential releases of mercury and other contaminants under base-flow conditions and storm events. Mercury removed from UEFPC surface water through the operation of this treatment system would be permanently removed for disposal. This alternative is expected to remove approximately 84% of the annual mercury flux discharged at Outfall 200 during a typical year.

This alternative would rely on continuation of the land use controls, including posting and periodic patrols, established under the Phase I ROD to prevent fish consumption from UEFPC as long as mercury levels in fish remain above the target concentration of 0.3 µg/g. This alternative would require the commitment to operation of the water treatment facility until other response actions are implemented to reduce mercury releases to UEFPC. The new water treatment facility would continue operation until

mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water, and might be retired following implementation of other response actions to remove mercury source areas and reduce releases to UEFPC surface water. Remedial actions under this alternative would not adversely impact wetland areas. Construction activities would impact the floodplain of UEFPC, but areas disturbed during implementation would be regraded and revegetated to prevent erosion.

While removal of mercury from UEFPC surface water for permanent disposal through treatment operations under this alternative would contribute to risk reduction, this interim action is only one component of a comprehensive remedial action program for UEFPC, and is not intended to address all site risks. CERCLA five-year reviews would be conducted to evaluate the protectiveness of the remedial actions and the effectiveness of the engineering and institutional controls. Compliance with the remedial action objectives would be monitored and the action modified, if necessary, to ensure protectiveness. Periodic surveillance and maintenance activities and environmental monitoring would be conducted on a regular basis, and any required maintenance performed as necessary. Actions taken under this alternative are consistent with actions taken previously at LEFPC and would not cause recontamination above LEFPC remediation levels. Surface water quality at UEFPC would be expected to improve following implementation of this alternative.

5.2.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 2c)

Treatment of UEFPC surface water would concentrate mercury and other contaminants in residual waste streams and reduce the volume, toxicity, and mobility of contaminated surface water. Alternative 2c is estimated to remove approximately 2600 g/year of mercury from UEFPC surface water or approximately 84% of the mercury flux at Outfall 200 during a typical year. Residual waste from the treatment system will be managed in accordance with all pertinent requirements.

5.2.4.5 Short-Term Effectiveness (Alternative 2c)

Alternative 2c would protect the community during implementation of remedial actions through the use of engineering and institutional controls. Storm-flow runoff controls would be implemented throughout all excavation and construction activities to prevent impacts to surface waters. Dust emission controls also would be implemented during all construction activities to minimize airborne releases. All activities would occur on DOE property and DOE roads that are currently inaccessible to the public. Access controls already in place at the Y-12 site prevent public access to the UEFPC area.

There would be some increase in traffic on the local roads as equipment (e.g., bulldozers, excavators, etc.) and trucks were brought to the site for remediation. No new construction of paved roads would be expected to be required, but existing roads at Y-12 may need to be rerouted or extended as needed. The increase in vehicle traffic would not be excessive.

By planning construction activities and staging in accordance with ALARA principles, industry and OSHA codes and requirements, and DOE Orders, exposure and accidental risks associated with remedial activities would be controlled to acceptable levels. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, environmental monitoring (e.g., ambient air for external gamma radiation and airborne radioactivity), and restrictions on access to contaminated areas. All machinery and equipment would be inspected regularly, surveyed for radioactive contamination, and decontaminated if necessary. Dust-control measures would limit the release of and exposure to contaminated particulate matter.

Short-term disturbance of the vegetation and wildlife habitat under Alternative 2c would be minimal. Remediation activities under this alternative would be limited to areas that have been previously disturbed

and do not present significant habitat. Some grass and trees would potentially be eliminated, but the wildlife and their habitats should not be affected. Storm-flow controls would prevent soil from moving into the aquatic environment during excavation.

The duration of implementation of Alternative 2c is estimated at approximately 5 years for construction, followed by 30 years of treatment operations. The new treatment system would be expected to achieve an immediate reduction in mercury releases from the WEMA storm sewer network to UEFPC surface water. Other site risks to be addressed by other response actions are outside the scope of this interim action.

5.2.4.6 Implementability (Alternative 2c)

Alternative 2c would be technically and administratively feasible to implement.

Technical Feasibility. Technical feasibility for Alternative 2c will be similar to that described previously for Alternatives 2a and 2b. All of the proposed remedial actions would be performed using standard construction equipment and techniques.

Administrative Feasibility. Administrative feasibility for Alternative 2c will be similar to that described previously for Alternatives 2a and 2b. No administrative barriers to implementation have been identified.

Availability of Services and Materials. All services and materials required for implementation of Alternative 2c are readily available, similar to that described previously for Alternatives 2a and 2b.

5.2.4.7 Cost (Alternative 2c)

The total capital cost for Alternative 2c is estimated at approximately $146 million, including direct and indirect costs. No contingent actions are identified for this alternative; rather, an adaptive management approach will be followed to identify any changes that may be needed in the future based on accumulated information – that is, after implementation of this alternative, monitoring data will be collected over time to evaluate the performance of the treatment facility and the attainment of downstream goals, and modifications of the facility may be proposed for FFA party consideration based on these data and all accumulated information.

O&M costs are estimated at approximately $3.1 million annually and include costs for operation of the treatment facility, purchase of process chemicals, disposal of treatment residuals, and environmental monitoring. While much of the environmental monitoring at UEFPC would continue to be conducted under the ongoing ORR-wide surveillance program, additional monitoring would be conducted to verify effectiveness of the treatment facility operations. O&M cost associated with implementation of institutional controls is already part of the Y-12 security mission. Similarly, costs for the required CERCLA five-year reviews for ORR remediation projects are already included in the OREM program budget.

The present worth of Alternative 2c is estimated at $185 million. Additional information regarding the cost estimate for Alternative 2c is presented in Appendix B.

5.2.4.8 Additional Considerations (Alternative 2c)

The additional CERCLA evaluation criteria of State Acceptance and Community Acceptance will be addressed in the Proposed Plan and ROD, following public comment on the preferred remedy, and are not discussed in this FFS.

Socioeconomic Impacts and Land Use – Socioeconomic and land use impacts for Alternative 2c would be equivalent to those described for Alternatives 2a and 2b – i.e., implementation of this alternative would not result in any long-term change in the local economy or land use.

Environmental Justice – Environmental justice impacts for Alternative 2c would be equivalent to those described for Alternatives 2a and 2b – i.e., no environmental justice impacts have been identified for this alternative.

Irreversible and Irretrievable Commitment of Resources – These impacts for Alternative 2c would be similar to those described for Alternatives 2a and 2b – i.e., the commitment of the construction site for the new water treatment facility which would not be available for other uses, and the consumption of fuel and nonrenewable resources and materials during implementation.

Cumulative Impacts – Cumulative impacts for Alternative 2c would be equivalent to those described for Alternatives 2a and 2b – i.e., no potential for significant cumulative impacts has been identified.

5.2.5 Alternative 2d: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 10 Million Gallons Stormwater Storage

Alternative 2d would include construction of a new water treatment facility to treat discharges from Outfall 200 with a treatment capacity for 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 10 million gallons. The headworks for this new treatment facility would be constructed to manage a maximum flow of 40,000 gpm, which would be directed to treatment or storage through a two-stage weir system. The conceptual design for the treatment system would include the general process operations of grit removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity for up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. The 10 million gallon storage capacity was selected to capture the stormwater from a 1-year 24-hour storm event (UCOR 2014). Peak flows from larger storm events would still bypass the treatment facility, although the initial runoff flow from these storm events (i.e., the "first flush") would be captured. The system design would be configured to maintain flexibility and expandability to accommodate additional unit operations, as needed in the future.

Technologies implemented by this alternative include surface water collection, storage, and treatment; disposal of treatment residuals; institutional controls; and monitoring. A representative conceptual design for this alternative is presented in this FFS for purposes of comparative evaluation and cost estimation. If this alternative is selected, a more detailed implementation plan will be presented in the ROD, and substantive components of the design, consistent with the ROD, will be finalized during remedial design.

5.2.5.1 Overall Protection of Human Health and the Environment (Alternative 2d)

Alternative 2d would achieve protection of human health and the environment through treatment of UEFPC surface water to reduce mercury contamination. The water treatment system would be designed to achieve a performance objective of reducing mercury concentrations to 51 ng/L (i.e. AWQC in-stream standard for recreational use) or less in system effluents, to support the goal of reducing mercury concentrations in UEFPC surface water at Station 17 to the interim goal of 200 ng/L and ultimately to the AWQC of 51 ng/L at Station 17. This action would result in permanent reduction of mercury in surface water and reduction of future contaminant releases from the Y-12 site to the offsite environment. Mass

balance modeling predicts capture rates of water above 92% for both average and heavy rainfall years for the system configuration in Alternative 2c, with 10 million gallons of storage capacity and maximum flow rates of 3000 gpm pumping capacity to the treatment facility directly and 37,000 gpm pumping capacity to the storage tanks. This capacity also would be sufficient to capture the first flush rainfall (defined as the runoff from the first 1 inch of rainfall) even from larger storm events for which the total volume exceeds the 10 million gallon storage capacity. Alternative 2c would be expected to remove approximately 2800 g/year of mercury from UEFPC surface water or approximately 91% of the mercury flux at Outfall 200 during a typical year.

As described for Alternative 2a, the new water treatment facility could provide benefits for treatment of wastewater from sources such as the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. While the future WEMA demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water, the water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. Alternative 2d would offer significant advantages over Alternatives 2a or 2b in this regard, due to the presence of stormwater storage capacity which could allow more flexible wastewater inputs.

Risks to remediation workers and facility operations workers during implementation of this alternative would be low and would be maintained as low as reasonably achievable through implementation of the health and safety plan. Increased protection of aquatic populations in surface water would be achieved by removing contaminants known to bioaccumulate in biota. Land use controls, including posting and periodic patrols, established under the Phase I ROD would continue as long as necessary for protection of human health and the environment.

Because contaminants would remain onsite above levels for unrestricted release, institutional controls would include continuing federal ownership of the Y-12 site, and access and use restrictions to preclude future residential, agricultural, or recreational use of this site that could result in completed exposure pathways. Groundwater use restrictions would continue, pending a future remedy decision for groundwater.

5.2.5.2 Compliance with ARARs (Alternative 2d)

Alternative 2d is expected to comply with all location-specific and action-specific ARARs in a manner similar to that discussed previously for Alternatives 2a-2c. In addition, all chemical-specific ARARs also would be achieved, with the exception of the recreational (organisms only) AWQC in-stream standard for mercury of 51 ng/L. No new waiver of any ARAR would be requested, but the interim waiver of this chemical-specific requirement previously approved in the Phase I ROD would remain in effect. Effluent from the treatment facility would contain reduced concentrations of mercury not to exceed 51 ng/L, which would contribute toward attainment of the interim goal of 200 ng/L at Station 17 as specified in the Phase I ROD and toward the long-term goal of meeting the AWQC in-stream standard. Because this is an interim action that would not address groundwater remediation, groundwater ARARs are not considered.

5.2.5.3 Long-Term Effectiveness and Permanence (Alternative 2d)

Alternative 2d would be effective in controlling the offsite migration of contaminated surface water using treatment technologies. Migration would be controlled by intercepting the storm sewer system discharges to UEFPC and treating the water to meet risk-based criteria. Long-term environmental impacts would be reduced by limiting potential releases of mercury and other contaminants under base-

flow conditions and storm events. Mercury removed from UEFPC surface water through the operation of this treatment system would be permanently removed for disposal. This alternative is expected to remove approximately 91% of the annual mercury flux discharged at Outfall 200 during a typical year.

This alternative would rely on continuation of the land use controls, including posting and periodic patrols, established under the Phase I ROD to prevent fish consumption from UEFPC as long as mercury levels in fish remain above the target concentration of 0.3 µg/g. This alternative would require the commitment to operation of the water treatment facility until other response actions are implemented to reduce mercury releases to UEFPC. The new water treatment facility would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water, and might be retired following implementation of other response actions to remove mercury source areas and reduce releases to UEFPC surface water. Remedial actions under this alternative would not adversely impact wetland areas. Construction activities would impact the floodplain of UEFPC, but areas disturbed during implementation would be regraded and revegetated to prevent erosion.

While removal of mercury from UEFPC surface water for permanent disposal through treatment operations under this alternative would contribute to risk reduction, this interim action is only one component of a comprehensive remedial action program for UEFPC, and is not intended to address all site risks. CERCLA five-year reviews would be conducted to evaluate the protectiveness of the remedial actions and the effectiveness of the engineering and institutional controls. Compliance with the remedial action objectives would be monitored and the action modified, if necessary, to ensure protectiveness. Periodic surveillance and maintenance activities and environmental monitoring would be conducted on a regular basis, and any required maintenance performed as necessary. Actions taken under this alternative are consistent with actions taken previously at LEFPC and would not cause recontamination above LEFPC remediation levels. Surface water quality at UEFPC would be expected to improve following implementation of this alternative.

5.2.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (Alternative 2d)

Treatment of UEFPC surface water would concentrate mercury and other contaminants in residual waste streams and reduce the volume, toxicity, and mobility of contaminated surface water. Alternative 2c is estimated to remove approximately 2800 g/year of mercury from UEFPC surface water or approximately 91% of the mercury flux at Outfall 200 during a typical year (UCOR 2014). Residual waste from the treatment system will be managed in accordance with all pertinent requirements.

5.2.5.5 Short-Term Effectiveness (Alternative 2d)

Alternative 2d would protect the community during implementation of remedial actions through the use of engineering and institutional controls. Storm-flow runoff controls would be implemented throughout all excavation and construction activities to prevent impacts to surface waters. Dust emission controls also would be implemented during all construction activities to minimize airborne releases. All activities would occur on DOE property and DOE roads that are currently inaccessible to the public. Access controls already in place at the Y-12 site prevent public access to the UEFPC area.

There would be some increase in traffic on the local roads as equipment (e.g., bulldozers, excavators, etc.) and trucks were brought to the site for remediation. No new construction of paved roads would be expected to be required, but existing roads at Y-12 may need to be rerouted or extended as needed. The increase in vehicle traffic would not be excessive.

By planning construction activities and staging in accordance with ALARA principles, industry and OSHA codes and requirements, and DOE Orders, exposure and accidental risks associated with remedial

activities would be controlled to acceptable levels. Risk to workers would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, environmental monitoring (e.g., ambient air for external gamma radiation and airborne radioactivity), and restrictions on access to contaminated areas. All machinery and equipment would be inspected regularly, surveyed for radioactive contamination, and decontaminated if necessary. Dust-control measures would limit the release of and exposure to contaminated particulate matter.

Short-term disturbance of the vegetation and wildlife habitat under Alternative 2d would be minimal. Remediation activities under this alternative would be limited to areas that have been previously disturbed and do not present significant habitat. Some grass and trees would potentially be eliminated, but the wildlife and their habitats should not be affected. Storm-flow controls would prevent soil from moving into the aquatic environment during excavation.

The duration of implementation of Alternative 2d is estimated at approximately 5 years for construction, followed by 30 years of treatment operations. The new treatment system would be expected to achieve an immediate reduction in mercury releases from the WEMA storm sewer network to UEFPC surface water. Other site risks to be addressed by other response actions are outside the scope of this interim action.

5.2.5.6 Implementability (Alternative 2d)

Alternative 2d would be technically and administratively feasible to implement.

Technical Feasibility. Technical feasibility for Alternative 2d will be similar to that described previously for Alternatives 2a-2c. All of the proposed remedial actions would be performed using standard construction equipment and techniques.

Administrative Feasibility. Administrative feasibility for Alternative 2d will be similar to that described previously for Alternatives 2a-2c. No administrative barriers to implementation have been identified.

Availability of Services and Materials. All services and materials required for implementation of Alternative 2d are readily available, similar to that described previously for Alternatives 2a-2c.

5.2.5.7 Cost (Alternative 2d)

The total capital cost for Alternative 2d is estimated at approximately $179 million, including direct and indirect costs. No contingent actions are identified for this alternative; rather, an adaptive management approach will be followed to identify any changes that may be needed in the future based on accumulated information – that is, after implementation of this alternative, monitoring data will be collected over time to evaluate the performance of the treatment facility and the attainment of downstream goals, and modifications of the facility may be proposed for FFA party consideration based on these data and all accumulated information.

O&M costs are estimated at approximately $3.4 million annually and include costs for operation of the treatment facility, purchase of process chemicals, disposal of treatment residuals, and environmental monitoring. While much of the environmental monitoring at UEFPC would continue to be conducted under the ongoing ORR-wide surveillance program, additional monitoring would be conducted to verify effectiveness of the treatment facility operations. O&M cost associated with implementation of institutional controls is already part of the Y-12 security mission. Similarly, costs for the required CERCLA five-year reviews for ORR remediation projects are already included in the OREM program budget.

The present worth of Alternative 2d is estimated at $221 million. Additional information regarding the cost estimate for Alternative 2d is presented in Appendix B.

5.2.5.8 Additional Considerations (Alternative 2d)

The additional CERCLA evaluation criteria of State Acceptance and Community Acceptance will be addressed in the Proposed Plan and ROD, following public comment on the preferred remedy, and are not discussed in this FFS.

Socioeconomic Impacts and Land Use – Socioeconomic and land use impacts for Alternative 2d would be equivalent to those described for Alternatives 2a-2c – i.e., implementation of this alternative would not result in any long-term change in the local economy or land use.

Environmental Justice – Environmental justice impacts for Alternative 2d would be equivalent to those described for Alternatives 2a-2c – i.e., no environmental justice impacts have been identified for this alternative.

Irreversible and Irretrievable Commitment of Resources – These impacts for Alternative 2d would be similar to those described for Alternatives 2a-2c – i.e., the commitment of the construction site for the new water treatment facility which would not be available for other uses, and the consumption of fuel and nonrenewable resources and materials during implementation.

Cumulative Impacts – Cumulative impacts for Alternative 2d would be equivalent to those described for Alternatives 2a-2c – i.e., no potential for significant cumulative impacts has been identified.

5.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparative analysis of the remedial alternatives for additional mercury abatement actions at UEFPC to supplement the selected remedy in the Phase I ROD with respect to the evaluation criteria described in Sect. 5.1. This is the second stage of the detailed evaluation process and provides information that forms the basis for selecting a preferred remedial alternative. Table 5.1 presents a summary of the primary features of the new water treatment system to be constructed under each of the action alternatives. This comparative analysis considers the threshold criteria and the primary balancing criteria described in Section 5.1. The threshold criteria reflect key statutory mandates of CERCLA and must be satisfied by an alternative in order for it to be eligible for selection:

- overall protection of human health and the environment; and
- compliance with ARARs.

The primary balancing criteria are used to compare the relative advantages and disadvantages of the alternatives to determine the most appropriate remedy.

- long-term effectiveness and permanence;
- reduction of toxicity, mobility, or volume through treatment;
- short-term effectiveness;
- implementability; and
- cost.

Table 5.1 Summary of Treatment System Components Under Remedial Alternatives

Treatment System Component	Remedial Alternative			
	Alternative 2a, Water Treatment Facility for Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage Capacity	**Alternative 2b, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage Capacity**	**Alternative 2c, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage Capacity**	**Alternative 2d, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity and 10 Million Gallons Stormwater Storage Capacity**
Headworks Capacity	3000 gpm to grit removal, flow greater than 1500 gpm and less than 3000 gpm is discharged to UEFPC following grit removal, flow in excess of 3000 gpm overflows to UEFPC without treatment	3000 gpm to grit removal, flow in excess of 3000 gpm overflows to UEFPC without treatment	3000 gpm to baseline grit removal chamber, next 37,000 gpm to storm-flow grit removal chamber, flow in excess of 40,000 gpm overflows to UEFPC without treatment	3000 gpm to baseline grit removal chamber, next 37,000 gpm to storm-flow grit removal chamber, flow in excess of 40,000 gpm overflows to UEFPC without treatment
Stormwater Storage Capacity	0	0	2,000,000 gallons (nominally one 2,000,000 gallon tank)	10,000,000 gallons (nominally five 2,000,000 gallon tanks)
Equalization Tank	500,000 gallons (minimum 1 hour holding time)	500,000 gallons (minimum 1 hour holding time)	500,000 gallons (minimum 1 hour holding time)	500,000 gallons (minimum 1 hour holding time)
pH Control/ Dechlorination Tank	2000 gpm (1500 gpm for influent surface water plus 500 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)
Precipitation Tanks (Sulfide functional polymer, ferric chloride coagulant)	2000 gpm (1500 gpm for influent surface water plus 500 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)
Inclined Plate Clarifiers	2000 gpm (1500 gpm for influent surface water plus 500 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)
Multimedia Filtration	2000 gpm (1500 gpm for influent surface water plus 500 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)
Clarifier Sludge Dewatering	2000 gpm (1500 gpm for influent surface water plus 500 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)	4000 gpm (3000 gpm for influent surface water plus 1000 gpm for recycle flows and stored stormwater)

The comparison of these five criteria forms the basis of the comparative analysis. The first two balancing criteria address the statutory preference for treatment as a principal element of the remedy. Together with the third and fourth criteria, they form the basis for determining the general feasibility of each alternative and for determining whether costs are proportional to the overall effectiveness.

The two modifying criteria, state acceptance and community acceptance, also must be satisfied if an alternative is to be selected. However, these criteria typically are not evaluated until the public has had the opportunity to comment on the proposed plan. Therefore, these criteria are not formally evaluated in this FFS.

5.3.1 Threshold Criteria

The threshold criteria consist of two of the nine EPA criteria that must be satisfied by the selected alternative. These are: (1) overall protection of human health and the environment and (2) compliance with ARARs. These criteria are important because they reflect the key statutory mandates of CERCLA. If an alternative does not satisfy both of these criteria, it is not eligible to be selected as a remedy. CERCLA Sect. 121(d) does provide that, under certain circumstances, an ARAR may be waived.

5.3.1.1 Overall Protection of Human Health and the Environment

The no-further-action alternative would not protect human health or the environment, because no additional remedial actions would be conducted at the UEFPC to supplement the selected remedy in the Phase I ROD. While releases of mercury to UEFPC have decreased significantly in recent years, partly as a result of implementation of the remedial actions under the Phase I ROD and Phase II ROD, as well as the Mercury Reduction Project and other related actions, mercury concentrations in surface water at Station 17 continue to exceed both the interim goal of 200 ng/L established in the Phase I ROD and the AWQC in-stream standard for mercury. As a result of the continued mercury concentrations measured at Station 17 in excess of the interim goal, the no-action alternative is not considered protective of human health. Similarly, the no-action alternative also would not be protective of the environment, since no additional remedial actions would be taken to attain AWQC levels in surface waters, and contaminant releases would continue unabated.

All of the action alternatives would achieve protection of human health and the environment through treatment of UEFPC surface water, and differ only with respect to the levels of treatment capacity and stormwater storage capacity to manage UEFPC base-flow, various amounts of storm flow, and potentially other inputs of mercury-contaminated water. Storm flow in excess of treatment and storage capacity would be discharged untreated to UEFPC under all alternatives. While all action alternatives achieve overall protectiveness, Alternative 2d employs the most robust actions, due to the inclusion of the largest amount of storage capacity to contain storm flows above the capacity of the treatment system for future treatment, followed by Alternative 2c, which includes a smaller stormwater storage capacity. Alternative 2a would provide the least amount of treatment capacity at 1500 gpm, such that UEFPC stream flow would bypass treatment more frequently than the other alternatives. Alternative 2b would provide a comparable level of treatment capacity to Alternatives 2c and 2d, but without the storage capacity to capture storm flow above the capacity of the treatment system. All action alternatives would be dependent upon ongoing operation and maintenance of the new water treatment facility to maintain protectiveness. All alternatives defer actions for groundwater to a future decision, so groundwater use restrictions would continue under all alternatives.

The proposed water treatment facility that would be constructed under all action alternatives also could have potential benefits for treatment of wastewater (e.g., contact stormwater and decontamination

waters) from the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. Alternatives 2c and 2d would offer advantages over Alternatives 2a and 2b for potential future treatment of this source due to the presence of stormwater storage capacity which could allow more flexible wastewater inputs.

Short-term risks during implementation of remedial actions would be maintained at acceptable levels through engineering and institutional controls under all action alternatives. Short-term risks to the community and non-remediation workers would be negligibly small under all action alternatives. Short-term risks to remediation workers also would be very small under all alternatives. There would be limited opportunity for contact with hazardous materials under all alternatives, primarily associated with excavation of stream sediments and floodplain soils during initial facility construction and the ongoing disposal of treatment system residual wastes during operations. Otherwise, most risks would be standard industrial risks associated with major construction projects.

5.3.1.2 Compliance with ARARs

ARARs can specify maximum concentrations of contaminants that can remain at a site, specify design or performance requirements for remedial technologies, or impose consideration of sensitive resources present at a site. Compliance with ARARs is achieved by either meeting the ARARs identified or by receiving a waiver under CERCLA from any requirement that cannot be met. The no-further-action alternative has no action-specific ARARs because no response actions would be taken.

All action alternatives are expected to achieve chemical-specific ARARs, with the exception of the recreational AWQC in-stream standard for mercury. No new waiver of any ARAR would be requested, but the interim waiver previously approved under the Phase I ROD for the recreational AWQC in-stream standard for mercury would not be affected by any modification of the remedy as a result of this FFS and would remain in effect.

All action alternatives would involve activities in floodplains and would comply with ARARs for these locations. Any adverse effects on floodplains would be very localized and limited in extent, and any adverse effects would be minimized and mitigated as specified in 10 CFR 1022.

All action alternatives will comply with all action-specific ARARs. All alternatives include control of fugitive emissions, best management practices for storm water runoff, and proper management of all waste streams generated. All ARARs for transportation and disposal would be met. Under all action alternatives, the proposed water treatment system would be expected to reduce mercury concentrations to 51 ng/L or less in the treated effluent. Actual system performance would be evaluated following facility construction and two years of operation. If the actual performance does not attain this target level, the FFA parties will collaborate on the selection and implementation of follow-on actions, which could include modifications of the facility to improve performance or waiver of this action-specific ARAR.

5.3.2 Balancing Criteria

5.3.2.1 Long-Term Effectiveness and Permanence

The no-further-action alternative would not be effective in the long term, because no additional remedial actions would be taken to supplement the actions in the selected remedy of the Phase I ROD, and mercury concentrations in surface water would continue to exceed both the interim goal established in the Phase I ROD and the AWQC.

All action alternatives would be effective in the long term and provide permanent solutions for removal of mercury contamination from UEFPC surface water. That is, mercury would be removed from UEFPC surface water for permanent disposal through the water treatment operations under each of the action alternatives. Alternative 2d would achieve the greatest reduction in mercury flux (~91%), followed by Alternative 2c (~84%), Alternative 2b (~68%), and Alternative 2a (~52%), respectively. The water treatment facility that would be constructed under these action alternatives would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water, and the facility might be decommissioned following implementation of other response actions to remove mercury source areas and reduce releases of mercury to UEFPC. All action alternatives would require a commitment to long-term operations of the water treatment system, and proper system operation, maintenance, and upkeep would be required to maintain effectiveness.

All alternatives also would continue to rely on existing land use controls included in the selected remedy in the Phase I ROD for protection of human receptors from fish consumption until mercury concentrations in fish fall to acceptable levels.

5.3.2.2 Reduction of Toxicity, Mobility, and Volume Through Treatment

The no-further-action alternative does not include treatment and will not result in a reduction of toxicity, mobility, or volume of contaminants.

All of the action alternatives include the construction of a new water treatment facility to treat WEMA storm sewer discharges at Outfall 200 to remove mercury contamination from UEFPC surface water, and differ only with respect to the levels of treatment capacity and stormwater storage capacity. The unit operations for the treatment system would be similar for all alternatives, except that stormwater storage capacity is included only in Alternatives 2c and 2d. Removal of mercury from UEFPC surface water would be achieved by precipitation and filtration technologies. Alternative 2d would provide the greatest reduction in toxicity, mobility, and volume by treating the largest volume of UEFPC surface water and achieving the greatest reduction in mercury flux (~91%) discharged at Outfall 200, followed by Alternative 2c (~84%) and Alternative 2b (~68%), respectively. Alternative 2a would provide the lowest reduction (~52%) by treating the smallest volume of surface water and would achieve the smallest reduction in mercury flux (52%).

5.3.2.3 Short-Term Effectiveness

The no-further-action alternative would not involve any remedial actions, and therefore, would result in no increase in short-term risks and no short-term environmental impacts.

All action alternatives would protect the community during implementation of remedial actions through the use of engineering and institutional controls. All activities would be conducted in accordance with applicable codes and requirements, DOE Directives, and ALARA principles to minimize exposure to radioactive and hazardous materials and control accident risks to acceptable levels. Stormwater runoff controls would be implemented throughout all excavation and construction activities to prevent impacts to surface waters. Dust emission controls also would be implemented during all construction activities to minimize airborne releases. All onsite activities would occur on DOE property and DOE roads that are currently inaccessible to the public. Access controls already in place at the Y-12 site prevent public access to the UEFPC area.

Increases in onsite and local vehicle traffic would occur under all action alternatives as equipment (e.g., bulldozers, excavators, etc.) and trucks were brought to the site for construction of the new facility. However, the increase in vehicle traffic would relatively small for all alternatives, and transportation

accidents are projected to result in less than one injury or fatality over the duration of the project under all alternatives. These impacts would be controlled by engineering controls, and transportation planning to minimize traffic.

Risk to workers would be very small and similar for all action alternatives. Worker risks would be mitigated through the proper use of safety protocols, personal protective clothing and equipment, environmental monitoring, and access restrictions.

Short-term disturbance of vegetation and wildlife habitat would occur under all action alternatives. Construction of the new water treatment facility would occur in areas that have been previously disturbed and do not present significant habitat. All activities would be conducted to minimize erosion and sediment deposition to UEFPC, such that only minor short-term effects to water quality would occur.

While relative differences among the action alternatives are small with respect to each of these short-term impacts, Alternative 2a would have the smallest short-term impacts due to the slightly smaller construction activities, while Alternative 2d would have the greatest impacts due to the construction of the much larger headworks and stormwater storage tanks, with Alternatives 2b and 2c intermediate between these.

The estimated time required for implementation of all action alternatives is estimated at 5 years for design and construction. All alternatives also would have similar ongoing costs for O&M associated with water treatment operations that would be permanent costs. It also should be noted that implementation schedules for any of the action alternatives could be significantly lengthened due to funding constraints in addition to constructability logic. The new treatment system under each of the action alternatives would be expected to achieve an immediate reduction in mercury releases from the WEMA storm sewer network to UEFPC surface water. Other site-related risks to be addressed by other response actions are outside the scope of this interim action.

5.3.2.4 Implementability

Under the no-further-action alternative, no remedial actions would be taken. Therefore, there would be no activities to implement.

All action alternatives would be technically feasible to implement. All activities associated with implementation of the action alternatives (water collection and treatment systems) would be performed using standard construction equipment and techniques. Services and materials required for implementation of all action alternatives would be readily available; only standard construction equipment, trades, and materials would be required.

While relative differences among the action alternatives are very small with respect to implementability, Alternative 2a would be the most easily implemented as a result of its lower treatment capacity, followed by Alternative 2b; Alternatives 2c and 2d also would be readily implementable but would require additional construction associated with the much larger headworks and stormwater storage tanks.

5.3.2.5 Cost

Cost estimates are used in the CERCLA evaluation process to eliminate remedial alternatives that are significantly more expensive than competing alternatives without offering commensurate increases in performance or overall protection of human health and the environment. The cost estimates are preliminary estimates with an intended accuracy range of +50 to -30 percent. Final costs will depend on

actual labor and material costs, actual site conditions, productivity, competitive market conditions, final scope, final schedule, final engineering design, and other variables.

The estimated capital, annual O&M, and total present value costs for each alternative are summarized in Table 5.2. Alternative 2d is the most expensive alternative with a present value cost of $221 million. Alternative 2a is the least expensive alternative, with a present value cost estimate of $142 million, followed by Alternative 2b with a present value cost estimate of $158 million and Alternative 2c with a present value cost of $185 million.

5.3.3 Additional Considerations – CERCLA Modifying Criteria and NEPA Values

The additional CERCLA evaluation criteria of State Acceptance and Community Acceptance are referred to as modifying criteria, which are incorporated into the evaluation of alternatives following public comment on the proposed plan. These criteria will be addressed in the Proposed Plan and ROD Amendment, following public comment on the preferred remedy, and are not discussed in this FFS.

Socioeconomic Impacts and Land Use. Because the no-further-action alternative is the baseline condition, the socioeconomic conditions of this alternative are those against which other alternatives will be compared. Land use under the no-action alternative normally is assumed to be unrestricted; however, the presence of the Y-12 National Security Complex and its ongoing national security mission renders the future use of the UEFPC site for any activities other than DOE-controlled industrial use completely implausible. None of the action alternatives would be expected to result in any long-term change in the local economy or socioeconomic impacts. The DOE-controlled land-use designation for the UEFPC would continue.

Environmental Justice – No environmental justice impacts have been identified for the no-further-action alternative. The Scarboro community is the only formally identified environmental justice community near the ORR. This community is located on the opposite side of Pine Ridge from the Y-12 site and UEFPC, and it would not be adversely impacted by the construction of the new water treatment facility. No short-term impacts would be expected during implementation. Similarly, no environmental justice impacts are anticipated for any action alternative, since no impacts to the Scarboro community would be expected to result from implementation of the remedial actions for UEFPC.

Irreversible and Irretrievable Commitment of Resources – No irretrievable commitment of resources would result directly from implementation of the no-further-action alternative. All action alternatives would require an irretrievable commitment of the site selected for construction of the new water treatment facility and restricted from other uses. All action alternatives also would require an irretrievable commitment of fuel and other nonrenewable resources during implementation of remediation activities, as well as other materials such as fertilizers, riprap, etc.

Cumulative Impacts – Because the no-further-action alternative is the baseline condition, there would be no cumulative impacts for this action. The potential for cumulative impacts related to the remedial actions implemented at UEFPC under any of the action alternatives is not considered significant due to the limit scope of this action. Numerous additional remedial actions as well as other construction activities will occur at Y-12 and throughout the ORR that could have cumulative impacts such as increases in vehicle traffic, degradation of habitat, etc. However, the likelihood of significant cumulative impacts is considered very remote.

5.3.4 Summary

Results of the comparative analysis of alternatives are summarized in Table 5.2. Alternative 1 (No Further Action) would not achieve any further reductions in mercury releases to UEFPC and would not be considered protective or effective. All action alternatives would achieve protection of human health and the environment through treatment of UEFPC surface water, and differ only with respect to the levels of treatment capacity and stormwater storage capacity. While all action alternatives achieve overall protectiveness, Alternative 2d employs the most robust actions, due to the inclusion of the largest amount of storage capacity to contain storm flows above the capacity of the treatment system for future treatment, followed by Alternative 2c, which includes a smaller stormwater storage capacity. Alternative 2a would provide the least amount of treatment capacity at 1500 gpm, such that UEFPC stream flow would bypass treatment more frequently than the other alternatives. Alternative 2b would provide a comparable level of treatment capacity to Alternatives 2c and 2d, but without the storage capacity to capture storm flow above the capacity of the treatment system.

All action alternatives would be expected to meet ARARs, with the exception of the recreational AWQC in-stream standard for mercury of 51 ng/L. No new waiver of any ARAR would be requested, but the interim waiver previously approved under the Phase I ROD for the recreational AWQC in-stream standard for mercury would not be affected by any modification of the remedy resulting from this FFS and would remain in effect.

All action alternatives would be effective in the long term and would provide permanent solutions for the mercury contamination removed from UEFPC surface water – that is, mercury would be removed from UEFPC surface water for permanent disposal through the water treatment operations under each of the action alternatives. Alternative 2d would achieve the greatest reduction in mercury flux at Outfall 200 (~91%), followed by Alternative 2c (~84%), Alternative 2b (~68%), and Alternative 2a (~52%), respectively.

The water treatment facility that would be constructed under these action alternatives would continue operation until mercury releases from the Y-12 site no longer present unacceptable impacts to UEFPC surface water - that is, planned remediation of mercury source areas at WEMA may result in reduction of mercury releases to UEFPC to levels that no longer require treatment; if so, the treatment facility might be decommissioned following implementation of these other response actions. Therefore, continuing operation of this water treatment system may or may not be part of the final remedy ultimately selected for the UEFPC watershed; however, the final remedy is outside the scope of this FFS.

All action alternatives meet the CERCLA preference for treatment to reduce the toxicity, mobility, or volume of contaminants. All action alternatives would be readily implementable using standard construction methods and readily available materials and services, and all would involve only minor short-term impacts during construction activities. All action alternatives also would continue to rely on existing land use controls included in the selected remedy in the Phase I ROD.

Among the action alternatives, Alternative 2d would achieve the greatest reduction in mercury releases to UEFPC (estimated to capture approximately 91% of the mercury flux at Outfall 200 for a typical year), but also would have the greatest cost and would be most difficult to implement. Alternatives 2c, 2b, and 2a would achieve progressively less reduction in mercury releases to UEFPC, estimated at approximately 84%, 68%, and 52%, respectively, of the mercury flux at Outfall 200 during a typical year, but also would have progressively lower costs and minor advantages in implementability.

Under all action alternatives, the proposed water treatment system would be expected to reduce mercury concentrations to 51 ng/L or less in the treated effluent. Actual system performance would be

evaluated following facility construction and two years of operation. If the actual performance does not attain this target level, the FFA parties will collaborate on the selection and implementation of follow-on actions, which could include modifications of the facility to improve performance or waiver of this action-specific ARAR. Under all action alternatives, the new water treatment facility would be constructed using a modular design that would be conducive to any future modifications that might be needed.

The proposed water treatment facility that would be constructed under all action alternatives also could have potential benefits for treatment of wastewater (e.g., contact stormwater and decontamination waters) from the future demolition of the major mercury process buildings at WEMA and remediation of the mercury contaminated soils beneath the buildings, in addition to achieving reductions in the ongoing mercury discharges from Outfall 200 to UEFPC. Alternatives 2c and 2d would offer advantages over Alternatives 2a and 2b for potential future treatment of this source due to the presence of stormwater storage capacity which could allow more flexible wastewater inputs. While the future WEMA demolition and remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants to UEFPC surface water, the proposed water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. However, this source has not been specifically evaluated in the conceptual design of the treatment system, but would be evaluated during the planning for these future projects as additional characterization data become available to better define potential contaminants of concern. The modular design of the water treatment system would facilitate any change that might be needed.

The new water treatment system that would be constructed under all action alternatives would be designed to supplement other response actions already underway or planned for future implementation under the Phase I ROD, and would not modify or replace any of those actions. Similarly, construction of this new facility would not impact the additional actions and studies are planned under the Y-12 Mercury Reduction Project and the *Strategic Plan for Mercury Remediation* which are separate from the actions being conducted under the Phase I ROD. Completion of all response actions to reduce mercury in UEFPC surface will require many years and the interim action considered in this FFS is only one component of this comprehensive remediation program. A CERCLA Alternatives Analysis planned for ~2021 will provide input to a future FFA-party agreement on any additional actions to be implemented in UEFPC or LEFPC, and would be followed by final RODs for UEFPC surface water and groundwater.

Table 5.2 Comparative Analysis of Remedial Alternatives

Criteria	Remedial Alternative				
	Alternative 1 No Further Action	**Alternative 2a, Water Treatment Facility for Outfall 200 with 1500 gpm Treatment Capacity & No Stormwater Storage**	**Alternative 2b, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity & No Stormwater Storage**	**Alternative 2c, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity and 2 Million Gallons Stormwater Storage**	**Alternative 2d, Water Treatment Facility for Outfall 200 with 3000 gpm Treatment Capacity & 10 Million Gallons Stormwater Storage**
Overall Protection of Human Health and the Environment	Not protective.	Protective of human health and the environment. Least protective of action alternatives.	Protective of human health and the environment. Intermediate among action alternatives.	Protective of human health and the environment. Intermediate among action alternatives.	Protective of human health and the environment. Most protective of the action alternatives.
Compliance with ARARs	Not applicable.	Meets all ARARs. [a]	Meets all ARARs. [a]	Meets all ARARs. [a]	Meets all ARARs. [a]
Long-term Effectiveness and Permanence	Not effective.	Effective with ongoing O&M (~52% mercury flux reduction)	Effective with ongoing O&M (~68% mercury flux reduction)	Effective with ongoing O&M (~84% mercury flux reduction)	Effective with ongoing O&M (~91% mercury flux reduction)
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment; therefore no reduction.	Least reduction of volume, toxicity, and mobility through ex situ treatment of UEFPC surface water.	Intermediate reduction of volume, toxicity, and mobility through ex situ treatment of UEFPC surface water.	Greater reduction of volume, toxicity, and mobility through ex situ treatment of UEFPC surface water.	Greatest reduction of volume, toxicity, and mobility through ex situ treatment of UEFPC surface water.
Short-term Effectiveness	No short-term impacts	Minor short-term impacts. Standard construction risks to workers.	Minor short-term impacts. Standard construction risks to workers.	Minor short-term impacts. Standard construction risks to workers.	Minor short-term impacts. Standard construction risks to workers.
Implementability	No remedial actions; no implementability issues.	Technically & administratively feasible; materials & services available.	Technically & administratively feasible; materials & services available.	Technically & administratively feasible; materials & services available.	Technically & administratively feasible; materials & services available.
Cost	None	CC: $ 155 Million O&M: $ 2.2 Million/year PV: $ 142 Million	CC: $ 125 Million O&M: $ 2.7 Million/year PV: $ 158 Million	CC: $ 146 Million O&M: $ 3.1 Million/year PV: $ 185 Million	CC: $ 179 Million O&M: $ 3.4 Million/year PV: $ 221 Million
NEPA Values	No impacts.	No socioeconomic, environmental justice, cumulative impacts; minor IRR.	No socioeconomic, environmental justice, cumulative impacts; minor IRR.	No socioeconomic, environmental justice, cumulative impacts; minor IRR.	No socioeconomic, environmental justice, cumulative impacts; minor IRR.
State Acceptance	TBE	TBE	TBE	TBE	TBE
Community Acceptance	TBE	TBE	TBE	TBE	TBE

CC = capital cost
O&M = operation and maintenance (30 years)
PV = present value cost
IRR = irretrievable & irreversible commitment of resources
TBE= to be evaluated after public comment
UEFPC = Upper East Fork Poplar Creek

[a]The interim waiver previously approved under the Phase I ROD for the recreational AWQC in-stream standard for mercury would not be impacted by this decision and would remain in effect.

6. REFERENCES

DOE (U.S. Department of Energy) 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Department of Energy, U. S. Environmental Protection Agency Region 4, and Tennessee Department of Environment and Conservation.

DOE (U. S. Department of Energy) 1992a. *Remedial Investigation Report for the Plating Shop Container Areas (S-334 and S-351) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR-1029&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1992b. *Record of Decision for the Y-12 Plating Shop Container Areas at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR-1049&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1994a. *Remedial Investigation Report on the Abandoned Nitric Acid Pipeline at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/01-1214&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1994b. *Record of Decision for the Upper East Fork Poplar Creek Operable Unit 2 (Abandoned Nitric Acid Pipeline) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1265&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1994c. Memorandum for Secretarial Officers and Heads of Field Elements from Hazel R. O'Leary, *Secretarial Policy Statement on National Environmental Policy Act*, U. S. Department of Energy.

DOE 1997a. *Engineering Evaluation/Cost Analysis for Lead Source Removal at the Former YS-860 Firing Ranges, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1658&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1997b. *Action Memorandum for Lead Source Removal at the Former YS-860 Firing Ranges, Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1622&D1, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1997c. *Record of Decision for an Interim Action for Union Valley, Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, DOE/OR/02-1545&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1997d. *Removal Action Work Plan for Building 9201-4 Exterior Process Piping Removal at the Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/02-1588&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1998a. *Report on the Remedial Investigation of the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/01-1641/V1-V4&D1, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1998b. E*ngineering Evaluation/Cost Analysis, Y-12 Plant 9822 Sediment Basin and Building 81-10 Sump, Oak Ridge, Tennessee*, DOE/OR/02-1691&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1998c. *Action Memorandum for the Y-12 Plant 9822 Sediment Basin and Building 81-10 Sump, Oak Ridge, Tennessee*, DOE/OR/01-1716&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1999a. *Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/01-1747&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1999b. *Engineering Evaluation/Cost Analysis for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee*, DOE/OR/01-1764&D4, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 1999c. *Action Memorandum for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee*, DOE/OR/01-1819&D2, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2000. *Addendum to the Feasibility Study for the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/01-1747&D3/A3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2001a. *Proposed Plan for Interim Source Control Actions for Contaminated Soils, Sediments, and Groundwater (Outfall 51) which Contribute Mercury and PCB Contamination to Surface Water in the Upper East Fork Poplar Creek Characterization Area at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, DOE/OR/01-1839&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2001b. *Cultural Resource Management Plan, DOE Oak Ridge Reservation, Anderson and Roane Counties, Tennessee*, DOE/ORO-2085, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2002. *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, DOE/OR/01-1951&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2005, *Phased Construction Completion Report for the Big Spring Water Treatment System at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2218&D1.

DOE 2006a. *Record of Decision for Phase II Interim Remedial Actions for Contaminated Soils and Scrapyard in Upper East Fork Poplar Creek, Oak Ridge, Tennessee*, DOE/OR/01-2229&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2006b. *Removal Action Report for the Oak Ridge Y-12 Plant East End Volatile Organic Compound Plume, Oak Ridge, Tennessee*, DOE/OR/01-2297&D1, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2006c. *Non-Significant Change to the Record of Decision for Phase 1 Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2007a. *Non-Significant Change to the Record of Decision for Phase 1 Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2007b. *2006 Remediation Effectiveness Report/Second Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/01-2289&D3, U. S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2008. *Remedial Design Report/Remedial Action Work Plan for Scrap Metal at the Y-12 Old Salvage Yard at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2376&D2, Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009a. *Upper East Fork Poplar Creek Soils Remedial Action Work Plan*, DOE/OR/01-2423&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009b. *Engineering Study Report for the West End Mercury Area (WEMA) Storm Sewer Remediation Project at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2429&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009c. *Waste Handling Plan, Part 1 for Scrap Metal at the Y-12 Old Salvage Yard at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2385&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009d. *Action Memorandum for the Removal of Legacy Materials from Building 9201-5 and 9204-4 at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2404&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009e. *Action Memorandum for Time-Critical Removal Action for Demolition of Building 9735 and the Building 9206 Filter House at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2405&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2009f. *Action Memorandum for Time-Critical Removal Action for Demolition of Buildings 9211, 9220, 9224 & 9769 (Biology Complex) at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2406&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2010a. *Addendum to the Upper East Fork Poplar Creek Soils Remedial Action Work Plan*, DOE/OR/01-2423&D1/A1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2010b. *Remedial Design Report/Remedial Action Work Plan for the West End Mercury Area (WEMA) Storm Sewer Remediation Project at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2447&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2010c. *Engineering Evaluation/Cost Analysis for the Y-12 Facilities Deactivation/Demolition Project, Oak Ridge, Tennessee*, DOE/OR/01-2424&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2010d. *Action Memorandum for the Y-12 Facilities Deactivation/Demolition Project, Oak Ridge, Tennessee*, DOE/OR/01-2462, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2010e. *Removal Action Work Plan for the Y-12 Facilities Deactivation/Demolition Project, Oak Ridge, Tennessee*, DOE/OR/01-2479&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2011a. *Phased Construction Completion Report for Scrap Metal Removal at the Old Salvage Yard Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2481&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2011b. *Removal Action Report for Building 9735 and 9206 Demolition Projects at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2502&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2011c, *Characterization Report for the 81-10 Area in the Upper East Fork Poplar Creek Area at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2485&D2.

DOE 2012a. *2011 Third Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/01-2516&D2, U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012b. *Explanation of Significant Differences for the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, DOE/OR/01-2539&D2, U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012c. *Phased Construction Completion Report for the West End Mercury Area (WEMA) Storm Sewer Remediation Project at the Y-12 National Security Complex Oak Ridge, Tennessee* (DOE/OR/01-2526&D2), U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012d. *Phased Construction Completion Report for the Y-12 Old Salvage Yard Soil Remediation Project, Y-12 National Security Complex, Oak Ridge, Tennessee* (DOE/OR/01-2564&D1), U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012e. *Removal Action Report for the Non-Time Critical Removal Action at the Just-In-Case Yard at the Y-12 National Security Complex, Oak Ridge, Tennessee*, (DOE/OR/01-2532&D1), U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012f. *Project Completion Report for the Removal and Disposition of Certain Legacy Material From Building 9204-3 (Beta-3), an Oak Ridge National Laboratory Facility Located at the Y-12 National Security Complex* (DOE/OR/01-2570&D1), U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012g. *Removal Action Report for the Removal of Legacy Material from Buildings Beta 4 (9204-4) and Alpha 5 (9201-5) at the Y-12 National Security Complex, Oak Ridge, Tennessee*, (DOE/OR/01-2519&D2), U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012h. *Removal Action Report for the Biology Area Demolition Project Buildings 9211, 9220, 9224, and 9769 at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2508&D2, U. S. Department of Energy, Environmental Restoration Division, Oak Ridge, TN.

DOE 2012i. A *Remedial Design Report for Soils in Exposure Unit 9 at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2581&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2012j. *Action Memorandum for Time-Critical Removal Action for the Removal of Mercury from the Storm Sewer System at the Y -12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/O1-2574&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2012k, *Technical Memorandum for Exposure Unit 9 of the Upper East Fork Poplar Creek (UEFPC) Characterization Area, Attachment B2 to the UEFPC Soils Remedial Action Work Plan*, DOE/OR/01-2423&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

DOE 2013a, *Removal Action Report for the Mercury Reduction Project at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2595&D1, U.S. Department of Energy, Oak Ridge Office, Oak Ridge, TN.

DOE 2013b, *East Fork Poplar Creek and Chestnut Ridge Administrative Watersheds Remedial Action Report Comprehensive Monitoring Plan*, DOE/OR/01-2466&D3, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

DOE 2013c, Memorandum from J.E. Surash to Distribution, *Green and Sustainable Remediation Contract Language*, December 30, 2013.

DOE 2014a. *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2605&D2, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

DOE 2014b. *Remedial Design Work Plan for the Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2599&D2, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

DOE 2014c, *2013 Remediation Effectiveness Report for the U. S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/01-2386&D1/V1-2, U. S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

DOE 2014d. *Non-Significant Change to the Record of Decision for Phase 1 Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, U. S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

DOE, EPA, and TDEC 1999. Memorandum of Understanding for Implementation of a Land Use Control Assurance Plan (LUCAP) for the United States Department of Energy Oak Ridge Reservation. Attachment: Land Use Control Assurance Plan for the Oak Ridge Reservation, November.

DuVall, G. D. 1992. *Archeological Evaluation of Y-12 Plant Facility Within the Fenced Areas of the Bear Creek Valley*, Oak Ridge, TN.

EPA (U. S. Environmental Protection Agency) 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004, Office of Emergency and Remedial Response, Washington, D.C.

EPA 1988b. *CERCLA Compliance with Other Laws Manual*. Draft Guidance (Interim Final), OSWER Directive 9234.1-01, Office of Emergency and Remedial Response, Washington, D.C.

EPA 1995. *Land Use in the CERCLA Remedy Selection Process*, OSWER Directive 9355.7-04, Office of Emergency and Remedial Response, Washington, D.C.

EPA 2012, *EPA Methodology for Understanding and Reducing a Project's Environmental Footprint*, EPA-542-R-12-002, February 2012.

ORNL 2010. Southworth, G., M. Greeley, M. Peterson, K. Lowe, and R. Ketelle. *Sources of Mercury to East Fork Poplar Creek Downstream from the Y-12 National Security Complex: Inventories and Export Rates*, ORNL/TM-2009/231, Oak Ridge National Laboratory, Oak Ridge, TN.

ORNL 2011. Peterson M, B. Looney, G. Southworth, C. Eddy-Dilek, D. Watson, R. Ketelle, and M. Bogle. *A conceptual model for mercury source areas, transport pathways, and flux at the Y-12 Complex*, Oak Ridge, TN. ORNL/TM-2011/75.

UCOR 2014. *Conceptual Design Report for the Outfall 200 Mercury Treatment Facility, Y-12 National Security Complex, Oak Ridge, Tennessee*. UCOR-4578. URS | CH2M Oak Ridge LLC. April 2014.

UCOR 2015a. *Watershed Diversion Modeling Report, Outfall 200 Mercury Treatment Facility*. UCOR-TMEM-008, Rev. 1. Prepared by CH2M Hill for URS | CH2M Oak Ridge LLC. March 2015.

UCOR 2015b. *Watershed Diversion Design Concepts*. UCOR-TMEM-009, Rev. 0. Prepared by CH2M Hill for URS | CH2M Oak Ridge LLC. February 2015.

UCOR 2015c. *Mercury Treatment Facility Pre-Design Study, Evaluation of Sources and Options for Diversion of Non-Stormwater Discharging to Outfall 200 at the Y-12 National Security Complex*. UCOR-4661. URS | CH2M Oak Ridge LLC. February 2015.

UCOR 2015d. *Stormwater Characterization Report, Outfall 200 Mercury Treatment Facility*. UCOR-TMEM-012, Rev. 0. Prepared by CH2M Hill for URS | CH2M Oak Ridge LLC. March 2015.

UCOR 2015e. *Mercury Flux Modeling Report, Outfall 200 Mercury Treatment Facility*. UCOR-TMEM-010, Rev. 0. Prepared by CH2M Hill for URS | CH2M Oak Ridge LLC. March 2015.

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

THIS PAGE INTENTIONALLY LEFT BLANK.

A.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, specifies that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate for the hazardous substances or particular circumstances at a site or obtain a waiver [40 *Code of Federal Regulations* (*CFR*) *300.430(f)(1)(ii)(B)*]. Inherent in the interpretation of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured. The purpose of this appendix is to summarize potential federal and state chemical-, location-, and action-specific ARARs identified for the evaluation of the remedial action alternatives for the Focused Feasibility Study (FFS) for Upper East Fork Poplar Creek (UEFPC).

ARARs include only federal and state environmental or facility siting laws/regulations designed to protect the environment and do not include occupational safety or worker radiation protection requirements. The U. S. Environmental Protection Agency (EPA) requires compliance with the Occupational Safety and Health Administration (OSHA) standards through Sect. 300.150 of the National Oil and Hazardous Substances Pollution Contingency Plan (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 federal- or state-promulgated regulations, other advisories, criteria, proposed standards, or guidance values may be considered in determining remedies and setting protective cleanup levels per *40 CFR 300.405(g)(3*). These are not potential ARARs but are to-be-considered (TBC) guidance.

CERCLA onsite remedial response actions must comply only with the substantive requirements of a regulation [CERCLA Sect. 121(e)]. To ensure that CERCLA response actions proceed as rapidly as possible, EPA has reaffirmed this position in the final NCP (55 *Federal Register* 8756, March 8, 1990). Substantive requirements pertain directly 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).

The NCP exempts onsite actions from having to obtain federal, state, or local permits, and defines "onsite" to mean "the areal extent of contamination and all suitable areas I very close proximity to the contamination necessary for the implementation of the response action" [*40 CFR 300.400(3)(1)*]. However, onsite actions must still comply with all substantive permit requirements.

ARARs can specify maximum concentrations of contaminants that can remain at a site (chemical-specific), specify design or performance requirements for remedial technologies (action-specific), or impose consideration of sensitive resources present at a site (location-specific). In accordance with 40 *CFR* 300.400(g), ARARs and TBCs have been identified for the remedial action alternatives evaluated in this focused feasibility study (FFS). Tables A.1 through A.3 list the chemical-specific, location-specific, and action-specific ARARs/TBCs, respectively, for the remedial action alternatives considered in this FFS. A brief description of key ARAR/TBC issues follows.

This FFS proposes no changes to the ARARs identified in the Phase I Record of Decision for UEFPC issued in May 2002. Regulatory citations have been updated to reflect changes by the respective state and federal agencies over the years. Additional detail has been included in some cases to better define the specific requirements for these actions. The remedial action alternatives considered in this FFS are expected to meet all identified ARARs, with the exception of attaining the recreational in-stream

ambient water quality criterion (AWQC) of 51 ng/L for mercury. An interim action waiver of this ARAR under CERCLA 121(d)(4)(A) was invoked and granted as part of the selected remedy under the Phase I ROD. The water treatment facility evaluated in this FFS would be an additional interim action under the Phase I ROD and would help to achieve the interim goal of 200 ng/L for mercury at Station 17 established in the Phase I ROD.

A.1.1 CHEMICAL-SPECIFIC ARARs/TBCs

Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, air) for specific hazardous substances, pollutants, or contaminants. Chemical-specific ARARs identified for the action alternatives evaluated in this FFS are listed on Table A.1 and discussed below.

Surface Water. Under Tennessee water quality regulations, streams may be designated for multiple use classifications (*TDEC 0400-40-04*) and different AWQC may be specified for each use classification (*TDEC 0400-40-03*). The entire length of East Fork Poplar Creek (EFPC) is currently designated for four use classifications: (1) fish and aquatic life, (2) recreation, (3) livestock watering and wildlife, and (4) irrigation. Among these four designated use classifications, recreation has the most stringent criterion for mercury at 51 ng/L. The recreation (organisms only) AWQC is for the protection of human health from the consumption of organisms (e.g., fish). This most stringent applicable AWQC standard was waived under the Phase I ROD and an interim risk-based goal of 200 ng/L was set. This AWQC standard was waived under the Phase I ROD because that interim ROD included surface water remediation as part of the scope in a phased approach to evaluating the nature and extent of contamination, to determining the risks, and to selecting and implementing remedial actions for all media at the UEFPC characterization area. At the time that the Phase I ROD was signed, DOE and the regulators agreed to waive the surface water quality chemical-specific AWQC until other phases of the interim action captured and/or removed more of the mercury sources that were located within the scope of the interim ROD. This FFS evaluates an additional action that is intended to capture and treat sources of mercury at UEFPC. The remedial alternatives evaluated in this FFS are designed to meet all identified chemical-specific ARARs, and the water treatment facility evaluated in this FFS would be designed to meet the AWQC standard of 51 ng/L in the treated effluent. The interim waiver previously approved under the Phase I ROD for the AWQC in-stream standard for mercury would not be impacted by any modification of the selected remedy as a result of this FFS and would remain in effect.

This water treatment facility also would be expected to provide benefits for capturing mercury releases from future demolition of the former mercury-use buildings and remediation of underlying mercury-contaminated soils; however, this source has not been specifically evaluated in the conceptual design of the treatment system, but would be evaluated during the planning for these future projects as additional characterization data become available to better define potential contaminants of concern.

UEFPC begins in the Y-12 industrial area and extends to the site boundary (near the Station 17 monitoring location) where it enters into Lower East Fork Poplar Creek (LEFPC). Following remediation of upstream mercury contaminant sources, a subsequent CERCLA decision document will address final surface water decisions regarding attainment of AWQC for the UEFPC and LEFPC.

Radiation Protection. In accordance with relevant and appropriate TDEC and U.S. Nuclear Regulatory Commission (NRC) radiation protection requirements (Tennessee is an NRC-agreement state) and TBC requirements of DOE, the radiation dose to members of the public must not exceed 100-mrem/year total effective dose equivalent from all sources excluding dose contributions from background radiation, medical exposures, or voluntary participation in medical/research programs [TDEC 0400-20-

05-.60(1)(a), 10 *CFR* 20.1301(a)(1), DOE Order 458.1(4)(b)] and must be further reduced below this limit as low as reasonably achievable (ALARA) [*TDEC 0400-20-05-.60(1)(c)*, 10 *CFR* 20.1101(b), DOE Order 458.1(4)(d)]. This dose limit addresses exposure to radiation from all sources and activities, including both operations and removal/remedial actions, at a facility and requires DOE to utilize procedures to maintain the dose ALARA. Thus, the actual dose that the public might receive from any individual activity such as this remedial action is expected to be a very small fraction of the 100 mrem/yr dose limit.

Groundwater and Soil. Final decisions regarding groundwater at UEFPC were deferred under the Phase I ROD to a future decision document following completion of the Phase I response actions. At that time, a decision will be made as to whether the Safe Drinking Water Act of 1974, as amended, maximum contaminant levels and maximum contaminant level goals are applicable or relevant and appropriate for groundwater response actions at UEFPC. Depending on the classification of the groundwater, remediation goals may include restoring groundwater to meet any corresponding criteria (both numeric and narrative) that are ARAR.

Excavation of contaminated surface and subsurface soils is being addressed under both the UEFPC Phase I ROD and Phase II ROD, and removal of contaminated storm sewer sediments is being conducted to reduce releases of mercury to UEFPC. While the alternatives evaluated in this FFS may involve limited removal and/or treatment of some contaminated streambed/bank soils and sediments during facility construction activities, the primary purpose of this action is the treatment of mercury-contaminated surface water, not soil or sediment. Soil and sediment requiring excavation will be managed and treated in accordance with the pertinent ARARs as identified in Tables A.1 and A.3.

A.1.2 LOCATION-SPECIFIC ARARs/TBCs

Location-specific requirements establish restrictions on permissible concentrations of hazardous substances or requirements for how activities will be conducted because they will take place in special locations (e.g., wetlands, floodplains, critical habitats, historic districts, streams). Location-specific ARARs identified for the action alternatives evaluated in this FFS are listed on Table A.2 and discussed below. The remedial action alternatives considered in this FFS include construction of a new water treatment facility near Outfall 200, which located within the Y-12 main industrial area, which has been extensively disturbed over the years. No wetlands and no threatened or endangered species or their environments were identified within the area that would be impacted by this project. Therefore, the requirements for protection of wetlands and threatened or endangered species are not identified as ARARs for these actions.

Floodplains. The remedial action alternatives considered in this FFS include construction of a new water treatment facility adjacent to the UEFPC stream channel near Outfall 200. Construction activities would take place at and adjacent to the UEFPC stream channel and may include excavation of floodplain soil or stream sediments. Floodplain requirements would be considered in siting and constructing the facility. Actions must avoid, to the extent possible, adverse impacts to the floodplains in accordance with Executive Order 11990 and *10 CFR 1022*. Appropriate mitigation measures would be implemented, such as minimum grading requirements, runoff controls, and design and construction constraints.

Aquatic Resources. Removal of streambed sediments and floodplain sols may involve diversion of stream flow, bank stabilization, removal of riparian vegetation, and dredging. All land-disturbing construction activities (e.g., excavation of soils or sediments) with the potential to impact surface waters from storm water runoff would be designed and implemented using best management practices and erosion and sedimentation controls, as needed, to comply with stormwater control and aquatic resource

alteration requirements. The adverse effects of water-related projects on fish and wildlife resources should be considered per the Fish and Wildlife Coordination Act. The Clean Water Act of 1972, as amended, Section 404 requirements for protection of aquatic resources (*40 CFR 230.10*) must be met if the action involves any discharges of dredged or fill material into aquatic ecosystems.

Cultural Resources. Y-12 has proposed historic districts and buildings that are eligible for inclusion on the National Register of Historic Places (NRHP). One building within the NRHP-eligible historic district at Y-12, Building 9204-3 (Beta 3), has been recommended for national historic landmark status. The remedial action alternatives considered in this FFS include potential construction of a new water treatment facility to the south of Building 9204-3. The National Historic Preservation Act of 1966 (NHPA), Section 106, requires that a proposed activity be assessed for impacts to buildings or historic structures that are considered historic properties. The proposed water treatment facility, as currently designed, would not be expected to impact Building 9204-3, so these requirements are not identified as ARARs in Table A.2. The substantive requirements of the NHPA, however, would be considered in the future if the project design changes.

An archeological survey conducted for Y-12, *Archeological Evaluation of Y-12 Plant Facility Within the Fenced Areas of the Bear Creek Valley* (DuVall 1992), stated that "the potential for preserved prehistoric or historic archaeological sites is virtually non-existent due to the previous amount of disturbance observed within the valley." In accordance with the "Programmatic Agreement Among the Department of Energy Oak Ridge Operations Office, the Tennessee State Historic Preservation Officer, and the Advisory Council on Historic Preservation Concerning Management of Historical and Cultural Properties at the Oak Ridge Reservation" (1994), ground disturbance activities associated with remedial actions may proceed without further consultation with the Tennessee State Historic Preservation Officer or the Advisory Council on Historic Preservation as long as the depth and extent of new disturbance do not exceed the depth and extent of previous disturbances.

A.1.3 ACTION-SPECIFIC ARARs/TBCs

Action-specific ARARs include operation, performance, and design requirements or limitations based on the waste types, media, and remedial activities. Component actions include treatment of mercury-contaminated surface water in a newly constructed onsite wastewater treatment facility, waste management (characterization, staging, treatment, and disposal) and transportation of waste for onsite or offsite disposal, as appropriate. ARARs for each component of the remedial action alternatives are listed in Table A.3 and discussed below.

General Construction Activities. Requirements for the control of fugitive dust and storm water runoff potentially provide ARARs for all site preparation, construction, demolition, and excavation activities. Reasonable precautions must be taken, including the use of best management practices for erosion control to prevent runoff and application of water on exposed soil/debris surfaces to prevent particulate matter from becoming airborne. In addition, diffuse or fugitive emissions of radionuclides to the ambient air from the remediation activities, which are only one of potentially many sources of radionuclide emissions at a DOE facility, must comply with the Clean Air Act of 1970 (CAA), as amended, requirements in *40 CFR 61.92* [and *TDEC 1200-3-11-.08(6)*].

Removal of Contaminated Media. Removal of contaminated streambed sediments and/or floodplain soil in UEFPC may occur during construction of a new water treatment facility. Such soils and sediments will be collected, dewatered, characterized, and managed accordingly. Excavated soils and sediments may potentially include low-level waste (LLW), Toxic Substances Control Act of 1976 (TSCA), polychlorinated biphenyls (PCBs), Resource Conservation and Recovery Act of 1976 (RCRA)

solid or hazardous waste, or mixed waste, depending on the extent of contamination, and will be characterized and disposed in an appropriate CERCLA-approved onsite or offsite facility.

Much of the soil and sediment may be contaminated with mercury, and may, depending on the concentrations, be considered RCRA hazardous waste due to the toxicity characteristic (RCRA Waste Code D009). Any RCRA hazardous waste removed from the areal extent of contamination for subsequent disposal must meet the pertinent RCRA land disposal restrictions for hazardous waste at 40 CFR Part 268 et. Seq. Alternative treatment standards for soil listed in *40 CFR 268.49* require treatment of any constituent subject to treatment to a 90% reduction standard, as measured in leachate from the treated media, capped at 10 times the universal treatment standard levels listed in *40 CFR 268.48* for the constituents subject to treatment.

PCB remediation waste, as defined in *40 CFR 761.3*, is waste containing PCBs as a result of a spill, release, or other unauthorized disposal and includes soil, rags, and debris generated as a result of any PCB spill cleanup. Bulk PCB remediation waste includes environmental media containing PCBs, such as soil and dredged sediments and aqueous decantate from sediment. Excavated PCB-contaminated soil or sediment will be disposed of in an appropriate CERCLA-approved onsite or offsite facility in accordance with the performance-based disposal requirements of *40 CFR 761.61(b)(2)*. Contaminated soil/sediment that is generated during excavation may be temporarily stored in containers that meet the RCRA/TSCA requirements. (See waste generation, characterization, management, treatment, and disposal requirements listed in Table A.3.)

There are no action-specific ARARs for these excavation activities other than the general requirements to control fugitive dust emissions and storm water runoff as discussed above. However, chemical-specfic ARARs for these actions include radiation protection requirements for the public. Also, depending on the location of the soil/sediment removal, location-specific ARARs to protect sensitive resources such as aquatic resources and floodplains may be triggered (see above).

Water Treatment. This supplemental action evaluates a potential modification to the selected remedy specified in the UEFPC Phase I ROD to include an additional "discrete phase" response action to those response actions that have been and will be implemented within the scope of the Phase I ROD. As described in Section 2.2, the actions evaluated in this FFS would be intended to capture, treat and discharge waters that flow through certain areas covered under the Phase I ROD and potentially transport mercury-contaminated soil and sediment. Because this water would be treated to remove mercury prior to discharge into UEFPC, the requirements that are applicable to discharges of treatment system effluent into waters of the United States are applicable to this action. Meeting these applicable action-specific requirements is consistent with and will assist in meeting the in-stream chemical-specific AWQC criteria in the final Record of Decision for UEFPC. (As noted in Section A.1.1, the interim waiver previously approved under the Phase I ROD for the recreational AWQC in-stream standard for mercury would not be impacted by the proposed modification of the selected remedy as a result of this FFS and would remain in effect.)

Mercury-contaminated surface water would be captured and treated in a water treatment facility (if selected, constructed and operated as a modification of the Phase I remedy) before discharge to UEFPC. Discharges from the treatment facility will meet designated project-specific effluent limitations to ensure the discharge does not contribute to an exceedance of TDEC water quality standards in the stream. Other wastewaters collected during construction, dewatering soil/sediment, or decontamination activities will, if necessary, be transported to an onsite wastewater treatment facility for treatment and discharge. Wastewaters that are hazardous only because they exhibit a hazardous characteristic, and which are otherwise restricted from land disposal, are not prohibited if such wastes are managed in a treatment system that subsequently discharges to waters of the United States pursuant to a permit issued under Sect. 402 of the Clean Water

Act of 1972 (CWA) unless the wastes are subject to a specified method of treatment other than DEACT in *40 CFR 268.40* or are D003 reactive cyanide [*40 CFR 268.1(c)(4)(i); TDEC 0400-12-01-.10(1)(a)(30(iv)*]. In addition, onsite wastewater treatment units that are part of a wastewater treatment facility subject to regulation under Section 402 or Section 307(b) of the CWA [i.e., are regulated under the CWA National Pollutant Discharge Elimination System (NPDES) program] are exempt from the requirements of RCRA Subtitle C for all tank systems, conveyance systems (whether piped or trucked), and ancillary equipment [*40 CFR 264.1(g)(6)*; 40 CFR 260.10; 40 CFR 720.1(c)(2); 53 FR 34079 (September 2, 1988)].

Discharge of any air contaminants from the water treatment system must be in accordance with the appropriate provisions of *TDEC 1200-03 et. seq.* Potential releases of regulated air pollutants must be analyzed to determine compliance with TDEC air emission requirements. Air emission controls may be required to implement compliance (*TDEC 1200-03-09-.01(1)(d)*]. Release points that have the potential to discharge radionuclides into the air in quantities that could cause an effective dose equivalent (EDE) in excess of 1% of 10 mrem/year to any member of the public must also be monitored. Emission measurements in accordance with *40 CFR 61.93(b)(4)(1)* [*TDEC 1200-03-11-.08(6)*] must be made and all radionuclides that could contribute greater than 10% of the total EDE for a release point must be taken.

Waste Management. All primary wastes (contaminated soil, sediments, and surface water) and secondary wastes (contaminated personal protective equipment, treatment residuals, and decontamination wastewaters) generated during remedial activities will be appropriate categorized as either RCRA (solid or hazardous waste), PCB waste, radioactive waste, or mixed waste, and managed in accordance with the appropriate RCRA, TSCA, or DOE requirements for the particular waste(s). Solid wastes generated from remedial actions will be disposed of in an appropriate CERCLA-approved onsite disposal facility where possible. Wastes that do not meet the waste acceptance criteria for disposal at an onsite facility will be transported offsite for treatment and disposal at an approved offsite facility. Paved equipment/waste staging areas, as well as temporary stockpile areas, will be set up for the various waste types. These areas will be in close proximity to the area(s) of contamination, are necessary for implementation of this remedial action, and are therefore deemed "onsite" under CERCLA 121(e)(1) [see also *40 CFR 300.400(e)(1)*]. The stockpiled wastes will be scanned, characterized, and disposed of at an onsite disposal facility, as appropriate. If the chemical and/or radiological waste acceptance criteria for onsite disposal cannot be achieved, the waste will be shipped to an approved offsite facility. Table A.3 lists in detail the requirements associated with the characterization, storage, treatment, and disposal of the aforementioned waste types.

Land-Use Controls. Land-use controls will be used to prevent access to residual contamination with depth, and inappropriate future use of the site by residents. In accordance with *TDEC 0400-15-1-.08(10)*, institutional controls such as water use and restrictions/notices are required to prevent or limit exposure to hazardous substances left in place that might pose an unreasonable threat to public health, safety, or the environment. Such controls will apply after completion of the remedial actions and will be described in the Land-Use Control Implementation Plan. These controls could include land- use restrictions, as well as notices designed to warn and restrict potential users of the areas that contain residual contamination. Administrative restrictions will be recorded in accordance with state law on the original property acquisition records of DOE (and its predecessor agencies) that will notify anyone searching Oak Ridge Reservation property records that certain areas at UEFPC are contaminated. In accordance with DOE Order 458.1, controls including signs and appropriate radiological safety measures will be used to prevent disturbance of residual radioactive material where necessary. An existing program for excavation/penetration permits will be used to limit or prohibit such activities in areas with residual contamination. Information on the extent of site contamination will be available to permit requestors.

Transportation. Any remediation wastes that are transferred offsite for treatment and/or disposal must meet the requirements summarized in Table A.3 depending on the type of waste (e.g., RCRA, PCB, LLW, or mixed). These include packaging, labeling, marking, manifesting, and placarding requirements for the specific waste type. Wastes transported in commerce along public rights-of-way must meet the U. S. Department of Transportation requirements for hazardous materials, as well as the specific requirements for the type of waste. Pursuant to a regulatory decision approved by the Federal Facility Agreement parties, the Oak Ridge Reservation is treated as one site for purposes of conducted CERCLA response actions, and transferring wastes between noncontiguous facilities on the ORR is considered onsite transfer. The transfer of waste off of the ORR is considered offsite transfer.

In addition, CERCLA Sect. 121(d)(3) provides that the offsite transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be to a treatment, storage, or disposal facility that is in compliance with applicable federal and state laws and that has been approved by EPA for acceptance of CERCLA waste (see also the "Off-Site Rule" at *40 CFR 300.440 et seq.*). Accordingly, DOE will verify with the appropriate EPA regional contact that any needed offsite facility is acceptable for receipt of CERCLA wastes before transfer.

Table A.1. Chemical-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee

Action/medium	Requirements	Prerequisite	Citation(s)
In-stream general water quality criteria for release of wastewater or UEFPC	Dissolved oxygen shall not be less than 5.0 mg/l. Substantial or frequent variations in dissolved oxygen levels, including diurnal fluctuations, are undesirable if caused by man-induced conditions. Diurnal fluctuations shall not be substantially different than the fluctuations noted in reference streams in the region. There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.	Release of wastewater or effluents into surface water—**applicable** as instream criteria beyond the mixing zone	TDEC 0400-40-03-.03(3)(a) TDEC 0400-40-03-.03(4)(a) TDEC 0400-40-03-.03(5)(a) TDEC 0400-40-03-.03(6)(a)
	The pH value shall not fluctuate more than 1.0 unit over a period of 24 hours and shall not be outside the following ranges: 6.0-9.0.		TDEC 0400-40-03-.03(3)(b) TDEC 0400-40-03-.03(4)(b) TDEC 0400-40-03-.03(5)(b) TDEC 0400-40-03-.03(6)(b)
	The hardness of or the mineral compounds contained in the water shall not impair its use for irrigation or livestock watering and wildlife.		TDEC 0400-40-03-.03(5)(c) TDEC 0400-40-03-.03(6)(c)
	There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to fish and aquatic life or recreation or impair its use for irrigation or livestock watering and wildlife.		TDEC 0400-40-03-.03(3)(c) TDEC 0400-40-03-.03(4)(c) TDEC 0400-40-03-.03(5)(d) TDEC 0400-40-03-.03(6)(d)
	There shall be no turbidity, total suspended solids, or color in such amounts or of such character that will materially affect fish and aquatic life or result in any objectionable appearance to the water, considering the nature and location of the water.		TDEC 0400-40-03-.03(3)(d) TDEC 0400-40-03-.03(4)(d)
	The maximum water temperature shall not exceed 3 degrees C relative to an upstream control point. The temperature of the water shall not exceed 30.5 degrees C and the maximum rate of change shall be 2 degrees C per hour. There shall be no abnormal water temperature changes that may affect aquatic life unless caused by natural conditions. The temperature in flowing streams shall be measured at mid-depth. Temperature shall not interfere with its use for irrigation or livestock watering and wildlife purposes.		TDEC 0400-40-03-.03(3)(e) TDEC 0400-40-03-.03(4)(e) TDEC 0400-40-03-.03(5)(e) TDEC 0400-40-03-.03(6)(e)
	Waters shall not contain substances that will impart unpalatable flavor to fish or result in noticeable offensive odors in the vicinity of the water or otherwise interfere with fish or aquatic life.		TDEC 0400-40-03-.03(3)(f) TDEC 0400-40-03-.03(4)(g)

Table A.1. Chemical-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action/medium	Requirements	Prerequisite	Citation(s)
	Waters shall not contain substances or combination of substances including disease-causing agents which, by way of either direct exposure or indirect exposure through food chains, may cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), physical deformations, or restrict or impair growth in fish or aquatic life or their offspring.		TDEC 0400-40-03-.03(3)(g)
	Water shall not contain toxic substances that will render the water unsafe or unsuitable for water contact activities including the capture and subsequent consumption of fish and shellfish, or will propose toxic conditions that will adversely affect man, animal, aquatic life, or wildlife.		TDEC 0400-40-03-.03(4)(j)
	Water shall not contain other pollutants that will be detrimental to fish or aquatic life, or adversely affect the quality of the waters for recreation, irrigation, or livestock watering and wildlife.		TDEC 0400-40-03-.03(3)(h) TDEC 0400-40-03-.03(4)(k) TDEC 0400-40-03-.03(5)(f) and (g) TDEC 0400-40-03-.03(6)(f) and (g)
	Water shall not contain iron at concentrations that cause toxicity or in such amounts that interfere with habitat due to precipitation or bacteria growth.		TDEC 0400-40-03-.03(3)(i)
	The one-hour and thirty-day average concentrations of ammonia shall not exceed the acute criterion and chronic criteria calculated using the equations given in TDEC 0400-40-03-.03(3)(j).		TDEC 0400-40-03-.03(3)(j)
	Water shall not contain nutrients in concentrations that stimulate aquatic plant and/or algae growth to the extent that aquatic habitat is substantially reduced and/or biological integrity fails to meet regional goals or that the public's recreational uses of the water body or downstream waters are affected. Quality of downstream waters shall not be detrimentally affected.		TDEC 0400-40-03-.03(3)(k) TDEC 0400-40-03-.03(4)(h)
	The concentration of the *e. coli* group shall not exceed 126 per 100 ml as a geometric mean based on a minimum of 5 samples collected as specified in the regulation. The concentration of *e. coli* group in any individual sample shall not exceed 1 per 100 ml.		TDEC 0400-40-03-.03(3)(l) TDEC 0400-40-03-.03(4)(f)

Table A.1. Chemical-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action/medium	Requirements	Prerequisite	Citation(s)
	Waters shall not be modified through the addition of pollutants or through physical alteration to the extent that diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or, in the case of wadeable streams, substantially different from conditions in reference streams in the same ecoregion. The parameters associated with this criterion are the aquatic biota measured. These are response variables.		TDEC 0400-40-03-.03(3)(m)
	Quality of stream habitat shall provide for development of a diverse aquatic community that meets regionally-based biological integrity goals. Types of habitat loss include channel and substrate alterations, rock and gravel removal, stream flow changes, accumulation of silt, precipitation of metals, and removal of riparian vegetation. For wadeable streams, instream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.		TDEC 0400-40-03-.03(3)(n)
	Stream flow shall support fish and aquatic life criteria and recreational use.		TDEC 0400-40-03-.03(3)(o) TDEC 0400-40-03-.03(4)(m)
Criteria for release to surface water of water containing radioactivity	Characterize planned and unplanned releases of liquids containing radionuclides from DOE activities consistent with the potential for on- and off-site impacts and provide an assessment of radiological consequences as necessary to demonstrate compliance with requirements of DOE O 458.1.	Release of liquids containing radionuclides from DOE activities to surface water bodies—**TBC**	DOE O 458.1(4)(g)(1)
	Comply with the ALARA process requirements in paragraph 4.d. of DOE O 458.1.		DOE O 458.1(4)(g)(2)
	Conduct activities to ensure that liquid releases containing radionuclides from DOE activities are managed in a manner that protects ground water resources now and in the future, based on use and value considerations.		DOE O 458.1(4)(g)(3)
	Conduct activities to ensure that liquid discharges containing radionuclides from DOE activities do not exceed an annual average (at the point of discharge) of either of the following:		DOE O 458.1(4)(g)(4)
	• 5 pCi (0.2 Bq) per gram above background of settleable solids for alpha-emitting radionuclides.		DOE O 458.1(4)(g)(4)(a)
	• 50 pCi (2 Bq) per gram above background of settleable solids for beta-gamma-emitting radionuclides.		DOE O 458.1(4)(g)(4)(b)
	Except for tritium and sanitary sewers, apply BAT if at the point of discharge:		DOE O 458.1(4)(g)(5)

Table A.1. Chemical-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action/medium	Requirements	Prerequisite	Citation(s)
	• The annual average concentration of a given radionuclide is greater than the DOE-approved DCS value for water contained in the *Derived Concentration Technical Standard*, DOE-STD-1196-2011, or for multiple radionuclides, the composite DCS must be the sum of the fractional DCS values derived from DOE-approved DCS values,		DOE O 458.1(4)(g)(5)(a)
	• The discharge contributes greater than 10 mrem (0.1 mSv) annual TED to members of the public, or		DOE O 458.1(4)(g)(5)(b)
	• The collective dose from all DOE sources is greater than 100 person-rem (1 person-Sv) and the liquid discharge contributes 50 percent or more of this collective dose.		DOE O 458.1(4)(g)(5)(c)
	Manage the disposition of non-process water potentially containing radionuclides from DOE activities to protect soil and ground water and prevent the creation of future cleanup sites.		DOE O 458.1(4)(g)(10)
	Ensure that storm water runoff containing radionuclides from DOE activities is considered, as appropriate, as a pathway of exposure that has the potential for on- and off-site impacts. Using a graded approach, the receiving ecosystem including, but not limited to, wetlands, floodplains, streams, ponds, basins and lakes must be monitored to evaluate human or ecological impacts when warranted based on site specific risk.		DOE O 458.1(4)(g)(11)
Radionuclides in the environment	Exposure to individual members of the public from radiation shall not exceed a TED of 0.1 rem/year (100 mrem/year), exclusive of the dose contributions from background radiation, any medical administration the individual has received, or voluntary participation in medical/research programs.	Release of radionuclides to the environment from an active NRC-licensed operation—**relevant and appropriate**	TDEC 0400-20-05-.60(1)(a) DOE O 458.1(4)(b) (TBC guidance)
	The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with 1200-02-07-.35, does not exceed 0.002 rem (0.02 mSv) in any one hour.		TDEC 0400-20-05-.60(1)(b)
	Shall use, to the extent practicable, procedures and engineering controls based on sound radiation protection principles to achieve doses to members of the public that are ALARA.		TDEC 0400-20-05-.60(1)(c) DOE O 458.1(4)(d) (TBC guidance)

ALARA = as low as reasonably achievable
ARAR = applicable or relevant and appropriate requirement
AWQC = ambient water quality criteria
BAT = best available technology
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DCS = Derived Concentration Standard
DOE O = U.S. Department of Energy Order
NRC = Nuclear Regulatory Commission
ROD = Record of Decision
TBC = To-Be-Considered
TDEC = Tennessee Department of Environment and Conservation
TED = total effective dose
UEFPC = Upper East Fork Poplar Creek

Table A.2. Location-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee

Location characteristic(s)	Requirement(s)	Prerequisite	Citation(s)
Floodplains			
Presence of floodplain as defined in 10 *CFR* 1022.4	Design or modify selected alternatives to reduce risk of flood loss, minimize harm to or within floodplains, and restore and preserve floodplain values to extent practicable. Structures constructed in a floodplain shall meet, at a minimum, building standards pursuant to the National Flood Insurance Program.	DOE actions that involve potential impacts to, or take place within, floodplains—**applicable**	10 *CFR* 1022.3(a)(1) through (4)
	Undertake a careful evaluation of the potential effects of any new construction in floodplains. Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse impacts on floodplains.		10 *CFR* 1022.3(b) and (d)
	Avoid, to the extent possible, the long- and short-term adverse effects associated with occupancy and modification of floodplains.		10 *CFR* 1022.3(c)
	Measures to take to mitigate adverse effects of actions in floodplains include, but are not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecology-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 in order to minimize potential harm to or within the floodplain, consistent with the policies set forth in Executive Order 11990.		10 *CFR* 1022.14(a)
Aquatic Resources			
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 shall 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 a stream or other body of water, except where the maximum surface area of an impoundment is less than 10 acres or for land management activities by federal agencies with respect to federal lands under their jurisdiction—**relevant and appropriate**	16 *USC* 662(a) (*Fish and Wildlife Coordination Act*)

Table A.2. Location-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Location characteristic(s)	Requirement(s)	Prerequisite	Citation(s)
Waters of the state as defined in *TCA* 69-3-103(33)	Must comply with the substantive requirements of the ARAP for erosion and sediment control to prevent pollution of waters of the state.	Action potentially altering the properties of any waters of the state—**applicable**	*TCA* 69-3-108(b)(1)(j)
	Pollution control requirements, as detailed in each particular General Permit, include but are not limited to, the following: Activity must not result in discharge of waste or substances that may be harmful to humans or wildlife; Material may not be placed in a location or manner so as to impair surface water flow into or out of any wetland area; • Work must be carried out in a manner that does not violate water quality criteria as stated in TDEC 0400-4-3-.03, including, but not limited to, prevention of discharges that cause a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 0400-4-4; • Excavation and fill activities shall be kept to a minimum, and all excess material shall be hauled upland and properly stabilized or disposed of. • Sediment shall be prevented from entering waters of the state; erosion and sediment controls shall be designed according to the size and slope of disturbed or drainage 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 and sedimentation control shall be in place and functional before earthmoving operations begin and must be maintained throughout the construction period. Temporary measures may be removed at the beginning of the work day but shall be replaced at the end of the work day. • Litter, construction debris, and construction chemicals exposed to stormwater shall be picked up prior to anticipated storm events or otherwise prevented from becoming a pollutant source for stormwater discharges.	Action potentially altering the properties of any waters of the state—**TBC**	TDEC ARAP Program conditions common to all General Permits

Table A.2. Location-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Location characteristic(s)	Requirement(s)	Prerequisite	Citation(s)
Waters of the state as defined in *TCA* 69-3-103(33) (continued)	• Clearing, grubbing, or other disturbance of areas immediately adjacent to waters of the state shall be limited to the minimum necessary to accomplish the proposed activity. Unnecessary vegetation removal is prohibited, and disturbed areas shall be stabilized and revegetated as soon as practicable. • Appropriate steps shall be taken to ensure petroleum products or other chemical pollutants are prevented from entering waters of the state, including groundwater; • Adverse impacts to T&E species or cultural, historical, or archeological features or sites are prohibited.		
Location encompassing aquatic ecosystem as defined in 40 *CFR* 230.3(c)	The discharge of dredged or fill material into waters of the United States is prohibited if there is a practical alternative that would have less adverse impact. No discharge shall be permitted that results in violation of state water quality standards, violates any toxic effluent standard, and/or jeopardizes an endangered species or its critical habitat. No discharge will be permitted that will cause significant degradation of waters of the United States. No discharge of dredged or fill material shall be permitted unless appropriate and practicable steps in accordance with 40 *CFR* 230.70 et seq. are taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem.	Action that involves 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
Within an area impacting stream or any other water body -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 conservation by preventing loss of and damage to such resources.	Action that impounds, modifies, diverts, or controls a stream or other body of water, except where the maximum surface area of an impoundment is less than 10 acres or for land management activities by federal agencies with respect to federal lands under their jurisdiction—**relevant and appropriate**	16 *USC* 662(a) (*Fish and Wildlife Coordination Act*)

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
DOE = U.S. Department of Energy
EO = Executive Order
T&E = threatened and endangered
TCA = Tennessee Code Annotated
TBC = To-Be-Considered
TDEC = Tennessee Department of Environment and Conservation
USC = United States Code

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee

Action	Requirements	Prerequisite	Citation(s)
General Construction Standards—All Remediation 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:	Fugitive emissions from demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land —**applicable**	TDEC 1200-03-08-.01(1)
	• use, where possible, of water or chemicals for control of dust, and		TDEC 1200-03-08-.01(1)(a)
	• application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces which can create airborne dusts;		TDEC 1200-03-08-.01(1)(b)
	Shall not cause or allow fugitive dust to be emitted in such a manner as to exceed 5 minute/hour or 20 minute/day beyond property boundary lines on which emission originates.		TDEC 1200-03-08-.01(2)
Activities causing radionuclide emissions	Shall not exceed those amounts that would cause any member of the public to receive an EDE of 10 mrem per year	Radionuclide emissions from point sources, as well as diffuse or fugitive emissions, at a DOE facility —**applicable**	40 *CFR* 61.92 TDEC 1200-03-11-.08(6)
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. TNR10-0000 ("General Permit for Stormwater Discharges Associated with Construction Activities") to ensure that storm water discharge:	Dewatering or storm water runoff discharges from land disturbed by construction activity—disturbance of ≥ 1 acres total—**applicable**	*TCA* 69-3-108(1) TDEC 1200-4-10-.03(2)(a) General Permit No. TNR10-0000 (effective May 24, 2011) (TBC guidance)
	• does not violate water quality criteria as stated in TDEC 0400-40-03-.03 including but not limited to prevention of discharges that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 0400-40-04;	Storm water discharges from construction activities—**TBC**	General Permit No. TNR10-0000, Sect. 5.3.2
	• does not contain distinctly visible floating scum, oil, or other matter;		
	• does not cause an objectionable color contrast in the receiving stream; and		
	• 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.		

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
	Water Treatment		
Construction of outfall structure for discharge of wastewater	Construction, maintenance, repair, rehabilitation, or replacement of intake or outfall structures shall be carried out in such a way that work: Does not violate water quality criteria as stated in TDEC 0400-40-03-.03, including, but not limited to, prevention of discharges that causes a condition in which visible solids, bottom deposits, or turbidity impairs the usefulness of waters of the state for any of the designated uses for that water body by TDEC 0400-40-04. Activities in non-navigable streams shall be conducted in the dry; in navigable streams, where impracticable to work in the dry, work may be conducted within the water column. Shall be located and oriented so as to avoid permanent alteration or damage to the integrity of the stream channel, including the opposite stream bank. Alignment of the structure (except for diffusers) should be as parallel to the stream flow as is practicable, with the discharge pointed downstream. Diffusers may be placed perpendicular to stream flow for more complex mixing. Intake and outfall structures shall be designed to minimize harm and prevent impoundment of normal or base-flows. Velocity dissipation devices shall be placed as needed at discharge locations to provide a non-erosive velocity from the structure. Activity may not be conducted in a manner that would permanently disrupt the movement of fish and aquatic life. Material may not be placed in a location or manner so as to impair surface water flow into or out of any wetland area. Backfill activities must be accomplished in a manner that stabilizes the streambed and banks to prevent erosion. All contours must be returned to pre-project conditions to the extent practicable and completed activities may not disrupt or impound stream flow. Stream beds must not be used as transportation routes for construction equipment; Temporary stream crossings shall be limited to one point in the construction area and erosion control measures shall be utilized where stream banks are disturbed. Crossing shall be constructed so that stream flow is not obstructed. Following work, all materials used for temporary crossing must be removed and disturbed stream banks restored and stabilized.	Construction of intake and outfall structures in waters of the state—TBC	TDEC General Permit for Construction of Intake and Outfall Structures (effective July 1, 2010)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Construction of outfall structure for discharge of wastewater (continued)	Materials used in intake and outfall structures must be free of contaminants and wastes as defined by *TCA* 69-3-103(18).		
	Clearing, grubbing and other disturbances to riparian vegetation shall be kept to a minimum necessary for slope construction and equipment operations. Unnecessary tree removal is prohibited.		
	Sediment shall be prevented from entering waters of the state. Erosion and sediment control measures shall be properly selected, installed, and maintained and must be in place and functional before earth moving operations begin.		
	Litter, construction debris, and construction chemicals exposed to storm water shall be picked up prior to anticipated storm events or otherwise prevented from becoming a pollutant source during storms.		
	Excavated materials, removed vegetation, construction debris, and other wastes shall be removed to an upland location and properly stabilized or disposed of to prevent reentry into the waterway.		
	Take appropriate steps to ensure petroleum products or other chemical pollutants are prevented from entering waters of the state. In the event of a spill, take immediate measures to prevent pollution of waters of the state.		
Collection/treatment of surface water	Onsite 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.	Onsite wastewater treatment units that are subject to regulation under Sect. 402 or Sect. 307(b) of CWA (NPDES permitted) —**applicable**	40 *CFR* 270.1(c)(2)(v) TDEC 0400-12-01-.07(1)(b)(4)(iv) 40 *CFR* 264.1(g)(6) 40 *CFR* 260.10 53 *FR* 34079, September 2, 1988
Discharge of treated water into UEFPC	Shall receive, prior to discharge, the degree of treatment or effluent reduction necessary to comply with water quality standards and, where appropriate, will comply with the standard of performance as required by the Tennessee Water Quality Control Act of 1977 at *TCA* 69-3-103(30).	Point source discharge(s) of pollutants into surface waters of the state as defined in TCA 69-3-103(33)—**applicable**	TDEC 0400-40-05-.08 40 CFR 122.44
	Industrial wastewater discharges that are point source discharges subject to regulation under § 402 of the CWA, as amended, are not solid wastes for the purpose of hazardous waste management.	Generation of industrial wastewater for discharge—**applicable**	40 *CFR* 261.4(a)(2) TDEC 0400-12-01-.02(1)(d)(1)(ii)
	Discharge is 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 CWA wastewater treatment system—**applicable**	40 *CFR* 268.1(c)(4)(iv); TDEC 0400-12-01-10(1)(a)(3)(iv)(IV)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Emissions from water treatment off-gas system	Discharge of air contaminants must be in accordance with the appropriate provisions of Rules of the TDEC Chap. 1200-03 *et seq*., any applicable measures of control strategy, and provisions of the Tennessee Air Quality Act.	Emissions of air pollutants from new air contaminant sources—**applicable**	TDEC 1200-03-09-.01(1)(d)
	Source impact analysis shall demonstrate that allowable emission increases would not cause or contribute to air pollution in violation of any ambient air quality standard in Chap. 1200-03-03, of any national ambient air quality standard, or any applicable maximum allowable increase as defined in TDEC 1200-03-09-.01(4) (i.e., maximum increase in pollutant over baseline concentrations).		TDEC 1200-03-09-.01(1)(f)
	Radionuclide emission measurements in conformance with 40 *CFR* 61.93(b) shall be made. Shall measure all radionuclides which could contribute greater than 10 percent of the potential EDE for a release point.	Release points which have the potential to discharge radionuclides into the air in quantities which could cause an EDE in excess of 1 percent of 10 mrem/year to any member of the public—**applicable**	40 *CFR* 61.93(b)(4)(i) TDEC 1200-3-11-.08(6)
	Periodic confirmatory measurements shall be made to verify low emissions.	Other release points which have the potential to release radionuclides into the air—**applicable**	
Waste Generation, Characterization, Segregation, and Storage			
Characterization of solid waste	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) TDEC 0400-12-01-.03(1)(b)(1)
	Must determine if waste is listed under 40 *CFR* Part 261; or		40 *CFR* 262.11(b) TDEC 0400-12-01-.03(1)(b)(2)
	Must determine whether the waste is identified in subpart C of 40 *CFR* 261, characterizing the waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.		40 *CFR* 262.11(c) TDEC 0400-12-01-.03(1)(b)(3)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chap. 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); TDEC 0400-12-01-.03(1)(b)(4)
Characterization of hazardous waste	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) TDEC 0400-12-01-.06(2)(d)(1)
	Must determine if the waste meets the treatment standards in 40 *CFR* 268.40, 268.45, or 268.49 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)(i)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Characterization of hazardous waste (continued)	Must determine the underlying hazardous constituents (as defined in 40 *CFR* 268.2[i]) in the waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-waste waters treated by CMBST, RORGS, or POLYM of Sect. 268.42 Table 1) for storage, treatment or disposal —**applicable**	40 *CFR* 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
	Must determine if the waste is restricted from land disposal under 40 *CFR* 268 *et seq.* by testing in accordance with prescribed methods or use of generator knowledge of waste.		40 *CFR* 268.7 TDEC 0400-12-01-.10(1)(g)(1)(i)
	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 *CFR* 268.40 *et. seq*.		40 *CFR* 268.9(a) TDEC 0400-12-01-.10(1)(i)(1)
Temporary storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that: • waste is placed in containers that comply with 40 *CFR* 265.171-173, and	Accumulation of RCRA hazardous waste on site as defined in 40 *CFR* 260.10 —**applicable**	40 *CFR* 262.34(a)(1)(i); TDEC 0400-11-01-.03(4)(e)(2)(ii)(I)
	• the date upon which accumulation begins is clearly marked and visible for inspection on each container, and		40 *CFR* 262.34(a)(2); TDEC 0400-12-01-.03(4)(e)(2)(ii)
	• container is marked with the words “hazardous waste,” or		40 *CFR* 264.34(a)(3) TDEC 0400-12-01-.03(4)(e)(2)(iv)
	• container may be marked with other words that identify the contents.	Accumulation of 55 gal or less of RCRA hazardous waste at or near any point of generation—**applicable**	40 *CFR* 262.34(c)(1) TDEC 0400-12-01-.03(4)(e)(5)(i)(II)
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* 265.171 TDEC 0400-12-01-.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* 265.172 TDEC 0400-12-01-.05(9)(c)
	Keep containers closed during storage, except to add/remove waste.		40 *CFR* 265.173(a) TDEC 0400-12-01-.05(9)(d)(1)
	Open, handle and store containers in a manner that will not cause containers to rupture or leak.		40 *CFR* 265.173(b) TDEC 0400-12-01-.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 of RCRA-hazardous waste in containers with free liquids—**applicable**	40 *CFR* 264.175(a) TDEC 0400-12-01-.06(9)(f)(1)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Storage of hazardous waste in container area (continued)	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or	Storage of RCRA-hazardous waste in containers that do not contain free liquids **—applicable**	40 *CFR* 264.175(c) TDEC 0400-12-01-.06(9)(f)(3)
	Containers must be elevated or otherwise protected from contact with accumulated liquid.		
Characterization of LLW	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)
	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	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	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)
	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 M 435.1-1(IV)(L)(1)(b)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Packaging of solid LLW (continued)	Containers shall be marked such that their contents can be identified.		DOE M 435.1-1(IV)(L)(1)(c)
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 ppm—**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
Management of PCB/radioactive waste	Any person storing such waste 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 for disposal of PCB/ radioactive waste with ≥ 50 ppm PCBs —**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.		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 nonhazardous waste landfill (e.g., PCB bulk product waste under 40 *CFR* 761.62[b][1]), the person may dispose of such waste without regard to the PCBs, based on its radioactive properties alone in accordance with applicable requirements.		
Temporary storage of PCB waste in containers	Container(s) shall be marked as illustrated in 40 *CFR* 761.45(a).	Storage of PCBs and PCB Items at concentrations 50 ppm for disposal —**applicable**	40 *CFR* 761.65(c)(1)
	Storage area must be properly marked as required by 40 *CFR* 761.40(a)(10).		40 *CFR* 761.65(c)(3)
	Any leaking PCB Items and their contents shall be transferred immediately to a properly marked non-leaking container(s).		40 *CFR* 761.65(c)(5)
	Container(s) shall be in accordance with requirements set forth in DOT HMR at 49 *CFR* 171-180.		40 *CFR* 761.65(c)(6) 40 *CFR* 761.65(c)(8)
	The date shall be recorded when PCB items are removed from service, and the storage shall be managed such that PCB items can be located by this date. (Note: date should be marked on the container.)	PCB items (includes PCB wastes) removed from service for disposal—**applicable**	
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be non-leaking.	Storage of PCB/radioactive waste in containers other than those meeting DOT HMR performance standards —**applicable**	40 *CFR* 761.65(c)(6)(i)(A)
	For non-liquid 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).		40 *CFR* 761.65(c)(6)(i)(B)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Storage of PCB/radioactive waste in containers (continued)	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)
Storage of PCB waste and/or PCB/radioactive waste in a RCRA-regulated container storage area	Does not have to meet storage unit requirements in 40 *CFR* 761.65(b)(1) provided unit:	Storage of PCBs and PCB items designated for disposal—**applicable**	40 *CFR* 761.65(b)(2)
	• is permitted by EPA under RCRA Sect. 3004, or		40 *CFR* 761.65(b)(2)(i)
	• qualifies for interim status under RCRA Sect. 3005, or		40 *CFR* 761.65(b)(2)(ii)
	• is permitted by an authorized state under RCRA Sect. 3006, and		40 *CFR* 761.65(b)(2)(iii)
	• PCB spills cleaned up in accordance with Subpart G of 40 *CFR* 761.		40 *CFR* 761.65(c)(1)(iv)
Treatment/Disposal of Waste			
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 40 *CFR* 268.40 before land disposal. The table lists either "total waste" standards, "waste-extract" standards, or "technology-specific" standards (as detailed further in 40 *CFR* 268.42).	Land disposal, as defined in 40 *CFR* 268.2, of restricted RCRA waste—**applicable**	40 *CFR* 268.40(a) TDEC 0400-12-01-.10(3)(a)
	For characteristic wastes (D001–D043) that are subject to the treatment standards, all underlying hazardous constituents must meet the UTSs specified in 40 *CFR* 268.48.	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment unit that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well—**applicable**	40 *CFR* 268.40(e) TDEC 0400-12-01-.10(3)(a)(5)
	Soils may be land disposed if treated prior to disposal according to the alternative treatment standards of 40 268.49(c) or according to the UTS specified in 40 *CFR* 268.48 applicable to the listed hazardous waste and/or applicable characteristic of hazardous waste if the soil is characteristic.	Land disposal, as defined in 40 *CFR* 268.2, of restricted hazardous soils—**applicable**	40 *CFR* 268.49(b) TDEC 0400-12-01-.10(3)(j)(2)
Variance from a treatment standard for RCRA restricted hazardous wastes	A variance from a treatment standard may be approved if it is: • not physically possible to treat the waste to the level specified in the treatment standard, or by the method specified as the standard; or • inappropriate to require the waste to be treated to the level specified in the treatment standard or by the method specified as the treatment standard even though such treatment is technically possible.	Generation of a RCRA hazardous waste requiring treatment prior to land disposal—**applicable**	40 *CFR* 268.44 TDEC 0400-12-01-.10(3)(e)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Disposal of RCRA wastewaters in an CWA wastewater treatment unit	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 wastewaters managed in a wastewater treatment system which is NPDES permitted—**applicable**	40 *CFR* 268.1(c)(4)(iv) TDEC 0400-12-01-.10(1)(a)(3)(iv)(IV)
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)
Disposal of solid LLW	LLW shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility.	Generation of LLW for disposal at a DOE facility—**TBC**	DOE M 435.1-1(IV)(J)(2)
Disposal of PCB decontamination waste and residues	Shall be disposed of at their existing PCB concentration unless otherwise specified in 40 *CFR* 761.79(g).	PCB decontamination waste and residues for disposal—**applicable**	40 *CFR* 761.79(g)
Disposal of PCB cleanup wastes	Shall be disposed of either: • in a facility permitted, licensed or registered by a state to manage municipal solid waste under 40 *CFR* 258 or nonmunicipal, nonhazardous waste subject to 40 *CFR* 257.5 thru 257.30; or • in a RCRA Subtitle C landfill permitted by a state to accept PCB waste; or • in an approved PCB disposal facility; or • through decontamination under 40 *CFR* 761.79(b) or (c).	Generation of non-liquid PCBs at any concentration during and from the cleanup of PCB remediation waste—**applicable**	40 *CFR* 761.61(a)(5)(v)(A)
Disposal of PCB cleaning solvents, abrasives, and equipment	May be reused after decontamination in accordance with 40 *CFR* 761.79. For liquids, disposed of in accordance with 40 *CFR* 761.60(a).	Generation of PCB wastes from the cleanup of PCB remediation waste —**applicable**	40 *CFR* 761.61(a)(5)(v)(B)
Performance-based disposal of liquid PCB remediation waste	Shall be disposed of according to 40 *CFR* 761.60(a) or (e), or decontaminate in accordance with 40 *CFR* 761.79.	Disposal of liquid PCB remediation waste as defined in 40 *CFR* 761.3—**applicable**	40 *CFR* 761.61(b)(1)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Performance-based disposal of PCB remediation waste	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 • through decontamination in accordance with under 40 *CFR* 761.79	Disposal of non-liquid PCB remediation waste as defined in 40 *CFR* 761.3 —**applicable**	40 *CFR* 761.61(b)(2) 40 *CFR* 761.61(b)(2)(i) *and* (ii)
Risk-based disposal of PCB remediation waste	May be disposed of in a manner other than prescribed in 40 *CFR* 761.61(a) or (b) if approved in writing by EPA and method will not pose an unreasonable risk of injury to human health or the environment.	Disposal of PCB remediation waste —**applicable**	40 *CFR* 761.61(c)
Disposal of universal waste	The generator of the universal waste must determine whether the waste exhibits a characteristic of hazardous waste. If it is determined to exhibit such a characteristic, it must be managed in accordance with TDEC 0400-12-01-.01 through .10. If the waste is not hazardous, the generator may manage and dispose of the waste in any way that is in compliance with applicable federal, state, and local solid waste regulations.	Generation of universal waste (as defined in 40 *CFR* 273) for disposal—**applicable**	40 *CFR* 273.33 TDEC 0400-12-01-.12(3)(d)
Disposal of asbestos-containing waste material (e.g., transite siding, pipe lagging, insulation, ceiling tiles)	All asbestos-containing waste material must be deposited as soon as practicable at a waste disposal site operated in accordance with Section 61.154 or a site that converts RACM and asbestos-containing waste material into nonasbestos (asbestos free) material according to the provisions of 40 *CFR* 61.155.	Removal and disposal of RACM except Category I nonfriable asbestos containing material—**applicable**	40 *CFR* 61.150(b)(1) and (2) TDEC 1200-03-11-.02(2)(j)(2)(i) and (ii)
	May use an alternative emission control and waste treatment method that will control asbestos emissions equivalent to currently required methods, the alternative method is suitable for the intended application, and the alternative method will not violate other regulations and will not result in increased water or land pollution or occupational hazards.		40 *CFR* 61.150(a)(4) TDEC 1200-03-11-.02(2)(j)(2)(iii)
Transportation			
Transportation of hazardous materials	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 *CFR* 171–180.	Transportation of hazardous materials off site "in commerce"—**applicable**	49 *CFR* 171.1(c)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)
Transportation of LLW off site	LLW waste shall be packed and transported in accordance with DOE O 460.1C (*Packaging and Transportation Safety*) and DOE O 460.2A (*Departmental Materials Transportation and Packaging Management*) as detailed in the accompanying DOE Manuals and Guides for these Orders.	Preparation of LLW for offsite shipment—**TBC**	DOE M 435.1-(I)(1)(E)(11)
	To the extent practical, the volume of the waste and the number of the shipments shall be minimized.	Shipment of LLW offsite**—TBC**	DOE M 435.1-1(IV)(L)(2)
Transportation of PCB wastes	Must comply with the manifesting provisions at 40 *CFR* 761.207 through 40 *CFR* 761.218.	Relinquishment of control over PCB wastes by transporting, or offering for transport—**applicable**	40 *CFR* 761.207 (a)
Transportation of universal waste off site	Offsite shipments of universal waste by a large quantity handler of universal waste shall be made in accordance with 40 *CFR* 273-38 (TDEC 0400-12-01-.12[3][i]).	Offsite shipment of universal waste by a large quantity generator of universal waste—**applicable**	40 *CFR* 273.38 TDEC 0400-12-01-.12(3)(i)
Transportation of used oil off site	Except as provided in paragraphs (a) to (c) of this rule, generators must ensure that their used oil is transported by transporters who have obtained EPA ID numbers.	Offsite shipment of used oil by generators of used oil—**applicable**	40 *CFR* 279.24 TDEC 0400-12-01-.11(3)(e)
Transportation of hazardous waste off site	Must comply with the generator requirements of 40 *CFR* 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding, Sect. 262.40, 262.41(a) for record keeping requirements, and Sect. 262.12 to obtain EPA ID number.	Offsite transportation of RCRA hazardous waste**—applicable**	40 *CFR* 262.10(h) TDEC 0400-12-01-.03(1)(a)(8)
	Must comply with the requirements of 40 *CFR* 263.11–263.31. A transporter who meets all applicable requirements of 49 *CFR* 171-179 and the requirements of 40 *CFR* 263.11 and 263.31 will be deemed in compliance with 40 *CFR* 263.	Transportation of hazardous waste within the United States requiring a manifest **—applicable**	40 *CFR* 263.10(a) TDEC 0400-12-01-.04(1)(a)(1)
	The generator manifesting requirements of 40 *CFR* 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 *CFR* 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way **—applicable**	40 *CFR* 262.20(f) TDEC 0400-12-01-.03(3)(a)(6)

Table A.3. Action-Specific ARARs and TBC Guidance for Upper East Fork Poplar Creek Focused Feasibility Study Remedial Alternatives, Oak Ridge, Tennessee (continued)

Action	Requirements	Prerequisite	Citation(s)

ARAR = applicable or relevant and appropriate requirement
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR = Code of Federal Regulations
CMBST = Combustion
CWA = Clean Water Act of 1972
DEACT = deactivation
DOE = U.S. Department Energy
DOE M = Radioactive Waste Management Manual
DOE O = DOE Order
DOT = U.S. Department of Transportation
EDE = effective dose equivalent
EPA = U.S. Environmental Protection Agency
FR = Federal Register
HMR = Hazardous Materials Regulations
HMTA = Hazardous Materials Transportation Act
ID = identification
LLW = low-level (radioactive) waste
NPDES = National Pollutant Discharge Elimination System

PCB = polychlorinated biphenyl
POLYM = Polymerization
RACM = regulated asbestos-containing material
RCRA = Resource Conservation and Recovery Act of 1976
RORGS = Recovery of Organics
TBC = To-Be-Considered
TCA = Tennessee Code Annotated
TDEC = Tennessee Department of Environment and Conservation
UEFPC = Upper East Fork Poplar Creek
UTS = Universal Treatment Standard
WAC = waste acceptance criteria

APPENDIX B

BASIS OF COST ESTIMATES

THIS PAGE INTENTIONALLY LEFT BLANK

BASIS OF COST ESTIMATES

B.1 GENERAL INFORMATION

A treatability study and conceptual design study were initiated in 2012 for a water treatment system to reduce discharge of mercury at Outfall 200 using available American Recovery and Reinvestment Act (ARRA) funding, in support of the Phase I ROD requirement to investigate the viability of large-scale treatment of mercury-contaminated surface water at UEFPC. The resulting Conceptual Design Report (UCOR 2014) and Remedial Design Work Plan (DOE 2014) provide much greater detail in the system design than is typically available for a feasibility study, and serve as the basis for the cost estimates used in this report.

B.1.1 Accuracy of Estimates

The cost estimates presented in this Focused Feasibility Study are derived from the Conceptual Design Report (UCOR 2014). The accuracy of the estimates is +50% –30% in accordance with CERCLA guidance.

B.1.2 General Assumptions

This section discusses assumptions used to generate the cost estimates for all action alternatives. All costs are presented in 2013 dollars.

A DOE-ORO management and integration (M&I) contractor is assumed to coordinate remedial action efforts for DOE-ORO environmental management activities. The M&I may subcontract remediation fieldwork activities to a General Contractor, who in turn may subcontract to specialty subcontractors to perform different remediation tasks.

Remedial design, pre-design characterization, and engineering studies will be subcontracted, generally via fixed price contracts.

Operation and maintenance (O&M) activities will be performed by the DOE-ORO prime M&I contractor or its subcontractors.

B.1.3 Project Indirect Costs

Indirect costs are based on current Y-12 indirect rates. Indirect costs would include the following types of activities.

Remedial Design Work Plan – Before the initiation of Remedial Design (RD), the Remedial Design Work Plan (RDWP) will be prepared to state the objectives of RD. The RDWP will contain the following elements: site description, site history, summary of existing data, technical information about the tasks to be performed, schedule of completion, and a project management plan. The RDWP will be reviewed by a construction manager (CM) and will be submitted for regulatory approval.

Remedial Design Report – The Remedial Design Report will include Titles I and II design-related activities. This report will result in an approved construction design package to be used as the basis for

remedial activities. The RD report will contain a description of the evaluations conducted to select the remedial action methods, and appropriate supporting information (e.g., design calculations, process flow diagrams, etc.). The report also will discuss permit requirements, procurement methods and availability concerns, as well as a preliminary description of O&M activities with a projected annual cost estimate. The RD report will be reviewed by the CM and will be submitted for regulatory approval.

Remedial Action Work Plan – The Remedial Action Work Plan (RAWP) will include the constructability review based on the RD report. It also will include the work description of all remedial action activities assigned to a general contractor and subcontractors, detailed schedule of activities, an overall construction schedule and site requirements of various plans [e.g., general and site-specific safety plan, work plan, rigging plan, quality assurance plan, etc.] to be submitted by relevant contractors. The RAWP will be reviewed by the Architect/Engineer (A/E) and will be submitted for regulatory approval.

Project Integration – The A/E will provide Title III engineering support services including bid evaluation and inspections during construction, both in the office and in the field. The CM will participate in bid evaluation and oversee construction activities during the entire period of construction. The CM will ensure that the work is performed according to all of the applicable codes, per the intent of the RD report and plans submitted by the contractors. At the end of the facility construction, the CM will prepare a report of the construction activities. For remediation activities within secured areas, the M&I or management and operating (M&O) contractor for the Y-12 National Security Complex will provide security and access to the site.

B.1.4 Project Direct Costs

Material and Labor Pricing – The RA estimate is based on quantities developed for each component planned for the alternative to accomplish the desired results and assumptions. Each activity is then estimated for material costs and labor costs.

Labor Rates – Labor rates used in the estimate are based on most recent M&I rates and local Oak Ridge average subcontractor rates. The labor rates include direct cost, fringes, employer's liability, and workmen's compensation.

Material, Equipment, and Production – The material, equipment, and production rates were generated using national averages obtained from nationally recognized cost references such as R. S. Means and Richardson. The estimators used their experience to modify national average production rates for remedial action work. Most national cost references are based on the construction of facilities and not the remediation of existing facilities; therefore, adjustments are required to reflect the actual estimated cost of the work.

Vendor Quotes – Vendor quotes may be used in the estimate for certain activities, which are not commonly found in cost references. These vendor quotes could change based on final engineering.

O&M Costs – O&M costs do not include capital cost for the installation of equipment, wells, or the modification of existing facilities. Groundwater monitoring wells are assumed to be existing, and well maintenance is provided by others. While O&M activities would continue as long as the water treatment facility is needed, cost estimates are based on a fixed 30-year period for all alternatives.

Escalation – Consistent with EPA CERCLA guidance (EPA 1993) and OMB Circular A-94, a discount rate of 7% is assumed for the present value calculations.

B.2 COST ESTIMATES FOR REMEDIAL ALTERNATIVES

As noted above, the cost estimates presented in this Focused Feasibility Study are derived from the Conceptual Design Report (UCOR 2014). The cost estimation approach used in the Conceptual Design Report was to first develop a conceptual-level cost estimate for design and construction of a "comprehensive" mercury water treatment facility. In accordance with the adaptive management philosophy, this comprehensive system included all of the capabilities that have been identified as potentially required for treatment of UEFPC surface water at Outfall 200 for mercury removal, including a low-flow and high-flow intake structure and grit removal system capable of capturing and pre-treating up to 40,000 gpm from UEFPC, surge tanks with a capacity of 10 M gallons for storage of stormwater during high flow conditions, a treatment facility with a capacity to treat up to 3000 gpm flow from UEFPC (and stormwater storage during lower flow periods) by chemical precipitation, and final polishing using granular activated carbon (GAC) adsorption for additional mercury removal prior to effluent discharge. The cost estimate for this comprehensive system includes cost for design, construction, and project management through operational startup. For alternative comparison purposes, the cost used is the total fully burdened cost in FY2013 dollars and includes escalation, tax where applicable, bonding and insurance for construction, and contractor G&A and fee.

Estimates for the alternatives considered in the FFS are derived from the estimate for a comprehensive treatment facility in the Conceptual Design Report. The cost estimate was generally organized with process segments (e.g., chemical precipitation, GAC, etc.) identified as line items. This organization allowed costs for the alternatives with capacities equal to the comprehensive facility to be determined by selecting (or removing) the appropriate line items from the cost estimate (e.g., a 3000 gpm facility without GAC). For alternatives with a treatment capacity of 1500 gpm (i.e., one-half the capacity of the comprehensive facility), a power factor of 0.6 based on the ratio of the treatment capacity was used. This factor was applied as follows:

$$Cost\ of\ process\ at\ 1500\ gpm\ capacity = cost\ of\ process\ at\ 3000\ gpm\ \times \left(\frac{1500}{3000}\right)^{0.6}$$

Annual operations costs were estimated for each alternative based on the operations cost estimate for a comprehensive facility. The operations estimate includes costs for labor (management, operations, and maintenance), chemicals, utilities, and residuals management and disposal.

B.2.1 Alternative 2a: Water Treatment at Outfall 200 with 1500 gpm Treatment Capacity and No Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity of 1500 gpm (2.2 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Alternative 2a is comparable to Scalability Option 2 described in the Conceptual Design Report (UCOR 2014), and much of the conceptual design information and cost information presented below is summarized from that document. This alternative is intended to represent a minimal system capable of treating UEFPC surface water under base-flow conditions only.

The headworks for this facility and the grit removal system would be designed to manage a maximum flow of 3000 gpm, while all subsequent treatment operations would be designed to manage flows up to 1500 gpm of influent surface water plus up to 500 gpm of recycle flows (e.g., backwash water, filter press filtrate). Major components of the new water treatment facility would include:

- Headworks and intake structure, including manually cleaned bar screen, and overflow diversion to UEFPC for flow rates in excess of 3000 gpm. (Note: Consistent with the adaptive management approach, the headworks will be designed to support future expansion of the facility to manage flow rates up to 40,000 gpm, if required.)

- Vortex-grit chamber for grit removal under base-flow conditions (up to 3000 gpm), and grit classifier/washer.

- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed (2000 gpm capacity).

- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank (2000 gpm capacity).

- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers (2000 gpm capacity).

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream (2000 gpm capacity).

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC (2000 gpm capacity).

- Equalization, effluent and backwash holding tanks (2000 gpm capacity).

Alternative 2a is equivalent to Scalability Option 2 from the Conceptual Design Report (UCOR 2014). This option differs from the "comprehensive" treatment facility in: (1) the elimination of the GAC polishing operation, (2) the elimination of the stormwater storage tanks, and (3) the reduction of the treatment capacity for the precipitation and dewatering operations to 1500 gpm of influent surface water. Therefore, the cost estimate for the building housing the precipitation and dewatering operations was reduced using the 0.6 power described above to reflect the smaller building size required without the GAC adsorption units, the site preparation cost was reduced to reflect the elimination of the storage tanks, and the stormwater storage and GAC effluent polishing piping costs were deleted. The resulting estimate of capital cost for this alternative is $115 million.

O&M cost estimates for this alternative also were developed by scaling the estimated O&M costs for the "comprehensive" treatment system. Routine annual O&M costs for Alternative 2a are estimated at 60% of those for the "comprehensive" treatment system, based on the 1500 gpm treatment capacity. In addition, labor, energy, and equipment replacement costs also were estimated based on the cost estimates for the "comprehensive" treatment system but were not a simple ratio of the treated water volume. The annual O&M cost for Alternative 2a is estimated at $2.2 million per year.

The estimates of capital costs and O&M costs described above were used to calculate the present value cost of Alternative 2a, assuming a discount rate of 7% and a 30-year duration for O&M. The present value cost is estimated at $142 million.

B.2.2 Alternative 2b: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and No Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity for 3000 gpm (4.3 Mgd) of influent surface water with no capacity for retention and storage of stormwater flow in excess of treatment capacity. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, chemical co-precipitation/clarification, and multi-media filtration. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Alternative 2b is comparable to Scalability Option 4 described in the Conceptual Design Report (UCOR 2014), and much of the conceptual design information and cost information presented below is summarized from that document. This alternative is intended to represent a system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200.

The unit operations of grit removal, precipitation/clarification, and multimedia filtration/dewatering all would be designed to manage flows up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate). Major components of the new water treatment facility would include:

- Headworks and intake structure, including manually cleaned bar screen, and overflow diversion to UEFPC for flow rates in excess of 3000 gpm. (Note: Consistent with the adaptive management approach, the headworks will be designed to support future expansion of the facility to manage flow rates up to 40,000 gpm, if required.)

- Vortex-grit chamber for grit removal under base-flow conditions (up to 3000 gpm), and grit classifier/washer.

- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed (4000 gpm capacity).

- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank (4000 gpm capacity).

- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers (4000 gpm capacity).

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream (4000 gpm capacity).

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC (4000 gpm capacity).

- Equalization, effluent and backwash holding tanks (4000 gpm capacity).

Alternative 2b is equivalent to Scalability Option 4 from the Conceptual Design Report (UCOR 2014). This option differs from the "comprehensive" treatment facility in: (1) the elimination of the GAC polishing operation, and (2) the elimination of the stormwater storage tanks. Therefore, the cost estimate for the building housing the precipitation and dewatering operations was reduced using the 0.6 power described above to reflect the smaller building size required without the GAC operation, the site preparation cost was reduced to reflect the elimination of the storage tanks, and the stormwater storage and GAC effluent polishing piping costs were deleted. The resulting estimate of capital cost for this alternative is $125 million.

O&M cost estimates for this alternative also were developed by scaling the estimated O&M costs for the "comprehensive" treatment system. Routine annual O&M costs for Alternative 2b are estimated at 75% of those for the "comprehensive" treatment system, based on the 3000 gpm treatment capacity. In addition, labor, energy, and equipment replacement costs also were estimated based on the cost estimates for the "comprehensive" treatment system but were not a simple ratio of the treated water volume. The annual O&M cost for Alternative 2b is estimated at $2.7 million per year.

The estimates of capital costs and O&M costs described above were used to calculate the present value cost of Alternative 2b, assuming a discount rate of 7% and a 30-year duration for O&M. The present value cost is estimated at $158 million.

B.2.3 Alternative 2c: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 2 Million-Gallon Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity for up to 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 2 million gallons to manage flows up to 40,000 gpm. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity of 3000 gpm. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Alternative 2c is comparable to Scalability Option 4 described in the Conceptual Design Report (UCOR 2014), with the addition of a 2-million-gallon stormwater storage tank. This alternative is intended to represent a treatment system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200, and capable of capturing stormwater in excess of these flow rates for future treatment. The 2 million gallon storage capacity is intended to capture the initial runoff flow from most storm events (i.e., the "first flush"). Stormwater flows in excess of this storage capacity would bypass the treatment facility.

The unit operations of grit removal, precipitation/clarification, and multimedia filtration/dewatering all would be designed to manage flows up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. Major components of the new water treatment facility would include:

- The headworks for this facility would be constructed to manage a maximum flow of 40,000 gpm, using a two-stage weir system. Water flowing from Outfall 200 would be diverted into the inlet

channel of the headworks through an intake structure with manual bar screens and an adjustable weir. Under normal flow conditions, all influent water would be directed to the base-flow grit removal chamber, as described for Alternatives 2a and 2b. However, unlike Alternatives 2a and 2b, this system would also contain a much larger grit removal chamber for stormwater flows, capable of treating influent flows up to 37,000 gpm (52 Mgd). When stream flow does not exceed the capacity of the smaller base-flow unit, all influent water would be processed for grit removal in the base-flow unit. The larger wet-weather unit would operate only during storm events or when flows exceed base-flow conditions, and the stormwater treated in that unit would be pumped to the stormwater storage tanks following grit removal. Influent flows exceeding the headworks capacity of 40,000 gpm or the storage capacity would overflow the weir system and bypass the facility and continue to flow down UEFPC without treatment.

- Stormwater storage would consist of one above-ground steel tank with a capacity of 2 million gallons. Stormwater stored in this tank would be pumped to the equalization tank for treatment during non-storm conditions at a flow rate up to 1000 gpm.

- Two vortex-grit chambers for grit removal – one unit for base-flow conditions (up to 3000 gpm), and a larger unit for stormwater flows up to 37,000 gpm; both units would use a common grit classifier/washer.

- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed (4000 gpm capacity).

- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank (4000 gpm capacity).

- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers (4000 gpm capacity).

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream (4000 gpm capacity).

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC (4000 gpm capacity).

- Equalization, effluent and backwash holding tanks (4000 gpm capacity).

Alternative 2c is equivalent to Scalability Option 4 from the Conceptual Design Report (UCOR 2014), with the addition of one two-million-gallon storage tank, which also requires the larger headworks and the storm-flow grit removal system. The cost estimate for the building housing the precipitation and dewatering operations was reduced using the 0.6 power described above to reflect the smaller building size required without the GAC operation, and the GAC effluent polishing piping costs were deleted. The resulting estimate of capital cost for this alternative is $146 million.

O&M cost estimates for this alternative also were equivalent to the estimated O&M costs for the "comprehensive" treatment system with the exception of the costs associated with the GAC adsorption operations. The annual O&M cost for Alternative 2c is estimated at $3.1 million per year.

The estimates of capital costs and O&M costs described above were used to calculate the present value cost of Alternative 2c, assuming a discount rate of 7% and a 30-year duration for O&M. The present value cost is estimated at $185 million.

B.2.4 Alternative 2d: Water Treatment at Outfall 200 with 3000 gpm Treatment Capacity and 10 Million-Gallon Stormwater Storage

A new water treatment facility would be constructed near Outfall 200 with a treatment capacity for up to 3000 gpm (4.3 Mgd) of influent surface water and capacity for retention and storage of stormwater flow up to 10 million gallons to manage flows up to 40,000 gpm. The conceptual design for the treatment system would include the general process operations of coarse solids (grit) removal, solids precipitation/clarification, and multi-media filtration, with a treatment capacity for flows up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. The system design would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or stormwater retention, as needed in the future. Alternative 2c is comparable to Scalability Option 7 described in the Conceptual Design Report (UCOR 2014), and is intended to represent a treatment system capable of treating UEFPC surface water under base-flow conditions and up to the 95th percentile stream flow in UEFPC at Outfall 200, and capable of capturing stormwater in excess of these flow rates for future treatment. The 10 million gallon storage capacity is approximately equivalent to water volume generated by the 1-year 24-hour storm event (UCOR 2014). Peak flows from larger storm events would bypass the treatment facility, although the initial runoff flow from these storm events (i.e., the "first flush") would be captured.

The unit operations of grit removal, precipitation/clarification, and multimedia filtration/dewatering all would be designed to manage flows up to 3000 gpm of influent surface water plus up to 1000 gpm of recycle flows (e.g., backwash water, filter press filtrate) and stored stormwater. Major components of the new water treatment facility would include:

- The headworks for this facility would be constructed to manage a maximum flow of 40,000 gpm, using a two-stage weir system. Water flowing from Outfall 200 would be diverted into the inlet channel of the headworks through an intake structure with manual bar screens and an adjustable weir. Under normal flow conditions, all influent water would be directed to the base-flow grit removal chamber, as described for Alternatives 2a and 2b. Like Alternatives 2c, this system would also contain a much larger grit removal chamber for stormwater flows, capable of treating influent flows up to 37,000 gpm (52 Mgd). When stream flow does not exceed the capacity of the smaller base-flow unit, all influent water would be processed for grit removal in the base-flow unit. The larger wet-weather unit would operate only during storm events or when flows exceed base-flow conditions, and the stormwater treated in that unit would be pumped to the stormwater storage tanks following grit removal. Influent flows exceeding the headworks capacity of 40,000 gpm or the storage capacity would overflow the weir system and bypass the facility and continue to flow down UEFPC without treatment.

- Stormwater storage would consist of five above-ground steel tanks with a capacity of 2 million gallons each, for a total storage capacity of 10 million gallons. Stormwater stored in these tanks

would be pumped to the equalization tank for treatment during non-storm conditions at a flow rate up to 1000 gpm.

- Two vortex-grit chambers for grit removal – one unit for base-flow conditions (up to 3000 gpm), and a larger unit for stormwater flows up to 37,000 gpm; both units would use a common grit classifier/washer.

- pH control and dechlorination system – reaction tank for pH adjustment and dechlorination, as needed (4000 gpm capacity).

- Chemical precipitation tanks - including a sulfide-functional polymer addition system and reaction tank, followed by a ferric chloride coagulant addition system and reaction tank (4000 gpm capacity).

- Inclined plate clarifiers for solids removal, with rapid mix and flocculation chambers (4000 gpm capacity).

- Sludge thickening and dewatering - sludge from the clarifiers would go to a sludge thickening tank and then to a filter press for dewatering. The resulting filter cake would be sent for disposal while the filtrate would go to a backwash tank and then recycled back into the influent stream (4000 gpm capacity).

- Multimedia filtration - liquid effluent from the clarifiers would go to a tank for pH adjustment and then to a multi-media filtration tank, prior to discharge of the treated effluent back to UEFPC (4000 gpm capacity).

- Equalization, effluent and backwash holding tanks (4000 gpm capacity).

Alternative 2d is equivalent to Scalability Option 7 from the Conceptual Design Report (UCOR 2014). This option differs from the "comprehensive" treatment facility only in the elimination of the GAC polishing operation. Therefore, the cost estimate for the building housing the precipitation and dewatering operations was reduced using the 0.6 power described above to reflect the smaller building size required without the GAC operation, and the GAC effluent polishing piping costs were deleted. The resulting estimate of capital cost for this alternative is $179 million.

O&M cost estimates for this alternative also were equivalent to the estimated O&M costs for the "comprehensive" treatment system with the exception of the costs associated with the GAC adsorption operations. The annual O&M cost for Alternative 2d is estimated at $3.4 million per year.

The estimates of capital costs and O&M costs described above were used to calculate the present value cost of Alternative 2d, assuming a discount rate of 7% and a 30-year duration for O&M. The present value cost is estimated at $221 million.

B.3 REFERENCES

UCOR 2014. *Conceptual Design Report for the Outfall 200 Mercury Treatment Facility, Y-12 National Security Complex, Oak Ridge, Tennessee*. UCOR-4578.

DOE 2014. *Remedial Design Work Plan for the Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2599&D2, U.S. Department of Energy, Oak Ridge Office of Environmental Management, Oak Ridge, TN.

EPA 1993. *Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis*, OSWER Directive 9355.3-20, Office of Solid Waste and Emergency Response, Washington, D.C.

DISTRIBUTION

File–EMEF DMC–RC

REVIEW COMMENT AND RESOLUTION MATRIX

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 1	Pg. 2-1 & 2-2, Sec. 2.2	*The Remedial Action Objectives (RAOs) for this evaluation of remedial alternatives needs to be revised consistent with EPA's feedback provided during Project Team scoping meetings*. Attached please find our comments on the RAOs in the form of redline revisions.	DOE appreciates the detailed suggestions for revision of this section. The discussion of RAOs has been revised to incorporate the greater specificity suggested by this comment. The revisions to the RAOs proposed in this comment have been incorporated with minor modifications and also reflect the recent inter-agency agreement. Regarding suggested sub-watershed RAO #5, results from the pre-design studies for stormwater diversion and non-stormwater diversion did not identify significant opportunities for diversions that would significantly impact the treatment system design, so this suggested RAO may not be appropriate. Regarding suggested sub-watershed RAO #6, DOE prefers to include discussion of this topic in the text rather than in the list of RAOs. The OF200 water treatment facility would provide benefits for reducing potential contaminant releases from future D&D and remedial actions at WEMA, but this source has not been specifically evaluated in the conceptual design of the treatment facility to date, but would be evaluated during the planning for these future actions as additional characterization data become available.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 2	-	The document is not consistent in describing whether an Interim ARAR Waiver will be required for the treated effluent discharged from the OF 200 treatment plant. Several sections refer to the Phase I ROD ARAR waiver at Station 17 needing to be continued for the scope of this response action (e.g., Executive Summary, Section 3.3, Section 5.2.2.6, Section 5.3.1.2, Section 5.3.4 and Table 5.2). However, in other sections of the document, it appears that DOE ORR's position is that a waiver may not be needed (e.g., Section 5.2.2.2, Section 5.2.3.2, and Section 5.2.4.2*). This FS should be clear throughout as to whether the alternatives will or will not meet ARARs.* EPA agrees that the scope of this response action will contribute toward meeting the Phase I ROD goal of achieving a 200 ppt mercury concentration level in the UEFPC surface water migrating offsite. However, EPA does not agree that the Phase I ROD watershed Interim ARAR waiver for the recreational in-stream ambient water quality criterion (AWQC) of 51 ppt for mercury is necessary or appropriate for the specific ARARs for the OF 200 water treatment plant for three primary reasons. First, as noted in the comment above and as described by DOE during several Project Team scoping meetings, the OF 200 treatment plant effluent discharge is expected to meet 51 ppt for mercury for the primary treatment components and with common industry treatment technologies, including a final stage treatment technology of granular activated carbon). EPA supports the use of a contingency remedy to deploy the final treatment stage, if necessary, based on an initial period of operation monitoring of the primary treatment stage. Second, the treatment of contaminated water in the treatment plant and its subsequent discharge is an action that is not considered interim for which an Action Specific ARAR waiver is appropriate. The treated water will migrate offsite and will not be available for any subsequent final treatment to meet 51 ppt as a part of an action under any final remedy. Moreover, discharging treated effluent to levels greater than 51 ppt for mercury that migrates in surface	The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect. Text in the FFS and Proposed Plan documents has been revised to more clearly indicate that no new ARAR waivers would be requested, but the previously approved waiver would remain in effect. As noted in this comment, mercury concentrations in fish tissue have not been observed to decrease over time commensurate with the reduction of mercury concentrations in UEFPC surface water. Ongoing and future studies may provide a better understanding of this apparently complex relationship between mercury concentrations in surface water and in fish tissue. The new water treatment facility at OF200, if selected and constructed, would be only one component of the comprehensive mercury remediation program for Y-12 that ultimately would attain reductions in mercury concentrations consistent with the AWQC in-stream standard and target levels in fish.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		water offsite does not meet 40 CFR 300.430(a)(ii) NCP Program Management Principle that an interim remedy "not be inconsistent with the final remedy." The FFA parties have agreed that the final remedy will achieve 51 ppt for mercury in UEFPC surface water. Discharge of treated effluent greater than this AWQC standard is inconsistent with the anticipated final remedy. Finally, Figure 2.1 shows that despite a historical reduction in mercury flux in water, fish concentrations have remained steady or have increased slightly. Given this lack of response in fish uptake similar to the downward trend in water and the listing of the creek as an impaired water body under Section 303(d) of the Clean Water Act for mercury, *further mercury inputs into the stream should not be allowed to exceed the legally required AWQC standard*. The current uncertainty in the relationship of the water column concentration trend as compared to fish uptake trend has not been demonstrated by DOE ORR as the basis for waiving the AWQC discharge standard. Longer term studies may reveal that the final cleanup goal should be lower than the AWQC to achieve the desired fish uptake goal.	
General 3	Pg 3-26, Fig. 3.3	Figure 3.3 includes activities to "Implement Feasible Diversions" of water run on that will be an important role in designing the feasible storm water runoff treatment capacity. *EPA views the planned and ongoing six pre-design studies and the resultant implementation of diversion of water inputs that add to base and storm flow are key components of the OF 200 remedy evaluation and must be included in the feasibility study.*	Figure 3.3 (and also 3.4) was excerpted from the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex*, and was included in the D1 FFS only to illustrate that the proposed water treatment system at OF200 is only one component of the comprehensive remedial action program for mercury at Y-12. Results of the pre-design studies conducted in support of the conceptual design of the proposed OF200 water treatment system have been incorporated into the FFS and Proposed Plan. The stormwater and non-stormwater diversion studies did not identify opportunities for

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
			stormwater diversion that would significantly impact the facility design. The stormwater characterization and mercury flux modeling studies helped to improve understanding of mercury flux at OF200.
General 4	Pg. 3-26, Fig. 3.3	Figure 3.3 includes additional studies that will lead to a "CERCLA Alternatives Evaluation." These activities are envisioned to be implemented within the current FFA Appendix E and first two years of the current FFA Appendix J time schedules. EPA expects a milestone for a FFA Primary Document work plan to define these studies and the schedule leading to a feasibility study report for subsequent response actions. In response to this comment *provide a plan to modify Appendix E and J for these activities.*	Figure 3.3 (and also 3.4) was excerpted from the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex*, and was included in the D1 FFS only to illustrate that the proposed water treatment system at OF200 is only one component of the comprehensive remedial action program for mercury at Y-12. The future CERCLA Alternatives Evaluation is outside the scope of this FFS.
General 5	-	The FFS does not indicate if the proposed alternatives are flexible enough to accommodate a final remedy that would meet the AWQC for mercury and effectively manage base flow water inputs, including storm water. The Executive Summary states, "The system design also would be configured to maintain flexibility and expandability to accommodate scaling up of treatment capacity, treatment processes, and/or storm water retention, as needed and if warranted by future conditions." However, the FFS does not present an outline for this future, final remedy and as such it is not clear if any of the proposed alternatives could be used in this scenario. *Revise the FFS to present a more detailed description of how the proposed alternatives would fit in with a potential final remedy for the site.* Also, the FFS does not present adequate alternatives for storm water storage. For example, Section 3.3.2, Alternative 2 – Water Treatment at Outfall 200, indicates	DOE agrees that it is appropriate to add another alternative with stormwater storage capacity less than 10 million gallons, to provide a more complete range of alternatives. The FFS and Proposed Plan have been revised to include this additional alternative. The new water treatment facility at OF200, if selected and constructed, would be only one component of the comprehensive mercury remediation program for Y-12. This facility would supplement the interim source control actions selected in the Phase I ROD. Operation of the new water treatment facility would continue until mercury releases from Y-12 to

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		that the large variability in stream flow is one of the primary challenges in designing a water treatment facility for UEFPC; however, one potential solution to this design issue, storm water storage, is only part of one alternative (Alternative 2c). As the large variability in stream flow is one of primary challenges of the design, it appears the additional alternatives should include storm water storage. *Revise the FFS to include additional alternatives for storm water storage and an explanation for why any alternative would not include storm water storage, given the large variability in stream flow.*	UEFPC have declined to levels that no longer require treatment – that is, completion of these source control actions may reduce mercury releases to the point to the point where this treatment facility is no longer needed, at which time the facility would be decommissioned. The OF200 water treatment system may or may not be a part of the final remedy for UEFPC, which has yet to be determined.
General 6	-	Page 1-24 lists other surface water COCs [e.g. PCBs] for which discharge ARARs may be needed.	The current treatment system design has been developed specifically for removal of mercury. No other COCs in UEFPC surface water currently exceed acceptable levels. The referenced text summarizes findings of the RI report, and has been revised for clarification.
General 7	-	The FFS does not provide alternatives which meet the Tennessee ambient water quality criteria (AWQC) for mercury of 51 nanograms per liter (ng/L) at the site boundary (i.e., Station 17), the Y-12 National Pollutant Discharge Elimination System (NPDES) permit compliance point. While the FFS indicates that the level of mercury in surface water remains above desirable levels, none of the proposed treatment technologies and system configurations (i.e., alternatives) appears capable of capturing and treating all of the yearly Outfall 200 (OF200) discharge volume. As a result, even with the most robust alternative, the FFS indicates approximately 13% of the mercury flux would not be treated, and approximately 8% of the water would bypass the system without being treated. As such, it is not clear why a treatment system which meets the AWQC at Outfall 200 and Station 17 is not proposed or a clear path towards achieving this criterion is not included in the FFS. While it is understood that this is response action is expected to be a	The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect. Under all action alternatives, some portion of the discharge from OF200 would bypass the treatment facility and would be discharged to UEFPC without treatment under some high flow conditions – that is, it would be cost prohibitive to construct a facility with treatment and storage

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		phased in approach to subsequent final remedial actions for the full scope of the watershed mercury cleanup strategy, a more comprehensive alternative(s) should be presented for this phase which meets AWQCs and is protective of human health and environmental. *Revise the FFS to present an alternative which meets the AWQC at Outfall 200.*	capacity sufficient for any possible storm event. All alternatives incorporate a modular and scalable design to allow for future increases in treatment and/or storage capacity if needed. All action alternatives are considered protective.
General 8	-	The FFS uses qualitative language to describe remedial goals in the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, DOE/OR/01-1951&D3, dated 2002 (Phase I ROD); however, specific, *quantitative based goals should be referenced*. For example, the Executive Summary indicates that the after the previous actions under the Phase I ROD, the level of mercury in surface water remains above "desirable levels." Also, the FFS indicates that the actions evaluated to modify the Phase I ROD selected remedy are to achieve "further reductions" in mercury releases. For clarity, *the FFS should use quantitative descriptions of the goals of the Phase I ROD and for goals of the FFS. Revise the FFS to use quantitative goals for mercury levels in surface water which are protective of human health and the environment.*	The FFS has been revised to specify remediation goals in a more quantitative manner as requested. The RAO specified in the Phase I ROD is correctly stated (i.e., "to restore surface water to human health recreational risk-based values at Station 17"). While this FFS does not propose to change the watershed-level RAO from the Phase I ROD, it also specifies "sub-watershed" RAOs specific to the proposed water treatment facility that would contribute toward attainment of the Phase I ROD RAO, as suggested by EPA and TDEC.
General 9	Exec. Summary (etc.)	The Executive Summary describes the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex, Oak Ridge, Tennessee*, DOE/OR/01-2605&D2, dated 2014 (Strategic Plan) and adaptive management as part of the on-going process to reduce mercury in the Upper East Fork of Poplar Creek (UEFPC); however, *the Strategic Plan and adaptive management are not part of the Phase I ROD.* While it appears appropriate to reference the Strategic Plan and adaptive management, it should be clearly stated that these documents/approaches do not supersede the CERCLA process. *Revise the FFS to address this issue.*	This comment is correct that the *Strategic Plan* is not part of this FFS or the Phase I ROD. The *Strategic Plan* is discussed in this FFS only to illustrate that the proposed water treatment system at Outfall 200 is only one component of the comprehensive remedial action program for mercury at Y-12. Appropriate CERCLA documentation will be prepared for other components of the *Strategic Plan* as required, but is outside the scope of this FFS. The FFS has been revised to clarify this issue.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 10	Exec. Summary	The Executive Summary describes the remedial actions in the FFS as early actions; however, according to Section *8.2.1 Interim Actions Versus Early Actions of the Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, dated July 1999 (ROD Guidance),* "Interim remedial actions should not be confused with 'early remedial actions.' 'Early', in this case is simply a description of when the action is taken in the Superfund process. Thus, an early action is one that is taken before the RI/FS for the site or operable unit has been completed." *Revise the Executive Summary to clearly indicate that the action proposed in the FFS is part of interim actions.*	DOE considers the interim source control measures selected in the Phase I ROD and the additional interim source control actions (i.e., additional water treatment at OF200) evaluated in this FFS to be CERCLA interim actions. The FFS has been revised to correct this terminology and eliminate the term "early action" (except where that term is part of the title for that action).
General 11	-	The FFS does not describe the path towards, or timetable for, achieving the long-term goal of attainment of the Tennessee AWQC for mercury in surface water throughout the UEFPC watershed. The Executive Summary states, "This RAO [Remedial Action Objective] was selected with the recognition that remediation of the UEFPC watershed would be conducted using a phased approach, and that an ultimate long-term goal would be the attainment of the Tennessee ambient water quality criteria (AWQC) for mercury." However, the completion of Phase I Interim ROD response actions was originally scheduled to be completed in 2016 and to be followed with a final Remedial Investigation Work Plan in 2017 and a final Upper East Fork Poplar Creek Surface Water ROD in 2018 (See FFA Appendix J April 15 2004). As such, it is not clear why the FFS does not refer to or propose FFA schedules for completing the interim action (e.g., require an Remedial Investigation/Feasibility Study (RI/FS) Work Plan for completing the RI/FS and select a final action) and not leave meeting the AWQC for mercury to an indeterminate future time. It is noted that Figure 3.4, Strategic Schedule for Mercury Cleanup at Y-12, indicates a Surface Water ROD is expected in the 2025 timeframe. *Revise the FFS to present the path forward, and timetable for, achieving the long-term goal of attainment of the Tennessee AWQC for mercury at Station 17 that is consistent with the current Appendix E and J.*	The scope of this FFS is limited to an interim source control action (i.e., treatment of the discharge from the WEMA storm sewer system at OF200) to supplement the source control actions previously selected under the Phase I ROD to further reduce mercury releases to UEFPC surface water. The schedules originally presented in the Phase I ROD for completion of the Phase I interim source control actions have been delayed due to funding constraints, construction logic, and other factors. Schedules and plans for completion of remedial actions at UEFPC may be updated as needed through appropriate documentation. The *Strategic Plan* is outside the scope of this FFS, and is discussed in this FFS only to illustrate that the focused scope of this FFS is only one component of the comprehensive remedial action program for mercury at Y-12.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 12	-	The performance objective for mercury in surface water (200 ng/L) at OF 200 proposed in the FFS does not appear to be appropriate. As there is an established AWQC for mercury, it is not clear why a series of alternatives was not developed to meet this criterion *Revise the FFS to include alternatives that meet the AWQC standards for all COCs.*	The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect. Otherwise, all action alternatives considered in this FFS would meet all ARARs.
General 13	Pg. 1-14 to 1-16, Sec. 1.1.5	Section 1.1.5, Integrated Mercury Strategy for Y-12, indicates studies are underway to evaluate methods to reduce the volume of baseflow and stormwater sewer contributions reaching the new treatment facility, with a goal of ultimately reducing the volume of water requiring treatment; however, these studies are critical to effect the development of alternatives in the FFS. For example, a significant reduction in flow might allow for a more comprehensive treatment system that does not require significant bypass. *Revise the FFS to discuss the implications of these future studies on selection of the remedy.*	Results of the pre-design studies conducted in support of the conceptual design of the proposed OF200 water treatment system have been incorporated into the FFS and Proposed Plan. The stormwater and non-stormwater diversion studies did not identify opportunities for water diversion that would significantly impact the facility design. The stormwater characterization and mercury flux modeling studies helped to improve understanding of mercury flux at OF200.
General 14	Pg. 2-1 & 2-2, Sec. 2.2	The RAO presented in the FFS lacks detail. Section 4.1.2.1 (Development and Screening of Alternatives) of the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA/540/G-89/004), dated October 1988 (RI/FS Guidance) states that RAOs should specify the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed. However, the RAO presented in Section 2, Remedial Action Objectives, lacks sufficient detail. Specifically, the contaminants and exposure pathways are not presented. In addition, the basis for the preliminary remediation	The FFS and Proposed Plan have been revised to discuss the RAOs in greater detail as suggested by this comment and General Comment 1. The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			Comments By: Jon Richards, USEPA (November 17, 2014)
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		goal (i.e., 200 ng/L) is not supported by calculations and a technical basis is not presented for not using the AWQC of 51 ng/L. As such, a range of treatment and containment alternatives to be developed cannot be adequately identified. *Revise the FFS to provide clearly defined RAOs that specify the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed.*	in effect.
General 15	-	The FFS makes reference to the "first flush" theory on several occasions; however, the FFS does explain why this theory is important or provide data to support the theory. It is noted that Appendix F (Dry Weather Flow and Wet Weather Flow Water Characterization Testing Results) of the Final Conceptual Design for Outfall 200 Mercury Treatment Facility, dated January 18, 2013 (CDR), presents the first flush theory which suggests that early in a storm event and later in the storm event's discharge cycle, the filterable (>0.45 micron) suspended particulate fraction diminishes, and the unfilterable (<0.45 micron) mercury concentrations rebound from the initial dilution during the storm peak. However, *this theory appears to be based on a limited data set from relatively smaller storm events.* The treatment technologies and system configurations presented in the FFS are directly impacted by whether or not the first flush theory is accurate. For example, if the mercury concentration and total suspended solids (TSS) do spike at the beginning of a storm event, an OF200 system can be designed to target this occurrence. However, insufficient data is currently provided to substantiate that the first flush theory is occurring during small and large storm events. *Revise the FFS to provide information to substantiate that the first flush theory is occurring during small and large storm events, and how this influences the proposed alternatives.*	The "first flush" theory – i.e., the enhanced release of mercury during the early stages of storm events – is suggested by available monitoring data for UEFPC and empirical observations during storm events. The stormwater characterization and mercury flux modeling studies conducted in support of the conceptual design of the proposed OF200 water treatment system provide a better understanding of flow dynamics in UEFPC and the flux of mercury and total suspended solids during base-flow conditions and storm events, and confirm the first flush effect. These studies estimated that the initial runoff from storm events contains an elevated loading of both total mercury and total suspended solids, and that these concentrations drop off rapidly after peaking as the flow subsides to pre-storm levels. Approximately 65% of the total mercury and 69% of the total suspended solids mass released during a storm event was estimated to occur in the runoff from the 60-minute period surrounding the hydrograph peak during the

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
			early phase of the storm. However, these studies also estimate that approximately 68% of the annual mercury flux but only 18% of the total suspended solids flux is estimated to occur during dry weather (base-flow) conditions with the remainder associated with storm events. Results of these studies have been incorporated into the FFS and Proposed Plan.
General 16	-	The FFS does not indicate if the proposed treatment system designs account for increased mercury loading from future demolition activities. As the FFS describes future demolition activities that may increase the mercury loading on the proposed alternatives for surface water treatment systems, it appears that the FFS should describe how this factor is included in the treatment system designs. *Revise the FFS to include information on how the proposed alternatives account for increased mercury loading from future demolition activities.*	The FFS has been revised to provide additional discussion of this potential future source. The proposed water treatment system at Outfall 200 may provide benefits for control of potential releases of contaminants from future WEMA D&D actions; however, this source has not been specifically evaluated in the conceptual design for the treatment system. The future WEMA remediation actions will include comprehensive contamination control measures and best management practices to minimize any release of contaminants. The facility would provide additional protection against potential contaminant releases to UEFPC, but the effectiveness of treatment would be evaluated during the planning for these future WEMA projects as additional characterization data become available. The modular design of the water treatment system would facilitate any changes that might be needed.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 17	-	The basis for the requested extension of the interim applicable or relevant and appropriate requirement (ARAR) waiver for the AWQC for mercury of 51 ng/L is not clear. As there appear to be treatment technologies available to meet this criterion, the basis for the continuation of the interim waiver is unclear. *Revise the FFS to provide additional information to support the requested extension of the interim ARAR waiver*.	The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to meet the AWQC standard of 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect.
General 18	-	The problem(s) to be addressed by the FFS are inconsistently, and potentially inaccurately, defined. Similarly, the RAOs, as they relate to addressing the problem(s) at hand, are unclear. For example, according to Section 1.2.1, Problem Summary, the FFS problems include "releases of mercury to Upper East Fork of Poplar Creek [UEFPC] surface water from shallow groundwater discharge, storm sewers, and other sources remain above interim and long-term goals." However, review of the FFS indicates that groundwater contamination (groundwater-to-surface water discharges) is not being addressed at this time. As such, it appears that the FFS problem summary in Section 1.2.1 warrants revision or additional clarification. In addition, Section 3, Screening of Remedial Action Technologies and Development of Alternatives, states that "the primary problem addressed in this FFS is exposure of human recreational receptors to ingestion of fish containing unacceptable levels of mercury due to the presence of mercury in UEFPC surface water and sediment as well as exposure of ecological receptors to mercury." However, the RAOs presented in Section 2.2, Remedial Action Objectives, do not address exposures to ecological receptors. As such, it is unclear if and how ecological receptor exposures will be addressed. *Revise the FFS to consistently present the problems to be addressed by the remedial alternatives presented in the FFS. In addition, revise the RAOs such that they address all of the problems at hand*.	DOE appreciates the identification of potential inconsistencies pointed out in this comment. The FFS has been revised to describe the site problems with greater consistency. The scope of this FFS is a highly focused interim action to reduce mercury releases from OF200 to UEFPC surface water. This interim action is only one component of a much larger multi-faceted remedial action program for UEFPC. Mercury concentrations in UEFPC surface water do not present an unacceptable risk to human receptors due to the administrative controls already implemented to prevent fish ingestion. Studies are underway to develop a better understanding of potential risks to ecological receptors, but these studies are outside the scope of this FFS. The RAOs for this interim action are not intended to address ecological risks, although the reduction in mercury releases that would result from this action could be beneficial to ecological receptors.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 19	-	It is unclear how the alternatives (i.e., Alternative 2 – Water Treatment at Outfall 200 and the associated sub-alternatives) presented in the FFS were developed based on the process options discussed in Section 3.2.2, Evaluation of Remaining Process Options. According to Section 4.2.6, Assemble Alternatives, of the RI/FS Guidance, "In assembling alternatives, general response actions and the process options chosen to represent the various technology types for each medium or operable unit are combined to form alternatives for the site as a whole." As discussed in Section 3.2.2 of the FFS, various institutional controls options, containment options, removal options, treatment options, and disposal options were carried forward as representative process options, and Section 3.3, Development and Description of Alternatives, states that "remedial alternatives have been developed to help achieve the RAO using process options identified in Section 3.2;" however, based on the descriptions of the alternatives presented in Section 3.3, it appears that numerous process options which were supposedly carried forward were actually screened out. The screening process which resulted in the alternatives that were developed is not discussed. In addition, it is noted that the last paragraph of Section 3.3 states that "the remediation strategy for the alternatives considered in this FFS focuses on ex situ treatment of surface water for mercury removal." *The FFS should be revised to more clearly discuss how the alternatives reflect the process options retained. It is recommended that a table be provided which summarizes and supports this discussion. Revise the FFS accordingly.*	This section has been revised to focus more narrowly on only those technologies and process options directly relevant to the proposed water treatment facility, as also suggested in a TDEC comment, and also to directly reference and incorporate the screening of treatment technologies conducted for the conceptual design report. Similarly, Section 3.3 has been revised to better describe how the screening of technologies and process options is carried forward into the development of alternatives for this highly focused interim action. (Note: Some of the text previously located in Section 3.3 describing the earlier evaluations of alternatives in the UEFPC FS and FS-Addendum leading to the Phase I ROD has been moved to Section 1.2 for better readability and logic flow.)
General 20	Sec. 5.3 & Table 5.3	The comparative analysis of alternatives presented in Section 5.3, Comparative Analysis of Alternatives, and on Table 5.2, Comparative Analysis of Remedial Alternatives, is not sufficiently detailed to allow for a meaningful distinction between alternatives. Page 55 FR 8719 of the Preamble of the National Contingency Plan (NCP), Section 300.430(e)(9), Detailed analysis of alternatives, states, "the purpose of the detailed analysis is to objectively assess the alternatives with respect to nine evaluation criteria that encompass statutory requirements and	The comparative analysis section has been revised to better describe the relative merits of each alternative and to clarify the issues identified in this comment. Due to the highly focused scope of this interim action, all action alternatives share many common characteristics and differ only in the system treatment capacity

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		include other gauges of the overall feasibility and acceptability of remedial alternatives (53 FR 51428). This analysis is comprised of an individual assessment of the alternatives against each criterion and a comparative analysis designed to determine the relative performance of the alternatives and identify major trade-offs (i.e., relative advantages and disadvantages) among them. The decision-maker uses information assembled and evaluated during the detailed analysis in selecting a remedial action." In addition, the RI/FS Guidance states in Section 6.2.5, Comparative Analysis of Alternatives, "[a]n effective way of organizing this section is, under each individual criterion, to discuss the alternative(s) that performs the *best overall* in that category, with other alternatives discussed in the *relative order in which they perform* [emphasis added]…the presentation of differences among alternatives can be measured either qualitatively or quantitatively, as appropriate, and should identify substantive differences." Further discrimination between factors is needed to make this process transparent to the public and regulatory agencies. *Revise the FFS to provide a system of rating using a ranking scale that allows for differentiation (i.e., use a range of terminology and identify the differentiating features) so that a straightforward determination of the relative performance of the alternatives and identification of major trade-offs can be made. In addition, ensure that the assessment clearly indicates the alternative(s) that performs the best overall in each category.*	and stormwater storage capacity. Given the commonalities among these alternatives, the relative differences with respect to the CERCLA evaluation criteria shown in this comparative analysis are relatively small. DOE has attempted to present the comparative analysis for this FFS in a level of detail that is appropriately graded for the very limited scope of this focused interim action and consistent with FS documents previously approved for other DOE-OREM CERCLA actions.
General 21	-	The FFS states that Alternative 2 (Water Treatment at Outfall 200) includes monitoring of influent and effluent; however, additional details of the proposed monitoring program are not provided. For example, the frequency of monitoring is not discussed, nor is the analyte list. As such, it is unclear if the remedial alternatives were appropriately scoped and costed so as to reflect a -30%/+50% margin as allowed for during the FS process. *Revise the FFS to provide the details of the proposed monitoring program.*	The text has been revised to provide additional description of monitoring requirements. Additional details of the monitoring requirements will be presented in the subsequent ROD Amendment and post-ROD documentation, consistent with standard practice for the DOE-OREM remedial action program.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
General 22	-	The assessment of long-term effectiveness and permanence in the FFS is inconsistent with the RI/FS Guidance. The analysis to be conducted as part of the assessment of this criterion should focus on any residual risk remaining at the site after the completion of the remedial action. The assessment is to include consideration of the degree of threat posed by the hazardous substances remaining at the site and the adequacy and reliability of any controls (e.g., engineering or institutional controls) used to manage the hazardous substances remaining at the site. *Revise the FFS to discuss the long-term effectiveness of each alternative in terms of the magnitude of residual risk and the adequacy and reliability of controls.*	The FFS has been revised to provide additional discussion of the long-term effectiveness and permanence of each action alternative as requested. The scope of this FFS is a highly focused interim action to reduce mercury releases from Outfall 200 to UEFPC, and this interim action is only one component of a comprehensive remedial action program for UEFPC. Future response actions for removal of primary sources of mercury contamination in the UEFPC watershed may reduce mercury releases to the point where the proposed treatment facility may no longer be needed, at which time it would be decommissioned.
General 23	-	The assessment of reduction in toxicity, mobility, or volume through treatment lacks sufficient detail. For example, according to Section 6.2.3.4, Reduction of Toxicity, Mobility, or Volume Through Treatment, of the RI/FS Guidance, the assessment should discuss factors such as the amount of hazardous materials that will be destroyed or treated and the degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude). *Revise the FFS to provide a more detailed assessment of reduction in toxicity, mobility, or volume through treatment for each sub-alternative in accordance with the RI/FS Guidance.*	The FFS has been revised to provide additional discussion of the treatment effectiveness for each alternative. All action alternatives meet the NCP preference for treatment, and incorporate treatment technologies for permanent removal of mercury from UEFPC surface water. All alternatives would be constructed using common treatment technologies with a modular design to promote future enhancement of treatment efficiency and/or capacity if needed.
General 24	-	According to Section 6.2.3.5, Short-Term Effectiveness, of the RI/FS Guidance, the evaluation of short-term effectiveness should include a discussion of the amount of time until protection against the threats being addressed by the alternative will be achieved, when any remaining site threats will be addressed,	The FFS has been revised to provide additional discussion of short-term effectiveness. Due to the commonalities among the action alternatives, the differences with respect to short-term

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		and when remedial response objectives will achieved. The assessments of short-term effectiveness for each sub-alternative do not address these issues. *Revise the FFS to include a discussion of these items in the evaluation of short-term effectiveness.*	effectiveness are relatively small. The scope of this FFS is a highly focused interim action to reduce mercury releases from Outfall 200 to UEFPC, and this interim action is only one component of a comprehensive remedial action program for UEFPC.
General 25	-	The FFS does not assess the environmental effects of the proposed remedial alternatives in accordance with Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites (EPA 542-R-08-002), dated April 2008 (EPA Green Remediation Guidance) or Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), dated February 2012 (EPA Environmental Footprint Guidance). For example, energy consumption, greenhouse gas emissions (carbon dioxide, methane, and nitrous oxides), pollutant emissions (carbon monoxide, oxides of sulfur, oxides of nitrogen, and particulate matter), water consumption, ecological impacts/change in resource use, resource consumption, and worker safety are not used to evaluate the environmental footprint of the remedial action alternatives. *Revise the FFS to meet the level of detail specified in the EPA Green Remediation Guidance and EPA Environmental Footprint Guidance.*	The FFS has been revised to reference EPA and DOE policies to incorporate sustainability principles into the remediation decision-making process. If the construction of this new water treatment facility is ultimately approved, the final facility design, construction, and operation would further reflect these principles. The scope of this FFS is a highly focused interim action to reduce mercury releases from Outfall 200 to UEFPC, and is only one component of a comprehensive remedial action program for UEFPC.
General 26	Sec. 1.2.1.3	As discussed in Section 1.2.1.3, Summary of Site Risks, the baseline human health and ecological risk assessments were developed as part of the UEFPC RI in 1998. Given that the risk assessments were conducted in 1998, the FFS should discuss pertinent updates to risk assessment methodology and toxicological criteria, as well as the sources of uncertainty and the impact on the quantitative estimates of risk and hazard. *Revise the FFS accordingly.*	This section has been revised to discuss changes in the risk assessment methodology and toxicological criteria for mercury since the RI was issued. A revision of the baseline human health risk assessment is outside the scope of this FFS.
Specific 1	Pg. xii, Exec.	The text states, "All action alternatives also would be expected to achieve all chemical-specific, location-specific, and action-specific ARARs, with the exception of the AWQC for mercury, for which the interim waiver approved in the	No new waivers of ARARs are requested in this FFS. The OF200 water treatment facility, if selected and constructed, would be designed to

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
	Summary	Phase I ROD would need to be continued for the near-term." However, the term "near term" is not defined. As such, it is not clear how long the waiver would be required if one were to be granted. *Revise the FFS to provide a timetable for compliance with AWQC if an extension of the interim ARAR waiver were granted.*	reduce mercury to meet the AWQC standard of 51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect.
Specific 2	Pg. 1-18, Sec. 1.2	This section states, "The Building 9201-2 water treatment system (designated the Big Spring Water Treatment System, BSWTS) has been very successful in reducing mercury releases from this major source area. Mercury flux to UEFPC from Outfall 51 has been reduced from approximately 2-4 g/d to less than 1 g/d." However, in addition to comparing the performance to mercury flux, it appears the effluent discharge mercury concentrations should be discussed. *Revise Section 1.2 to include a discussion of the effluent concentrations from BSWTS.*	The text has been revised as requested to describe the ongoing monitoring of mercury concentrations in BSWTS effluent.
Specific 3	Pg. 1-23, Fig. 1.6	It is not clear if this figure presents a complete conceptual site model (CSM). For example, all surface water sources from the West End discharge through OF200; however, given the complicated nature of the site and stormwater system, it is not clear if this is accurate. In addition, this figure appears outdated as it still shows flow augmentation. Further, this figure shows a number of small downstream sources after OF200; however, this issue is not discussed as part of the remedial alternatives presented in the FFS. *Revise this figure to clarify if all surface water sources from the West End discharge through OF200 and remove flow augmentation from the figure. Also, include a discussion of smaller sources downstream of OF200 in the description and evaluation of the alternatives in the FFS.*	Figure 1.6 depicts the current conceptual site model for UEFPC, as developed by ORNL through a conceptual model study conducted during 2008-2011. This figure has been revised to indicate the termination of flow augmentation. More extensive revision of the CSM is not necessary for the limited scope of this interim action and is outside the scope of this FFS.
Specific 4	Pg. 3-15, Sec. 3.2.2.7	This section states, "existing treatment facilities designed for mercury removal (e.g., BSWTS, CMTS [Central Mercury Treatment System]) do not have sufficient excess treatment capacity for UEFPC surface water;" however, details on the CMTS are not provided in the FFS. As such, it is not clear if the capacity	The text has been revised to include the requested information regarding CMTS. (Note: The referenced text now has been moved from Section 3 to Section 1.2.2, which now describes

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		of BSWTS and CMTS is sufficient to treat UEFPC surface water. For clarity, *revise the FFS to provide a short summary on the CMTS.*	the actions previously implemented under the Phase I ROD.)
Specific 5	Pg. 3-20, Table 3.2	This table does not present planned dates for the UEFPC sediment/soil removal or the Lake Reality sediment removal. Both are indicated in the table as "20??". *Revise this table to included estimated dated for both of these removal activities.*	This table has been revised as requested.
Specific 6	Pg. 3-22, Sec. 3.3.2	This section indicates that the system design would be configured to accommodate scaling up of the treatment capacity and stormwater retention; however, it does not indicate if the system would be scalable to accommodate processing and treatment of all stormwater flow through OF200. *Revise this section to indicate if the proposed systems would be scalable to accommodate processing and treatment of all stormwater flow through OF200, and an estimate of what this conceptual system would include*.	The treatment system will incorporate a modular and scalable design that will be amenable to future modification as needed. However, since stormflow is a stochastic event, it would never be possible to design a system to capture all possible storm events. The text has been revised to clarify these issues.
Specific 7	Pg. 3-22, Sec. 3.3.2	This section states, "UEFPC is characterized by a relatively low baseflow in the range of 800 to 1000 gpm during dry conditions, with significantly increased flow during storm events, peaking as high as 40,000 gpm or more (up to 86,000 gpm);" however, a reference to the source of this data is not provided. For clarity, *revise this section to provide a reference to the source of this data*.	This text has been revised as requested.
Specific 8	Pg. 3-22, Sec. 3.3.2	This section states, "Influent flows greater than 1500 gpm but less than 3000 gpm would flow through the grit removal system and then be discharged to UEFPC without further treatment;" however, this section does not summarize or quantify the benefit of grit removal only on flows from 1,500 gpm to 3,000 gpm. To allow for a full evaluation of the alternatives, *revise this section to quantify the benefit of grit removal only on flows from 1,500 gpm to 3,000 gpm in Alternative 2a.*	The FFS has been revised to note the potential benefit of this grit removal system in Alternative 2a for streamflow greater than 1500 gpm and less than 3000 gpm in a qualitative manner. However, data are not yet available to quantify this additional mercury reduction.
Specific 9	Pg. 3-23, Sec. 3.3.2	This section states, "storage capacity is approximately equivalent to water volume generated by the 1-year 6-hour storm event;" however, a reference to the source of this data is not provided. For clarity, *revise this section to provide a reference to the source of this data.*	The text has been revised to include the appropriate reference for this information.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
Specific 10	Pg. 4-1, Sec. 4.2	This section indicates that future modifications to the treatment system may include granular activated carbon (GAC); however, it is not clear why this modification is not part of the existing alternatives. Since GAC as part of the treatment train will likely reduce mercury effluent concentration, it is not clear why it is not proposed as part of the FFS alternatives. *Revise this section to clarity why GAC is not part of the treatment train, or alternatively include GAC as part of the treatment train*.	All action alternatives in this FFS are designed such that effluent polishing using GAC can be added in the future if needed. GAC is considered as a potential future add-on for each alternative, if needed, rather than a stand-alone alternative based on the conceptual design screening which determined that precipitation/coagulation technology would be preferable and to promote a fair comparison of the alternatives. The FFS has been revised to better clarify this rationale.
Specific 11	Pg. 5-20, Sec. 5.3.2.1	Section 5.3.2.1 states that all sub-alternatives would be effective in the long term; however, it is unclear which sub-alternative is considered to be the most effective in the long-term overall. Given that Alternative 2c has the highest water capture and mercury removal rates, it appears that this sub-alternative is the most effective in the long-term as the magnitude of remaining risk will be the lowest overall as a result of its implementation. It is recommended that the discussion of long-term effectiveness be revised to include a ranking of each sub-alternative with respect to how each meets the factors associated with the long-term effectiveness criterion. Table 5.2, Comparative Analysis of Alternatives, should be similarly revised. *Revise the FFS accordingly*.	Section 5.3.2.1 and Table 5.2 have been revised to better describe the alternatives with respect to long-term effectiveness. All action alternatives utilize the same unit processes for treatment, and differ only with respect to treatment capacity and stormwater storage capacity, differences in long-term effectiveness are relatively minor. This water treatment system may be decommissioned in the future following completion of other response actions. While the actual water treatment facility may or may not be a component of the final remedy, mercury would be permanently removed from UEFPC surface water during treatment operations.
Specific 12	Pg. 5-21, Sec. 5.3.2.4	Section 5.3.2.4 states that all sub-alternatives would be technically feasible to implement; however, it is unclear which sub-alternative is considered to be the most easily implemented. Given that Alternatives 2a and 2b appear to include less complex treatment systems, it appears that these alternatives would be more easily	Section 5.3.2.4 and Table 5.2 have been revised to better differentiate the alternatives with respect to implementability. All action alternatives utilize the same unit processes for

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		implemented than Alternative 2c. It is recommended that the discussion of implementability be revised to include a ranking of each sub-alternative with respect to how each meets the factors associated with the implementability criterion. Table 5.2, Comparative Analysis of Alternatives, should be similarly revised. *Revise the FFS accordingly*.	treatment and differ only with respect to treatment capacity and stormwater storage capacity. Further, all action alternatives utilize only established and readily available treatment technologies, use readily available equipment and materials, and use standard construction equipment and techniques. Therefore, differences in implementability among the alternatives are relatively minor.
Specific 13	Pg. 5-24, Table 5.2	According to Section 5.3.2.2, Reduction of Toxicity, Mobility, and Volume Through Treatment, Alternative 2c would provide the greatest reduction in toxicity, mobility, and volume; however, this is not reflected in Table 5.2. *Revise Table 5.2 to state that Alternative 2c would provide the greatest reduction in toxicity, mobility, and volume compared to that of the other sub-alternatives.*	Section 5.3.2.2 and Table 5.2 have been revised to better differentiate the alternatives with respect to reduction of toxicity, mobility and volume through treatment. Since all action alternatives utilize the same unit processes for treatment, and differ only with respect to treatment capacity and stormwater storage capacity, differences in reduction of toxicity, mobility and volume through treatment among the alternatives are relatively minor.
Specific 14	Pg. A-10, Table A.1	Table A.1 on page A-10 contains the following statement: "[*The most stringent applicable AWQC for mercury – a recreational organisms-only criterion of 51 ng/L – was waived under the UEFPC Phase I ROD and an interim risk-based goal of 200 ng/L was set.]" Please remove this text from the table, and add it to the descriptive text in Section A.1.1 under "Surface Water" on page A-4. Further, please add the following text of the end of this quoted language: The AWQC criteria was waived in the Phase I Interim ROD because that Interim ROD included surface water remediation as part of the scope in a phased approach to evaluating the nature and extent of contamination, to determining*	The suggested revisions have been incorporated with minor modification. DOE agrees that the TDEC AWQC standard for mercury is an ARAR that ultimately must be attained by the remedial action program in UEFPC. No new waivers of ARARs are requested in this FFS. The OF200 water treatment facility, if selected and constructed, would be designed to reduce mercury to meet the AWQC standard of

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
		the risks, and to selecting and implementing remedial actions of all media at Y-12 (UEFPC). At the time that the Phase I IROD was signed, DOE and the regulators waived the surface water quality chemical-specific AWQC until other phases of the interim action captured and or removed more of the mercury sources that were located within the scope of the IROD. This FFS documents one of those actions that is intended to capture and treat mercury sources at Y-12.	51 ng/L in the treated effluent. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect.
Specific 15	Pg. A-7, A.1.3	Please add the following description to Section A.1.3 under "Water Treatment": *This supplemental action seeks to evaluate an additional "discrete phase" to those that have been and will be implemented within the scope of the Phase I IROD. As described in the Remedial Action Objectives (Section 2.2), the actions evaluated in this FFS are intended to capture, treat and discharge waters that flow through certain areas covered by the Phase I ROD and to "pick up" mercury-contaminated soil and sediment. Because this water will be treated to remove the mercury prior to discharge waters into UEFPC, the requirements that are applicable to discharges of treatment system effluent into waters of the United States are applicable to this action and will not be waived. Meeting these applicable action-specific requirements are consistent with and will assist in meeting the in-stream chemical-specific AWQCs in the final Record of Decision for UEFPC.*	The suggested revisions have been incorporated with minor modification. DOE agrees that the TDEC AWQC standard for mercury is an ARAR that ultimately must be attained by the remedial action program in UEFPC. No new waivers of ARARs are requested in this FFS. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect.
Specific 16	Pg. A-18, Table A.3	*Please add the following action-specific requirements to the ARARs table* (Table A.3). To the degree that they overlap with already cited state requirements that are not more stringent than the federal requirement, it is acceptable (as has been done in this document) to include the federal and state citation in the same row.	Table A.3 has been revised to incorporate the suggested additions as appropriate. Specifically, the citation of 40 CFR 122.44 has been added (first two entries suggested in this comment). Other suggested entries are considered by DOE to be administrative requirements or do not exist in the current CFR (40 CFR 125.100 and 125.104) and have not been added. Consistent with OSWER 9234.2-05/FS, "if a State is authorized to implement a program in lieu of a

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014			**Comments By: Jon Richards, USEPA (November 17, 2014)**
Cmnt Number	**Page/ Section**	**Comment**	**Resolution**
			Federal agency, State laws arising out of that program constitute ARARs instead of the Federal authorizing legislation", DOE holds that the current ARAR citations are consistent with TDEC Water Quality Control Act requirements.

REVIEW COMMENT AND RESOLUTION MATRIX

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee,* August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee,* August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
General Comments		
-	Evaluation of effectiveness of Outfall 200 treatment must include measuring concentrations of total mercury (total and dissolved) and methyl mercury (total and dissolved) at influent, effluent, and plant bypass during a range of stormflow and dry weather events, sufficient to establish a statistically significant data set.	DOE agrees that comprehensive monitoring will be needed to evaluate performance. Additional discussion of monitoring requirements has been added to the FFS and Proposed Plan. Additional details of the performance monitoring requirements will be specified in the ROD Amendment and post-ROD documentation.
-	Outfall 200 Mercury Treatment Plant (OF200 MTP) was discussed by FFA Parties Environmental Program Counsel (EPC) on October 23, 2014. During that discussion, TDEC referenced Focused Feasibility Study (FFS) Figure 3.4, "Strategic Schedule for Mercury Cleanup at Y-12" and noted Beta 4 Complex D&D begins about FY2020/2021 during the OF200 MTP Assessment of Operations and Attainment of Goals. TDEC questions the schedule and noted the proposed remedial design and remedial action objectives are not sufficient to prevent mercury release during West End Mercury Area (WEMA) D&D and the schedule does not include time to secure funding and upgrade the OF200 MTP, as necessary, to prevent mercury release during WEMA D&D. Ms. Susan Cange, Acting Oak Ridge EM Manager, responded for DOE that D&D of WEMA is not scheduled to begin for another 10 years and that the goal is to build something that is modular and scalable, and could be modified in the future to address the large flux of mercury from WEMA D&D. Ms. Cange stated that the OF200 MTP was never intended to be a stand-alone remedy and the schedule is misleading since there will be one or two years of deactivation to prepare the buildings for D&D. Ms. Cange also stated that the schedule for WEMA D&D would be pushed back because DOE cannot perform OF200 MTP upgrade and D&D at the same time. Ms. Laura Wilkerson further stated that DOE has not yet	Figure 3.4 was excerpted from the *Strategic Plan for Mercury Remediation at the Y-12 National Security Complex*, DOE/OR/01-2605&D2, and was included in the D1 FFS only to illustrate the fact that the new water treatment facility at Outfall 200, if selected and constructed, would be only one component of the comprehensive remedial action program for mercury at Y-12. The schedule of activities is subject to change over time due to funding constraints and other factors. However, DOE agrees that the new OF200 water treatment facility, if selected, should be operating in compliance with its design standards prior to the WEMA D&D actions. The FFS and Proposed Plan have been revised to better clarify the potential benefit of the OF200 water treatment facility in the future WEMA D&D actions. While the future WEMA D&D actions will include comprehensive contamination control

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
	worked out how releases will be controlled during WEMA D&D and will not know until the contractor is on board. Ms. Cange concluded that the OF200 MTP establishes a trajectory to reduce mercury in water and to allow DOE to better prepare to put in place control measures for D&D. Please update the FFS and Proposed Plan to include the process, schedule and commitment to upgrade the OF200 MTP prior to WEMA D&D.	measures and best management practices to minimize any release of contaminants during these response actions, the OF200 water treatment facility could provide an additional level of protection against potential contaminant releases to UEFPC. However, this source has not been specifically evaluated in the conceptual design for the treatment system, but would be evaluated during the planning for these future WEMA projects as additional characterization data become available. The modular design of the water treatment system would facilitate any changes that might be needed for additional COCs.
-	There have also been discussions in the team meetings and the EPC that several additional options should be evaluated. Please add these options and assure that all evaluated options have a far, balanced, and rigorous evaluation. For example, current option evaluations do not evaluate effectiveness of each option in assisting with implementing controls to eliminate release of mercury during WEMA D&D.	An additional alternative has been included to better capture the range of potential treatment and storage capabilities. Additional discussion of the effectiveness of the water treatment system constructed under each of the action alternatives for reducing potential releases from future WEMA D&D actions has been added. However, this source has not been specifically evaluated in the design of the treatment system.
-	The FFS Remedial Action Objectives include a cleanup standard for treatment and has no standard for what bypasses the treatment system. If DOE's current best evaluated option remains the selected alternative after reevaluation of alternatives, the proposed mercury treatment plant captures 95% UCL of base flow and some initial or first flush of small storms may be treated. Other storm flows would bypass. The amount of storm water capture and treatment should be a data driven decision and it is recognized that additional data is needed to base an informed decision of	Regardless of the treatment system design alternative ultimately selected, some degree of stormwater bypass will be required – that is, it would be cost prohibitive to design for the maximum possible storm event, even if such an entity could be defined. DOE agrees with TDEC's comment that data are needed to define the

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
	the volume of storm water or portion of the hydrograph/pollute-graph needing capture and treatment to control mercury release during WEMA D&D. To assist in this determination and planning for actions to control mercury release during WEMA D&D, TDEC recommends that a combination of controls and capture and treatment sufficient to prevent release of mercury to Upper East Fork Poplar Creek be in place prior to WEMA D&D so that the combined OF200 MTP effluent and bypass be no greater than the ambient water quality criteria (51 ng/L).	optimal treatment capacity and storage capacity parameters. Results from the pre-design studies have provided additional data for this purpose, which are now incorporated in the FFS and Proposed Plan. The OF200 water treatment facility would be designed to reduce mercury concentrations in the treated effluent to meet the AWQC standard of 51 ng/L. While the OF200 water treatment facility would provide additional protection against potential contaminant releases to UEFPC from future WEMA D&D actions, this source has not been specifically evaluated in the conceptual design for the treatment system.
-	For the OF200 MTP, it is recognized that the ambient water quality criteria for mercury in surface water is 51 ng/L. Review of the DOE conceptual design document indicates the design should achieve the ambient water quality criteria. TDEC therefore will concur with DOE to build and test the concept design and to optimize the design to achieve greater reduction of mercury than in the concept design. However, prior to D&D of WEMA, TDEC expects a combined OF200 MTP effluent and bypass numerical standard. As DOE committed in the October 23, 2014 EPC discussion to upgrade the OF200 MTP, if needed, to control mercury release, TDEC expects the treatment plant will be upgraded, as needed, to achieve the combined treatment plant effluent and bypass numerical standard prior to WEMA D&D.	DOE agrees that the AWQC in-stream standard for mercury of 51 ng/L is an ARAR that should be attained by the comprehensive remedial action program for UEFPC. The OF200 water treatment facility would be designed to reduce mercury concentrations in the treated effluent to meet this standard. The interim waiver previously approved in the Phase I ROD for the AWQC in-stream standard for mercury would not be affected and would remain in effect. DOE agrees that the new OF200 water treatment facility, if selected, should be operating in compliance with its design standards prior to the WEMA D&D actions.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
Remedial Action Objectives	1. Capture base flow and stormwater runoff within WEMA to mitigate uncontrolled discharges of Hg (and other hazardous substances) into UEFPC. Capture the portion of stormwater runoff from WEMA that maximizes mercury flux reduction, to the greatest extent reasonable (e.g., it is expected that the initial storm flow period for all storm events represents the most significant mercury flux). 2. Store captured wastewater with a sufficient capacity to minimize mercury flux by-pass of the treatment unit under peak stormwater conditions. 3. Treat collected wastewater using best available treatment (BAT) technology prior to discharge into UEFPC. 4. Discharge treated effluent in compliance with ARARs (including 51ppt Hg effluent limit based upon AWQC) and at levels that are protective of the receiving water. It is TDEC's position that the Standard of Performance should be a treated effluent attaining 51 ng/L Total Mercury. The justification of this is that during base flow, the treated effluent becomes the entire stream flow and must meet TN Water Quality Criteria (WQC). The WQC for waters classified as Recreation – Organisms Only for mercury is 51 ng/L, established in 1999 based on EPA recommended national WQC. An effluent concentration of 51 ng/L is required as a Standard of Performance, defined by the TN Water Quality Control Act, and as interpreted in published WQC, stating: *The criteria and standards provide that all discharges of sewage, industrial waste, and other wastes shall receive he degree of treatment or effluent reduction necessary to comply with water quality standards, or state or federal laws and regulations pursuant thereto, and where appropriate will comply with the "Standards of Performance" as required by the Tennessee Water Quality Control Act (T.C.A. §§ 69-3-101, et seq.).*	DOE appreciates these detailed suggestions for revision of the RAOs. The RAO discussion in the FFS and Proposed Plan have been revised to incorporate the greater specificity suggested by this comment. The revisions to the RAOs proposed in this comment have been incorporated with minor modifications to reflect the recent dispute resolution agreement. Regarding suggested RAO #5, results from the pre-design studies for stormwater diversion and non-stormwater diversion did not identify significant opportunities for diversions that would significantly impact the treatment system design, so this suggested RAO may not be appropriate. Regarding suggested sub-watershed RAO #6, DOE prefers to include discussion of this topic in the text rather than in the list of RAOs. The OF200 water treatment facility would provide benefits for reducing potential contaminant releases from future D&D and remedial actions at WEMA, but this source has not been specifically evaluated in the conceptual design of the treatment facility to date, but would be evaluated during the planning for these future actions as additional characterization data become available.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
	Attainment of 51 ng/L total mercury daily maximum effluent limit is feasible, based on bench tests for treatability in DOE's Conceptual Design Report. Appendix H, Water Chemistry Evaluation and Modeling, concluded that attainment of AWQC was feasible through the design and routine operational adjustments. 5. Divert inflow of water into WEMA to minimize the amount of captured water requiring treatment before discharge. 6. Prevent the potential for increased contaminant releases to UEFPC during subsequent response action in the WEMA (e.g., Building D&D, Principal Threat Sources, Contaminated Soil).	
Specific Comments on the Focused Feasibility Study		
Page ix, Exec. Summary, 2nd ¶, 2nd sentence	Instead of stating "surface water remains above desirable levels", DOE should be more specific regarding surface water goals and standards.	The FFS has been revised to describe surface water goals with greater specificity throughout the document.
Page 1-7, Sec. 1.2, Soils/ Geology/ Hydrogeology	"The groundwater-surface water connections provide a route for mass transfer of contaminants from shallow groundwater to UEFPC and vice-versa." How is the project going to deal with this connection and is Mercury observed in the shallow groundwater?	The water treatment system evaluated under this interim action would deal with shallow groundwater only after its discharge to UEFPC. The stated connection is part of the site conceptual model, but is not specifically addressed by this interim action. Groundwater remediation is deferred to a future decision. The text has been revised to clarify these issues.
Page 1-15, Sec. 1.1.5, Integrated Mercury Strategy for Y-	"Completion of early action to reduce mercury releases from Y-12 from the average value of 18 grams per day measured over the last 7years at Station 17." Eighteen g/day roughly equates to 6570 g/y at Station 17. Now, there seems to be a lot of missing mercury between OF200 and Station 17. Sections 4.2.1, 4.2.2, and 4.2.3	This comment correctly observes the considerable uncertainty in mercury flux estimates. The text has been revised to better reflect such uncertainties in the mass/flux balance. The mercury flux modeling

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
12	have paragraphs that discuss the performance modeling. The performance modeling suggests that about 6300 g/y, 7800 g/y, and 10500 g/y (depending on the method selected) of mercury will be removed from OF200. Based on the percentage removal efficiency, OF200 has approximately 12000 g/y of mercury flux. Please reconcile this mass flux balance.	and stormwater characterization pre-design studies have helped to refine our flux estimates at OF200. DOE will continue to evaluate the discrepancies identified in this comment and attempt to better reconcile the mass/flux balance to the extent practicable. However, revision of the conceptual site model is outside the scope of this FFS.
Page 1-21, Sec. 1.2.1.1, Nature and Extent of Contamination	"Important non-point sources of baseflow mercury identified in the RI include non-point inputs to the reach of stream between the termination of the north-south pipe (Outfall 200) and Outfall 109. More recent data indicate that this non-point source may have been partially associated with the scouring by the increased streamflow from the flow augmentation program, which was terminated in 2014." Is there data to confirm this since the augmentation water was shut off? Also, sudden changes in high energy storm water fluxes account for most erosional features along creeks. Has this been looked at?	The referenced statement has been revised throughout the document to more accurately reflect the uncertainty in this source of mercury flux, and clarify that any impacts from the termination of the flow augmentation program are not yet characterized.
Page 3-2, Sec. 3.1, Key Site Problems	First bullet. It would be good to show a site map with all the fluxes of mercury to see if they balance out or if there are other potential sources.	The scope of this FFS is limited to the mercury flux expressed in the WEMA storm sewer discharge at Outfall200. The conceptual site model (Fig. 1.6) provides a qualitative indication of the relative flux from various sources at the Y-12 site. Revision of the conceptual site model is outside the scope of this FFS.
Page 3-3, Sec. 3.1, Key Site Problems	"These studies and the operating experience from the BSWTS now suggest that construction of additional water treatment facilities to further reduce mercury releases to UEFPC surface water should be reevaluated." Please clarify in the context of OF200 treatment.	This text has been revised more clearly describe this rationale.
Page 3-22, Sec. 3.3.2, Alt. 2,	"…which may be partially attributed to increased erosion resulting from the flow augmentation program initiated in 1996, which was terminated in April 2014. With	The referenced text has been revised to more accurately reflect the uncertainty in this source of

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
Water Treatment at Outfall 200	the termination of the flow augmentation program, discharge from the WEMA storm sewer system at Outfall 200 is expected to be the predominant source of mercury releases to UEFPC under baseflow conditions." There should be some data by now to confirm that statement. Please reference data for baseflow and stormflow conditions.	mercury flux, and clarify that any impacts from the termination of the flow augmentation program are not yet characterized.
Page 3-5, Table 3.1	This table should be deleted in its entirety and replaced with one that relates exactly to the scope of this water treatment FFS. There are superfluous listings in this table that do not relate to water treatment or even the secondary wastes from it. Screening out solid waste technologies now can only preclude later more informed decisions on UEFPC projects that will really deal with solid waste media.	Table 3.1 has been deleted and Section 3.2 has been revised to focus more narrowly on the limited scope of this interim action and to directly reference the technology screening conducted under the conceptual design report.
Specific Comments on the Proposed Plan		
Page 1, ¶ 1	"…mercury in UEFPC surface water remains above desirable levels." "Desirable" is not a regulatory term, but vague, undefined and subjective. "Clean Water Act Standards and CERCLA Risk Thresholds" would be better or similar regulatory language.	The Proposed Plan has been revised to describe surface water goals with greater specificity.
Page 3, First ¶, Right Side	"…Phase I ROD is not currently protective for ecological receptors…" It is not protective for ecological receptors or human receptors through ingestion pathways.	There currently is no unacceptable risk to human health via ingestion or any other pathway, due to the institutional controls in place to prevent fish ingestion.
Page 5, Site History	"Mercury contamination is widespread at the Y-12 site and has been identified in soil, sediment, surface water, groundwater, buildings, drains, and sumps. Mercury continues to be released into UEFPC from point (discrete) and non-point (diffuse) sources within the Y-12 site. Mercury enters UEFPC from direct erosion of contaminated soil, migration of dissolved mercury through storm drains and outfalls, and through shallow groundwater…" This description makes a case for stormwater diversion to aid in meeting the AWQC goals for EFPC.	DOE agrees that opportunities for stormwater diversion at UEFPC should be fully evaluated. Stormwater diversion studies conducted in support of the conceptual design of the proposed water treatment system at Outfall 200 did not identify opportunities for stormwater diversion that would significantly impact the facility design.

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
Page 10, Flow Management	"However, this flow augmentation resulted in the unintended consequences of increased mobilization of mercury from contaminated UEFPC stream sediments, and was terminated in 2014." This conceptual model is a good case for stormwater diversion since most stream erosional features are due to rapid rise in high energy flowing water.	DOE agrees that opportunities for stormwater diversion at UEFPC should be fully evaluated. Stormwater diversion studies conducted in support of the conceptual design of the proposed water treatment system at Outfall 200 did not identify opportunities for stormwater diversion that would significantly impact the facility design.
Page 14, Summary of Site Contamination	DOE should include a discussion of potential releases during future remedial actions from both soil and D&D remedial actions. This discussion should include the need and benefit of having a mercury treatment facility to capture and remove mercury leaving the Y-12 property.	This section has been revised to include discussion of this topic. However, potential releases from the future WEMA actions have not yet been characterized and have not been evaluated in the conceptual design of the proposed water treatment facility. These future WEMA actions will include comprehensive contamination control measures and best management practices to minimize releases of contaminants to UEFPC.
Page 15, Conceptual Site Model	"Figure 4 shows the most recent version of the site conceptual model for mercury releases to UEFPC, from a conceptual model study conducted in 2008-2010 (ORNL 2011). This study found that the combined inputs from WEMA and other upstream areas (as measured at Outfall 200) now represents the most important source of mercury inputs to UEFPC surface water – i.e., this source now contributes up to 70-80% of the mercury flux at Station 17, particularly under low to average flow conditions, as opposed to an estimate of approximately 20% of the flux at Station 17 when the Phase I ROD was issued." The mercury flux numbers don't add up for each Outfall, sediment, Station 17, and the preliminary performance numbers from the conceptual design report.	Figure 4 depicts the current conceptual site model for UEFPC, as developed by ORNL through a conceptual model study conducted during 2008-2011, and includes the best information available at that time. This figure has been revised to indicate the termination of flow augmentation. However, more extensive revision of the CSM is outside the scope of this interim action.
Page 30, Table 2	DOE should show the differences in each alternative's ability to reduce mercury in the stream to achieve the final goal of 51 ng/L.	Table 2 has been revised to include available estimates of mercury removal to be achieved by

Document Number/Title: DOE/OR/01-2660&D1, *Focused Feasibility Study for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014; & DOE/OR/01-2661&D1, *Proposed Plan for Supplemental Mercury Abatement Actions under the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee*, August 2014		**Comments By: Roger B. Petrie, TDEC (November 10, 2014)**
Page/ Section	**Comment**	**Resolution**
		each alternative.
Page 34, Description of the Preferred Alternative	"This preferred alternative is designed for treatment of UEFPC surface water under baseflow conditions and up to the 95th percentile streamflow in UEFPC at Outfall 200." By ignoring the other inputs, this project is just designed to capture the WEMA area. It will be necessary to have this treatment system during the WEMA remediation, but it does not completely address the contamination leaving Y-12.	The OF200 water treatment facility would be designed specifically to reduce mercury releases from the WEMA storm sewer system, as expressed at the Outfall 200 discharge point. This system is not designed to address all contaminant sources at Y-12. As stated in the FFS and Proposed Plan, the OF200 water treatment facility is only one component of a larger multi-faceted remedial action program for mercury remediation at Y-12.
Page 38, Mercury-Use Building Demolition	The success of this treatment plant should not be a substitute for excellent water-borne and airborne contamination control at demolition projects. Contaminants might bypass the plant. Or, otherwise innocuous chemicals from projects may poison the treatment plant and cause outages.	DOE is in complete agreement with this comment. The proposed water treatment facility would not diminish comprehensive contamination control practices and best management practices during to minimize releases during future D&D activities.
Page 42, 2nd ¶, last sentence	DOE should revise the last sentence to: "Such modifications would be made through FFA-party agreement, to achieve both the goal of reducing mercury levels in UEFPC and meeting AWQC in UEFPC."	Text revised as requested and consistent with the recent inter-agency agreement. DOE agrees that response actions for UEFPC ultimately should achieve the AWQC in-stream standard for mercury of 51 ng/L, and the OF200 water treatment facility would be designed to reduce mercury to 51 ng/L in the treated effluent.
Page 42, Conclusion	The end of this section should include another table which clearly presents the remedial action objectives anticipated by the implementation of the preferred alternative. These objectives will ultimately be used to determine the effectiveness of the action.	The requested table summarizing the RAOs has been added to the RAO section, rather than in the Conclusions as suggested in this comment, for better flow.