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Remedial Investigation Work Plan for the Upper East Fork Poplar Creek Characterization Area, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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Energy Systems Environmental Restoration Program
Y-12 Environmental Restoration Program

Remedial Investigation Work Plan for the Upper East Fork Poplar Creek Characterization Area, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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OAK RIDGE Y-12 PLANT
Oak Ridge, Tennessee 37831-8169
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the
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under contract DE-AC05-84OR21400

PREFACE

This *Remedial Investigation Work Plan for the Upper East Fork Poplar Creek Characterization Area, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (DOE/OR/01-1396&D1) was prepared in accordance with the requirements under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 for documenting the plans to be implemented for site characterization. This work was performed under work breakdown structure 1.4.12.1.1.03.41 (activity data sheet 2303, "Upper East Fork Poplar Creek"). Publication of this document meets a Federal Facilities Agreement milestone of September 30, 1995. This document outlines the strategy to be implemented by the Environmental Restoration Program to characterize the nature and extent of contamination in the Upper East Fork Poplar Creek Characterization Area. The results of implementation of this work plan will form the basis of the Upper East Fork Poplar Creek Characterization Area Remedial Investigation Report.

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ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
BAT	best available technology
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
BMAP	Biological Monitoring and Abatement Program
CA	characterization area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
COPEC	contaminant of potential ecological concern
CWA	Clean Water Act of 1972
DAR	Data Adequacy Report
DCG	derived concentration guide
DOE	U.S. Department of Energy
DOE-ORO	U.S. Department of Energy Oak Ridge Operations
DQO	data quality objective
DSP	Data Summary Package
EDE	effective dose equivalent
EFPC	East Fork Poplar Creek
Energy Systems	Martin Marietta Energy Systems, Inc.
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FFA	Federal Facilities Agreement
FR	*Federal Register*
FS	feasibility study
GWPP	Groundwater Protection Program
GWQAR	Groundwater Quality Assessment Report
H&S	health and safety
HHRA	human health risk assessment
IP	integration point
LEFPC	Lower East Fork Poplar Creek
LMES	Lockheed Martin Energy Systems, Inc.
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
NCP	National Contingency Plan
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
Y-12 Plant	Oak Ridge Y-12 Plant
ORR	Oak Ridge Reservation
OU	operable unit
PCB	polychlorinated biphenyl

ppm	part(s) per million
PRG	preliminary remediation goal
QAPjP	Quality Assurance Project Plan
QC	quality control
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act of 1976
RD	remedial design
RI	remedial investigation
RMPE	Reduction of Mercury in Plant Effluent
ROD	Record of Decision
SAFER	Streamlined Approach for Environmental Restoration
SAP	Sampling and Analysis Plan
SCM	site conceptual model
SDWA	Safe Drinking Water Act
SMCL	secondary maximum contaminant level
SSL	soil screening level
SWMU	Solid Waste Management Unit
TBC	to be considered
TCA	*Tennessee Code Annotated*
TDEC	Tennessee Department of Environment and Conservation
TPH	total petroleum hydrocarbons
TSCA	Toxic Substances Control Act of 1976
UEFPC	Upper East Fork Poplar Creek
USC	*United States Code*
UST	underground storage tank
WQC	Water Quality Criteria

EXECUTIVE SUMMARY

The Oak Ridge Y-12 Plant, located within the Oak Ridge Reservation (ORR), is owned by the U.S. Department of Energy (DOE) and managed by Lockheed Martin Energy Systems, Inc. (LMES) (formerly Martin Marietta Energy Systems, Inc.). The Y-12 Plant includes approximately 800 acres near the northeast corner of the ORR and adjacent to the city of Oak Ridge. The U.S. Army Corps of Engineers built the Y-12 Plant in 1943 as part of the Manhattan Project. The plant is a manufacturing and developmental engineering facility that produced components for various nuclear weapons systems and provides engineering support to other LMES facilities. More than 200 contaminated sites created by past waste management practices have been identified at the Y-12 Plant. Many of the sites have been grouped into operable units based on priority and on investigative and remediation requirements.

The Y-12 Plant is one of three major facilities on the ORR. The ORR contains both hazardous and mixed-waste sites that are subject to regulations promulgated under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986. Under RCRA guidelines and requirements from the Tennessee Department of Environment and Conservation (TDEC), the Y-12 Plant initiated investigation and monitoring of various sites within its boundaries in the mid-1980s. The entire ORR was placed on the National Priorities List (NPL) of CERCLA sites in November 1989. Following CERCLA guidelines, sites under investigation require a remedial investigation (RI) to define the nature and extent of contamination, evaluate the risks to public health and the environment, and determine the goals for a feasibility study (FS) of potential remedial actions.

The need to complete RIs in a timely manner resulted in the establishment of the Upper East Fork Poplar Creek (UEFPC) Characterization Area (CA) and the Bear Creek CA. The CA approach considers the entire watershed and examines all appropriate media within it. The UEFPC CA, which includes the main Y-12 Plant area, is an operationally and hydrogeologically complex area that contains numerous contaminants and contaminant sources, as well as ongoing industrial and defense-related activities. The UEFPC CA also is the suspected point of origin for off-site groundwater and surface-water contamination. Boundaries of the CA include the base of Pine Ridge to the north, the base of Chestnut Ridge to the south, the eastern boundary of the Bear Creek CA to the west, and the DOE/ORR property line to the east. The UEFPC CA RI also will address a carbon-tetrachloride/chloroform-dominated groundwater plume that extends east of the DOE property line into Union Valley, which appears to be connected with springs in the valley (e.g., SCR 7.1SP). In addition, surface water in UEFPC to the Lower East Fork Poplar Creek CA boundary will be addressed. Through investigation of the entire watershed as one "site," data gaps and contaminated areas will be identified and prioritized more efficiently than through separate investigations of many discrete units.

The overall objectives of the UEFPC CA RI are to evaluate the nature and extent of known and suspected contaminants, to provide the data necessary to support an Ecological Risk Assessment and a human health risk assessment, to support the evaluation of remedial alternatives for the FS, and to develop a Proposed Plan and a Record of Decision (ROD) for the CA. To meet these objectives, the RI will compile and use existing data from the UEFPC CA to the greatest extent possible. Additional sampling will be limited and will be completed only if needed to fill a critical risk assessment and FS data gap. By agreement among the Federal Facilities Agreement (FFA) stakeholders, an expedited RI strategy will be followed to shorten the time needed to complete a ROD and to maximize cost efficiency.

A substantial amount of historical data exists for the UEFPC CA. Investigations and remedial actions under RCRA and CERCLA have been ongoing since 1983. Activities have included RCRA closures, underground storage tank removals, and sample collection and analysis. A comprehensive, facility-wide groundwater monitoring program was established in 1988. Surface water monitoring under the National Pollutant Discharge Elimination System requirements, sampling for the Reduction of Mercury in Plant Effluent Program, air monitoring, meteorological monitoring, the Biological Monitoring and Abatement Program, and environmental restoration investigations all are sources of data for the CA.

A streamlined RI approach has been proposed and accepted by the participating parties of the FFA because of the volume of historical data available for this CA. This approach will use historical data to the fullest extent possible to complete the RI and the FS, and will focus additional data collection efforts on risk assessment and FS needs. An extensive storm sewer system underlies the CA, and an extensive network of more than 200 groundwater monitoring wells lies within the CA.

A "subbasin" approach will be used to link information (e.g., soil data, inventories) from potential source areas to historical surface water and shallow groundwater data. Subbasins have been identified by topographic and storm-drain-system analyses and represent drainage areas for specific outfalls to UEFPC within the watershed. This approach, combined with the use of groundwater contaminant plume maps, will allow large areas of the CA to be prioritized according to the relative contaminant contributions or contaminant flux to surface water and groundwater.

The primary component of the RI approach will be the focus on existing CA data. The strategy will be to examine the data to evaluate individual source areas and contaminant flux on a subbasin basis, primarily for surface water and, to a lesser extent, for groundwater—in other words a "top-down/bottom-up" approach. This approach consists of evaluating data on individual source areas and determining the transport and fate of contaminants from these source areas (i.e., "top down"), as well as evaluating surface water and groundwater to determine the nature of contaminants in exit pathways and working back to a source of the contamination (i.e., "bottom up"). The goal is to prioritize the major sources of contaminants to the exit pathways and to understand their characteristics for risk characterization and for development of remedial alternatives.

The intent of this Work Plan is to outline the strategy to be followed to complete the UEFPC CA RI. The plan will present a detailed description of the proposed RI approach, including the types of data analysis to be performed, the results to be generated, the contaminants of potential concern, and the potential receptors and exposure pathways for both human and ecological populations. It is not the intent of this plan to identify specific types, numbers, and locations of samples to be collected. As discussed at the Data Quality Objectives Workshop, which was held in March 1995, focused Sampling and Analysis Plans will be prepared only after analysis of existing data sets and subsequent identification of uncertainties and prioritization of data needs. In keeping with this intent, the Work Plan does not include a Quality Assurance Project Plan, a Health and Safety Plan, or a Waste Management Plan; these plans will be incorporated into the focused Sampling and Analysis Plans as they are prepared.

1. INTRODUCTION

This Work Plan outlines the activities necessary to complete a remedial investigation (RI) of the Upper East Fork Poplar Creek (UEFPC) Characterization Area (CA) at the Oak Ridge Y-12 Plant (Y-12 Plant). The UEFPC CA consists of both the surface water and groundwater components of the UEFPC watershed and appropriate source areas located within the watershed. The CA is a point of origin for both surface water and groundwater contamination off-site. The purpose of the RI is to analyze existing data and collect additional data to do the following:

- evaluate the nature and extent of known and suspected contaminants,
- support and develop a baseline ecological risk assessment (BERA) and a baseline human health risk assessment (BHHRA),
- support the evaluation of remedial alternatives and completion of an FS, and
- support development of a Proposed Plan and a Record of Decision (ROD) for the CA.

This section of the Work Plan provides overviews of the regulatory initiative governing the investigation of UEFPC and of the RI strategy, objectives, and schedule. Subsequent sections present details concerning the RI approach, the risk assessment and FS methods to be followed, and the remedial design (RD) and RA processes.

1.1 REGULATORY INITIATIVE

The Y-12 Plant, located within the Oak Ridge Reservation (ORR), is owned by the U.S. Department of Energy (DOE) and managed by Lockheed Martin Energy Systems, Inc. (LMES) [formerly Martin Marietta Energy Systems, Inc. (Energy Systems)]. The Y-12 Plant is one of three major facilities on the ORR. The ORR contains both hazardous and mixed-waste sites that are subject to regulations promulgated under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986.

Under RCRA guidelines and requirements from the Tennessee Department of Environment and Conservation (TDEC), the Y-12 Plant initiated investigation and monitoring of various sites within its boundaries in the mid-1980s. The entire ORR was placed on the National Priorities List of CERCLA sites in November 1989. Following CERCLA guidelines, sites under investigation require an RI to define the nature and extent of contamination, evaluate the risks to public health and the environment, and determine potential remedial goal objectives.

DOE, the U.S. Environmental Protection Agency (EPA), and TDEC negotiated a Federal Facilities Agreement (FFA) in response to the placement of the ORR on the National Priorities List. The FFA was developed for compliance pursuant to CERCLA, RCRA, the National Environmental Policy Act of 1969 (NEPA), and the National Contingency Plan (NCP). A common goal of the parties that entered into the FFA is to ensure that past releases from operations and waste management at the ORR are thoroughly investigated and that appropriate RA is taken for the protection of human health and the environment.

The general purposes of the FFA are to establish a framework and schedule for development, implementation, and monitoring of response actions at the ORR in accordance with applicable guidance and policy; to coordinate responses under CERCLA and RCRA to maximize flexibility and preclude redundant activity; to minimize duplication of analytical and investigative work; to ensure quality of data management; and to expedite response actions.

1.2 OAK RIDGE RESERVATION ENVIRONMENTAL RESTORATION PROGRAM

DOE established the Environmental Restoration (ER) Program to plan and implement investigation and remediation of the ORR in cooperation with the parties to the FFA. A fundamental goal in the implementation of the program is that RA be emphasized. The goal acknowledges that no investigatory process can resolve all uncertainties and that RAs must be able to accommodate deviation from original hypotheses once initiated. This approach to the process of investigation and remediation promotes early remedy selection, flexibility for the RA, and contingencies to account for new data obtained during investigation and remediation of the sites. Removal actions will be implemented, as necessary, to protect human health and the environment from an imminent short-term threat. Interim RAs also may be implemented if the site warrants quick stabilization or risk reduction.

The lead agency for the investigations and RAs on the ORR is the DOE Oak Ridge Operations (DOE-ORO) Office. The duties of the lead agency include overseeing and managing ORR RAs pursuant to the FFA, serving as the primary contact and coordinator with regulators for implementation of the FFA, and ensuring the availability of resources required to implement the site management plan. EPA and TDEC are working together within the terms of the FFA to provide regulatory oversight regarding initiation of RAs.

DOE-ORO has delegated remediation activities at each waste area grouping or operable unit (OU) to three primary contractors in addition to LMES. Jacobs Engineering Group, Inc., is responsible for the FS, Environmental Assessments, Proposed Plans, interim Records of Decision, and RODs. Foster Wheeler is responsible for RDs. MK-Ferguson of Oak Ridge Company is responsible for RAs. Additional information on the ER Program is available in the *Oak Ridge Reservation Site Management Plan for the Environmental Restoration Program*, DOE/OR-1001/R2 (Energy Systems 1992).

1.3 FACILITY-SPECIFIC ENVIRONMENTAL RESTORATION PROGRAM

The Y-12 Plant, one of three major DOE facilities on the ORR, includes approximately 800 acres near the northeast corner of the reservation, adjacent to the city of Oak Ridge (Fig. 1.1). The U.S. Army Corps of Engineers built the Y-12 Plant in 1943 as part of the Manhattan Project. The plant is a manufacturing and developmental engineering facility that produced components for various nuclear weapons systems and currently provides engineering support to other LMES facilities. More than 200 contaminated sites created by past waste management activities have been identified at the Y-12 Plant. Historically, many of the sites have been grouped into OUs based on priority and on investigative and remediation requirements.

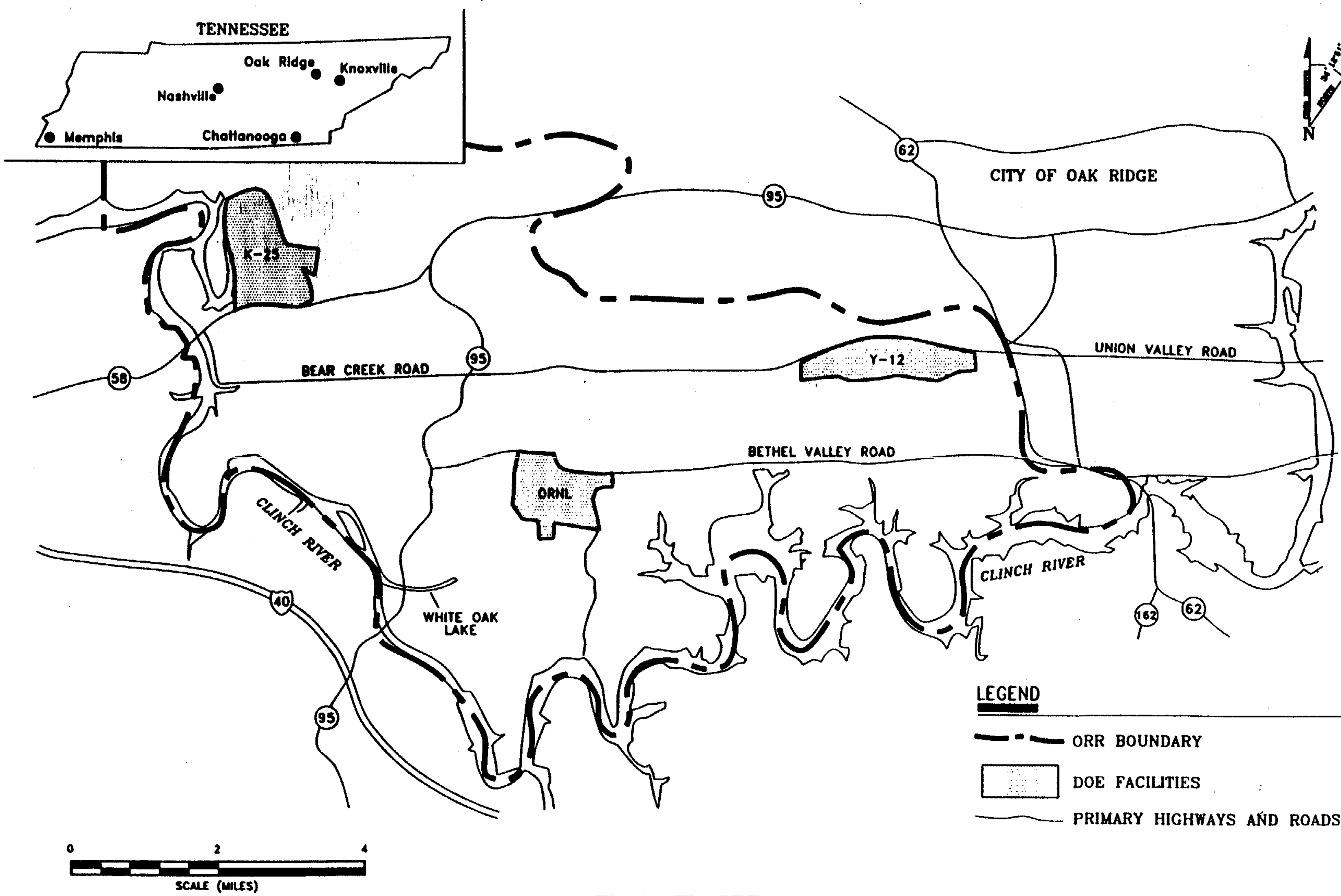

Fig. 1.1. The ORR.

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A major component of the investigative and remedial strategy to be applied to the Y-12 Plant and the entire ORR is a structured approach. This approach is based on integrated studies of groundwater, surface water, and contaminant sources. The hydrogeologic regime at the Y-12 Plant is complex and includes surface water drainage as well as groundwater flow through unconsolidated materials and through fracture-dominated and karst-dominated bedrock systems. Numerous sources may have contributed to groundwater and surface water contamination; for example, sources contributing to groundwater that is part of one OU often contribute to groundwater contamination that is part of another one. The current strategy is to combine OUs, where appropriate, into CAs.

Given these circumstances, the parties to the FFA concluded that the most timely and cost-efficient investigations would result if sources of contamination were studied separately from groundwater and surface water. This conclusion led to the designation of source control and integrator OUs. Source control OUs focus on the nature and extent of contaminant contributions from a specific source or group of sources. Integrator OUs, on the other hand, focus on the nature and extent of contamination in a particular medium, such as surface water or groundwater, independent of the specific source or sources. Some of the ORR OUs, such as the four Chestnut Ridge OUs, combine both source control and integrator aspects.

The need to complete RIs for Y-12 Plant integrator OUs in a timely manner resulted in the establishment of the UEFPC CA and the Bear Creek CA. The CA approach considers the entire watershed and examines all appropriate media within it. The UEFPC CA, which includes the main Y-12 Plant area, is an operationally and hydrogeologically complex area that contains numerous contaminants and contaminant sources as well as ongoing industrial and defense-related activities. The UEFPC CA also is the point of origin for off-site groundwater and surface water contamination. Boundaries of the CA include the base of Pine Ridge to the north, the base of Chestnut Ridge to the south, the Bear Creek CA to the west, and the DOE/ORR property line to the east (Fig 1.2). Several waste units that are potential contaminant sources and fringe these boundaries also are included in the CA.

The UEFPC CA RI also will address a carbon-tetrachloride-dominated groundwater plume that extends east of the DOE property line into Union Valley. Spring SCR 7.1SP, shown on Fig. 1.2, is a spring connected to the groundwater plume that exhibited an elevated concentration of carbon tetrachloride when sampled in the fall of 1994. Note that the plume is not shown on Fig. 1.2 because its configuration is not known precisely. In addition, surface water in UEFPC to the Lower East Fork Poplar Creek (LEFPC) CA boundary will be addressed. Through investigation of the entire watershed as one "site," data gaps and contaminated areas will be identified and prioritized more efficiently than through investigation of many discrete waste units.

1.4 OVERALL REMEDIAL INVESTIGATION OBJECTIVES

The overall objectives of the UEFPC CA RI are to evaluate the nature and extent of known and suspected contaminants, to provide the data necessary to support a BERA and a human health risk assessment (HHRA), to support the evaluation of remedial alternatives for the FS, and to support development of a Proposed Plan and a ROD for the CA. To meet these objectives, the RI will compile and utilize existing data from the UEFPC CA to the greatest extent possible. Additional sampling will be limited, will be driven primarily by risk assessment and FS needs, and will be completed only if needed to fill a critical data gap. By agreement among the FFA stakeholders, an expedited RI strategy (described in Sect. 1.5) will be followed to shorten the time needed to complete a ROD and to maximize cost efficiency.

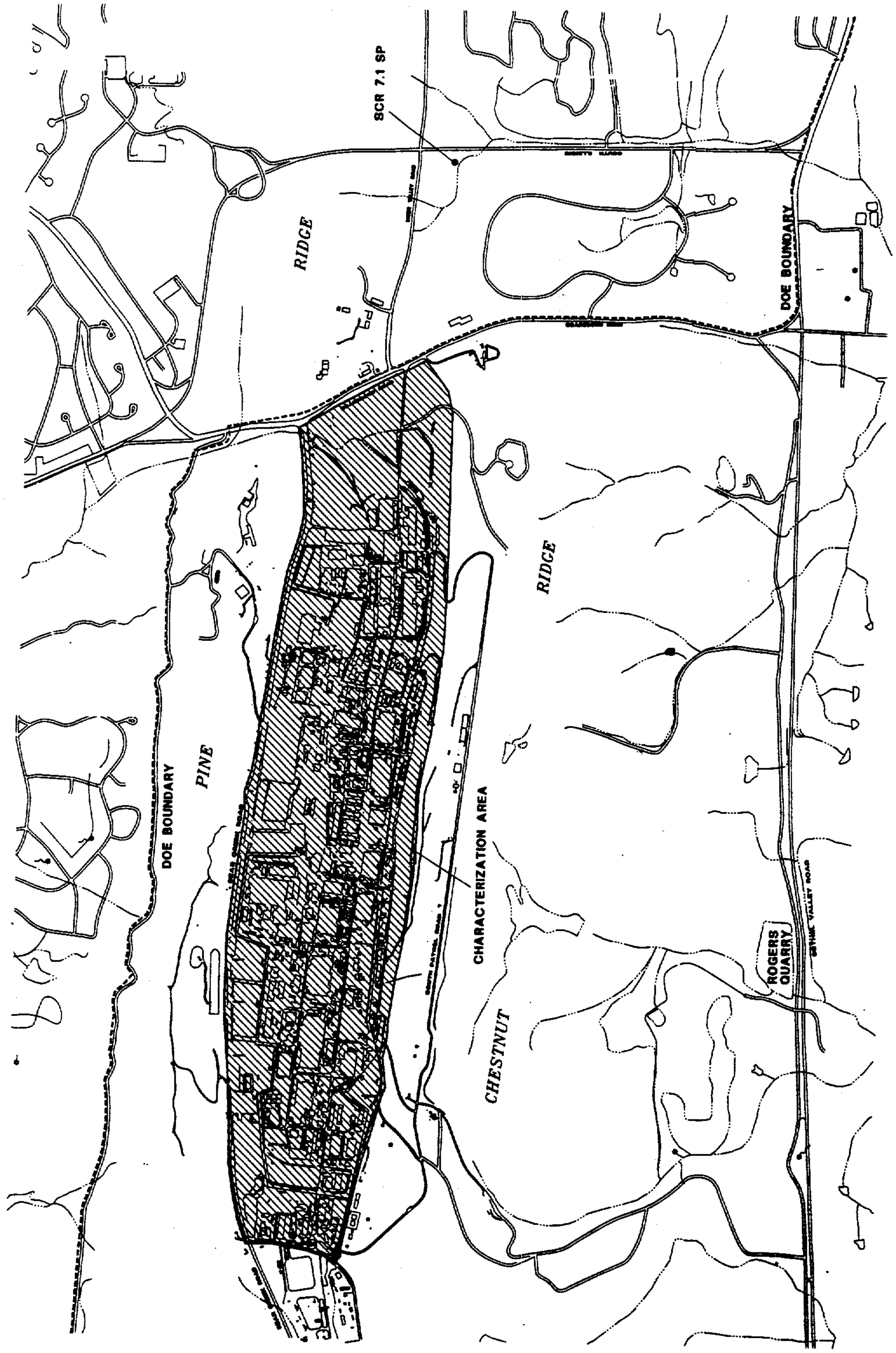

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Fig. 1.2. The UEFPC CA.

1.5 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the required quality of sample collection and analysis based on the intended uses of the data. The purpose of DQOs is to ensure that the data collected in a given study are of appropriate quality to support the activities, such as site characterization, risk assessment, evaluation of remedial alternatives, or development of design criteria, required by that study. DQOs are project-specific and apply to all data collection activities. This section describes the DQO process as applied to the UEFPC CA. Additional detail concerning DQOs will be included with any Sampling and Analysis Plans (SAPs) generated for specific sites or groups of sites within the CA.

DOE convened a DQO workshop on March 28 through 30, 1995, to present an approach for the completion of the UEFPC CA RI and FS and to gain concurrence on the RI/FS approach and other issues related to the CA. Representatives from DOE, EPA, TDEC, LMES, and Jacobs Engineering Group, Inc., LMES subcontractors, attended the workshop. The workshop had seven overall objectives:

- to reach agreement on the CA boundaries,
- to reach agreement on remedial action objectives (RAOs),
- to focus discussion on historical data use and the data analysis process,
- to focus discussion on critical data deficiencies,
- to critique technical components of the expedited RI/FS approach,
- to reach agreement on the RI Work Plan format and FFA milestones, and
- to reach agreement on an action item schedule.

The workshop included presentations and discussions on various aspects of the UEFPC CA RI and FS. The major agreements reached during the workshop included the CA approach; the CA boundaries; the CA land use designation; the proposed RI approach; and the format for this RI Work Plan, which deviates from the annotated outline developed by Energy Systems for FFA documents (Energy Systems 1993a). The workshop also identified general data assessment and collection needs. A meeting summary, issued in April 1995, includes a day-by-day synopsis of the workshop and information on the major agreements reached, the identified data needs, and the materials used for workshop presentations (Energy Systems 1995a).

The development of DQOs for new data collection (i.e., focused SAPs) is straightforward and will follow established guidelines for the process. The intended uses of the newly acquired data will be to characterize the following:

- the nature and extent of contamination in the UEFPC CA to the extent needed to conduct the baseline risk assessments and FS;
- the significant contaminant sources in the UEFPC CA to drive the alternatives assessment and the FS;
- the contaminant concentrations to determine if human and environmental receptors are at risk from exposure; and

- the ecological communities in the UEFPC CA, and to perform tests and collect data on the levels of contaminants in flora and fauna to support an ERA.

  Data objectives to meet the intended uses are listed here.

- Scientific data generated will be of sufficient quality to withstand technical and scientific scrutiny.
- Data will be gathered or developed in accordance with procedures appropriate for their intended use. All field and laboratory methods/procedures will be specified in SAPs and will comply with or exceed EPA requirements for CERCLA investigations.
- Data will be of known precision, accuracy, representativeness, completeness, and comparability; parameters will be established and will be presented in SAPs.

The approach of relying heavily on existing data raises issues relative to data quality that must be evaluated and resolved on a case-by-case basis. The quality and quantity of existing data and their adequacy were discussed at the DQO workshop through presentations of the current status of various data sets (e.g., soils and source area data, groundwater data, surface water data). The Data Summary Package (DSP) and Data Adequacy Report (DAR) for the UEFPC CA (see Sect. 1.7 for a description of these documents) present data summaries.

Workshop participants generally agreed that the historical groundwater data are of a quality consistent with CERCLA quality assurance (QA)/quality control (QC) requirements, as are a majority of the surface water data, which were collected under the Clean Water Act of 1972 (CWA) National Pollutant Discharge Elimination System (NPDES) compliance program. Subsequent to the DQO workshop, issues associated with the radiological groundwater data were identified. An evaluation of the data by LMES indicated that uncertainties on the results and batch minimum detectable activities generally were too large. As a result of these problems, most of the data screened out as nondetected or unusable. Appropriate corrective actions currently are being implemented to address these problems. Soils data have been collected to support a variety of investigative programs; therefore, aspects of sample collection and analysis are more variable than are those for samples collected under a single program. Regardless of the source, however, all of the historical data that are being evaluated to conduct this RI have been or will be scrutinized carefully to determine their appropriateness for their intended use.

1.6 UPPER EAST FORK POPLAR CREEK CHARACTERIZATION AREA STRATEGY

The UEFPC CA encompasses the UEFPC watershed and includes both surface water and groundwater components of it. The main Y-12 Plant area is within the CA, and, therefore, the CA contains many contaminant sources. Many contaminant sources exist within the UEFPC CA. Infiltration of contaminants from the S-3 Ponds Area is the primary source of contamination at the western end of the CA. The Salvage Yard, the S-2 Area, and the Building 81–10 Area also are known contaminant sources within the CA. In addition, approximately 175 RCRA Solid Waste Management Units (SWMUs) exist within the CA. Many of the SWMUs are of known low priority as contaminant sources and were previously grouped into the "Y-12 Study Area" of sites that were to be investigated as preliminary assessments/site investigations.

In keeping with the watershed approach discussed in Sect. 1.3, the strategy for the UEFPC CA RI will be to evaluate the data in terms of their significance to watershed contamination, migration, and risk. Existing data will be evaluated, and new data collected where necessary, in order to characterize the sources and the extent of contamination within the watershed. As these data are evaluated, sources of contamination and contaminated media that are not contributing to surface water and exit pathways will be clearly distinguished. This will allow the risk assessment and FS to focus their work on the sources and contamination that are contributing to contaminants in the watershed exit pathways.

A substantial amount of historical data exist for the UEFPC CA. Investigations and RAs under RCRA and CERCLA have been ongoing since 1983. Activities have included RCRA closures, underground storage tank (UST) removals, and sample collection and analysis. A comprehensive, facility-wide groundwater monitoring program was established in 1988. Surface water monitoring under NPDES requirements, sampling for the Reduction of Mercury in Plant Effluent (RMPE) Program, air monitoring, meteorological monitoring, the Biological Monitoring and Abatement Program (BMAP), ER investigations, and health and safety (H&S) characterization information from Y-12 Plant line item projects all are sources of data for the CA.

A streamlined RI approach has been proposed and accepted by the participating parties of the FFA because of the volume of historical data available for this CA. This approach will use historical data to the fullest extent possible to complete the RI and the FS and will focus additional data collection efforts on risk assessment and FS needs. For example, data exist from an extensive storm sewer system that underlies the CA and from a network of more than 200 groundwater monitoring wells within the CA.

A "subbasin" approach will be used to link information (e.g., soil data, inventories) from potential source areas to historical surface water and shallow groundwater data. Subbasins have been identified by topographic and storm drain system analyses and represent drainage areas for specific outfalls to UEFPC within the watershed. This approach, combined with the use of groundwater contaminant plume maps, will allow large areas of the CA to be prioritized according to the relative contaminant contributions or contaminant flux to surface water and groundwater. Contaminant "flux" is the concentration of a contaminant multiplied by the flow rate of the source.

The primary component of the RI approach will be the focus on existing CA data. The strategy will be to examine the data to evaluate individual source areas and contaminant flux on a subbasin basis, primarily for surface water and, to a lesser extent, for groundwater—in other words, a "top-down/bottom-up" approach. This approach consists of evaluating data on individual source areas and determining the transport and fate of contaminants from these source areas (i.e., "top down"), as well as evaluating surface water and groundwater to determine the nature of contaminants in exit pathways and working back to a source of the contamination (i.e., "bottom up"). The goal is to prioritize the major sources of contaminants to the exit pathways and to understand their characteristics for risk characterization and for development of remedial alternatives.

Reaching this goal of major source prioritization will involve a significant effort in the assessment of existing data. The first step in the process will be the analysis of existing data. Source (largely surface and subsurface soils) data, surface water data, groundwater data, sump data, and ecological data all will be analyzed. This effort will require the integration of data from many programs, including NPDES, the Groundwater Protection Program (GWPP), RMPE, and BMAP. An initial risk evaluation also will be initiated. The data will be screened against appropriate benchmarks (see Sect. 2.1 for details) to identify problem areas or "hot spots" and to clarify the distribution of contaminants across the CA.

Preparation and implementation of sampling plans will occur only when necessary to fill key data needs identified from the data analysis and based on needs identified from the risk assessment and FS. The data obtained from any additional sampling will be analyzed and screened in the same manner as the existing data. Results from additional sampling will be summarized in technical communication memoranda (TCMs) for use by the RI project team and FFA stakeholders. Ultimately all data will be summarized and incorporated into the RI report. If the data analysis and/or additional sampling investigations identify the need for removal actions or interim RAs, these activities will be initiated as soon as possible and may precede the completion of the RI report. Initiations of these actions will be dependent on the availability of funding. Preparation of the RI report will follow the completion of all analysis, prioritization, and sampling. The entire process will rely heavily on coordination and feedback among all stakeholders to focus on and adjust priorities, if needed, and to manage uncertainties.

The management of uncertainty is a significant issue related to minimizing data collection during the implementation of an RI of this size and scope. During the implementation of the RI, uncertainties concerning data quality, quantity, and adequacy will arise. Uncertainties will be identified, acknowledged, and documented. As conclusions regarding key technical issues, such as priority source areas, release mechanisms, and flow paths, are being developed, the impact of the uncertainties on the conclusions will be estimated. This process will allow the project team and FFA stakeholders to evaluate the sensitivity of key technical issues to identified uncertainties, and to define the uncertainty boundaries as needed to make the appropriate decisions.

1.7 INTENT AND SCOPE OF THE WORK PLAN

The intent of this Work Plan is to outline the strategy to be followed to complete the UEFPC CA RI. The plan will present a detailed description of the proposed RI approach, including the types of data analysis to be performed, the results to be generated, the contaminants of potential concern (COPCs), and the potential receptors and exposure pathways for both human and ecological populations. It is not the intent of this plan to identify specific types, numbers, and locations of samples to be collected. As discussed at the DQO workshop in March 1995, focused SAPs will be prepared for data collection activities only after analysis of existing data sets and subsequent identification of uncertainties and prioritization of data needs. Stakeholders and the project team will attend one or more Streamlined Approach for Environmental Restoration (SAFER) workshops to identify and discuss data gaps, data needs, and prioritization of data collection efforts. In keeping with this intent, the Work Plan does not include a Quality Assurance Project Plan (QAPjP), an H&S Plan, or a Waste Management Plan; these plans will be incorporated into the focused SAPs as they are prepared.

The UEFPC RI report will include a thorough discussion of the UEFPC CA environmental setting, including geography, demography, climate, topography, geology, soils, groundwater, surface water, sediments, and ecology. Relevant historical and operational information concerning the Y-12 Plant also will be presented and discussed or referenced from other documents. Some information on site characteristics is included in Sect. 2.1, accompanying the presentation of the site conceptual model (SCM).

Much of the existing data has been summarized in other documents. For example, Hatcher et al. (1992) and Solomon et al. (1992) provide details on and a synthesis of the ORR geology and hydrology, respectively. The Groundwater Quality Assessment Reports (GWQAR), published annually since 1989 (HSW Environmental), summarize and interpret the groundwater quality and chemistry within the UEFPC CA. Hundreds of other documents, including Work Plans, reports, and closure permits, also provide information relevant to the UEFPC CA.

Two other documents, prepared specifically for the UEFPC CA RI process, are a DAR (Energy Systems 1995b) and a DSP (Energy Systems 1995c). The DAR was prepared to identify and present existing data generated by the program and by activities at the Y-12 Plant that will support the RI process. The DSP is a compilation of pertinent information relevant to the UEFPC CA extracted from various reports and includes an extensive bibliography of the existing reports and other such information. Topics such as geology, hydrology, karst, and surface water are included in the DSP. The two documents together are approximately 2000 pages in length, and the reader is encouraged to review these documents for information related to the UEFPC CA. An effort currently is under way to update these documents with the most recent monitoring data available and to screen all of the data against applicable or relevant and appropriate requirements (ARARs).

The scope of the Work Plan includes an overview of environmental investigations and regulatory actions leading to the UEFPC CA RI, and a discussion of the approach and specific components that will constitute the RI. To fulfill this scope, the Work Plan consists of five sections. Section 1 defines the UEFPC CA, summarizes relevant environmental activities and regulatory initiatives at the Y-12 Plant, and defines the project objectives and approach. Section 2 presents the RI approach and its components in detail, including analysis of existing data, identification of the COPCs, prioritization of RI actions, and development of SAPs. Section 3 discusses the approach to be followed for both the HHRA and the ERA. Sections 4 and 5 present an overview of activities associated with the FS, RD, and RA.

1.8 SPECIAL ISSUES

Many ongoing monitoring and compliance programs generate data for various media within the UEFPC CA. Examples of such programs include RMPE, NPDES compliance monitoring, the GWPP, BMAP, and LEFPC sampling. The activities of these programs are not part of the UEFPC CA RI; therefore, special consideration will have to be made to coordinate and resolve any issues related to sampling or exchange of data. In addition, corrective actions specified in the current (July 1, 1995) NPDES permit (TN0002968) (TDEC 1995) regarding surface water quality have a direct impact on the UEFPC CA RI. The current corrective actions included in the NPDES permit include mercury treatment remediation, minimum flow specification from Station 17, and ammonia reduction. These corrective actions could potentially preempt certain remedial options under the CERCLA process and alter site characteristics over the course of the RI (e.g., elimination of outfalls, addition of new treatment systems, routing discharges to a different subbasin).

Much of the UEFPC CA is within the protected area of the Y-12 Plant; therefore, personnel who will require access to this area will need a security clearance. In addition, because some of the current and historical operations at the Y-12 Plant are classified, access to some process information and data also will require a security clearance. Samples collected from certain areas may have to be handled as classified material until the results are reviewed and reclassified appropriately. Some information and data may not be declassified and, therefore, will not be included in the RI report or in other documentation available to the public. Determination concerning classification status will be made on a case-by-case basis.

1.9 SCHEDULE

Table 1.1 shows the anticipated schedule for the completion of the RI Work Plan, the implementation of the RI and preparation of the RI report, the FS, and other activities through the submittal of the ROD for approval. It should be noted that this schedule is based on a resource-limited UEFPC CA baseline, which is being reviewed and is subject to modification. According to the current schedule, this Work Plan should receive final approval in April 1996, the D1 version of the RI report will be submitted for review in September 1999, and the ROD will be presented to the public in December 2002. Milestones and specific dates included in the schedule are subject to change during the implementation of the RI.

Table 1.1. Proposed schedule for UEFPC CA RI

Task name	Start date	End date
RI Plan	July 1994	April 1996
Field Activities	November 1996	April 1999
RI Report (D1)	October 1995	September 1999
Treatibility Studies	September 1997	November 1999
FS Report (D1)	October 1995	July 2001
Proposed RA Plan (D1)	November 1999	December 2001
ROD (D1)	May 2001	December 2002

1.10 QUALITY ASSURANCE

All QA and QC activities related to the UEFPC CA RI will be governed by Energy Systems' *Environmental Restoration Quality Program Plan*, ES/ER/TM-4/R4 (1992a), which addresses guidance in EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80 (1983); the specifications of Energy Systems' *Policies, Standards, and Procedures, Vol. 4, Quality Procedures Manual* (1993b); the American Society of Mechanical Engineers' document *Quality Assurance Program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers NQA-1 (1989); and applicable DOE orders and LMES procedures. When appropriate, existing subcontractor quality procedures will be used to supplement ES/ER/TM-4/R4 requirements. A QAPjP is not included in this Work Plan. When SAPs are prepared to address specific data gaps and needs (Sect. 2.5), a project-specific QA Plan will be included in which QA requirements and goals will be presented and discussed.

1.11 PROPOSED TABLE OF CONTENTS FOR REMEDIAL INVESTIGATION REPORT

The RI report will present the results of the investigation and the risk assessments as well as the conclusions reached. The regulatory history, the environmental setting, ARARs, and preliminary RA goals also will be summarized. A proposed table of contents for the RI report follows.

UPPER EAST FORK POPLAR CREEK CHARACTERIZATION AREA
REMEDIAL INVESTIGATION REPORT
PROPOSED TABLE OF CONTENTS

This outline follows the guidelines for preparation of RI reports in the annotated outline for preparation of FFA deliverables (Energy Systems 1993a).

2. REMEDIAL INVESTIGATION APPROACH

This section provides an overview of the approach to be applied to the UEFPC CA RI. To augment the text, Fig. 2.1 illustrates the key components of the RI process and the activities comprising the components. For each component, the purpose or goal of the component is defined. The figure provides a context for the discussion in this section and will enable the reader to understand how the various components of the RI fit together. The chapter begins with a description of the current SCM. Components of the RI, including the identification of COPCs, data analysis, the evaluation of RI actions, and the development of SAPs, are discussed subsequently.

2.1 SITE CONCEPTUAL MODEL

The development of a SCM is an integral part of the RI/FS process. The conceptual model depicts site conditions and is constructed from available information on the physical setting, waste sources, pathways, and receptors at the site to evaluate potential risks to human health and the environment. The model is used throughout the project to communicate information about the site and typically is refined as data are collected, analyzed, and evaluated. This section presents the current SCM for the UEFPC CA and provides an overview of its components. The DAR (Energy Systems 1995b) and the DSP (Energy Systems 1995c) for the UEFPC CA provide more detail on all aspects of the SCM and its components. Figures 2.2 and 2.3 depict the SCM for the UEFPC CA. Although this document does not present a detailed description of the environmental setting, it is necessary to present some hydrogeological information to allow the reader to understand the SCM and the RI approach.

The UEFPC CA includes the main Y-12 Plant area and is complex in that it contains numerous contaminants and contaminant sources as well as ongoing industrial and defense-related activities. Boundaries of the CA are defined by the base of Pine Ridge to the north, the base of Chestnut Ridge to the south, the Bear Creek CA to the west, and the DOE/ORR property line to the east. The CA also includes a carbon-tetrachloride/chloroform-dominated groundwater plume that extends east of the DOE property line into the Union Valley corridor, which essentially is a northeastward extension of Bear Creek Valley. The groundwater plume seemingly is connected with springs in Union Valley (e.g., SCR 7.1SP).

The main Y-12 Plant area extends from New Hope Pond and Lake Reality on the east to the S-3 Ponds on the west. The western end of the main plant complex corresponds to a topographic and hydrologic divide that is the boundary between the Bear Creek Hydrogeologic Regime and the UEFPC Hydrogeologic Regime. The main plant complex includes many industrial facilities, some of which are no longer in use.

The geologic structure and stratigraphy of the CA control the direction and extent of contaminant movement in groundwater. The Conasauga Group, a Middle Cambrian sequence of interbedded limestones, shales, and dolostones, underlies the Y-12 Plant, all of Bear Creek Valley, and the adjacent Union Valley corridor to the northeast. In the CA the Conasauga Group is approximately 1828 ft (557 m) thick and is subdivided into six formations that are, in ascending stratigraphic order, the Pumpkin Valley Shale, the Rutledge Limestone (mostly shales in the CA), the Rogersville Shale, the Maryville Limestone (mostly shales in the CA), the Nolichucky Shale, and the Maynardville Limestone.

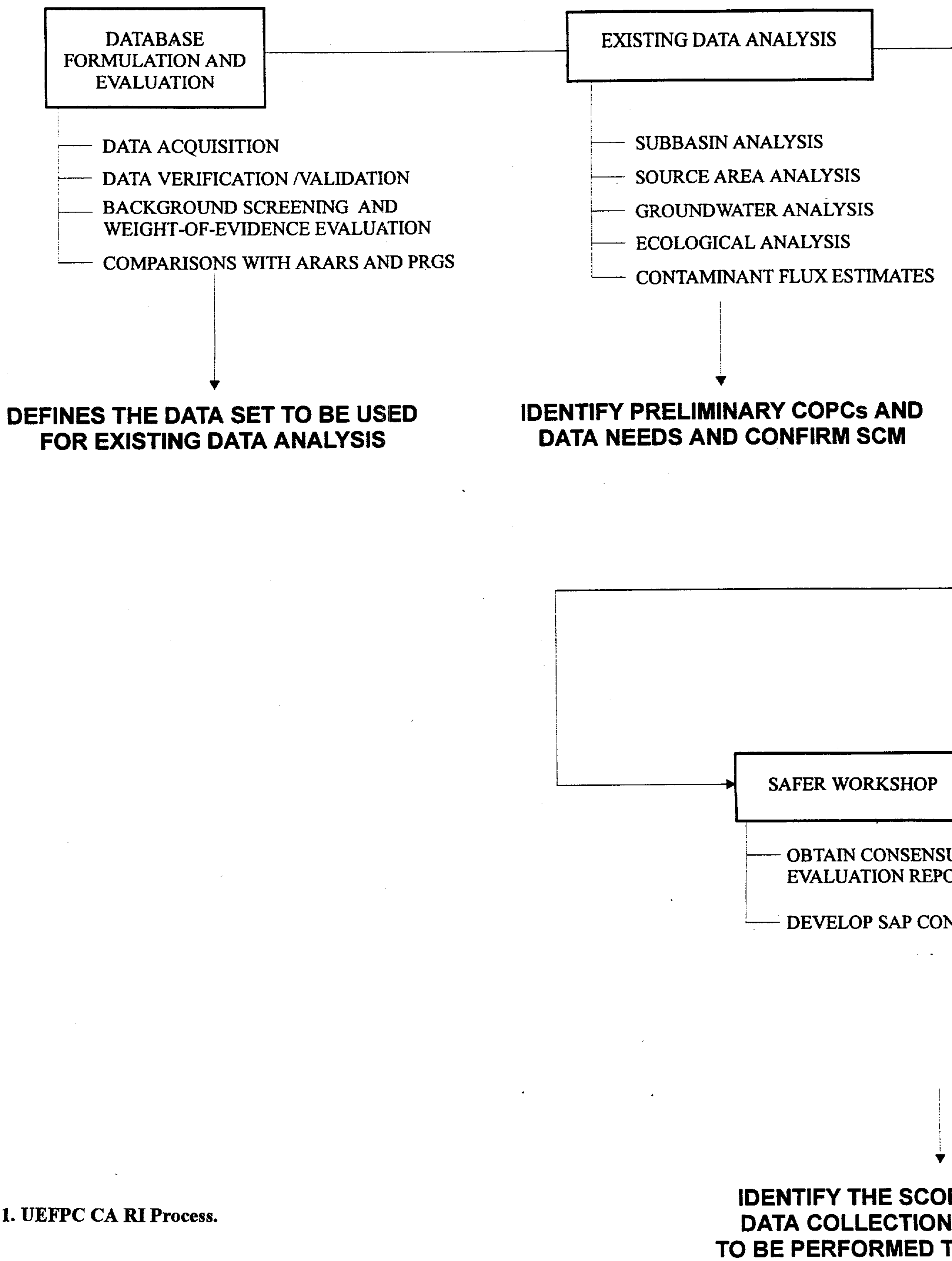
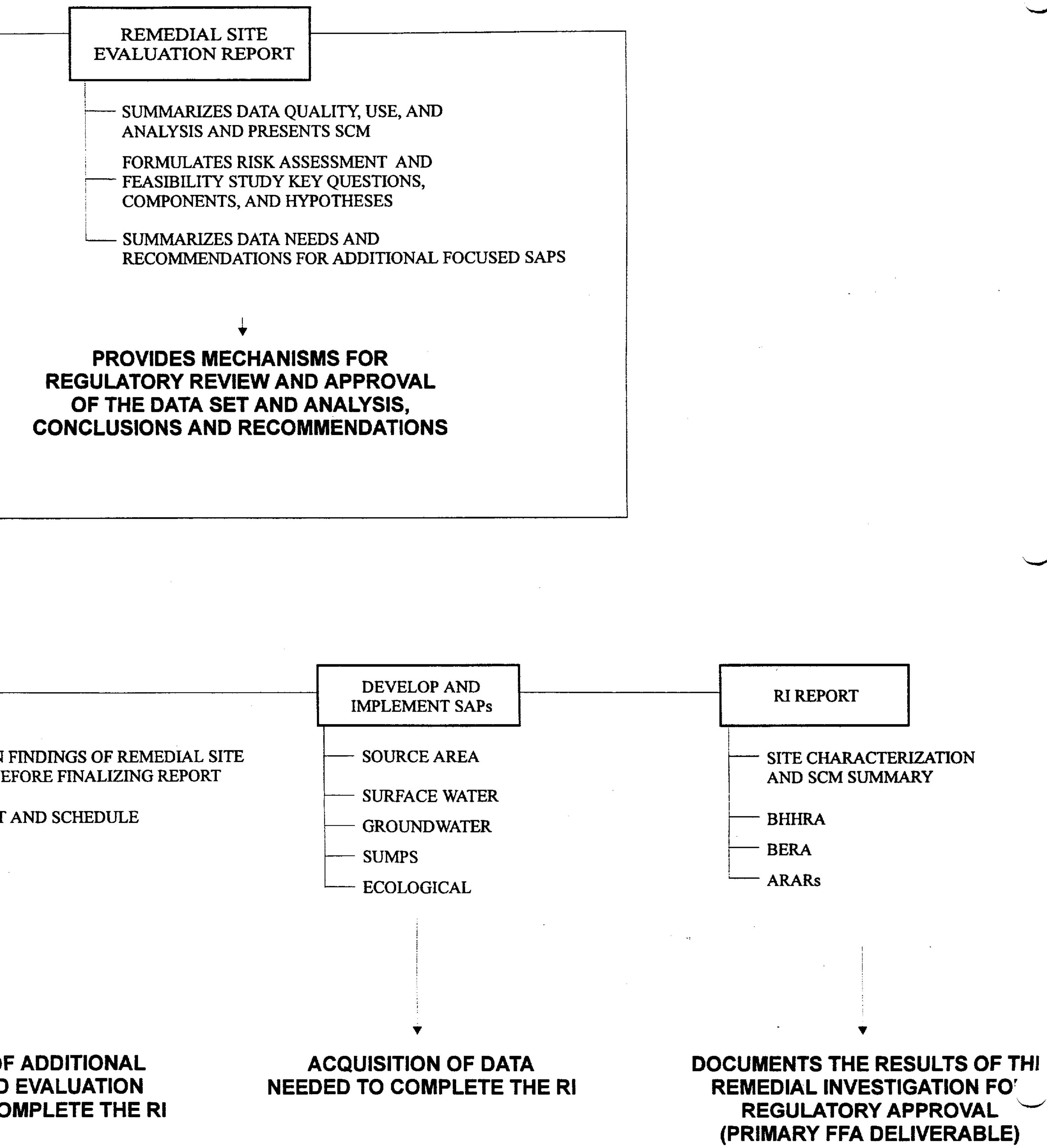


Fig. 2.1. UEFPC CA RI Process.

RICIIART.CDR


REMEDIAL SITE
EVALUATION REPORT
SUMMARIZES DATA QUALITY, USE, AND
ANALYSIS AND PRESENTS SCM
FORMULATES RISK ASSESSMENT AND
FEASIBILITY STUDY KEY QUESTIONS,
COMPONENTS, AND HYPOTHESES
SUMMARIZES DATA NEEDS AND
RECOMMENDATIONS FOR ADDITIONAL FOCUSED SAPS
PROVIDES MECHANISMS FOR
REGULATORY REVIEW AND APPROVAL
OF THE DATA SET AND ANALYSIS,
CONCLUSIONS AND RECOMMENDATIONS
DEVELOP AND
IMPLEMENT SAPs
SOURCE AREA
SURFACE WATER
GROUNDWATER
SUMPS
ECOLOGICAL
RI REPORT
SITE CHARACTERIZATION
AND SCM SUMMARY
BHHRA
BERA
ARARs
FINDINGS OF REMEDIAL SITE
EFORE FINALIZING REPORT
T AND SCHEDULE
F ADDITIONAL
D EVALUATION
OMPLETE THE RI
ACQUISITION OF DATA
NEEDED TO COMPLETE THE RI
DOCUMENTS THE RESULTS OF THI
REMEDIAL INVESTIGATION FO
REGULATORY APPROVAL
(PRIMARY FFA DELIVERABLE)

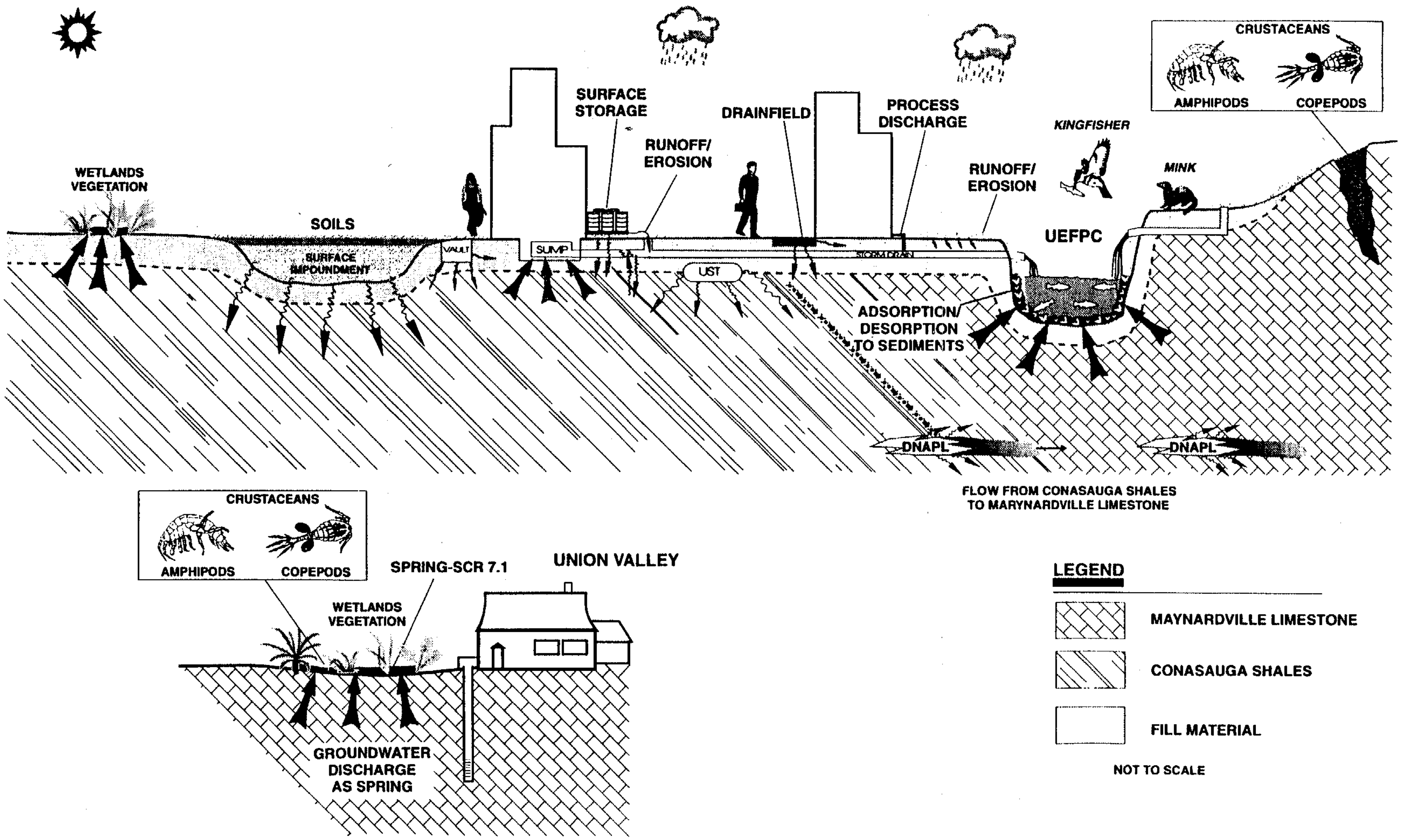
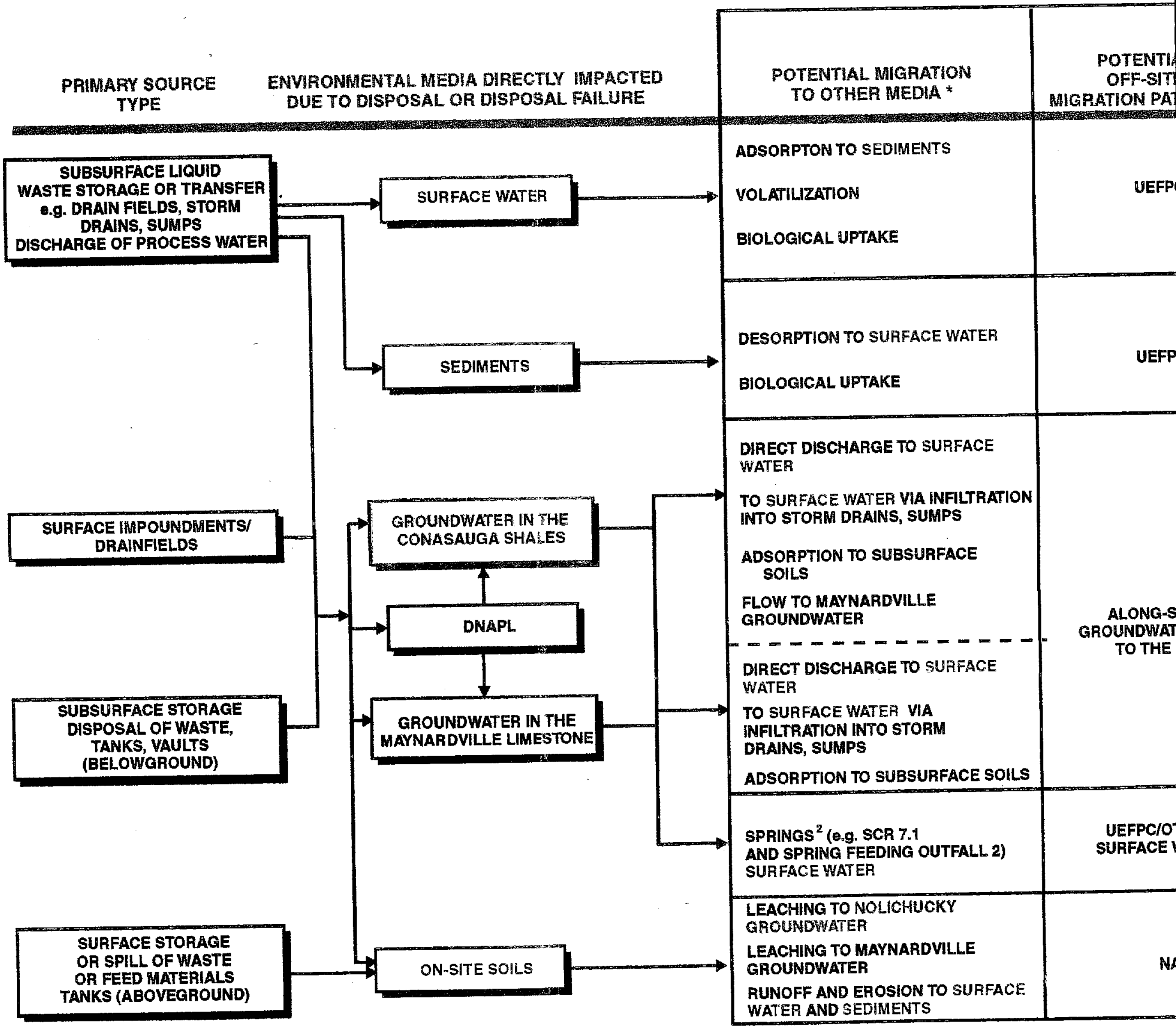


Fig. 2.2. UEFPC CA SCM.

L E HWAYS	POTENTIAL EXPOSURE MEDIUM	POTENTIAL RECEPTORS/EXPOSURE ROUTES — ON-SITE: HYPOTHETICAL** FUTURE RESIDENT	ON-SITE: CURRENT/ FUTURE INDUSTRIAL WORKER	ON-SITE: ECOLOGICAL RECEPTORS	OFF-SITE: CURRENT/ FUTURE RESIDENT	OFF-SITE: ECOLOGICAL RECEPTORS
C[1]	SURFACE WATER	INGESTION INHALATION DERMAL CONTACT INGESTION OF FISH[3]	NONE	PISCIVORES AQUATIC BIOTA	INGESTION[4] INHALATION DERMAL CONTACT[3] INGESTION OF FISH	PISCIVORES[4] AQUATIC BIOTA
C	SEDIMENTS	NONE	NONE	AQUATIC BIOTA	NONE	AQUATIC BIOTA
RIKE R FLOW AST	GROUNDWATER	INGESTION INHALATION DERMAL CONTACT	NONE	CAVE[5] AQUATIC BIOTA	INGESTION INHALATION DERMAL CONTACT	CAVE[5] AQUATIC BIOTA
HER ATER	SPRING WATER	NONE	NONE	WETLAND PLANTS	INGESTION[6] INHALATION DERMAL CONTACT	WETLAND[6] PLANTS, AQUATIC BIOTA
	SOILS	INCIDENTAL INGESTION INHALATION, DERMAL CONTACT, EXTERNAL EXPOSURE TO RADIONUCLIDES	INCIDENTAL INGESTION INHALATION, DERMAL CONTACT, EXTERNAL EXPOSURE TO RADIONUCLIDES	NONE	NONE	NONE

TAMINANTS ARE IN ANOTHER MEDIUM
D IN THIS COLUMN IN COLOR, REFER
THWAY DESCRIBED FOR THAT MEDIUM
COND COLUMN

INCLUDED ONLY FOR BASELINE
SIONS TO OTHER ORO PROJECTS.



1 ASSUMES SURFACE WATER DOES NOT RECHARGE GROUNDWATER

2 SPRINGS AND SEEPS THAT DISCHARGE DIRECTLY TO UEFPC ARE CONSIDERED UNDER SURFACE WATER

3 RECREATIONAL FISHERMAN

4 OFF-SITE SURFACE WATER IS LOWER EAST FORK POPLAR CREEK

5 IF DATA ARE AVAILABLE

6 THIS APPLIES SPECIFICALLY TO SPRING SCR 7.1

NA = NOT APPLICABLE, SEE OTHER MEDIA

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IDENTIF
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IN THE

** SCENAI
COMPA

Fig. 2.3. UEFPC CA SCM.

Unconsolidated materials such as alluvium, colluvium, residuum (from the weathering of bedrock), saprolite (a mixture of residuum and bedrock remnants), and weathered bedrock generally overlie bedrock. The thickness of unconsolidated materials is typically 40 ft or less (HSW Environmental Consultants 1994). Fill, consisting of reworked natural materials mixed with building debris, is a component of the unconsolidated materials within the Y-12 Plant area. The fill was deposited during the construction of the plant in conjunction with cut-and-fill and grading activities that included the straightening of the UEFPC channel. Many tributaries that drained into UEFPC were filled or fitted with storm drains.

Among the bedrock units the Maynardville Limestone is of particular interest because it is the primary pathway for groundwater movement through and out of Bear Creek Valley. The Maynardville Limestone consists of fine- to coarse-grained, thin-bedded to massive limestone and dolostone, interbedded with thin-bedded shale. In the CA the Maynardville Limestone averages approximately 400 ft (122 m) in thickness. Additional information on the stratigraphy and lithology of the Maynardville can be found in numerous publications (e.g., Energy Systems 1995c, Hatcher et al. 1992, Shevenell et al. 1992).

All of the bedrock strata in the CA were affected by faulting and mountain-building processes associated with the formation of the southern Appalachians. As a result all of the stratigraphic units are highly fractured and have been tilted approximately 45° to the southeast. The fractures form a network of discontinuities and intersections that provides pathways for groundwater flow. Fracture density is highly variable and decreases with depth; fracture lengths are similarly variable. In the Maynardville Limestone and in strata of the Knox Group, which directly overlie the Conasauga Group, dissolution has enlarged some fractures, resulting in preferential pathways for groundwater. Karst features, such as cavities and caverns, are also well developed in the Maynardville and the Knox, and these features provide additional potential pathways for groundwater.

Varying hydrologic properties of the underlying geologic units control groundwater movement in the CA. Solomon et al. (1992) identified two significant hydrogeologic groupings in the study area, the "Knox aquifer," consisting of formations of the Knox Group and the underlying Maynardville Limestone, and the "ORR aquitards," consisting of the remaining geologic units on the ORR. Groundwater in the study area is delineated as shallow (water-table interval, generally in the overburden or shallowest bedrock), intermediate (dominated by an active fracture flow system in bedrock), and deep (dominated by a sluggish saline fracture flow system in bedrock).

The flow of groundwater in the Maynardville Limestone is dominated by strike-parallel movement through solution features resulting from karst processes, although flow also occurs through fractures, especially at greater depths. Groundwater flow in the Maynardville is connected with and discharges through springs and seeps to UEFPC in Bear Creek Valley and Scarboro Creek in the Union Valley corridor. UEFPC is the primary surface water body in the CA and originates near the western edge of the Y-12 Plant as a surface water drainage system. As mentioned above, construction of the Y-12 Plant altered the course of UEFPC, and numerous tributaries were filled or routed through storm drains. Many of the old process buildings contain sumps, many of which discharge to the storm drains, providing a direct pathway for contaminant transport to UEFPC and shallow groundwater.

The headwaters of UEFPC are in underground collection pipes that extend to the central area of the plant, where the creek emerges aboveground. The creek then flows along the southern boundary of the plant and enters Lake Reality. UEFPC then exits an outfall at Lake Reality and passes through a gap in Pine Ridge into the city of Oak Ridge, where it becomes LEFPC. Earlier evaluations of flow data concluded that approximately 29 to 33% of the base flow in UEFPC can be attributed to groundwater infiltration (CDM Federal Programs Corporation 1994).

Nonhuman biota may be exposed to contaminants in the UEFPC CA. The assessment endpoint entities and exposure pathways that will be considered in theBERAinclude: aquatic biota (fish and/or macroinvertebrates) exposed to contaminated surface water and sediments; piscivorous wildlife, which are represented by the belted kingfisher (*Ceryle alcyon*) and mink (*Mustela vison*), exposed to contaminated surface water and fish; wetland plants exposed to contaminated seep surface water; and aquatic cave biota exposed to contaminated groundwater, if this pathway is shown to be complete. The rationale and approach to assessing the risks to these endpoints are discussed in Sect. 3.2.

Figures 2.2 and 2.3 illustrate the numerous types of potential contaminant sources within the CA, including surface impoundments, storage vaults, sumps, USTs, storm drains, process discharge, and others. The potential transport mechanisms are similarly diverse and include infiltration, runoff and erosion, adsorption, desorption, subsurface flow, and others. Potential on-site receptors include a hypothetical future resident, a current or future industrial worker, and ecological receptors. Potential off-site receptors include current or future residents and ecological receptors.

It is emphasized that as the RI proceeds and new data are collected for the UEFPC CA, the SCM will be reviewed and revised, if necessary. The RI report will present the revised SCM and note any modifications made based on data evaluated during the RI.

2.2 IDENTIFICATION OF CONTAMINANTS OF POTENTIAL CONCERN

A list of COPCs for the UEFPC CA will be developed by screening all existing data against criteria specified below. Contaminants of potential ecological concern (COPECs) will be identified in a similar manner. This process also will be used to confirm the completeness of the data set and to identify any outstanding data needs. Before data screening starts, the uncertainty of all existing data will be evaluated and documented.

An initial, preliminary list of COPCs was developed before the DQO workshop in March 1995 and is shown in Table 2.1. This list will be updated to develop the final list of COPCs. The COPCs are an essential component of all risk assessment and FS activities. This section first describes the criteria to be used for screening and comparison, and then describes the uncertainty evaluation and screening process.

2.2.1 Applicable or Relevant and Appropriate Requirements

2.2.1.1 Introduction

Section 121(d) of the CERCLA specifies that RAs for cleanup of hazardous substances must comply with requirements or standards under federal, or more stringent state, environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of ARARs is that the protection of human health and the environment is ensured. In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding, but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs, but are "to be considered" (TBC) guidance [40 *Code of Federal Regulations* (*CFR*) 300.400(g)(3)]. This chapter documents a preliminary list of available federal and state chemical- and location-specific ARARs that may be considered for the remediation of the UEFPC CA.

Table 2.1. Preliminary COPCs at the UEFPC CA

Inorganics	Radionuclides	Organics
Arsenic	^{241}Am	Chloromethane
Beryllium	^{137}Cs	Methylene chloride
Chromium	^{3}H	Trichloroethylene
Selenium	^{237}Np	1,1-Dichloroethane
Manganese	^{238}Pu	1,2-Dichloroethane
Mercury	$^{239/240}Pu$	1,2-Dichloroethylene
Nickel	^{226}Ra	Benzene
Boron	^{228}Ra	Carbon tetrachloride
Cadmium	$^{89/90}Sr$	Chloroform
Cyanide	^{99}Tc	Tetrachloroethylene
Lead	^{228}Th	Vinyl chloride
Molybdenum	^{230}Th	Polychlorinated biphenyls (PCBs)
Silver	^{232}Th	
Zinc	$^{233/234}U$	
Nitrates	^{235}U	
	^{238}U	
	Gross Alpha	
	Gross Beta	

2.2.1.2 Chemical-specific applicable or relevant and appropriate requirements

Chemical-specific requirements provide health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants [53 *Federal Register* (*FR*) 51437, 55 *FR* 8741]. As shown in Table 2.1, the COPCs for the UEFPC CA include nitrate (as N), metals, volatile organic compounds, and radionuclides in the surface water and groundwater, and metals, VOCs, polychlorinated biphenyls (PCBs), and uranium isotopes in the soil and sediment.

Groundwater. As stated in the NCP (55 *FR* 8666), EPA's goal for contaminated groundwater is to return usable groundwater to its beneficial use within a given time frame that is reasonable for the particular circumstances at a CERCLA site.

Under the TDEC Underground Injection Control regulations, all groundwater in the state is classified for domestic and industrial water supply, livestock watering and wildlife, and irrigation. However, the Underground Injection Control regulations [TDEC 1200-4-6-.02(4)] define an underground source of drinking water as meaning "an aquifer or its part that: (a) currently supplies any public water system; or (b) contains a sufficient quantity of groundwater to supply a public water system; and 1. currently supplies drinking water for human consumption; or 2. contains fewer than 10,000 mg/L total dissolved solids; and (c) which is not classified for underground injection use pursuant to Rule 1200-4-6-.05(3)."

The Groundwater Management Section of the Tennessee Division of Water Supply has developed a draft groundwater classification system for Tennessee groundwaters. Chap. 1200-4-3-.07 of the proposed rule lists four classifications for groundwater: Class A—current or future source of water supply; Class B—current or future source of water supply, but which will not support all uses as a water supply as a result of contamination; Class C—not a current or future source of water supply for drinking or other beneficial use; and Class D—groundwater that flows to the surface of the ground or mixes with surface water. Although this proposed classification scheme could readily apply to groundwater at the ORR, the State has delayed the promulgation of this rule indefinitely. TDEC is currently rewriting portions of this draft rule and expects to reissue a proposed rule in late 1995.

CERCLA §121(d)(2)(A) specifies that RAs must require a level or standard of control that at least attains maximum contaminant level goals (MCLGs) where such goals are relevant and appropriate under the circumstances of the release. The NCP requires the use of the Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) for RA compliance for carcinogens that have a zero-value MCLG and any nonzero-value MCLG for systemic toxicants [40 *CFR* 300.430(e)(2)]). Alternate concentration limits may also be used when active restoration of the groundwater to MCLs or nonzero MCLGs is not practical [40*CFR* 300.430(e)(2)]). Chapter 1200-5-1 of the Rules of the TDEC, as amended in January 1993, lists MCLs for public water systems that are identical to the federal MCLs. Table 2.2 lists the MCLs and MCLGs for the contaminants of concern in groundwater at the UEFPC CA.

National Secondary Drinking Water Standards regulate contaminants that affect the aesthetic qualities related to public acceptance of drinking water and are implemented in 40 *CFR* 143.3 as secondary maximum contaminant levels (SMCLs). These regulations are not federally enforceable, but rather are intended to serve as guidelines for use by states in regulating water supplies. Tennessee has promulgated SMCLs in TDEC, Chap. 1200-5-1.12, and considers these SMCLs as enforceable rather than aesthetic guidelines. Tennessee's SMCLs are also listed on Table 2.2 for the contaminants of concern at the UEFPC CA.

Leaking USTs have contributed to groundwater contamination at this CA. TDEC Chap. 1200-1-15-.06(7)(e)(1) requires that groundwater contaminated with benzene or total petroleum hydrocarbons (TPH) from USTs be remediated to meet levels listed in Appendix 3 of the rule; these levels are based on whether the groundwater is considered a drinking- or non-drinking-water source. Acceptable benzene levels are 5 μg/L and 70 μg/L for drinking water and non-drinking water, respectively; the values for TPH are 100 μg/L and 1000 μg/L, respectively. For sites where the background levels of petroleum, as a result of natural conditions, exceed the level of cleanup found in Appendix 3, the owner or operator will be required to clean up to background levels [TDEC, Chap. 1200-1-15-.06(e)(3)]. The TDEC UST Division has published UST Environmental Assessment Guidelines (January 1994), which provide a groundwater classification procedure. To determine the groundwater classification of a site, a field survey, records search, and survey of adjacent property owners should be performed within a 0.5 mile radius to determine the existence of any water supplies and their uses. If an affected aquifer or water source fails to meet any of the primary or secondary drinking water standards of TDEC Chap. 1200-5-1 for contaminants other than petroleum products, which are regulated under TDEC Chap. 1200-1-15-.06, and it is not a drinking-water supply as determined in the water use survey, it may be classified as a "non-drinking-water supply." Petroleum-contaminated groundwater has been delineated at four UST sites. Groundwater monitoring is being conducted at two of the sites using the non-drinking water cleanup levels. A request for a site-specific standard has been submitted to the TDEC UST Division for the other two sites. If approved, a differing standard would be applicable at each respective UST location.

Table 2.2. Chemical-specific federal SDWA regulations[a] for groundwater contamination at the UEFPC CA

Compound	National Primary Drinking Water Regulations (μg/L)		National Secondary Drinking Water Regulations (mg/L)	Proposed Criteria (Proposed Rule, 56 *FR* 33050, July 18, 1991)
	MCLs[b]	MCLGs[c]	SMCLs[d]	
Arsenic	50	Na[e]		
Benzene	5	0		
Beryllium	4	4		
Boron	NA	NA		
Cadmium	5	5		
Carbon tetrachloride	5	0		
Chloroform	0.1[f] (0.08[g])			
Chloromethane	NA	NA		
Chromium, total	100	100		
Cyanide	200	200		
1,1-Dichloroethane	NA	NA		
1,2-Dichloroethane	5	0		
1,1-Dichloroethylene	7	7		
1,2-Dichloroethylene	70	70		
Lead	TT[h,i]	0		
Manganese	NA	NA	0.05	
Mercury	2	2		
Methylene chloride	5	0		
Molybdenum	NA	NA		
Nickel	NA[j]	Na[j]		
Nitrate (as N)	10,000	10,000		
Nitrite (as N)	1,000	1,000		
Nitrate + Nitrite (as N)	10,000	10,000		
PCBs	0.5	0		
Selenium	50	50		
Silver	NA	NA	0.1	
Tetrachloroethylene	5	0		
1,1,1-Trichloroethane	200	200		
1,1,2-Trichloroethane	3	5		
Vinyl Chloride	2	0		
Zinc	NA	NA	5	

Table 2.2 (continued)

Compound	National Primary Drinking Water Regulations (μg/L) MCLs[b]	National Primary Drinking Water Regulations (μg/L) MCLGs[c]	National Secondary Drinking Water Regulations (mg/L) SMCLs[d]	Proposed Criteria (Proposed Rule, 56 *FR* 33050, July 18, 1991)
		Radionuclides		
Radium	5 pCi/L			20 pCi/L
Gross Alpha	15 pCi/L			
Gross Beta	4 mrem/year			
Strontium-90	8 pCi/L[k]			42 pCi/L[k]
Tritium	20,000 pCi/L[k]			60,900 pCi/L[k]
Natural Uranium				20 μg/L[l]
All Other Man-made Radionuclides	4 mrem/year[m]			

[a]The State of Tennessee drinking water MCLs/MCLGs (TDEC, Chap. 1200-5-1) are identical to the federal ones.
[b]MCL = maximum contaminant level (40 *CFR* 141)
[c]MCLG = maximum contaminant level goal (40 *CFR* 141)
[d]SMCL = secondary maximum contaminant level
[e]NA = not applicable
[f]"Total trihalomethanes" refers to the sum of the concentration of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.
[g]Proposed Rule for Disinfectants and Disinfection By-Products, 59 *FR* 38668, July 29, 1994
[h]TT = Treatment Technology
[i]When the "action level" of 15 μg/L for lead (measured in the 90th percentile at the consumer's tap) is exceeded, corrosion control studies and treatment requirements are triggered. However, an Office of Solid Waste and Emergency Response memorandum (June 21, 1990) recommends that a final cleanup level of 15 μg/L for lead in groundwater usable as drinking water is protective of sensitive subpopulations; this is TBC guidance, not an applicable or relevant and appropriate requirement.
[j]EPA has deleted from the *CFR* the MCL and MCLG for nickel, which have been vacated by a court effective June 29, 1995 (60 *CFR* 33926, June 29, 1995).
[k]These values are not MCLs, but are concentrations that result in the effective dose equivalent (EDE) of 4 mrem/year, the MCL for gross beta emissions.
[l]Approximately equal to 30 pCi/L
[m]If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.
Source: Drinking Water Regulations and Health Advisories, Office of Water, EPA, May 1995.

The provisions of the Uranium Mill Tailings Radiation Control Act (40 *CFR* 192) regulate disposal and RAs at DOE-owned inactive uranium processing plants. Following a Tenth Circuit Court of Appeals remand of the groundwater provisions of 40 *CFR* 192.20(a)(2) and (3), 40 *CFR* 192 has been revised to provide final groundwater protection standards for disposal sites (Subpart A) and for remediation (Subpart B) (Final rule, 60 *FR* 2854, January 11, 1995). DOE must determine which of the listed constituents in Appendix I, Part 192, are reasonably expected to be derived from residual radioactive materials at a site; concentration limits of such constituents must then not exceed background, RCRA 40 *CFR* 264.94 MCLs, or alternate concentration limits (40 *CFR* 192.02). Additional MCLs were added in 40 *CFR* 192.02 for nitrates (10 mg/L), molybdenum (0.1 mg/L), and some radionuclides. These groundwater protection standards may be relevant and appropriate or TBC guidance for remediation of radioactively contaminated groundwater at the UEFPC CA.

Surface water. CERCLA §121(d)(2)(A) specifically states that RAs shall attain at least federal ambient Water Quality Criteria (WQC) established under the CWA (Pub. L. 92-522) if they are relevant and appropriate. EPA has derived WQC for ingestion of drinking water and aquatic organisms and for the ingestion of aquatic organisms only. WQC for certain toxic pollutants were withdrawn and others revised in the "National Toxics Rule" (57 *FR* 60848), and the EPA Region IV Water Quality Standards Unit has adopted these criteria. The federal WQC are usually adopted by the states as state surface water quality standards and are considered ARARs.

The purpose of the Tennessee Water Quality Control Act [*Tennessee Code Annotated (TCA)* 69-3-102(b)] is "to abate existing pollution of the waters of Tennessee, to reclaim polluted waters, to prevent the future pollution of waters and to plan for the future use of the waters...." Tennessee has promulgated regulations to fully protect existing uses of all surface waters as established under the Water Quality Control Act that are considered to be relevant and appropriate to CERCLA cleanup of surface water bodies. Chapter 1200-4-3 of the Rules of the TDEC lists seven use-designation categories for Tennessee's surface waters; specific water quality standards are promulgated for each use category. Under the Tennessee Water Quality Control Act, the Tennessee Water Quality Control Board has classified the East Fork Poplar Creek (EFPC) for industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife uses (TDEC, Chap. 1200-4-4). The standards also state that "all other streams, named and unnamed, which have not been specifically noted shall be classified for fish and aquatic life, recreation, irrigation, and livestock watering and wildlife uses."

As part of the federal requirement for a triennial review of state water quality standards, the TDEC Division of Water Pollution Control has promulgated amendments to Chaps. 1200-4-3 and 1200-4-4 of the Rules of the TDEC, which incorporate all of the current EPA Region IV WQC. Additional criteria for protection of recreational uses include WQC for consumption of aquatic organisms only. The TDEC WQC for carcinogens differ from those of EPA Region IV in that they are based on a risk of 10^{-5} rather than EPA's 10^{6} risk. Table 2.3 lists TDEC ambient WQC for the protection of recreational users from the consumption of aquatic organisms.

EPA Region IV has also revised WQC for the protection of freshwater aquatic life based on current toxicity and bioaccumulation data for aquatic organisms. TDEC has adopted these WQC, which also appear in Table 2.3. EPA has determined that WQC for metals are more accurately expressed as dissolved metal rather than as the current method of total recoverable metal (60 *FR* 22229, May 4, 1995); when this revised approach is promulgated by TDEC, the WQC for aquatic life will more closely approximate the bioavailable fraction of metal in the water column. Presently, TDEC's WQC contain standards based on the dissolved phase and total recoverable metals (TDEC, Chap. 1200-4-3-.03).

Table 2.3. Tennessee ambient WQC for the protection of human health and fish and aquatic life in surface water at the UEFPC CA

	Recreation WQC[a] (μg/L)		Fish and Aquatic Life WQC[b] (μg/L)	
Compound	For aquatic organisms and drinking water[c]	For aquatic organisms only	Maximum[d]	Continuous[e]
Inorganics				
Arsenic (c[f])	0.18	1.4		
Arsenic (III) ©			360	190
Beryllium	--[g]	--[g]		
Cadmium, dissolved[h]			3.9	1.1
Chromium, total			Na[i]	100
Chromium (VI)			16	11
Cyanide	700	220,000	22	5.2
Lead, dissolved[h]			81.7	3.2
Mercury	0.14	0.15	2.4	0.012
Nickel, dissolved[h]	610	4,600	1,418	158
Selenium			20	5
Silver, dissolved[h]			4.1	NA
Zinc, dissolved[h]			117	106
Volatiles				
Benzene ©	12	710		
Carbon tetrachloride ©	2.5	44		
Chloroform ©	57	4,700		
1,2-Dichloroethane ©	3.8	990		
1,1-Dichloroethylene ©	0.57	32		
Methylene chloride (Dichloromethane) ©	47	16,000		
Tetrachloroethylene ©	8	88.5		
1,1,1-Trichloroethane ©	--[g]	--[g]		
1,1,2-Trichloroethane ©	6	420		
Vinyl chloride ©	20	5,250		

Table 2.3 (continued)

Compound	Recreation WQC[a] (μg/L)		Fish and Aquatic Life WQC[b] (μg/L)	
	For aquatic organisms and drinking water[c]	For aquatic organisms only	Maximum[d]	Continuous[e]
		Pesticides		
PCB, each Aroclor ©			NA	0.014
PCB, total ©	0.00044	0.00045		

[a]TDEC, Chap. 1200-4-3-.03(4), effective July 30, 1995.
[b]TDEC, Chap. 1200-4-3-.03(3), effective July 30, 1995.
[c]The water and organisms criteria should only be applied to those waters classified for both recreation and domestic water supply.
[d]One-hour average concentration not to be exceeded more than once every 3 years.
[e]Four-day average concentration not to be exceeded more than once every 3 years.
[f]The letter *c* stands for ***carcinogen***; TDEC uses a 10^{-5} risk level for all carcinogenic pollutants for organisms only.
[g]These are **federal** criteria, taken from the CWA, Section 303(c)(2)(B); 57 *FR* 60848, December 22, 1992. EPA is not promulgating human health criteria for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics.
[h]Criteria for these metals correspond to a total hardness of 100 mg/L.
[i]NA = Not available.

Soil. Currently few promulgated federal or state regulations directly address cleanup criteria for contaminated soils at CERCLA sites; however, a number of unpromulgated guidance criteria may be used as TBC guidance. Before the signing of the FFA for the ORR, some sources within the CA were designated as RCRA SWMUs. If a site is identified as a RCRA §3004(u) SWMU, it is subject to RCRA corrective action regulations. The proposed RCRA corrective action regulations address risk-based cleanup standards for soils (55 *FR* 30798). These standards, and those for treatment to meet the land disposal restrictions for contaminated soil at CERCLA sites, will be analyzed further as action-ARARs one remedial alternatives are selected for this CA.

The TDEC UST regulations require that soil contaminated by petroleum from UST systems be addressed in a corrective action plan, using cleanup levels for benzene and TPH listed in Appendix 4 of the Rule [TDEC, Chap. 1200-1-15-.06(e)(2)]. Soil cleanup levels vary depending on the permeability of the soil and the classification (i.e., drinking- or non-drinking-water supply) given for groundwater at the site. For sites where the natural background levels of petroleum exceed the level of cleanup found in Appendix 4, the owner or operator will be required to clean up to background levels [TDEC Chap. 1200-1-15-.06(e)(3)]. These regulations may supply ARARs for cleanup of soils contaminated by leaking USTs.

EPA has developed a standardized method to estimate site-specific soil screening levels (SSLs) under a conservative residential land use scenario Office of Solid Waste and Emergency Response Directive 9355.4-14FS, December 1994, Review Draft. Areas with soil contamination below SSLs generally would not warrant further study or action under CERCLA. Default parameters have been used in the standardized approach to develop a table of "generic" SSLs for 107 chemicals; the generic SSLs are default options for use when site-specific values are not available. These SSLs may be used as screening tools, but are not cleanup criteria or TBC guidance.

Although not an ARAR, EPA has codified a PCB spill cleanup policy (40 *CFR* 761.120 et seq.) under the Toxic Substances Control Act of 1976 (TSCA) (Pub. L. 94-469). This policy, effective for spills occurring after May 4, 1987, recommends cleanup standards for PCBs of varying concentrations depending on the contaminant location, potential for exposure following cleanup, concentration of PCBs initially spilled, and the nature and size of the population potentially exposed. Cleanup of any historic spills that occurred before that date must be approved by the EPA Regional Administrator. However, EPA considered the cleanup requirements of the spill policy in developing guidance levels for RAs at Superfund sites containing PCB contamination (EPA 1990). Preliminary remediation goals (PRGs) at the soil surface are set at 1 part per million (ppm) (a risk of 10^{-5}) for residential land use and between 10 and 25 ppm (a risk of 10^{-4}) for industrial and/or remote areas. Alternatives should reduce concentrations of PCBs to these levels, or limit possible contaminant exposure. This guidance indicates that a 10-in. cover of clean soil will reduce the risk by approximately one order of magnitude. The guidance stresses that the TSCA anti-dilution provisions [40 *CFR* 761.1(b)] are applicable only after a remedy response begins, and do not apply when dilution has occurred as a result of the introduction of PCBs into the environment under earlier activities at CERCLA sites. Rather, in selecting response actions and cleanup levels of PCBs, EPA should evaluate the form and concentration of the PCB contamination "as found" at CERCLA sites.

EPA has proposed a remediation strategy for PCBs undergoing cleanup under RCRA or CERCLA (59 *FR* 62788, December 6, 1994; final rule December 1996). Under this strategy PCBs disposed of, placed in a land disposal facility, spilled, or otherwise released into the environment before April 18, 1978, are presumed to have been disposed of in an environmentally-safe manner. However, if the EPA Regional Administrator determines that there is a risk of exposure from such wastes, the burden will be on the site owner or operator to prove that PCB wastes in concentrations of 50 ppm or greater in environmental media do not pose a risk of injury to human health or the environment. Disposal options proposed for remediation wastes containing PCBs will be addressed as action-specific ARARs during the FS phase of this project.

Sediment. EPA uses an approach to deriving cleanup levels of PCBs in sediments called the "sediment quality criteria," which is based on a function of organic carbon concentrations and is meant to protect wildlife consumers of freshwater benthic species (EPA 1990). These values are considered TBC guidance, not ARARs. EPA has proposed sediment quality criteria for five chemicals for the protection of benthic organisms (59 *FR* 2652, January 18, 1994). The preamble to the proposed rule states that these SQC should not be used as mandatory cleanup levels because of many factors, including the potential for causing environmental damage through disturbing contaminated sediments (59 *FR* 2654). These SQC should be used as tools to evaluate sites to determine the need for remediation, but are neither ARARs nor TBC guidance for remediation.

EPA Region IV, Waste Management Division, has made available a summary of chemical-specific concentrations to serve as preliminary screening tools for the review of chemical data associated with hazardous waste sites. These values may be used to flag contaminant levels of concern in sediments (EPA 1994). These values are intended for use as ecological risk screening levels and are not intended as cleanup standards or TBC guidance.

2.2.1.3 Radiation Protection Standards

The Atomic Energy Act of 1954 (Pub. L. 83-703) and its amendments delegated authority for control of nuclear material to DOE, the U.S. Nuclear Regulatory Commission (NRC), and EPA. DOE is authorized to control source material, byproduct material, and special nuclear material at sites under its jurisdiction and is exempt from the licensing requirements of the TDEC/NRC Radiation Protection Standards for activities occurring within plant boundaries [TDEC, Chap. 1200-2-10-.06(1)]. Therefore, TDEC/NRC regulations are not considered legally applicable for on-site CERCLA remedial activities at the ORR. The DOE regulations for handling and cleanup of radioactive materials are outlined in a series of internal DOE orders that are contractually binding to DOE contractors, but are not considered by EPA to be ARARs. However, the DOE orders are functionally equivalent to the TDEC/NRC requirements and include all "appropriate" requirements from the TDEC/NRC regulations. In developing ARARs, DOE orders will be treated as TBC guidance.

U.S. Environmental Protection Agency Regulations. EPA has promulgated MCLs for radionuclides in community water systems (see Table 2.2). These MCLs appear in two forms: concentration limits for certain alpha-emitting radionuclides (40 *CFR* 141.15) and an annual dose limit for the ingestion of certain beta- and gamma-emitting radionuclides (40 *CFR* 141.16). MCLs and MCLGs were proposed for radon and uranium and reproposed for ^{226}Ra, ^{228}Ra, and beta and photon emitters on July 18, 1991. Final action to promulgate the concentration limits is on hold while EPA reprioritizes its SDWA rulemakings. As with the chemical-specific MCLs, these MCLs may be relevant and appropriate for cleanup of contaminated groundwater at the UEFPC CA; the proposed MCLs are considered TBC guidance until they are promulgated.

Subpart H of 40 *CFR* 61 addresses atmospheric radionuclide emissions from DOE facilities and may be applicable to point-source emissions during the cleanup of the ORR. The final National Emission Standards for Hazardous Air Pollutants for radionuclides limit the emissions of radionuclides to the ambient air from DOE facilities to amounts that would not cause any member of the public to receive an EDE of 10 mrem/year or more (40 *CFR* 61.92). This standard will be analyzed further as an action-specific ARAR once remedial alternatives are proposed for this site.

EPA is developing regulations to establish cleanup levels for sites, including federal facilities, contaminated with radionuclides subject to the Atomic Energy Act of 1954 and CERCLA. This regulation is being developed in coordination with NRC's parallel rulemaking on criteria for NRC-licensed sites. Early indications are that EPA will propose a cleanup level equivalent to the unrestricted release limit of 15 mrem/year proposed by the NRC. A proposed rule is expected by December 1995 (Houlberg et al. 1995).

U.S. Department of Energy Orders. The radiation exposure limits for the general public, as defined in DOE Order 5400.5 (Radiation Protection of the Public and the Environment, January 7, 1993), are an EDE of 100 mrem/year from all exposure pathways and all DOE sources of radiation and a dose of <500 mrem/year as a temporary maximum exemption under specially permitted and DOE-approved circumstances. The overriding principle of the DOE order is that all releases of radioactive material shall be as low as reasonably achievable.

DOE Order 5400.5, Chap. III, lists derived concentration guides (DCGs) for radionuclide isotopes, which are based on an EDE of 100 mrem/year for the inhalation of air or the ingestion of water. For liquid wastes containing radionuclides that are discharged to surface waters, the best available technology (BAT) must be used if the receiving water, at the point of discharge, would receive radioactive material at a concentration greater than the DCG (guidelines for selecting the BAT are provided). Implementation of the BAT process is not required if annual releases to surface water are below the DCG. In cases of multiple-radionuclide release, the sum of the fractional DCGs must not exceed unity (one). In addition, effluent releases to surface water must not result in exposures to aquatic organisms that exceed an absorbed dose of 1 rad/day.

DOE has proposed these radiation protection standards for the public and the environment for codification at 10 *CFR* 834 (58 *FR* 16268). These standards, which are due to become final in August 1995 (Houlberg et al. 1995), will then be legally applicable for cleanup at DOE sites. In the interim, they may be considered TBC guidance.

DOE Order 5820.2A (Radioactive Waste Management, September 26, 1988) pertains to the management of high-level, transuranic, and low-level radioactive waste. The order states that the management of low-level radioactive waste must ensure that external exposure to the waste and the concentrations of radioactive material that may be released into surface water and soil does not exceed 25 mrem/year for any member of the public. Releases to the atmosphere shall not exceed 10 mrem/year; however, reasonable effort should be made to keep releases to the environment to levels that are as low as reasonably achievable. The committed EDE received by individuals inadvertently intruding into the facility after the loss of active institutional controls (assumed to be 100 years) must not exceed 100 mrem/year for continuous exposure or 500 mrem for a single acute exposure. This order will be analyzed further once remedial alternatives are proposed for this site.

2.2.1.4 Location-specific applicable or relevant and appropriate requirements

Location-specific requirements "set restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 *FR* 51437, 55 *FR* 8741). Table 2.4 lists the major federal and state location-specific ARARs that may be pertinent to RAs at the UEFPC CA.

Wetlands/floodplains. A survey of wetlands by Cunningham and Pounds (1991) concluded that wetlands are found at the UEFPC CA. Wetlands present on the ORR are considered waters of the United States and the State of Tennessee. The EFPC floodplain is the largest floodplain on the ORR and is considered the only unlogged and undisturbed floodplain on the reservation.

If any remedial alternatives are selected that would impact floodplains or wetlands, the requirements found in Executive Order 11988 (Floodplain Management, May 24, 1977), Executive Order 11990 (Protection of Wetlands, May 24, 1977), 40 *CFR* 230, and 10 *CFR* 1022 may provide ARARs. The requirements in 10 *CFR* 1022 instruct DOE to avoid, to the extent possible, the adverse impacts associated with the destruction of wetlands, and to avoid occupancy and modification of floodplains and wetlands wherever there is a practicable alternative.

Aquatic resources. EFPC, with its various tributaries and forks, has been classified by TDEC for, among other uses, fish and aquatic life and wildlife use. Provisions of the Tennessee Water Quality Control Act (*TCA* 69-3-101 et seq.) may provide ARARs should any RAs at the UEFPC CA cause, or be likely to cause, harm to wildlife or aquatic life in any downstream EFPC waters. If any RAs result in the control or structural modification of a natural stream or water body, the provisions found in TDEC's aquatic resource alteration regulations (TDEC, Chap. 1200-4-7) and the Fish and Wildlife Coordination Act of 1972 [16 *United States Code* (*USC*) 661 et seq.] may provide ARARs.

Table 2.4. Potential location-specific ARARs[a] and TBC[b] guidance for the remediation of the UEFPC CA

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
	Wetlands		
Presence of wetlands as defined in EO[c] 11990 §7(c)	Whenever possible, actions must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. New construction in wetlands areas should be particularly avoided unless there are no practicable alternatives. Wetlands protection considerations shall be incorporated into planning, regulating, and decision-making processes.	Agency action that involves: • acquiring, managing, and disposing of lands and facilities • providing federally undertaken, financed, or assisted construction and improvements • conducting federal activities and programs affecting land use	EO 11990 (May 24, 1977) 10 *CFR*[d] 1022
Presence of jurisdictional wetlands as defined in 40 *CFR* 230.3(t) and 33 *CFR* 328.3(b)	Action to avoid degradation or destruction of wetlands must be taken to the extent possible. Discharges for which there is a practicable alternative with less adverse impacts or those which would cause or contribute to significant degradation are prohibited. If adverse impacts are unavoidable, action must be taken to enhance, restore, or create alternative wetlands.	Action involving discharge of dredge or fill material into wetlands	CWA (Pub. L. 92-522), §404 40 *CFR* 230
	Floodplains		
Within "lowland and relatively flat areas adjoining inland and coastal waters and other floodprone areas such as offshore islands including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year" [EO 11988 §6(c) and TDEC[e], Chap. 1200-1-7)]	Action shall be taken to reduce the risk of flood loss; minimize the impact of floods on human safety, health and welfare; and restore and preserve the natural and beneficial values of floodplains. The potential effects of actions in floodplains shall be evaluated and consideration of flood hazards and floodplain management ensured. If action is taken in floodplains, alternatives that avoid adverse effects and incompatible development and minimize potential harms shall be considered.	Action that involves: • acquiring, managing, and disposing of lands and facilities • providing federally undertaken, financed, or assisted construction and improvements • conducting federal activities and programs affecting land use	EO 11988 (May 24, 1977) 10 *CFR* 1022

Table 2.4 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
	Aquatic resources		
Within area encompassing or affecting waters of the State of Tennessee, as defined in *TCA* 69-3-103(32), and the presence of wildlife or aquatic life	Discharge of "substances" that "will result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life" is prohibited.	Action involving the discharge of any pollutants into the waters of the State [see *TCA* 69-3-103(18) and (21) for noninclusive list]	Tennessee Water Quality Control Act of 1977 (*TCA* 69-3-101 et seq.) Stream Use Classifications (TDEC, Chap. 1200-4-4)
Within an area affecting a stream or river	Must comply with the substantive requirements of the aquatic resource alteration permitting process and be protective of sensitive resources and downstream waters.	Action involving aquatic resource alterations, including alteration of wet weather conveyances, bank stabilization, debris removal, and sand and gravel dredging	Aquatic Resource Alteration (TDEC, Chap. 1200-4-7)
Within area affecting stream or river *-and-* presence of fish or wildlife resources	The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project-related damages or losses to fish and wildlife resources. Consultation with the FWS[e], NMFS[f], and/or appropriate State agency is strongly recommended for on-site actions.	Action that results in the control or structural modification of a natural stream or body of water	Fish and Wildlife Coordination Act of 1972 (16 *USC*[g] 661 et seq.)
Location encompassing aquatic ecosystem with dependent fish, wildlife, other aquatic life, or habitat	Degradation or destruction of aquatic ecosystems must be avoided to the extent possible. Discharges that cause or contribute to significant degradation of the water of such ecosystems are prohibited.	Action involving the discharge of dredge or fill material into aquatic ecosystem	CWA (Pub. L. 92-500), §404 40 *CFR* 230

Table 2.4. (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Endangered, threatened, or rare species			
Presence of endangered or threatened species *-or-* critical habitat of such species as designated in 50 *CFR* 17, 50 *CFR* 226, or 50 *CFR* 227	Actions that jeopardize species/habitat must be avoided or appropriate mitigation measures taken. Consultation with DOI[h], FWS, NMFS, and/or State agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat is strongly recommended for on-site actions.	Action that is likely to jeopardize species or destroy or adversely modify critical habitat	Endangered Species Act of 1973 (16 *USC* 1531 et seq.) 50 *CFR* 402 Fish and Wildlife Coordination Act of 1972 (16 *USC* 661 et seq.)
Presence of endangered or threatened species or critical habitat (see above citation) of same within an aquatic ecosystem as defined in 40 *CFR* 230.3(c)	Dredge or fill material shall not be discharged into an aquatic ecosystem if doing so would jeopardize such species or would likely result in the destruction or adverse modification of a critical habitat of the species.	Action involving discharge of dredge or fill material into aquatic ecosystem	CWA (Pub. L. 92-500), §404 40 *CFR* 230.10(b)
Presence of Tennessee state-listed endangered or threatened animal species as created and amended pursuant to *TCA* 70-8-105	Protected species may not be taken, possessed, transported, exported, processed, sold, offered for sale, or shipped. Certain exceptions may be allowed for reasons such as education or science or, where necessary, to alleviate property damage or protect human health or safety.	Action having an impact on such species, if present	Tennessee Non-game and Endangered or Threatened Wildlife Species Conservation Act of 1974 (*TCA* 70-8-101 et seq.)
Cultural resources			
Presence of archaeological resources on public land (i.e., within the ORR boundaries)	Steps must be taken to protect archaeological resources and sites.	Action that would have an impact on resource	Archaeological Resources Protection Act of 1979 (16 *USC* 470aa-ll) 43 *CFR* 7

Table 2.4 (continued)

Location characteristic(s)	Requirement(s)	Operating condition(s)	Citation(s)
Presence of federally owned, administered, or controlled prehistoric or historic resources *-or-* the likelihood of undiscovered resources	Consultation with the SHPO[i] should be conducted if cultural resources are inadvertently discovered during remediation activities. Consultation should be initiated with the SHPO and Advisory Council on Historic Preservation before the initiation of any groundbreaking activities to determine the need for any additional archaeological or historic survey work and the need for an MOA[j] regarding protection of archaeological resources.	Action that would have an impact on resource	National Historic Preservation Act of 1966 (16 *USC* 470a-w) EO 11593 36 *CFR* 800
Presence of archaeologic or historic resources	The Secretary of Interior must be advised of the presence of the data. A survey of affected areas for resources and data must be conducted and steps taken to recover, protect, and preserve data therefrom or request must be made that DOI do so.	Action involving alteration of terrain that might cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeologic resources	Archaeological and Historic Preservation Act of 1974 (16 *USC* 469a-c)

[a]ARARs = appropriate or applicable and relevant requirements.
[b]TBC = "to be considered."
[c]EO = Executive Order.
[d]*CFR* = *Code of Federal Regulations.*
[e]FWS = Fish and Wildlife Service.
[f]NMFS = National Marine Fisheries Service.
[g]*USC* = *United States Code.*
[h]DOI = Department of Interior.
[i]SHPO = State Historical Preservation Officer.
[j]MOA = memorandum of agreement.

Rare, threatened, or endangered species. Species of terrestrial flora and fauna considered endangered by the Department of the Interior have been observed in the area surrounding the Y-12 Plant; however, no study has been formally undertaken to determine whether any of these species actually reside within 1 mile of the Y-12 Plant. No threatened or endangered species or their habitats have been identified within the Y-12 Plant fence boundaries. Should any RAs at the UEFPC CA have an impact upon any federally listed endangered or threatened species or their habitats that may be identified during site investigations, the provisions found in the Endangered Species Act of 1973 (16 *USC* 1531 et seq.) and 50 *CFR* 402 may provide ARARs.

The Tennessee Rare Plant Protection and Conservation Act of 1985 (*TCA* 11-26-201 et seq.) protects and preserves state-listed threatened and endangered plant species and may provide ARARs for proposed RAs. If any proposed actions have an impact on state-listed endangered or threatened animal species that may be identified, the Tennessee Non-game and Endangered or Threatened Wildlife Species Conservation Act of 1974 (*TCA* 70-8-101 et seq.) may provide ARARs.

Cultural resources. DuVall (1992) reports that no archaeological sites have been identified within the fence boundaries at the Y-12 Plant. If any RA is taken that would cause irreparable harm, loss, or destruction to significant archaeological resources that may be identified or discovered during investigations or remediation, the provisions of the Archaeological Resources Recovery Act of 1979 (16 *USC* 470aa-ll), the National Historic Preservation Act (16 *USC* 470a-w), 36 *CFR* 800, and 43 *CFR* Part 7 may provide ARARs.

2.2.2 Preliminary Remediation Goals

PRGs are initial cleanup levels that are protective of human health and comply with ARARs. PRGs typically are developed early in the RI process based on readily available information, and may be modified as the RI progresses. The primary uses of PRGs are in selecting analytical procedures and sample quantitation limits, in developing COPCs for evaluation in the HHRA, and in the initial evaluation of remedial alternatives.

PRGs are risk-based and are developed for individual analytes under specific medium and land-use combinations. The most common sources of chemical-specific PRGs are risk-based concentrations [The ARARs include concentration limits that have been set by regulatory statutes (e.g., CWA, SDWA)]. The risk-based concentrations (i.e., PRGs) represent calculated concentrations that are protective of receptor populations based on a given exposure scenario and a defined level of risk (e.g., risk = 1 E−06). Risk values represent the potential incremental lifetime cancer risk for exposure to a carcinogen and/or health hazards from exposure to a noncarcinogen and include specific exposure scenarios and site-specific exposure values. For the purposes of this RI, the PRGs from the document *Preliminary Remediation Goals for Use at the U. S. Department of Energy Oak Ridge Operations Office* (ES/ER/TM-106, Energy Systems 1995a) will be used.

2.2.3 Background Concentrations

A number of the analytes present in the various media within the UEFPC CA, especially inorganics (i.e., metals), are naturally-occurring across the ORR. Some of these constituents are naturally occurring at low concentrations; therefore, it is critical that naturally-occurring constituents be differentiated from site-related contaminants so that proper decisions concerning risk and remediation are made. Typically, if the concentration of an analyte is less than the background concentration, the analyte is not considered to be a COPC.

Soils data from the CA will be compared with the data from the Background Soil Characterization Project for the ORR, conducted by DOE and Energy Systems. The overall objectives of the Background Soil Characterization Project were to provide baseline background data for contaminated site assessments and to provide estimates of potential human health risk associated with background concentrations of constituents in native soils. The project consisted of two phases, the results of which were issued in two reports in 1993 (Energy Systems 1993c).

Groundwater data from the CA will be compared to a set of background values assembled from a project completed by the Y-12 Plant ER Program and the Energy Systems Groundwater Program Office. This project applied rigorous statistical treatment to groundwater data from the Y-12 Plant; data were grouped on the basis of geochemical parameters, and a cluster analysis was performed for groupings of monitoring wells at the Y-12 Plant. A report summarizing the project and its results is currently being prepared and will be issued by the Groundwater Program Office in 1995 or 1996.

A discrete set of background values for UEFPC surface water and sediments is currently unavailable. Nevertheless, several possibilities exist for use as elements in a background comparison. For example, groundwater background values, described above, may be appropriate because of the strong connection between UEFPC surface water and groundwater. Other possibilities for surface water include the background values developed for either the Bear Creek CA or LEFPC and the surface water data collected by the U.S. Geological Survey from McCoy Branch and other streams within the ORR. Comparison values for UEFPC CA sediments also may be values developed for either the Bear Creek CA or LEFPC. The RI project team will identify the most appropriate and applicable set of surface water and sediment background values to be used for screening.

2.2.4 Uncertainty Evaluation

The existing data from the UEFPC CA were collected for various programs and purposes, and the level of QA/QC applied is quite variable. Existing data sets will be evaluated to determine the degree of accompanying uncertainty. The data will be verified and validated to the greatest extent possible. For example, data sets will be examined for the presence or absence of field QC samples (e.g., trip blanks, duplicates, field blanks, etc.) And laboratory blanks and evidence of calibration. The data also will be examined for holding times and standard field measurements such as temperature and specific conductance. Data sets that already have been validated by a third party will be not be subject to extensive uncertainty evaluation. Much of the groundwater data, for example, was collected for compliance monitoring and has been validated.

Inconsistencies and problems within data sets will be documented. An uncertainty log will be maintained as a controlled document to track uncertainties identified during the data evaluation. The uncertainty log will include entries that identify the data set (e.g., location, dates of collection, medium) and the issues associated with the set that create uncertainties (e.g., no accompanying QC samples, missed holding times). The impact the uncertainties may have on decisions to be made will be summarized, and the uncertainty associated with the data set will be flagged as "low," "medium," or "high." The uncertainty evaluation will be summarized in the Remedial Site Evaluation Report, to be prepared at the conclusion of data analysis.

2.2.5 Screening Process

All available existing data will be screened as a first step in the UEFPC CA RI. The current data base is quite large and includes data collected for compliance monitoring (e.g., NPDES) and for investigations under various regulatory guidelines (e.g., RCRA, CERCLA). Data types in the data base include groundwater, surface water, soils, sump water from buildings, and biological data. The

DAR (Energy Systems 1995b) and DSP (Energy Systems 1995c), prepared for the UEFPC CA, summarize the data base, which includes NPDES data, data from GWQARs (HSW Environmental), reports of investigations, and data in other formats. Before the screening process begins, the DAR will be updated to include data not available for inclusion in the first editions, so it represents the most current UEFPC CA data base.

When the data base is compiled fully and the uncertainty associated with the data sets has been evaluated, the data will be used to develop a list of COPCs for the UEFPC CA. The process of COPC identification begins with a screening of data against background values. The analytes that transcend their respective background concentrations are termed site-related contaminants. The SRCs are next compared with human health PRGs; SCRs in excess of respective PRGs are COPCs. COPECs are identified in a similar manner, by comparison of SRCs with ecological benchmarks. The data also will be compared with ARARs to identify the nature and extent of regulatory transcendencies and the impact the transcendencies may have on the need for RAs. The comparisons with ARARs, however, will not be used to identify COPCs or COPECs.

The identification of COPCs will not be based solely on screening and comparison. After the screen against background, a weight-of-evidence assessment will be made, following the specifications provided in EPA's *Risk Assessment Guidance for Superfund* (EPA 1989a). The "5% rule" will be applied to the data, where background transcendencies for a given parameter can be discarded if <5% of the values actually transcended the background value. For example, if 1 value from a set of 100 values transcended the background, this transcendency may be discarded. In addition, observations from field investigations, historical information, and process information will be considered, where appropriate, in the evaluation and screening of the data. The COPCs identified for the UEFPC Ca will be used, as required, to update and revise the SCM.

2.3 DATA ANALYSIS

The primary component of the RI process is data analysis. Typically, an existing data base is used to identify specific data needs to adequately characterize the nature and extent of contamination for the risk assessments and FS, and then an investigation is undertaken to collect these data. In almost every case, some data are available before initiation of the RI. The RI to be performed for the UEFPC CA differs significantly from the usual RI in that a preponderance of data exists, and the need for additional data collection to "adequately" characterize the nature and extent of contamination is expected to be minimal. Key to this expectation is the definition of "adequately." In this case, as presented and discussed at the DQO Workshop in March 1995, uncertainty management will be used continually to evaluate the need for additional actions to produce an adequate characterization.

Although a systematic approach will be taken to review and evaluate the individual study areas as primary sources of contamination, actions will not be taken at these locations until an overall ranking of primary and secondary sources is completed to ensure that the "worst" or "most likely" contributors to contaminant flux in surface water and groundwater are addressed first. ***Flux*** is the concentration of any given substance in solution multiplied by flow rate. In this RI, flux will be used to calculate mass loading and loading rates of contaminants. Primary and secondary sources of contamination initially will be investigated using existing data. The analysis of source areas and subbasin contaminant flux will be executed in a step-by-step fashion and is described in detail in subsequent sections. Groundwater analysis will also be performed in this manner, using, as necessary, groundwater modeling techniques developed for Bear Creek Valley and appropriately modified to reflect specific hydrogeological differences in the UEFPC CA.

2.3.1 Source Area Analysis

The analysis of data by potential source area is the "top-down" component of the UEFPC CA RI approach. The purpose of this analysis is to evaluate each identified potential source of contamination to the UEFPC CA and to determine the significance of the source relative to the overall RAOs. There are several hundred regulated sites (i.e., potential contaminant sources) within the boundaries of this CA, located both inside and outside of the numerous buildings in the main plant area. The number and status of these sites changes frequently.

Table 2.5 includes 62 sites within the UEFPC CA boundaries that are listed in a proposed revision to Appendix C of the FFA. This appendix identifies sites needing to be addressed in the CERCLA process and is usually updated annually. Therefore, the 62 subject sites are currently the proposed components of the CERCLA scope in the UEFPC CA. The other sites listed in Table 2.5 are regulated under other environmental compliance programs such as RCRA and TSCA. While these sites are not components of the CERCLA process in the strict sense, the operational history and any existing environmental data associated with these other sites are important in the comprehensive evaluation of the watershed and will be addressed in the source area analysis.

Overall, the source area analysis will focus on an evaluation of the existing data first to determine if enough data exist to identify COPCs and transport mechanisms (confirmation of the SCM), as well as to determine if sufficient data exist for a particular area to complete the HHRA, ERA, and FS. If sufficient data do not exist for a particular study area (or groups of areas) to complete these tasks, then the analysis will aid in determining the types of data which should be collected during sampling and analysis activities. Ultimately the source area analysis, in conjunction with the subbasin analysis, will determine which site or sites pose the greatest risk and which are the most significant contributors to contamination in the UEFPC CA.

Table 2.5. Study areas at the UEFPC CA

CA components	FFA–App. C	ID no.	Count
Mercury-contaminated Areas	Y	YS-127	1
UEFPC	Y	YS-602	2
S-2 Site	Y	YD-103	3
Salvage Yard Oil Storage	Y	YS-018	4
Salvage Yard Oil/Solvent Drum Storage Area	Y	YS-020	5
Salvage Yard Scrap Metal Storage Area	Y	YS-111	6
Building 81-10 Area	Y	YS-117	7
Tank 2063-U	Y	YS-204	8
Salvage Yard Drum Deheader	Y	YT-109	9
Beta-4 Security Pits	Y	YD-100	10
Acetonitrile (ACN) Drum Yard	Y	YS-015	11
Interim Drum Yard	Y	YS-030	12
Roofing Waste Pile	Y	YS-122	13
Tank 2116-U	Y	YS-214	14
Mercury-contaminated Gully Soil Pile	Y	YS-131	15
Bldg. 9720-13 West Yard	Y	YS-341	16
Prenco Incinerator	Y	YT-001	17

Table 2.5 (continued)

CA components	FFA–App. C	ID no.	Count
Rust Construction Garage Area	Y	YS-400	18
Bldg. 9206 Underground Tank	Y	YS-245	19
Laundry Sump	Y	YS-242	20
Bldg. 9766 Tank 2064-U	Y	YS-205	21
Tank 2077-U	Y	YS-510	22
Tank 2090-U	Y	YS-516	23
Tank 2091-U	Y	YS-517	24
Tank 2092-U	Y	YS-518	25
Coal Pile Trench	Y	YD-104	26
Bldg. 9201-5 NE Yard	Y	YS-322	27
Bldg. 9401-3 East Yard	Y	YS-335	28
Bldg. 9204-2 West Yard	Y	YS-329	29
Bldg. 9215 West Pad	Y	YS-333	30
Bldg. 9404-11 West Yard	Y	YS-336	31
Bldg. 9720-3 North Yard	Y	YS-339	32
Bldg. 9418-3 Uranium Vault	Y	YD-115	33
Z-oil Contaminated Areas	N	YP-500	34
Bldg. 9720-2 Drum Storage Area	N	YP-503	35
Bldg. 9404-7 Drum Storage Facility	N	YS-016	36
Machine-coolant Storage Tanks	N	YS-022	37
Line Yard	N	YS-120	38
Bldg. 9418-9 Waste Z-oil Tank	N	YS-121	39
Bldg. 9204-1 Transformer Storage Area	N	YS-129	40
Bldg. 9204-3 Transformer Storage Area	N	YS-130	41
Fire Training Facility (Bldg. 9816)	N	YS-132	42
Bldg. 9712 Tank 0084-U	N	YS-201	43
Bldg. 9201-5 Tank 0688-U	N	YS-202	44
Bldg. 9201-5N Tank 0690-U/Transfer Station	N	YS-203	45
Tank 2103-U	N	YS-211	46
Bldg. 9720-22 Tank	N	YS-215	47
Tank/Transfer Station	N	YS-216	48
Bldg. 9204-4 Tank	N	YS-217	49
Bldg. 9204-4 Tank	N	YS-218	50
Bldg. 9206 Tank	N	YS-227	51
Bldg. 9206 Tank	N	YS-228	52
Bldg. 9215 Tank and Transfer Station	N	YS-238	53
Bldg. 9767-13 Tank 2102-U	N	YS-244	54
Dock 6, Bldg. 9212 (NW Corner)	N	YS-300	55
Dock 16, Bldg. 9996 West End	N	YS-304	56
Dock 17, Bldg. 9998 West End	N	YS-305	57

Table 2.5 (continued)

CA components	FFA–App. C	ID no.	Count
Dock 20, Bldg. 9998 (NW Corner)	N	YS-308	58
Dock 50, Bldg. 9728	N	YS-309	59
Dock 125, Bldg. 9977-1 East Side	N	YS-310	60
Dock 155, Bldg. 9201-4 North Side	N	YS-312	61
Dock 164, Bldg. 9808 East Side	N	YS-313	62
Dock 168, Bldg. 9201-5 North Side	N	YS-315	63
Dock 169, Bldg. 9201-5 North Side	N	YS-316	64
Dock 212, Bldg. 9204-2E East Side	N	YS-317	65
Dock 213, Bldg. 9204-2E (SW Corner)	N	YS-318	66
Dock 214, Bldg. 9204-4 (SE Corner)	N	YS-319	67
Bldg. 9201-1 West Yard	N	YS-321	68
Bldg. 9201-5E South Yard	N	YS-323	69
Bldg. 9201-5W South Yard	N	YS-324	70
Bldg. 9202 East Dumpsters	N	YS-325	71
Bldg. 9202 West Pad	N	YS-327	72
Bldg. 9204-2 Hypochlorite Tanker Station	N	YS-328	73
Bldg. 9204-4 East Pad	N	YS-330	74
Bldg. 9204-4 Southwest Yard	N	YS-331	75
Bldg. 9731 South Pad	N	YS-347	76
Bldg. 9204-2 Tank 0134-U	N	YS-504	77
Bldg. 9754-1 Tank 2068-U	N	YS-505	78
Bldg. 9754 Tank 2073-U	N	YS-506	79
Bldg. 9754 Tank 2074-U	N	YS-507	80
Bldg. 9754 Tank 2075-U	N	YS-508	81
Tank 2076-U	N	YS-509	82
Bldg. 9995 Tank 2078-U	N	YS-511	83
Bldg. 9995 Tank 2079-U	N	YS-512	84
Bldg. 9995 Tank 2080-U	N	YS-513	85
Bldg. 9212 Tank 2081-U	N	YS-514	86
Bldg. 9929-1 Tank 2117-U	N	YS-519	87
Bldg. 9409-5 Storage Facility	Y	YS-017	88
Third Street Soil Pile	Y	YS-116	89
Cooling Tower Basin 9409-3	Y	YS-124	90
Tank 2105-U	Y	YS-213	91
Bldg. 9202 East Pad	Y	YS-326	92
Bldg. 9620-2 West Yard	Y	YS-337	93
Bldg. 9720-6 North Polytank Station	Y	YS-340	94
Tank 2089-U	Y	YS-515	95
Tank 2284-U	Y	YS-520	96
Development Incinerator	Y	YT-119	97

Table 2.5 (continued)

CA components	FFA–App. C	ID no.	Count
Bldg. 9204-4 Tank	Y	YS-241	98
Waste Machine Coolant Biodegradation Facility	Y	YT-003	99
Ravine Disposal Site	Y	YD-105	100
Garage USTs	Y	YS-019	101
Bldg. 9712 NE Yard	Y	YS-338	102
New Hope Pond	Y	YT-010	103
Tank	Y	YS-239	104
Urea Storage Site	N	YS-834	105
Burnhouse Area (Former Bldg. 9811)	N	YT-123	106
Y-12 Plant Pistol Range	N	YS-860	107
Old Fuel Station Site	N	YS-861	108
Scarboro Rd. Debris Burial	N	YS-864	109
Bldg. 9401-1 Old Steam Plant (Building)	Y	YP-501	110
Bldg. 9766 Beryllium-contaminated Ducts	Y	YP-502	111
Old Steam Plant Area, Bldg. 9401-1	Y	YS-029	112
Bldg. 9201-5 Tank 0074-U	Y	YS-200	113
Bldg. 9204-4 Tank and Transfer Station	Y	YS-233	114
Bldg. 9744 North Dock	Y	YS-342	115
Bldg. 9206 SID 30/31 Polytank Station	Y	YS-343	116
Bldg. 9201-2 Transformer and Capacitor Storage Area	Y	YS-128	117
Building 9201-4	Y	NA	118
Tank	N	YS-226	119
Tank	N	YS-229	120
Tank	N	YS-230	121
Tank	N	YS-231	122
Tank and Transfer Station	N	YS-234	123
Tank and Transfer Station	N	YS-235	124
Tank and Transfer Station	N	YS-236	125
Tank and Transfer Station	N	YS-237	126
Tank	N	YS-240	127
Tank	N	YS-243	128
Dock 12	N	YS-301	129
Dock 13	N	YS-302	130
Dock 14 Area	N	YS-303	131
Dock 18	N	YS-306	132
Bldg. 9201-5 Southwest Yard	N	YS-307	133
Dock 147	N	YS-311	134
Dock 167	N	YS-314	135
Dock 216	N	YS-320	136
Bldg. 9206 Southeast Dock	N	YS-332	137

Table 2.5 (continued)

CA components	FFA–App. C	ID no.	Count
SID 50/51 Tanker Station	N	YS-344	138
SID 56 Polytank Station	N	YS-345	139
SID 64/91 Station	N	YS-346	140
Dock 119	N	YS-348	141
Bldg. 9733-2 Dock	N	YS-349	142
Building 9818 Recycling Unit	N	YR-110	143
Building 9811-1 RCRA Storage Facility	N	YS-021	144
RCRA and Mixed Waste Storage and Staging Bldg.	N	YS-028	145
Building 9720-9 Storage Facility	N	YS-031	146
Building 9215 Tank/Transfer Station	N	YS-032	147
Building 9808 Tank	N	YS-033	148
Building 9201-2 Tank	N	YS-034	149
Building 9720-13 Tank	N	YS-035	150
Building 9212 Tank Farm	N	YS-041	151
Classified Waste Storage Facility Building 9720-25	N	YS-046	152
Tank	N	YS-219	153
Tank (F-3002)	N	YS-220	154
Tank (between 9416-7 and 9401-2)	N	YS-221	155
Tank/Transformer Station	N	YS-222	156
Tank F-1055	N	YS-223	157
Tank F-1052A	N	YS-224	158
Tank	N	YS-225	159
Bldg. 9111/9112 Dock	N	YS-350	160
Biodenitrification Facility	N	YT-002	161
Cyanide Treatment Facility	N	YT-005	162
Central Pollution Control Facility	N	YT-006	163
West End Treatment Facility	N	YT-007	164
Waste Management Preparation Facility	N	YT-013	165
Plating Rinsewater Treatment Facility	N	YT-036	166
Steam Plant Wastewater Treatment Facility	N	YT-037	167
Reactive Waste Treatment Facility	N	YT-048	168
Groundwater Treatment Facility	N	YT-053	169
Uranium Chip Oxidation Facility	N	YT-113	170
Tank/Transformer Station	N	YS-232	171
Tank 2100-U[a]	Y	YS-209	172
Tank 2101-U[a]	Y	YS-210	173
Tank 2104-U[a]	Y	YS-212	174

[a]This tank has received an interim action ROD.

The process that will be used to conduct the source area analysis is shown on the flowchart on Fig. 2.4. The first step will be to evaluate the existing data for each area to identify COPCs and confirm the SCM. The data sets that will be used to perform this analysis include the soil, groundwater, surface water, and sump data summarized in the DAR and DSP, as well as any additional data collected from ongoing monitoring programs such as NPDES, BMAP, or RMPE available since the publication of these documents. The data will be sorted such that each site will be matched with the data that are most applicable to that site. This process will be fairly straightforward for the soils data since much of these data originally were collected for a particular site evaluation. The surface water and groundwater data sets, however, include regional data as well as some site-specific data. These data will be more difficult to associate with a particular source; however, they will be used to the extent possible for source area characterization.

When data analysis is complete, a decision will be made as to whether particular areas can be grouped for further evaluation. Site groupings will be made based on characteristics such as location, site type (e.g., tanks storing similar materials), and contaminant type. For those sites that can be evaluated as a group, the use of generic approaches and presumptive remedies for that group will be assessed to determine if the data set for the group is adequate for those approaches/remedies. Uncertainties can be managed for groups in that all information for each site may not be necessary if the data for the group as a whole are adequate for risk assessment and FS purposes.

As the process continues, a determination will be made as to whether the SCM should be revised based on the characteristics of the sites or groups of sites. If revisions are needed, the model will be updated to reflect the conditions documented during the data evaluation. The overall impact to the model will be evaluated to determine if the basic assumptions regarding RA goals or data needs have changed based on the revisions made.

As the model is confirmed, the source area data will be evaluated against the risk assessments and FS needs to ensure that the data set is adequate for these purposes. If it is not, or if other data needs are identified, SAPs will be scoped and developed to obtain the data necessary to complete the evaluation. The development and implementation of SAPs are discussed in Sect. 2.5. After the new data (if required) have been collected and incorporated into the data set, the SCM will again be evaluated to ensure that no additional revisions are warranted. Once the model has been confirmed and the data set is complete, the risk assessments and FS can be completed. If critical risks that warrant immediate actions are identified, alternatives will be evaluated and the appropriate actions taken (i.e., removal actions, BMAPs, or interim RAs). Similarly, if treatability data become necessary for full evaluation of potential remedial alternatives, treatability studies will be implemented.

The results of the source area analysis will provide key components to the UEFPC RI/FS as described here.

- Each study area will systematically be evaluated to determine its potential for contamination of the CA. This evaluation, combined with the subbasin analysis results, will help identify the major contaminant sources and pathways. (The SCM will be confirmed or updated.)

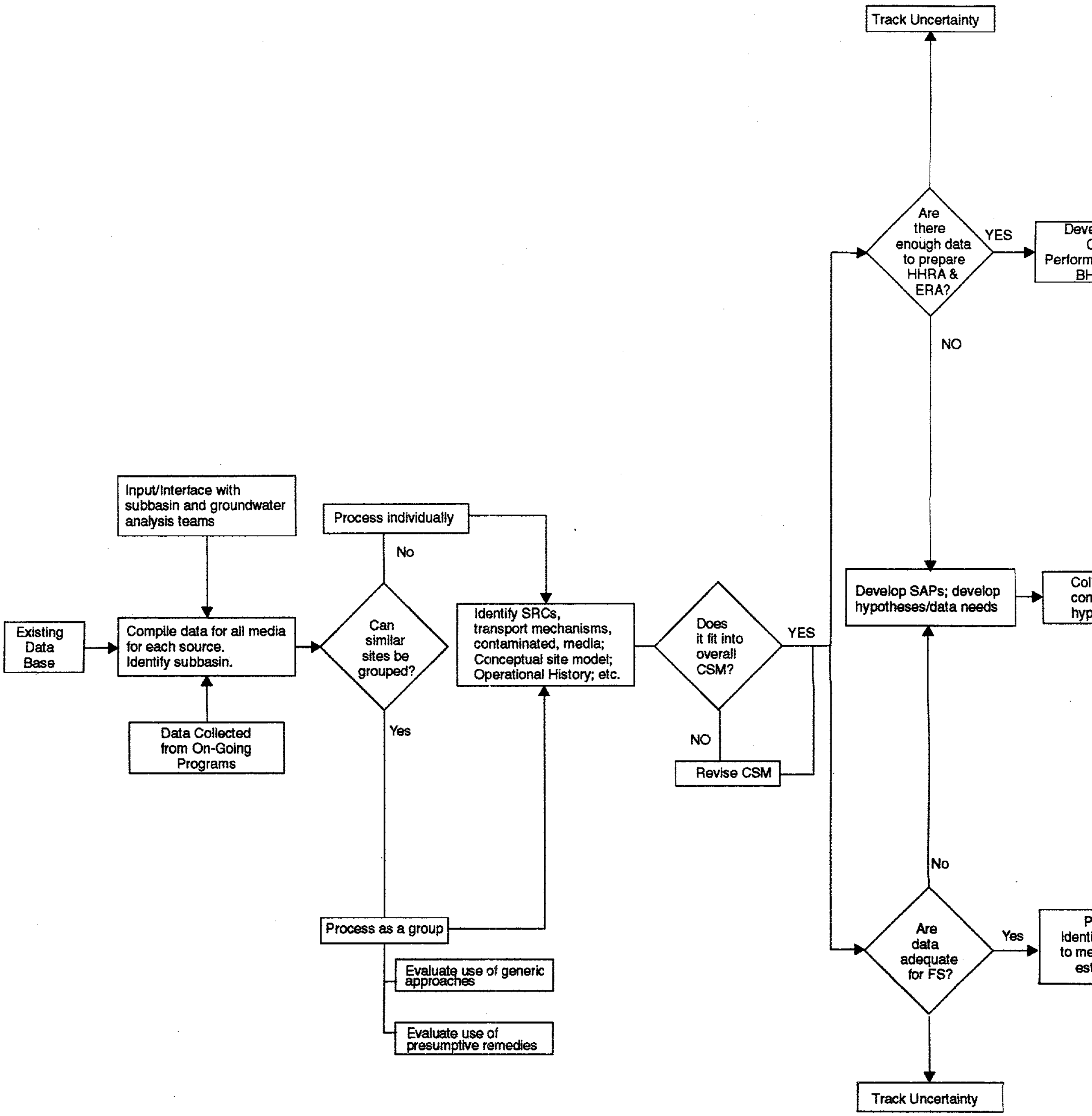
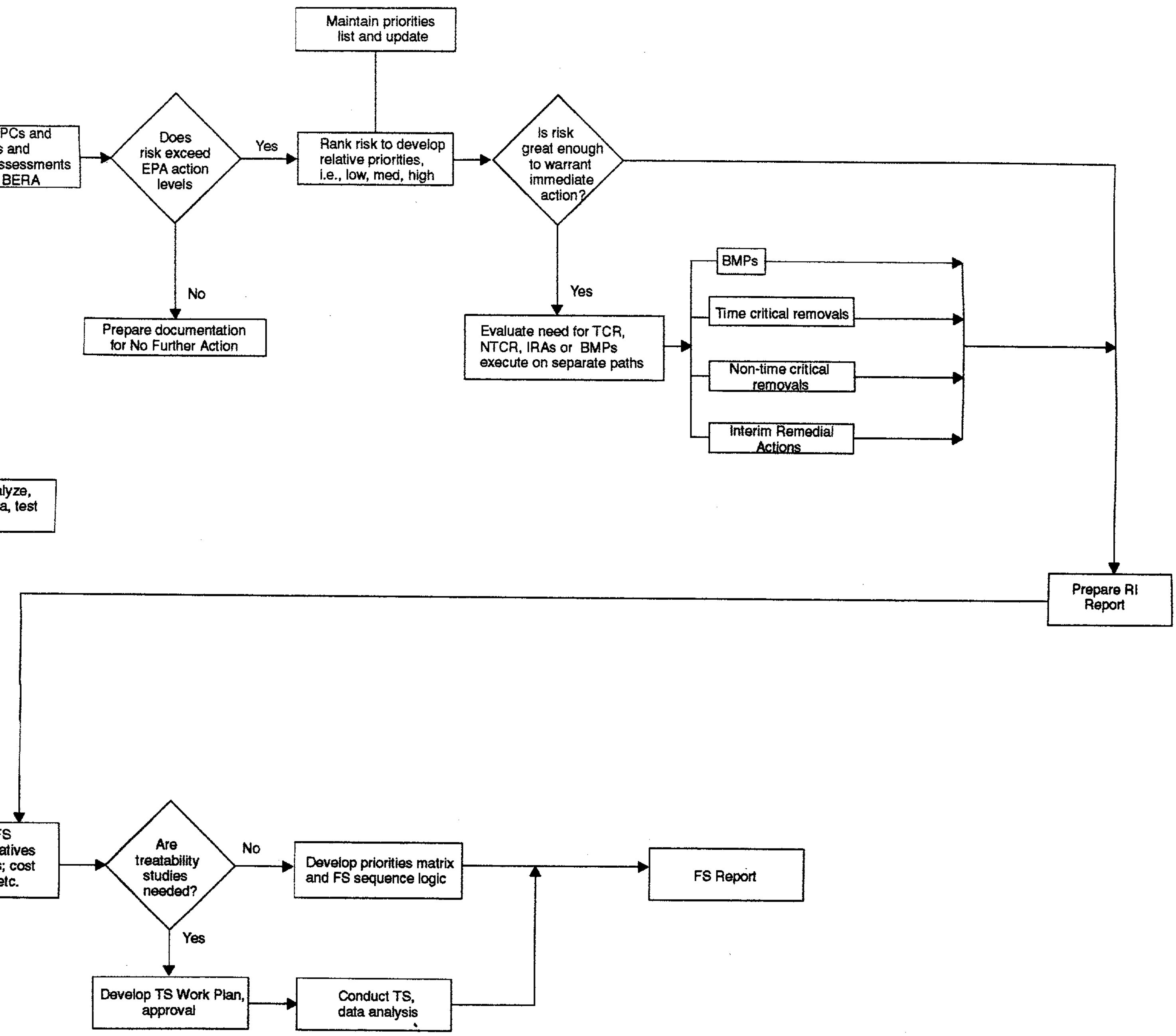


Fig. 2.4. Source Area Analysis.


Maintain priorities list and update
PCs and s and ssessments BERA
Does risk exceed EPA action levels
Yes
Rank risk to develop relative priorities, i.e., low, med, high
Is risk great enough to warrant immediate action?
No
Prepare documentation for No Further Action
Yes
Evaluate need for TCR, NTCR, IRAs or BMPs execute on separate paths
BMPs
Time critical removals
Non-time critical removals
Interim Remedial Actions
lyze, a, test
Prepare RI Report
S atives ; cost etc.
Are treatability studies needed?
No
Develop priorities matrix and FS sequence logic
FS Report
Yes
Develop TS Work Plan, approval
Conduct TS, data analysis

- Data will be generated so that an evaluation of the relative risks posed by each study area can be completed.
- Data will be generated so that an FS of alternatives for source actions can be completed.

All of this information can then be synthesized to determine the need and relative priority for actions at a source or at groups of sources based on risk and on contribution to contamination in the CA.

2.3.2 Subbasin Analysis

In the 1980s, the Y-12 Plant was divided into 11 subbasins to support NPDES permitting activities. A subbasin is a distinct area within a watershed or basin, within which water drains to a given point. Subbasins constitute a secondary system of internally consistent drainages within the basin. The analysis of data by subbasin is the "bottom-up" component of the UEFPC CA RI approach. The bottom-up component will evaluate surface water and groundwater data to determine the nature of contaminants in the surface water exit pathway and to work back to the sources of contamination within individual subbasins. The overall goal will be to prioritize further subbasin analysis with respect to contaminant contribution to UEFPC. The subbasin analysis focuses specifically on surface water and shallow groundwater within the main plant area. Figure 2.5 illustrates the subbasin analysis process, and the following text describes it.

The process begins with a compilation of all data from the existing Y-12 data base and from ongoing data collection programs. The DAR (Energy Systems 1995b), prepared for the UEFPC CA, includes a compilation of most of the existing data. Recent data, which were not included in the DAR, will be retrieved from the Site Oak Ridge Environmental Information System or will be obtained from the appropriate data collection programs. The complete data set then will be reviewed and screened as described in Sect. 2.2 to identify the COPCs. The data also will be analyzed to determine the flux from each of the subbasins and at the exit pathway from the Y-12 Plant (Station 17). After identification of COPCs and determination of subbasin flux, the preliminary list of alternatives will be reviewed to evaluate their appropriateness and associated data needs and to make any necessary modifications or adjustments.

The next step in the process will be to prioritize the subbasins based on flux. The total flux will be examined to discriminate the various inputs to it. Three basic components to total flux will be discriminated: storm-water flux, process-water flux, and groundwater discharge. Flux resulting from storm water will be evaluated using data from Category 1 outfalls, which discharge only storm water. The data will be reviewed to determine if the data set is adequate for the identification of COPCs and source areas; uncertainties associated with the data will be tracked as part of the review. If the data set is inadequate, a sampling plan will be developed and implemented to obtain the needed data. When the complete data set has been assembled, an attempt will be made, in conjunction with results from the source area analysis, to match COPCs with potential contaminant sources and to evaluate flux from each source. The result will be the delineation and prioritization of major storm water sources.

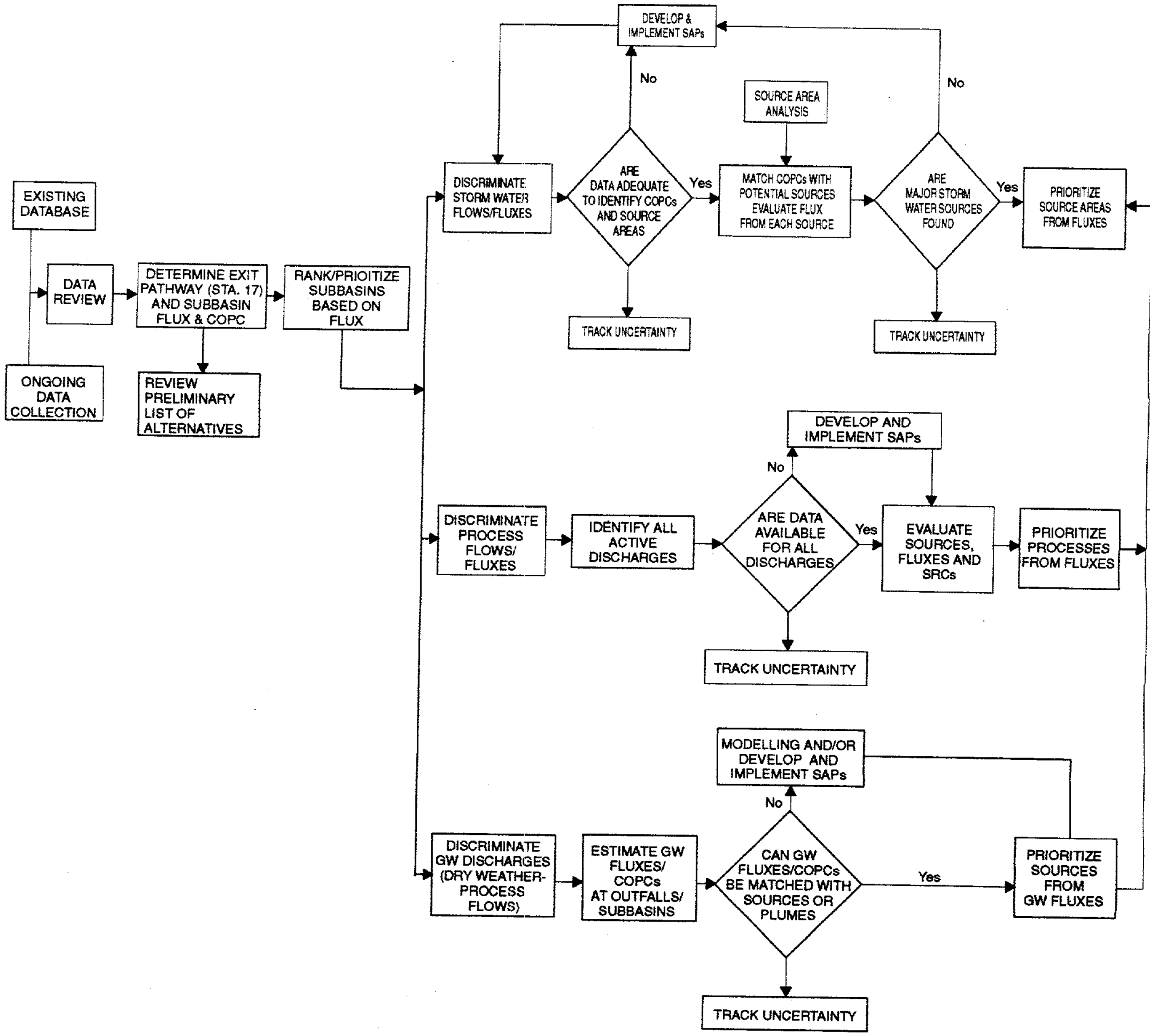
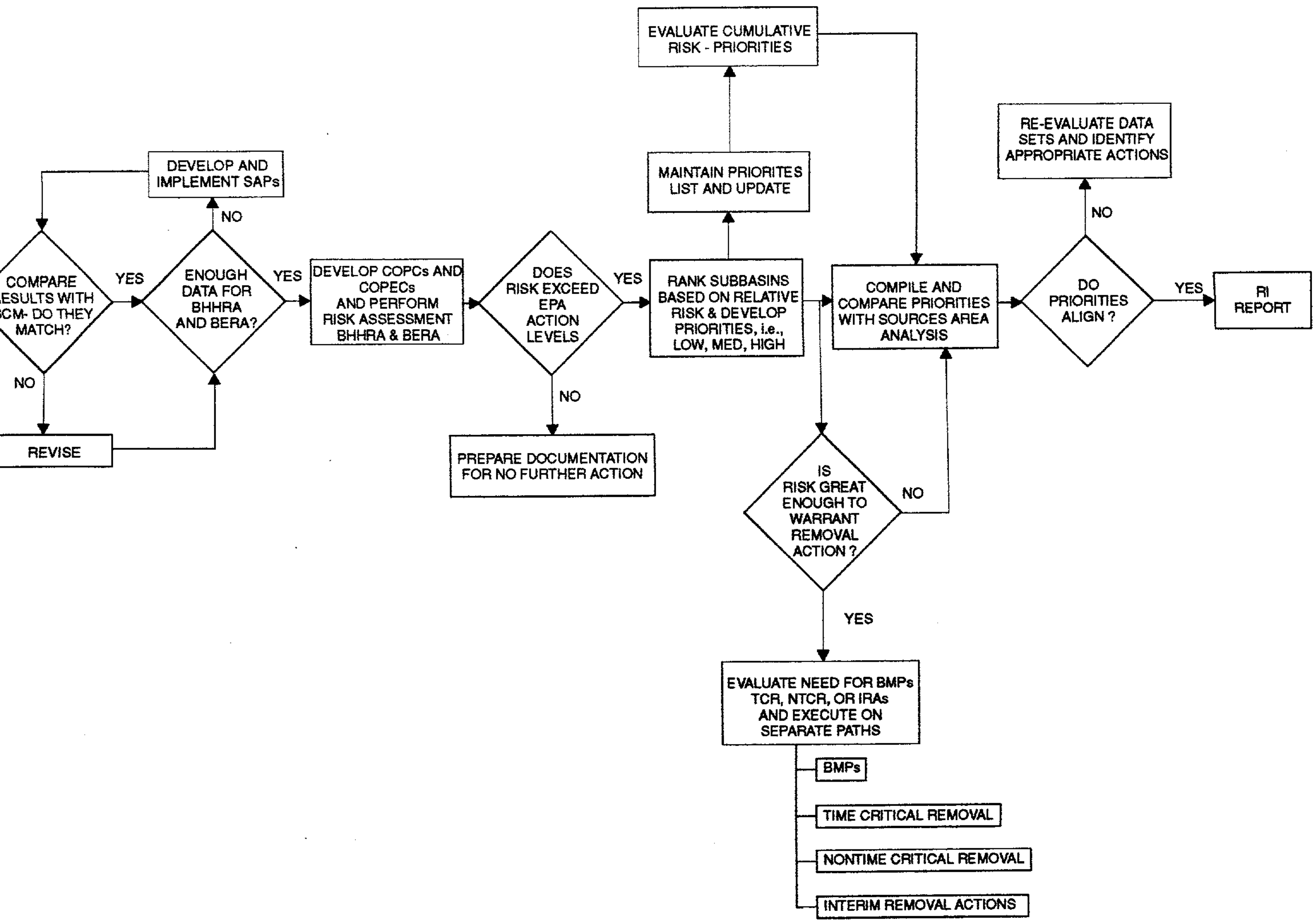


Fig. 2.5. Subbasin Analysis.


EVALUATE CUMULATIVE RISK - PRIORITIES
DEVELOP AND IMPLEMENT SAPs
MAINTAIN PRIORITES LIST AND UPDATE
RE-EVALUATE DATA SETS AND IDENTIFY APPROPRIATE ACTIONS
NO
NO
COMPARE ESULTS WITH CM- DO THEY MATCH?
YES
ENOUGH DATA FOR BHHRA AND BERA?
YES
DEVELOP COPCs AND COPECs AND PERFORM RISK ASSESSMENT BHHRA & BERA
DOES RISK EXCEED EPA ACTION LEVELS
YES
RANK SUBBASINS BASED ON RELATIVE RISK & DEVELOP PRIORITIES, i.e., LOW, MED, HIGH
COMPILE AND COMPARE PRIORITIES WITH SOURCES AREA ANALYSIS
DO PRIORITIES ALIGN ?
YES
RI REPORT
NO
REVISE
NO
PREPARE DOCUMENTATION FOR NO FURTHER ACTION
IS RISK GREAT ENOUGH TO WARRANT REMOVAL ACTION ?
NO
YES
EVALUATE NEED FOR BMPs TCR, NTCR, OR IRAs AND EXECUTE ON SEPARATE PATHS
BMPs
TIME CRITICAL REMOVAL
NONTIME CRITICAL REMOVAL
INTERIM REMOVAL ACTIONS

The discrimination of flux resulting from process waters will start with the identification of all active discharges. Information from Y-12 Environmental Compliance and any other appropriate programs then will be examined to determine if data are available for all of the discharges. Existing data will be reviewed and uncertainties with the data set will be tracked. A sampling plan will be developed and implemented if data are not available for active discharges or if the existing data are deemed inadequate to identify COPCs. After evaluation of the complete data set, processes that are sources of COPCs and their respective fluxes will be determined, and these process fluxes will be prioritized.

The third component of total flux, groundwater discharge, will be estimated using the data collected during the dry weather surface water characterization (Energy Systems 1995g). The storm water component is absent, and the process water component can be calculated; therefore, the groundwater component will be estimated by taking the difference between total flux and process-water flux. Unlike storm-water and process-water flux, groundwater discharge cannot be measured directly. The estimated groundwater discharge will be used to match the flux and COPCs from groundwater with sources or known plumes. If the data set and/or discharge estimate is found to be inadequate, a SAP will be developed and implemented. Uncertainties associated with estimates, data, and modeling results will be tracked appropriately. After the evaluation is completed, contaminant sources resulting from groundwater discharge will be prioritized.

Next, the results from the discrimination process will be compared with the SCM. If the ranking of the flux components is not consistent with the model, appropriate revisions will be made to the SCM. The complete set of evaluated data will then be examined to determine if it is adequate for the HHRA, ERA, and ES. Information and coordination with the results of the source area analysis and its associated prioritization of sites will accompany this examination. If critical data are absent, a SAP will be developed and implemented. Any additional data collected will similarly be compared to the SCM and revisions to the model will follow, if needed. If the evaluation of the data suggests a substantial risk associated with any subbasins or sites within subbasins, immediate actions, such as best management practices, time-critical removal actions, or non-time-critical removal actions, may be initiated.

2.3.3 Groundwater Data Analysis

The analysis of groundwater quality from the UEFPC CA will build upon the extensive data base developed by the Y-12 GWPP since the late 1980s. The GWPP publishes the annual GWQARs, which provide information on the monitoring well network, data collected from the monitoring wells, and interpretations of the extent and sources of contamination. These reports, in a single volume for each individual RCRA Interim Status Unit, were first published for each, by March 1st of the next year. After calendar year 1990, the GWQARs were issued on a hydrogeologic regime-wide basis to reflect the strategy of the Comprehensive Groundwater Monitoring Program. The regime-wide GWQARs are issued in two parts: Part 1, which is a presentation and summary of the data, and Part 2, which is an interpretation of groundwater quality. These reports thoroughly tabulate, summarize, and graphically present the groundwater data.

In addition to the GWQARs, numerous other documents have been produced from RCRA and CERCLA investigations independent of the GWPP. These data also will be included in the data analysis. The subsurface data base of Jones, Thompson, and Field (1994) is a comprehensive summary of information such as that regarding monitoring well locations, construction, designations, dates of installation, and will be used as a reference throughout the data analysis. The analysis will refine the groundwater component of the SCM. To that end, the Bear Creek Valley CA SCM will be used for comparison and clarification. The geologic and hydrogeologic characteristics of the Bear Creek

Valley CA are very similar, and in some cases identical, to those of the UEFPC CA; therefore, the UEFPC model will build upon and modify the Bear Creek Valley model. The evaluation of and modifications to the SCM will be a critical component of the data analysis because the model is the primary mechanism for predicting and evaluating what is happening in the groundwater system and what changes may occur with time.

The analysis of groundwater data will be tied closely to the subbasin analysis. The subbasin analysis will establish the flux of COPCs out of each subbasin to the UEFPC. The groundwater discharge component of total flux from each subbasin will be evaluated, and data from monitoring wells within each subbasin will be used in the evaluation. If the data set from a particular subbasin is found to be inadequate, a SAP will be developed or groundwater modeling will be initiated. The analysis of groundwater data also will be tied closely to the initial evaluation of potential remedial alternatives, which may drive additional sampling or modeling requirements in the FS, if appropriate.

The groundwater data will be screened against the standards as described above (Sect. 2.2.5) for identification of COPCs. The screened data will be tabulated and graphically presented for evaluation. Contaminant concentrations and contours will be prepared on maps and cross sections, as appropriate, to depict the extent of contamination and significant trends. Water level data also will be presented in tabular form and plotted on a map to evaluate any patterns in hydrostatic head for the groundwater. To the extent possible, existing graphical presentations from the GWQARs will be used and revised.

Modeling may be needed to clarify the flow patterns in groundwater and the fate and transport of contaminants. The groundwater systems within the UEFPC CA, which include a water table system in the overburden and a fracture flow and/or karst system in the bedrock, are complex and their characteristics may not be intuitively obvious. Groundwater flow in an aquifer system can be described by a third-order partial differential equation. Exact solutions to the equation are not known; however, models may be used to approximate the solution to groundwater flow using simplifying assumptions and calculus techniques. Modeling of the UEFPC CA groundwater system will not produce precise answers, but it will provide evaluation of uncertainty needed to guide the remedial decisions to be made.

The exact model to be used and its setup will be determined by the project team, but it is likely that the model FRAC3DVS will be used. This model is for three-dimensional, steady-state or transient, variably saturated flow and advective-dispersive solute transport in porous or discretely fractured porous media. The code uses finite-difference and finite-element formulation to implement the model. The ultimate goal will be to simulate contaminant fate and transport through the CA, incorporating the concepts of surface water and groundwater interactions. The sensitivity, accuracy, and precision of the modeling will be evaluated to establish the applicability of the results and the assumptions accompanying them.

2.4 EVALUATION OF REMEDIAL INVESTIGATION ACTIONS

The analysis of existing data, as described in Sect. 2.3, will facilitate the evaluation of potential RI actions. The completion of the UEFPC CA RI in a timely and cost-efficient manner requires that additional data collection actions be evaluated and ranked relative to the need for such actions to support the baseline risk assessments, preliminary RAOs, and the FS. This section discusses the evaluation process, the identification of preliminary RAOs, the identification of potential classes of RAs, and the identification of data gaps and additional data needs.

2.4.1 Evaluation Process

The purpose of evaluating potential RI actions will be to focus the RI on critical activities needed to complete the investigation (e.g., risk assessments, FS). The basis for the evaluation process will be the development of a hierarchy of key questions or decisions. The results of source area, subbasin, groundwater, and ecological data analysis will provide data for the development of key questions and for the testing of hypotheses associated with key questions. The development of key questions and hypotheses can be concurrent with the analysis of existing data; however, new data collection will occur only if necessary to support resolution of key questions.

The complexity of the UEFPC CA with its numerous primary sources and interrelated secondary sources, transport mechanisms, pathways, and COPCs demands an organized approach to the development of key questions and related hypotheses to test the questions. Thorough uncertainty management and tracking of the impact of one finding or outcome on all the other processes and components is necessary to ensure a coherent approach. If, for example, the uncertainty associated with a given data set is too great for the intended purpose, then additional sampling and analysis will likely be needed to verify or disprove the hypothesis in question.

To ensure the management of uncertainties and interrelated components of this RI, the project team, along with all interested stakeholders, will develop a list of key questions or decisions related to characterization, risk, remediation, or other areas of concern. After the key questions are identified, the next step will be to identify key components that focus on specific aspects of these questions. Identification of key components is an iterative process that will continue until all issues associated with each component of each question have been identified. Finally, development will require careful analysis to identify acceptable uncertainty boundaries (such as confidence limits in statistical analyses); to optimize the design for obtaining data, if applicable; to identify success factors; and to establish the specific relationship to other key questions and components.

This process will result in a pyramid-like hierarchy of key questions or decisions that terminate in specific hypotheses. Figure 2.6 presents a schematic of this hierarchy. Key questions occupy Level 1 in the hierarchy, followed by key components at Level 2, and hypotheses at Level 3. The construct of a hierarchy illustrates the interrelationship between the various questions and hypotheses developed during the process and the need to progress in an orderly manner. Following a process like this is critical to tracking uncertainty and to the ability to evaluate the result of one hypothesis on other hypotheses.

An example of how this hierarchy process would operate follows. Assume that a key question identified as a result of the data analysis is:

Do building sumps contribute contaminants to shallow groundwater and UEFPC?

After consideration of this question and additional discussion of the data analysis, components of this question are identified:

Do the data from sumps in Building X indicate that contaminants are being released to shallow groundwater and UEFPC?

What percentage of total flux from sumps discharges directly to UEFPC via storm drains?

What percentage of total flux from sumps discharges directly to shallow groundwater?

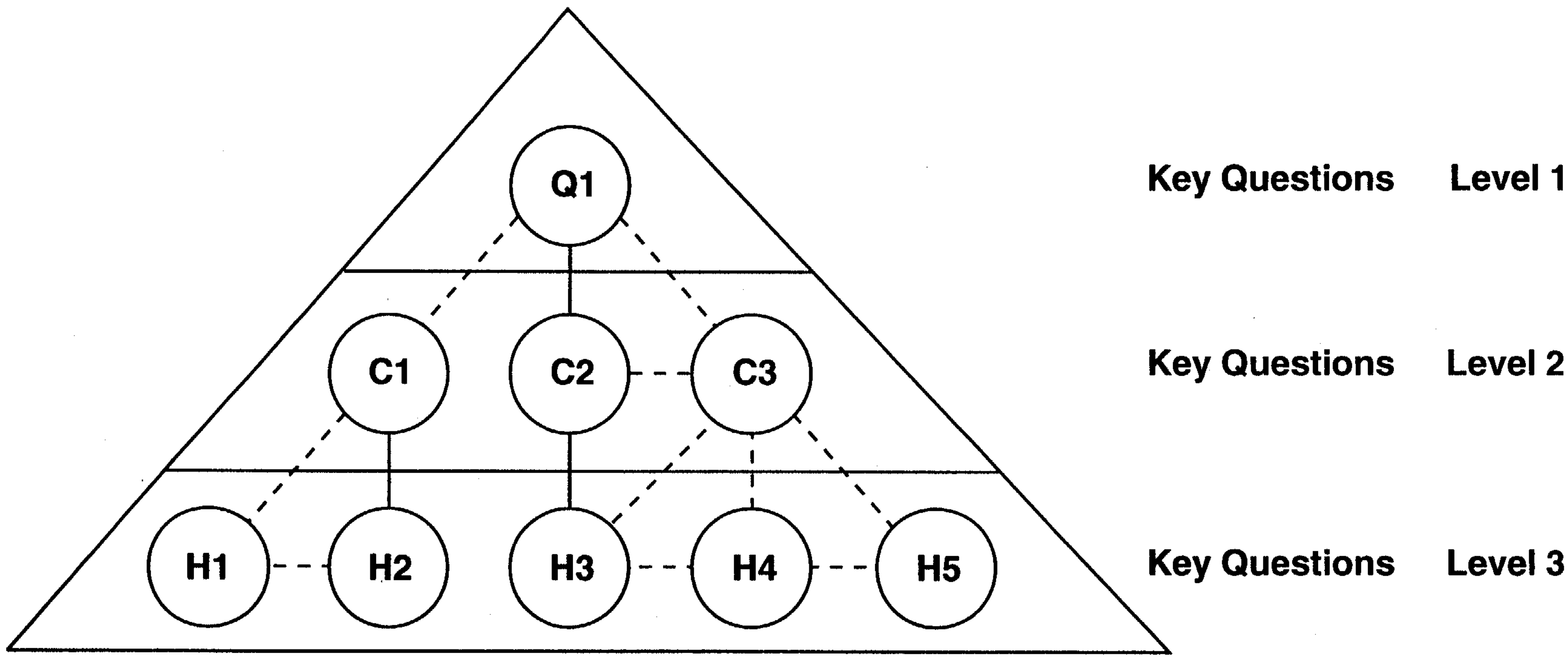


Fig. 2.6 Schematic of Logic Hierarchy.

With the key question broken into its components, additional consideration and discussion will result in a series of hypotheses designed to verify or disprove the components, and, ultimately the question:

> Sumps in Building X do not contribute contaminants to shallow groundwater or UEFPC because the data do not exceed screening criteria.
>
> Sumps in Building Y do not contribute contaminants to shallow groundwater because groundwater is too deep.
>
> Sumps in Building Z contribute mercury to shallow groundwater and UEFPC because historically mercury was used heavily in the building.

Ranking will occur among the key questions and key components to accelerate response to the elements that have the greatest dependencies. This ranking is critical to ensure that time and money are not spent pursuing an insignificant issue.

Development of the key questions is the starting point of the prioritization process and, as mentioned before, will require involvement of the project team and stakeholders. Some of the key questions concerning the UEFPC CA have already been developed. The questions come from the preliminary RAOs, which specifically address both the risk issues and FS needs. The following is a list of key questions that have been identified to date.

Potential Key Questions

Some potential key questions currently identified for the UEFPC CA RI include those listed here.

- Do current contaminant concentrations in environmental media present a risk to human health or the environment?
- Can sources contributing to groundwater and surface water contamination be identified?
- Is it feasible to restore groundwater on site and/or off site to meet residential-use standards?
- Is it feasible to contain the contaminant plume in groundwater on-site/off-site?
- Is source control of contaminants feasible?
- Is it possible to locate, characterize, or remediate dense, nonaqueous phase liquids in groundwater?
- Is the no-action alternative viable?
- Are there effective methods to stabilize or contain mercury in soils in situ? Are there effective methods to remove or contain mercury in UEFPC above Station 17?

Additional key questions will be identified during the process of developing the key components and hypotheses for these questions, as well as through communication with stakeholders. To maximize the process and efficiency of pursuing answers, all key questions will be identified up front. If a new key question arises after the overall hierarchy has been established, it will be incorporated and will have a ripple effect on the other existing elements that will have to be resolved.

This type of process provides a mechanism for tracking uncertainty and evaluating cumulative uncertainty, as well as understanding and managing the relationships between elements. The source area, subbasin, groundwater, and ecological data analysis processes will provide the information needed for hierarchy development and the data to test hypotheses. The hierarchy ultimately will be used to evaluate and rank potential RI activities.

2.4.2 Identification of Preliminary Remedial Action Objectives

Preliminary RAOs were developed and presented to regulators during the March 28-30, 1995, DQO workshop. Preliminary RAOs will be used to focus the RI toward collecting and analyzing data that will be useful in developing and evaluating remediation alternatives. The preliminary RAOs agreed upon during the DQO meeting are listed below

- Protect future off-site residents from exposure to contaminated groundwater originating from the CA.
- Protect ecological receptors and future off-site residents on Scarboro Creek at spring SCR7.1SP from exposure to contaminated surface water resulting from migration of contamination in the Maynardville Plume originating from the CA.
- Protect ecological receptors on UEFPC from exposure to contaminated surface water and sediment.
- Protect future off-site residents and ecological receptors from exposure to contamination transported from UEFPC by surface water.
- Protect future on-site industrial workers from exposure to primary sources of contamination on site.

Final RAOs to be presented in the FS will be less specific to allow a wider range of alternatives to pass initial screening and be carried forward for detailed analysis. A list of potential RAOs follows.

- Protect future off-site residents from exposure to contamination originating from the UEFPC CA.
- Protect ecological receptors from exposure to contamination originating from the UEFPC CA.
- Protect future on-site industrial workers from exposure to on-site contamination.

2.4.3 Identification of Potential Classes of Remedial Actions

Section 300.430(a)(1)(iii) of the NCP lists EPA's expectations in developing appropriate remedial alternatives at a CERCLA site. Potential classes of RAs (also referred to as general response actions) that can meet the EPA expectations will be considered in the FS (see Chap. 4) and are described below.

- *No Action* is a response required by CERCLA that serves as a baseline against which other actions can be measured.
- ***Institutional controls***, such as water use and deed restrictions, industrial procedures and policies, fencing and other access restrictions, and monitoring, may be used alone or as supplements to engineering controls to prevent or limit exposure to hazardous substances.
- ***Containment technologies***, such as caps, liners, vertical and horizontal barriers, and dust suppression, may be used to control contaminated areas that pose a relatively low long-term

threat and for sites where treatment is impracticable. Groundwater withdrawal (extraction wells) can be used to contain plumes.

- ***Removal technologies***, such as excavation of solid media and pumping of surface water or groundwater, may be used alone or in combination with treatment to remove contamination or to abate further migration of contaminants.
- ***Treatment technologies***, including both in situ and ex situ physicochemical, biological, or thermal technologies, can be used alone or in combination with any of the previously mentioned technologies. EPA prefers the use of treatment technologies that reduce toxicity, mobility, or volume of contamination over containment or institutional-control technologies.
- ***Innovative technologies*** may be considered when they offer the potential for superior treatment performance or lower cost compared to demonstrated technologies.
- ***Disposal technologies*** for solid or liquid wastes are required for treatment residuals or untreated waste removed from the site.

2.4.4 Identification of Data Gaps and Additional Data Needs

The identification of data gaps and additional data needs will result from key question development as well as from both the source area and subbasin analyses described in Sect. 2.3. As data are evaluated and screened and hypotheses are developed, questions may be posed concerning the prioritization of source areas and subbasins as contaminant contributors to UEFPC. If the data set is deemed inadequate for prioritization of the source areas or subbasins or to test these hypotheses, the data gaps critical to completing these activities will be identified. SAPs then will be developed to obtain the needed data.

The SCM will be revised, as required, during the data evaluation, and questions will similarly be posed concerning the adequacy of the model and the need for critical data to fully develop the model. Finally, after actions are prioritized, the adequacy of the data for completion of risk assessments and the FS will be determined, and then the process of sampling plan development and data acquisition will ensue. New data will be collected only when essential to completion of the risk assessment and FS activities.

2.5 DEVELOPMENT OF SAMPLING AND ANALYSIS PLANS

SAPs will be developed when the existing data for a given subbasin, source area, or medium are inadequate for the completion of the risk assessments and the FS. As discussed in the preceding sections, the data analysis process starts with key questions to be answered by the RI. Components of these questions will be identified, and ultimately hypotheses will be developed and tested using the data to resolve the questions. The development of SAPs will follow from this analysis. In addition, DQOs specific to the planned sampling will be developed by the RI project team to ensure that data of appropriate quantity and quality are collected. Sampling plans will focus on the critical data needed to answer key questions and to address uncertainty in the existing data set. SAPs prepared for the RI will follow the annotated outline developed by LMES for FFA documents (Energy Systems 1993a) and will be subject to review and approval by TDEC and EPA as described in Sect. 2.5.3. The final Work Plan will be issued as a controlled document to provide an official mechanism for modifications. The SAPs will be prepared as addenda to this Work Plan.

2.5.1 Characterization Strategy

The additional data collected during this RI will be used by the RI team and stakeholders to refine the SCM and to feed back into the data analysis process to answer key questions related to risk assessment and FS needs. The focused nature of the process and the limited number of samples to be collected will require the acceptance of some degree of uncertainty. The issue of uncertainty will be discussed and managed throughout the process. Collection of samples will occur if, and only if, the uncertainty associated with using the existing data is too great or data simply are not available with which to test hypotheses or to answer key questions. The quality of the data to be collected will be consistent with its intended uses. EPA has developed two data quality categories for the CERCLA program: screening data and definitive data (EPA 1994). Both types of data may be appropriate for filling data gaps for this RI.

Sampling plans will provide details on the characterization strategy and the types and quantities of data needed. The hypotheses to be tested and their relationship to key questions or components will also be clearly identified. The characterization strategy will specify the applicable data quality category (i.e., screening, definitive, or a combination of the two) and will fully develop DQOs for data collection and analyses. The plans will also specify data evaluation and validation requirements, as appropriate.

The characterization strategy in each SAP will designate the list of constituents for analysis. In general, a significant amount of information is available on contaminants in various media within the CA, so the list of analytes will be designed to address known contaminants at each site. Only in cases for which no data are available from a site will the full target compound list/target analyte list of analytes be measured.

2.5.1.1 Screening data

Screening data are generated quickly using less precise methods and less rigorous sample preparation than are definitive data (EPA 1994). These data are useful for the identification and quantification of contaminants; however, the precision associated with the results is not high. The EPA recommends that 10% of the data be confirmed by methods and procedures associated with definitive data. Data of this quality would be useful for completely unknown areas for which no information on the presence or absence of contaminants is available or in areas in which contaminants are known and can readily be detected by screening devices (i.e., radiological contaminants). In the latter case, screening instruments might be used to establish the extent of contamination for development of volume estimates.

Field screening techniques that may be used include immunoassays, soil-gas surveys, hydraulic probe sampling for groundwater (e.g., Hydropunch), ultrasonic ranging and data system (for radiological surveys), field gas chromatography, and X-ray fluorescence. A percentage of newly obtained screening-level samples will be submitted to a fixed-base laboratory for confirmation. Results obtained by field screening techniques will be reviewed to determine if definitive sampling is necessary based on comparison to exposure and screening criteria.

2.5.1.2 Definitive data

Definitive data are generated using rigorous reference methods (e.g., SW-846, Contract Laboratory Procedure) with associated rigorous procedures and protocol (EPA 1994). Analytical or total-measurement error is determined, and stringent QA and QC elements accompany the analysis. Examples of QA/QC elements include QC blanks, matrix spike recoveries, performance evaluation samples, and others. Definitive data are of defensible quality and should be adequate for most, if not all, intended uses of the data. Definitive data would be appropriate for a site at which contaminants are known, for example, from process knowledge. In this case, definitive data would be screened to determine specific concentration ranges of contaminants needed for risk assessment and the development of remedial alternatives. In general, definitive data are required for risk assessment purposes.

Sampling associated with definitive data requires more stringent standardized techniques that improve sample quality and reduce data uncertainty. Appropriate techniques may include soil borings for surface and subsurface soil; well points or monitoring wells for groundwater; grab sampling of storm water, surface water and sediments, and building sumps; and ecological sampling. The definition of COPCs and the analysis of existing data will dictate the appropriate analyte list associated with the samples.

All SAPs developed during the RI will include a section describing the analytical methods to be used for sample analysis and the associated QA and QC considerations. Accepted, approved methods will be used in all cases, and the laboratory will be subject to periodic audits to ensure the implementation of all QA requirements.

2.5.2 Data Analysis and Reporting

The data analysis process for newly collected samples will begin with the data verification and validation process. Data verification is simply the process of reviewing analytical data packages for completeness and checking electronic deliverables for accuracy. Independent data validation will be performed on a percentage of the samples following data verification. The percentage of samples subject to data validation will vary depending on the types of samples and analyses to be performed, as well as on the intended use of the data.

When the data validation process is complete, a validation summary will be prepared to determine if DQOs for the data set were met. In addition, a set of Form I's, which present all analytical results including any validation qualifier, will be compiled for transmittal to the project team as appropriate. An electronic version of analytical results will be entered into the Site Oak Ridge Environmental Information System.

Results of the data analysis will be summarized in a Remedial Site Evaluation Report, which will be prepared and disseminated to the project team and stakeholders to expedite the process of development and resolution of key questions and refinement of the SCM. The report will present the results of the data analysis, including the evaluation of data uncertainties, the screening process and identification of SRCs, the development of COPCs and COPECs, flux estimates to integrators (i.e., UEFPC and groundwater in the Maynardville Limestone), integration point (IP) assessment, a compilation of data gaps, and a summary of key questions. Appropriate data summaries, tabulations, and graphical representations will be included in the report to support the discussion in the text.

2.5.3 Sampling and Analysis Plan Preparation and Approval Process

The preparation, review, approval, execution, and reporting for SAPs and activities are crucial parts of the RI and require explanation because the process for the UEFPC CA is somewhat unconventional and requires understanding and acceptance on the parts of all the project team members and the stakeholders, especially with regard to schedule.

SAPs will be prepared when decisions are made concerning the need for acquisition of critical data; therefore, plans may be developed at any time during data evaluation. In general, the development of SAPs will follow initial evaluations performed for the risk assessments and FS; in most cases the plans will be developed for specific data needs associated with these activities. The preparation, review, and approval of the plans will be on as accelerated a schedule as possible to allow timely completion of the RI/FS. Figure 2.7 presents a schematic of the process and schedule for development of the SAPs.

The schedule for preparation and approval of the SAPs is extremely aggressive, as shown in Fig. 2.7. However, the extraordinary characteristics of the UEFPC CA and the current administrative environment demand an aggressive approach to complete this investigation and proceed with remediation, as appropriate. Review periods for all parties have been compressed to one week (five working days). The SAPs will follow the annotated outline and, therefore, there should be minimal discussion of the format; therefore, the focus will be on what samples need to be collected and why. When the D1 version of the SAP is complete, it will be submitted to TDEC and EPA for a period of 1 week for review, followed by the SAFER workshop to review the plan and approach. The intent is to gain consensus on the scope of the SAP at this meeting and to obtain regulator approval. All regulator comments will be available by the end of the meeting and the project team will immediately produce the D2 SAP and submit it to the regulators for formal approval. Once the D2 SAP is complete, the readiness review and mobilization activities will be initiated; however, sample collection will not begin until written approval of the SAP is received from the regulators. The D2 SAP then will be issued as an addendum to the approved RI Work Plan, as a controlled document, and the SAP will be executed.

Theoretically, as many as five different SAPs may be produced on overlapping schedules. The SAPs would specifically address one of the five major areas of data analysis and investigation: source areas, surface water, groundwater, ecological, and sumps. Depending on the timing, more than one of these areas could be included in the same SAP. As a result of the magnitude of the potential work to be performed, the activities are organized independently so incremental progress can be made, if appropriate. It is also possible that SAPs will not be necessary.

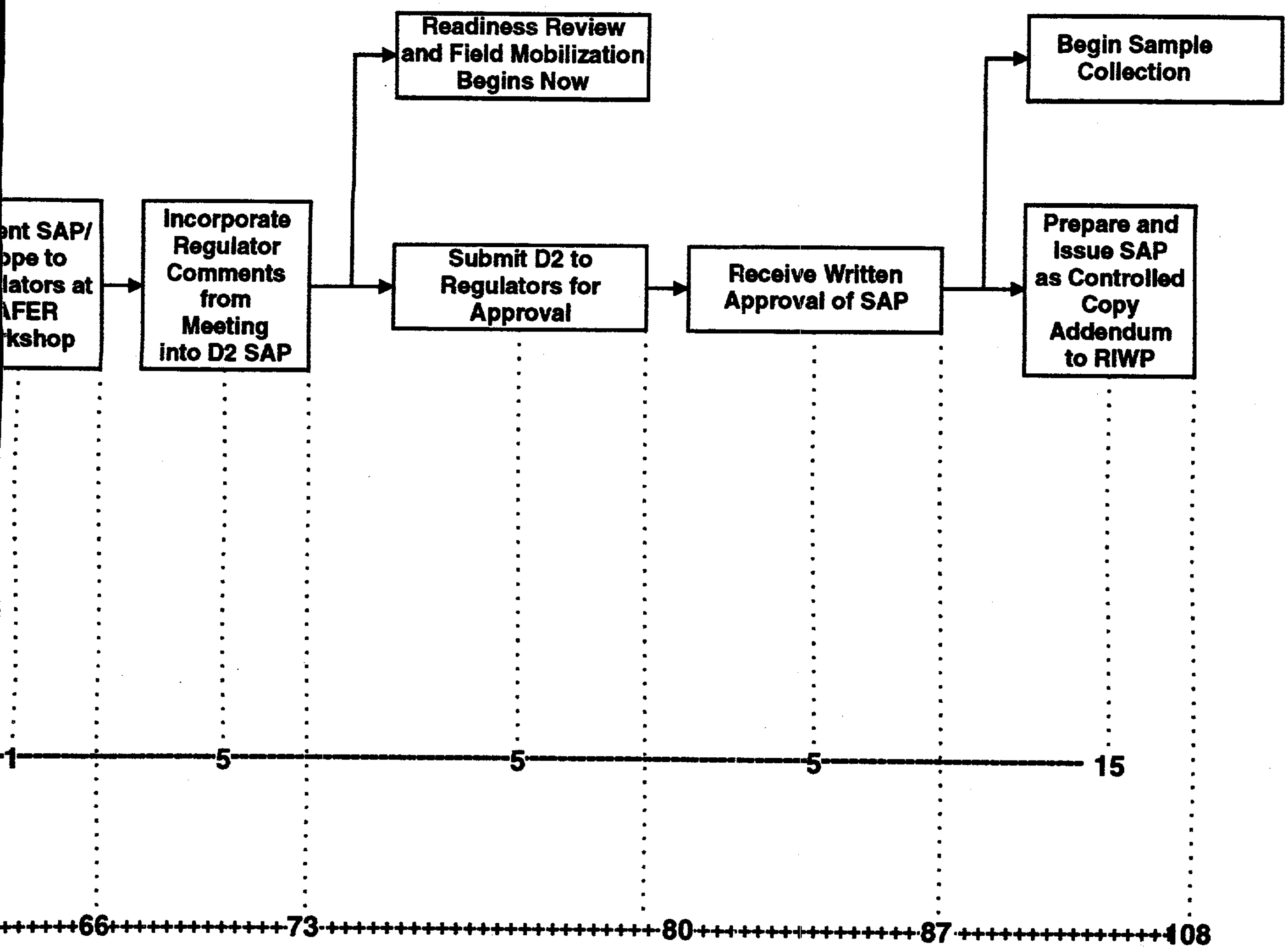
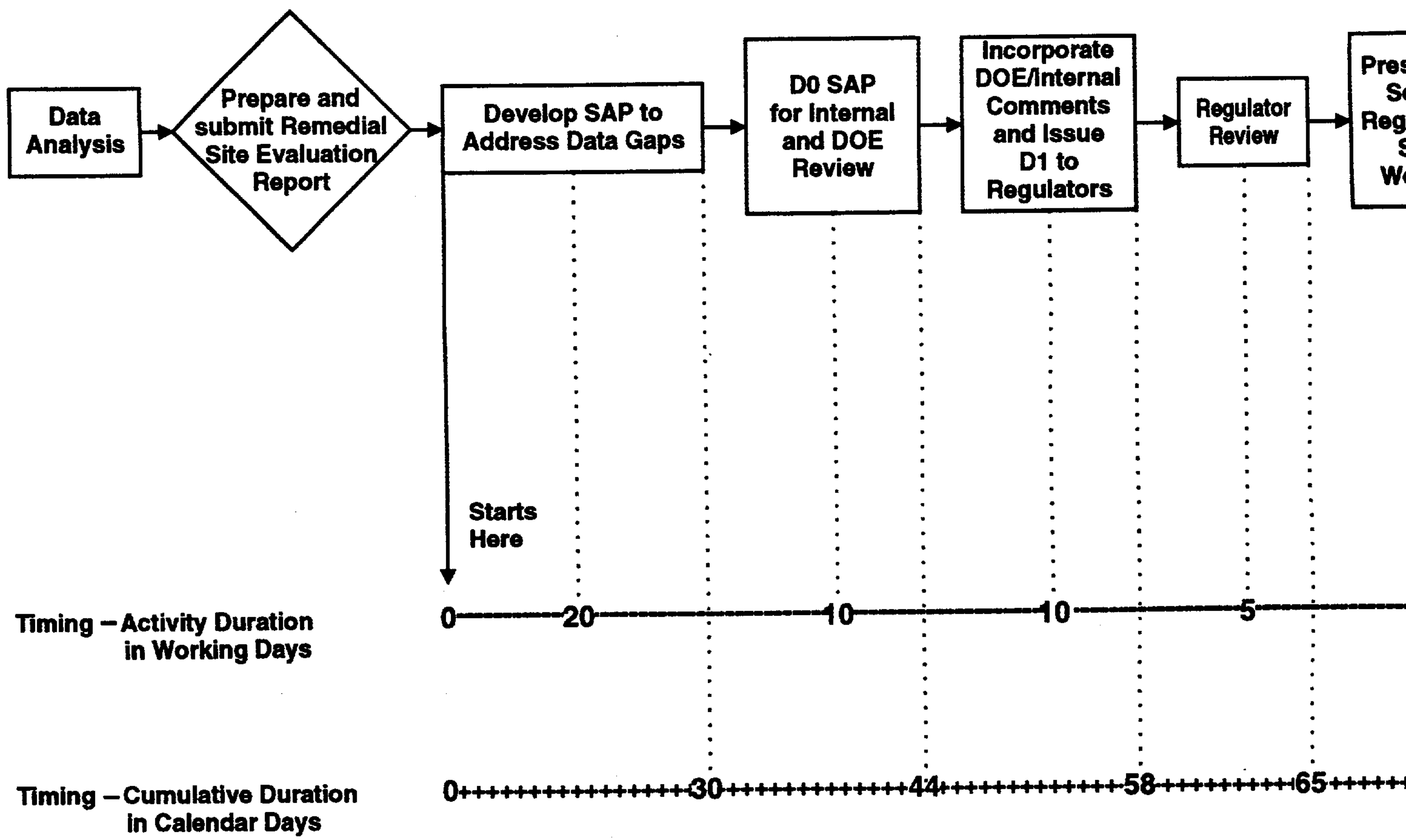


Fig. 2.7. SAP Process and Schedule.


Data Analysis
Prepare and submit Remedial Site Evaluation Report
Develop SAP to Address Data Gaps
D0 SAP for Internal and DOE Review
Incorporate DOE/Internal Comments and Issue D1 to Regulators
Regulator Review
Starts Here
Timing – Activity Duration in Working Days
0 20 10 10 5
Timing – Cumulative Duration in Calendar Days
0 30 44 58 65

3. RISK ASSESSMENT

3.1 POTENTIAL RECEPTORS, LAND USE, AND EXPOSURE PATHWAYS

This section summarizes the potential human health and ecological receptors that may be exposed to the COPCs in the UEFPC CA. Potential receptors to the contaminated media in the UEFPC CA are defined for current and future land-use scenarios. Current receptors are identified to make intermediate decisions in the CERCLA process, such as determining the need for an expedited removal action. Future receptors are identified to make decisions involving long-term management of the sources and/or the UEFPC CA. Refer to Figs. 2.2 and 2.3 in Sect. 2.1 for the Human Health and Ecological SCM.

3.1.1 Human Populations

As agreed upon in the UEFPC CA DQO Workshop (Energy Systems 1995a), two land uses will be considered for this BHHRA: industrial and residential. These two land uses will support remedial decisions and the evaluation of remedial alternatives in the FS, Proposed Plan, and ROD. The current on-site land use is industrial, and the future on-site land use is also expected to be industrial. However, to be consistent with the NCP and for the purposes of comparisons across DOE facilities, hypothetical residential and industrial land uses will also be evaluated in the UEFPC CA BHHRA for the future on-site land use (as agreed upon in the DQO Workshop). Currently Union Valley is partially an industrial area; however, off-site land use, both current and future, will be assumed to be residential.

3.1.1.1 On-site receptors

The potential current and future on-site receptor to the contaminated sources/soils/wastes in the UEFPC CA is the industrial worker; risks to the industrial worker will be evaluated in the BHHRA. An on-site residential receptor will also be evaluated in the BHHRA as agreed upon in the DQO Workshop (Energy Systems 1995a).

3.1.1.2 Off-site receptors

Current and future off-site land use for the UEFPC CA will be evaluated under residential land-use conditions (Energy Systems 1995a). For example, a residential receptor will be evaluated for the off-site BHHRA.

3.1.1.3 Future receptors

If appropriate groundwater/surface water modeling information is available, risks at future times will be evaluated at the exit pathway locations (e.g., DOE/Y-12 Plant boundary at Scarboro road, Station 17, and spring SCR7.1SP) for the residential receptor; this evaluation is not part of the BHHRA but is a risk-related activity and will be included in the RI report if appropriate.

3.1.1.4 Exposure pathways

An exposure pathway is the course that a COPC takes from the source to the receptor. A completed exposure pathway exists if all of the following factors are present: a source of potential contamination (e.g., contaminated soils); a mechanism for release for the source (e.g., chemical partitioning from soils to water); a route of migration from the source (e.g., groundwater transport);

a point of exposure, the location at which receptor comes into contact with the COPC (e.g., groundwater drawn from a well); a route of exposure (e.g., ingestion of groundwater); and a receptor (i.e., a human). Tables 3.1 and 3.2 summarize the land uses, receptors, exposure media, and exposure routes/pathways that will be evaluated in the UEFPC CA BHHRA.

Table 3.1. UEFPC BHHRA uses, receptors, and exposure media

	Current on-site	Future on-site	Future on-site[a]	Current/future off-site[b,c]
Exposure medium	Industrial worker (existing soil or RCRA caps)	Industrial worker (no caps)	Residential[d] (no caps)	Residential[d]
Soils/wastes	X	X	X	
Surface water			X	X
Groundwater			X	X

[a]Risks to human health from exposure to COPCs through consumption of fish caught in the UEFPC CA creek will also be evaluated in this BHHRA for the future recreational fisherman.

[b]Off-site groundwater in Union Valley and spring/surface water at SCR7.1SP (associated with the off-site carbon tetrachloride plume) and surface water associated with Station 17 of UEFPC will be evaluated as part of this UEFPC CA.

[c]There are no current exposures of the commercial off-site receptors (in Union Valley) to the groundwater contamination [see *Union Valley Interim Study Remedial Site Evaluation* (Y/ER-206/R1) (Energy Systems 1995f)].

[d]Residential receptors will include: adult/child combination for soil ingestion (for carcinogens), adult and child separately for soil ingestion (for noncarcinogens), and adult only for all other exposure media and pathways.

Table 3.2. UEFPC BHHRA exposure media and exposure routes/pathways

Exposure medium	Exposure routes/pathways
Soils/wastes	Incidental ingestion, Inhalation (dust and volatiles), Dermal, External exposure to radionuclides
Surface water	Ingestion, Inhalation of volatiles (while showering), Dermal (while showering)
Groundwater	Ingestion, Inhalation of volatiles (while showering), Dermal (while showering)
UEFPC Fish	Ingestion

Current and future on-site industrial worker. For the UEFPC CA BHHRA, exposure to soils/wastes will be evaluated for the industrial worker receptor through the incidental ingestion, inhalation of dust, dermal contact, and external exposure to radionuclides routes of exposure. Exposure to soils/wastes covered by existing soil or RCRA caps will not be evaluated for the current industrial worker because there are no complete exposure pathways. Similarly, no exposure pathways are complete for industrial worker exposure to surface water and/or groundwater in the UEFPC CA;

therefore, these media will not be evaluated in the BHHRA for the UEFPC CA for the industrial worker receptor (refer to Tables 3.1 and 3.2) (Energy Systems 1995a).

On-site residential. For the UEFPC CA BHHRA, exposure to soils/wastes will be evaluated for the hypothetical future residential receptor through the incidental ingestion, inhalation of dust, dermal contact, and external exposure to radionuclides exposure routes. Exposure to soils/wastes covered by existing soil or RCRA caps will be evaluated for the hypothetical future residential receptor because deterioration of the caps may occur under residential land-use conditions. The hypothetical future residential receptor could also be exposed to surface water and groundwater through the ingestion, inhalation-of-volatiles (while showering), and dermal-contact (while showering) exposure routes; these exposure routes will be evaluated in the UEFPC CA BHHRA. Residential receptors evaluated in this BHHRA will include the adult/child combination for soil ingestion (for carcinogens), the adult and child separately for soil ingestion (for noncarcinogens), and the adult only for all other exposure media and routes/pathways; these evaluations are conservative in terms of protecting human health (refer to Tables 3.1 and 3.2). In addition, risks (through the residential ingestion-of-groundwater exposure route) will be determined for each groundwater well, and these risks will be contoured (if possible) and/or represented graphically for the entire UEFPC CA.

Off-site residential. For the UEFPC CA BHHRA, the hypothetical resident could be exposed to surface water (at Station 17 in UEFPC and at spring SCR7.1SP) and to groundwater (Union Valley groundwater) through the ingestion, inhalation-of-volatiles (while showering), and dermal-contact (while showering) exposure routes; these exposure routes will be evaluated in the UEFPC CA BHHRA. The adult receptor will be evaluated for all groundwater/surface water exposure pathways; these evaluations are conservative in terms of protecting human health (refer to Tables 3.1 and 3.2).

Recreational fisherman. Potential human health risks/hazards from exposure to COPCs through consumption of fish caught in the UEFPC will also be evaluated in this BHHRA (Energy Systems 1995a).

3.1.2 Ecological Populations

This RI is concerned with UEFPC, Lake Reality, the land associated with the Y-12 Plant, groundwater at the plant, and the Union Valley Groundwater plume. Terrestrial habitat in this area is very limited because the CA is currently an industrialized area. The future land use has also been identified as industrial; therefore, areas providing terrestrial habitat are relatively small and isolated. Consequently, the ecological assessment is primarily concerned with aquatic populations in UEFPC, including Lake Reality; the wide-ranging species (i.e., piscivores) that may use the area; and the wetland east of New Hope Cemetery. The sources for the following description of aquatic and terrestrial biota are Hinzman (1995); Loar and Hinzman (1995); King, Awl, and Gabrielsen (1994); and Rosensteel (1994). An ecological SCM has been developed for the UEFPC CA and is included in Sect. 3.3 with the BERA methodology.

3.1.2.1 Aquatic biota

Species richness and abundance of fish communities are recommended assessment endpoints for aquatic ERAs on the ORR (Suter et al. 1994). Twenty-one species of fish are found in EFPC above Bear Creek Road, eight of which have been observed above Lake Reality (Table 3.3). Mean densities and biomasses have increased steadily since sampling began in 1985, but the UEFPC communities are still classified as very poor to poor. Closing New Hope Pond removed the barrier to upstream migration of fish in EFPC, and a permanent, reproducing fish community is now established above Lake Reality. Also, the distribution and density of fish above Lake Reality have increased since dechlorination began in 1992. Although recovery of the fish community in UEFPC is continuing, pollution-intolerant species still dominate, especially above Lake Reality, and habitat quality may prevent complete recovery of these communities.

Species richness and abundance of benthic invertebrate communities are also recommended assessment endpoints for ERAs of sediments and surface water on the ORR (Suter et al. 1994). Very minor recovery of the benthic invertebrate communities above Bear Creek Road may have occurred between 1986 and 1993 (i.e., a slight but statistically significant increase in the total number of taxa and the number of pollution-intolerant taxa was observed). These communities are still highly degraded, however, relative to reference sites, and high densities of a few pollution-tolerant species suggests the presence of excess nutrients in UEFPC. Also, the composition and structure of the invertebrate communities suggest the occurrence of significant episodic disturbances, such as releases

Table 3.3. Fish species found at least once during quantitative and qualitative sampling of EFPC above Bear Creek Road from 1988 through 1995

Common name	Scientific name	Observed above Lake Reality[a]
	Clupeidae	
Gizzard shad	*Dorsoma cepedianum*	No
	Cyprinidae	
Central stoneroller	*Campostoma anomalum*	Yes
Common carp	*Cyprinus carpio*	No
Striped shiner	*Luxilus chrysocephalus*	Yes
Bluntnose minnow	*Pimephales notatus*	No
Fathead minnow	*Pimephales promelas*	No
Blacknose dace	*Rhinichthys atratulus*	Yes
Creek chub	*Semotilus atromaculatus*	Yes
	Catostomidae	
White sucker	*Catostomus commersoni*	Yes
Northern hog sucker	*Hypentelium nigricans*	No
Spotted sucker	*Minytrema melanops*	No
	Ictaluridae	
Yellow bullhead	*Ameiurus natalis*	No
	Poeciliidae	
Western mosquitofish	*Gambusia affinis*	No
	Centrarchidae	
Redbreast sunfish	*Lepomis auritus*	Yes
Green sunfish	*Lepomis cyanellus*	Yes
Bluegill	*Lepomis macrochirus*	Yes
Redear sunfish	*Lepomis microlophus*	No

Table 3.3 (continued)

Common name	Scientific name	Observed above Lake Reality[a]
Largemouth bass	*Micropterus salmoides*	No
	Percidae	
Snubnose darter	*Ethostoma simoterum*	No
Yellow perch	*Perca flavescenes*	No
	Sciaenidae	
Freshwater drum	*Aplodinotus grunniens*	No

[a]Collected from EFPC at kilometers 24.2 or 25.1.

Sources: R. L. Hinzman ed., *Second Report on the Oak Ridge Y-12 Plant Biological Monitoring and Abatement Program for East Fork Poplar Creek*, Y/TS-888, Oak Ridge National Laboratory and M. G. Ryon, Oak Ridge National Laboratory, personal communication, July 5, 1995.

of toxicants or disturbance of the habitat from excessive run-off during storm events. Distinguishing the effects of contaminant sources from habitat factors is one of the purposes of the ERA.

3.1.2.2 Terrestrial biota

The UEFPC CA is a highly industrialized area composed primarily of buildings, parking lots, mowed lawns, scrapyards and other industrial areas; therefore, habitat suitable for terrestrial biota is limited to small isolated patches that are unlikely to support distinct or ecologically important populations of terrestrial biota. As a result, assessment endpoint species distinct to the subbasin areas were not identified in the DQO workshop.

Fish and other aquatic animals in UEFPC and Lake Reality are a resource for piscivores. In 1994, researchers trapped a mink (*Mustela vison*) in LEFPC, collected hair samples for chemical analysis, and tagged the mink with a radio-transmitter (Stevens 1995). Tracking efforts revealed that this individual made extensive use of the UEFPC area, including sections of the creek near the North/South Pipe. Also, the hair collected before the tracking efforts had extremely high levels (104 mg/kg) of mercury (Stevens 1995). Belted kingfishers (*Ceryle alcyon*) have also been observed using Lake Reality, though burrows were not found in the UEFPC stream channel (Ashwood 1994a). Given these observations, mink and kingfishers were selected as assessment endpoint populations for piscivorous wildlife using the UEFPC CA.

3.1.2.3 Threatened and endangered species

The UEFPC CA, which is primarily an industrialized area, is likely to provide only limited habitat for threatened and endangered species. The carcass of a gray bat (*Myotis griscens*), which is a federal- and state-listed endangered species, was found in a building in the Y-12 Plant; these bats are likely to use areas near the Clinch River. Gray bats are unlikely to use the UEFPC CA regularly, however, because there is a lack of suitable habitat (i.e., caves and large bodies of water). A survey of UEFPC CA for threatened and endangered plant species conducted in 1993 (King et al. 1994) identified a population of pink lady-slippers (*Cypripedium acuale*) north of Bear Creek Road, which is considered outside of the UEFPC CA. Suitable habitat for two state-listed species, ginseng (*Panax quinquefolius*) and lesser ladies tresses (*Spiranthes ovalis*), however, was identified "south of Bear Creek Road." No other federally- or state-listed threatened or endangered plant, reptile, amphibian, invertebrate, mammal, or bird has been observed in the UEFPC CA. Surveys for threatened and endangered species other than plants have not been conducted for this specific CA. Specially designated species that may occur are listed in Table 3.4.

Table 3.4. Federal- and state-listed threatened and/or endangered species and species designated in need of management by the state of Tennessee known or expected to occur on the ORR for which suitable habitat may exist in the UEFPC CA[a]

Common name	Scientific name	Administrative status[b]
	Fish	
Tennessee dace	*Phoxinus tennesseensis*	INM
	Amphibians and Reptiles	
Six-lined racerunner	*Cnemidophorus sexlineatus*	INM
Slender glass lizard	*Ophisaurus attenuatus*	INM
	Birds	
Yellow-bellied sapsucker	*Sphyrapicus varius*	INM
Red-headed woodpecker	*Melanerpes erythrocephalus*	INM
Red-shouldered hawk	*Buteo lineatus*	INM
Barn owl	*Tyto alba*	INM
Black vulture	*Coragyps atratus*	INM
	Mammals	
Eastern small-footed bat	*Myotis leibii*	FC, INM
Rafinesque's big-eared bat	*Plecotus rafinesquii*	FC, INM
	Plants	
Ginseng	*PANAX QUINQUEFOLIUS*	S
Lesser ladies tresses	*SPIRANTHES OVALIS*	ST
Pink lady-slippers	*Cypripedium acuale*	SE

[a]Based on the species list in Appendix C of T. L. Ashwood et al. 1994b. *Work Plan for the Oak Ridge Reservation Ecological Monitoring and Assessment Program*, DOE/OR/01-1298&D1, ES/ER/TM-127&D1, Oak Ridge National Laboratory. Habitat requirements and availability provided in B.E. Sample, L. A. Baron, and B. L. Jackson (in preparation, 1995), *Preliminary Assessment of Ecological Risks to Wide-Ranging Wildlife Species on the Oak Ridge Reservation*, Oak Ridge National Laboratory, and A. L. King, J. J. Awl, and L. A. Gabrielsen (1994), *Environmentally Sensitive Areas Surveys Program Threatened and Endangered Species Survey Progress Report*, ES/ER/TM-130, Oak Ridge National Laboratory.

[b]FC = candidate for federal listing, INM = in need of management according to the state of Tennessee, S = special concern in Tennessee, SE = state endangered, and ST = state threatened.

3.1.2.4 Wetlands and floodplains

A wetlands survey of selected areas in the Y-12 area of responsibility conducted in 1994 identified one wetland in the UEFPC CA (Rosensteel 1994). This wetland was located at a seep adjacent to an "East Fork Poplar Creek subtributary" in a small, wooded area between New Hope Cemetery and Bear Creek Road and was characterized as an emergent wetland. The adjacent subtributary reportedly receives storm run-off from the Y-12 garage area by means of an NPDES-permitted outfall. No other wetlands were identified in the UEFPC CA; however, ten EFPC tributary streams originate on the lower slopes of Pine Ridge that were filled and/or piped during construction of the Y-12 Plant. Emergent wetlands and scrub/shrub wetlands were identified in the remnants of these stream bottoms. These areas are on the north side of Bear Creek Road and not considered part of this CA. Wetlands are included as assessment endpoint communities because they are areas of special concern.

Floodplain soils have not been characterized along EFPC above Bear Creek Road. This section of stream is in an industrial facility and has been engineered to reduce erosion and over-bank conditions (i.e., the stream is channelized and has steep banks). Only a narrow strip of riparian vegetation remains along this section of EFPC. Given these conditions, assessment endpoints distinct to the UEFPC floodplain were not identified in the DQO workshop.

3.2 HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The HHRA activities to be performed for the UEFPC CA include a CERCLA BHHRA, screening/comparisons with risk-based PRGs, IP assessments, and an estimation of potential future exit pathway risks based on modeled concentration data.

The overall objective of the BHHRA evaluation process is to document potential risks and provide information necessary for making remedial decisions. The BHHRA methodology used is based on *Risk Assessment Guidance for Superfund* (EPA 1989a). A quantitative analysis of the COPCs for each identified area and contaminated media is used to characterize the potential risk to human health associated with exposure to these COPCs. The results of the BHHRA are used to document and evaluate risks to human health, to determine the need for RA, to determine contaminant concentrations protective of current and future human receptors, and to provide risk information for comparison of remedial alternatives.

Screening/comparisons with PRGs will be performed to support source area and subbasin characterization as described in Sect. 2.2.2. PRGs are initial concentration guidelines that are protective of human health, based on readily available information, and comply with ARARs. PRGs are derived in accordance with the methodology outlined in RAGS (EPA 1991). The PRG screening analyses help identify COPCs, transport and exposure pathways that should be adequately characterized in subsequent sampling activities, data limitations and data deficiencies, and appropriate detection limits. In addition to using risk-based PRG screens for source characterization, contaminant concentrations in all media will be screened/compared with PRGs to support the selection of COPCs in the BHHRA (Energy Systems 1995e).

The IP assessment will be used to help prioritize (based on risk) the areas/subbasins within the UEFPC CA relative to migration of COPCs off-site. The majority of off-site migration of COPCs can occur in surface water and groundwater. The primary surface water migration pathway in the UEFPC CA is the UEFPC. Off-site groundwater migration is most likely to occur in the Maynardville Limestone. Hydraulic connections exist between the UEFPC and the Maynardville Limestone, so the surface water and groundwater COPC exit pathways are related and will have impacts on one another (see UEFPC GWQARs for details).

The IP assessment is used to evaluate risks at different points within the integrator (i.e., UEFPC surface water and/or Maynardville Limestone groundwater), to identify and prioritize source areas contributing to the integrator, and to provide the basis for evaluating the degree of risk reduction a source control action potentially can achieve (Energy Systems 1995e). The IP assessment is a flux-based assessment that will be performed for each subbasin and at additional points (e.g., the

DOE/Y-12 Plant boundary at Scarboro Road, Station 17, and spring SCR7.1SP) of the UEFPC CA as described in Sect. 2.3.2. Flux takes into account the flow rate and the COPC concentrations. RAs taken to control sources of contamination in areas/subbasins having high fluxes of COPCs to the integrators will help reduce existing and potential off-site migration.

If appropriate groundwater/surface water modeling information is available, risks at future times (e.g., 100 years) will be evaluated at the exit pathway locations (e.g., DOE/Y-12 Plant boundary at Scarboro road, Station 17, and spring SCR7.1SP).

3.2.1 Preliminary Remediation Goal Screening

Comparisons of data from all media (e.g., soils, surface water, groundwater, sediments) to PRGs will be performed to: (1) develop the COPCs for the BHHRA (EPA 1989); (2) provide stakeholders with additional information (e.g., potential agricultural contamination in produce, meat, and milk) (Energy Systems 1995e); and (3) support source area/subbasin characterization (Energy Systems 1995a), as described in Sects. 2.2 and 2.3.

PRG screening will be used in developing the list of COPCs that will be evaluated quantitatively in the BHHRA in terms of risks to human health through the exposure routes/pathways and media shown in Table 3.2. Contaminants with concentrations less than the residential (or industrial, when applicable) PRGs will not be considered COPCs for the BHHRA. (Those analytes with concentrations below the PRGs would not be risk drivers and, therefore, are not considered COPCs.)

Comparisons of UEFPC CA soil and water concentrations with meat, milk, and produce (i.e., agricultural) PRGs will be performed and reported in the BHHRA. These comparisons will be performed to provide stakeholders with additional information for routes/pathways that will not be further quantitatively evaluated as part of the BHHRA.

To support the source area/subbasin soils/wastes characterization (refer to Sects. 2.3.1, 2.3.2, and 2.5), screening of soils/waste concentration data against industrial PRGs will be performed to identify areas of potential concern for exposure of an industrial worker. Screening of soils/wastes data against industrial PRGs will be used [along with other criteria (refer to Sect. 2.5)] to determine if definitive sampling for various source areas is necessary to support the determination of the nature and extent of contamination in the RI/FS and to support the BHHRA.

3.2.2 Integration Point Assessment

The IP assessment will be used to help prioritize areas/subbasins for RAs (based on potential risks to off-site receptors) for the areas/subbasins within the UEFPC CA relative to migration of COPCs off-site. The majority of off-site COPC migration occurs in surface water (UEFPC) and groundwater (the Maynardville Limestone); therefore, the IP assessment will be used to evaluate risks at different points within the integrator (i.e., UEFPC surface water and/or Maynardville Limestone groundwater), to identify and prioritize source areas contributing to the integrator, and to estimate the degree of risk reduction (to potential off-site receptors) a source control action potentially can achieve (Energy Systems 1995e).

The IP assessment considers exposures (through ingestion of water) to a residential receptor. The IP assessment is a flux-based assessment (i.e., takes into account the flow rate and the COPC concentrations) and will be performed for each subbasin surface water/groundwater connection within the UEFPC CA, at the DOE/Y-12 Plant boundary at Scarboro Road, at Station 17, and at spring SCR7.1SP (refer to Sect. 2.3.2).

3.3 ECOLOGICAL RISK ASSESSMENT METHODOLOGY

A BERA will be performed for the UEFPC CA because it is the risk integrator for the Y-12 Plant area and a source of contaminants in water to LEFPC. Manifest effects on fish and piscivores also exist in these areas. The goals of the baseline risk assessment will be to determine (1) whether significant ecological effects are occurring in the CA, (2) the cause of any such effects, (3) the source of that causal agent, (4) the contribution to off-CA risks, and (5) the consequences of leaving the system unremediated. Accomplishment of these goals calls for an epidemiological approach based on the weight of evidence.

The BERA for the UEFPC CA will be consistent with the *Approach and Strategy for Performing Ecological Risk Assessments for the U.S. Department of Energy's Oak Ridge Reservation: 1994 Revision* (Suter et al. 1994), which is referred to hereafter as "the ORR Strategy." This approach is consistent with relevant EPA documents (EPA 1989b, Warren-Hicks et al. 1989, Risk Assessment Forum 1992). The ORR Strategy is based on the four types of OUs identified in the ORR Site Management Plan (ERD 1994). These OUs (and the comparable areas of the UEFPC CA), are the source OUs (subbasin areas), aquatic integrator OU (UEFPC and Lake Reality), groundwater OU (groundwater under the CA and the Union Valley groundwater plume), and the terrestrial integrator OU (the ORR).

Problem formulation is the first phase of the ORR Strategy. This phase defines the sources of concern, media of concern (e.g., surface water, sediment, soil, and groundwater), spatial extent, and assessment endpoints (an endpoint entity and a level of effect). After the problem is defined, exposure and effects are assessed. The primary exposure data are the analyses of contaminants in media (e.g., surface water) and biota (e.g., fish). Three types of effects data will be used: biological survey data obtained by the BMAP, toxicity tests of ambient media, and toxicological effects data (e.g., regulatory criteria and literature toxicity values) for individual chemical constituents. The final phase is the weighing of evidence from the exposure and effects assessments to characterize the risks to the assessment endpoints. The risk characterization is a summary and explanation of the results and associated uncertainties. This assessment will consist of the media, areas of concern, endpoints, and types of data described below, as agreed to in the DQO workshop for the UEFPC CA. The ecological SCM for this CA is based on the generic conceptual models in the ORR Strategy and is presented in Fig. 3.1.

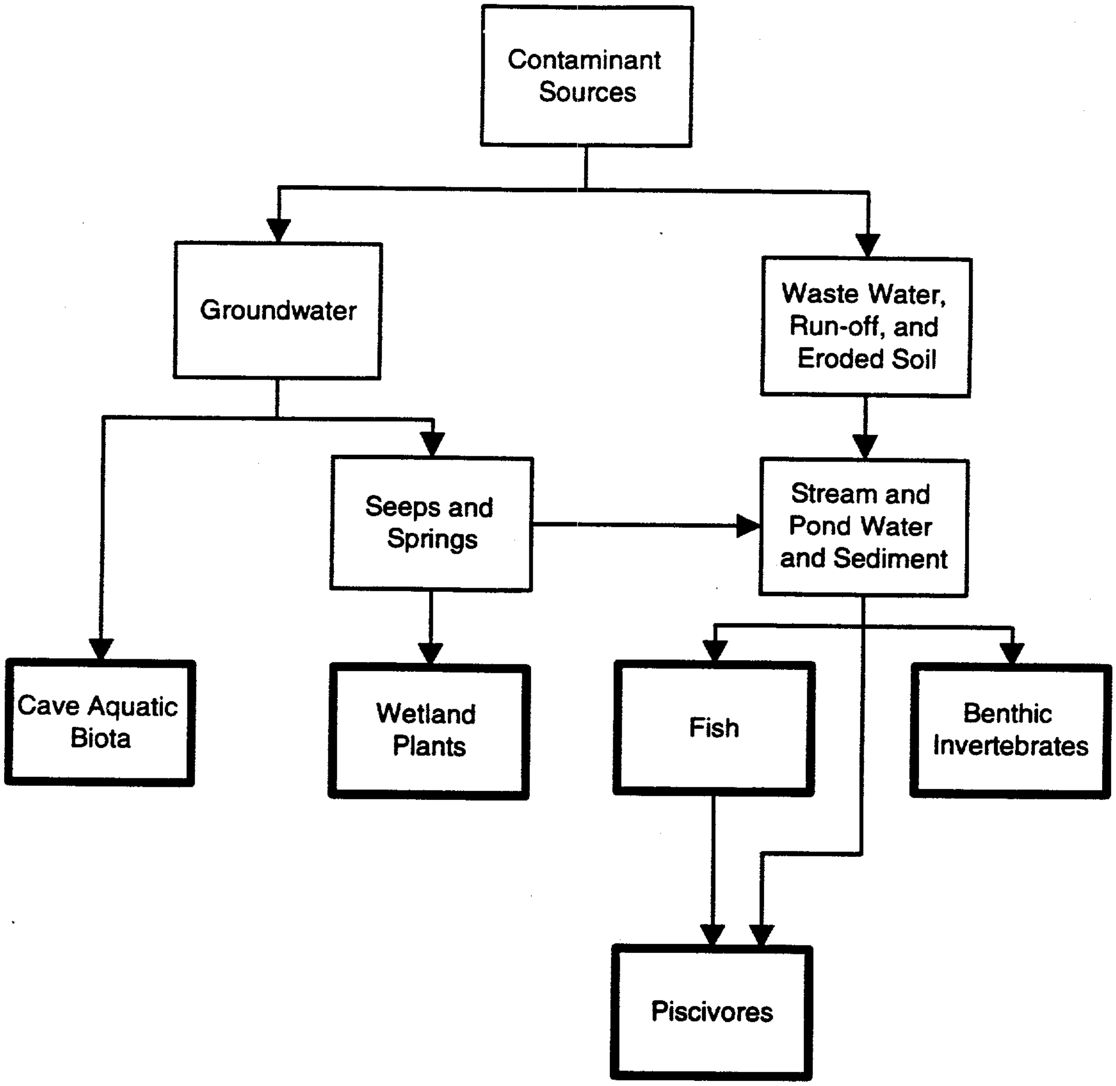
Surface water is the primary medium of ecological concern in the CA. UEFPC, from the North/South Pipe to the CA boundary at Bear Creek Road, and Lake Reality are the areas of concern and constitute the aquatic integrator OU. Surface water discharges (e.g., outfalls and ditches) from individual subbasins will be evaluated for their contribution to risks in UEFPC, but not as habitats for distinct endpoint communities. Surface water in UEFPC will be evaluated as a source to LEFPC. Ecological risks in LEFPC were evaluated as part of the BERA for that OU and will not be reassessed as part of this effort; rather, risks from contaminants in surface water at the CA boundary will be related to the risks identified in the LEFPC BERA. The assessment endpoint for surface water in UEFPC and Lake Reality is a 20% or greater reduction in species richness or abundance of the fish community as a result of toxicity. Data types include fish community surveys and aqueous toxicity tests by BMAP and chemical analyses of surface water.

Contaminated surface water and fish in the CA will also be evaluated as sources of exposure for piscivorous wildlife. The assessment endpoint will be reduction in abundance or production of piscivorous wildlife populations as a result of toxicity. Risk assessment will be based on contaminant concentrations in fish, dietary exposure models, and toxicological benchmarks for wildlife because biological surveys would not reveal effects on piscivorous wildlife (densities are too low), and toxicity tests are not feasible for piscivorous wildlife. The representative piscivorous species will be the belted kingfisher (*Ceryle alcyon*) and mink (*Mustela vison*).

Contaminated sediments in UEFPC and Lake Reality will be evaluated as sources of exposure for aquatic biota. The assessment endpoint will be a 20% or greater reduction in species richness or abundance of benthic macroinvertebrate communities as a result of toxicity. Current and historical benthic invertebrate community surveys by the BMAP will be compared to reference sites to determine the magnitude of the impacts. Sediment chemical data are very limited, and sediment toxicity tests have not been performed. Sediments in UEFPC will be mapped and existing sediment data will be reviewed to determine the data needs for this component of the assessment.

Exposure to soil in the CA will not be evaluated because the soil does not constitute a significant habitat for terrestrial biota (i.e., potentially contaminated soil occurs in small isolated patches separated by buildings and other industrial areas). Furthermore, current and future land management of the CA is designated for DOE-industrial uses. Floodplain soils associated with UEFPC have not been characterized because the stream is channeled and it flows through an industrial area. Given these conditions, endpoint entities distinct to the subbasin and floodplain soils (e.g., plants, soil invertebrates, and small mammals) were not selected as assessment endpoints in the March 1995 DQO workshop.

Assessment of potential exposures to contaminated groundwater in the Y-12 Plant area of the UEFPC CA will be limited to cave biota, should their presence be confirmed. It is unclear what species may actually occur in caves on the ORR; it is also unclear whether caves occur in the CA and contain contaminated groundwater. Assessment endpoints and data needs will be identified only if caves receiving contaminated groundwater are identified. Groundwater will not be evaluated as a source to vascular plants in the CA because the Y-12 Plant area is not an important habitat for trees, and the Union Valley Groundwater plume is generally too deep (i.e., more than 20 ft below the surface) for plant exposures. The two exceptions are the discharge point of the groundwater plume at seep SCR7.1SP and the wetland located at a seep in a small, wooded area between New Hope Cemetery and Bear Creek Road. Risks to plants from exposure to contaminated water will be assessed using contaminant concentrations in seep water and ecotoxicological benchmarks for terrestrial plants. Water in seep SCR7.1SP also will be assessed as a source to aquatic biota by comparing contaminant concentrations to ecotoxicological benchmarks for aquatic biota. Aqueous toxicity tests (i.e., of *Ceriodaphnia*) of seep SCR7.1SP water will be conducted if risks are indicated by the screening against benchmarks. Risks in Scarboro Creek will not be assessed as part of this BERA.



Boxes with heavy borders designate endpoint receptors.

Fig. 3.1. SCM for the UEFPC CA ERA.

4. FEASIBILITY STUDY

The following sections describe the FS contractor's responsibilities, the tasks necessary to produce the FS report for the UEFPC CA, and the site data needs to support FS development. The FS report will generally follow EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988). Integration of the RI and FS will also follow DOE's SAFER (DOE 1993) and EPA's Superfund Accelerated Cleanup Model to manage the uncertainties regarding this ER project. The FS report will integrate NEPA values as appropriate according to DOE guidance.

Upon approval of the FS by EPA and TDEC, a proposed plan presenting DOE's preferred remediation alternative will be submitted for review by regulators and the public. The preferred alternative is expected to recommend a series of discrete actions that would be implemented in a designated sequence, each building on the others to accomplish the RAOs. Upon approval of a ROD by EPA and TDEC, RD, and RAs will commence (see Sect. 5).

4.1 FEASIBILITY STUDY CONTRACTOR RESPONSIBILITIES

The FS contractor will coordinate activities with the RI contractor to ensure that RI activities are focused on gathering and analyzing data relevant to the development and evaluation of remedial alternatives. The FS contractor will review preliminary RI information and reports, review and comment on drafts of the RI report, and provide updates on FS status to the RI team.

The FS contractor will ensure that the FS is prepared within project quality, cost, and scheduling goals. The FS contractor will provide engineering and technical resources to support QC efforts, provide project management, and coordinate project activities to ensure that established goals are achieved. Monthly progress reports will be issued to DOE.

Completion of the FS process will include preparing the following milestone documents: (1) the FS report, which documents the process used to develop and analyze a range of RA alternatives that protects human health and the environment and also incorporates NEPA values; (2) the proposed plan, which is a summary plan selecting and presenting the preferred alternative; and (3) one or more RODs, which are legal documents specifying the RAs to be taken and identifying all regulatory requirements (i.e., ARARs, see Sect. 2.2.1) with which the actions must comply.

4.2 SCOPE AND ASSUMPTIONS

As stated in Sect. 2.4.2, the preliminary RAOs are intended to protect specified human receptors (e.g., residents or industrial workers) or ecological receptors at identified points of compliance from exposure to contamination originating from the UEFPC CA. The RI will characterize the nature and extent of contamination (see Sect. 2). The risk assessments (as part of the RI) will identify current and future risks to the identified receptors at the points of compliance (see Sect. 3). The FS will develop and analyze a range of RA alternatives that are protective of human health and the environment and, to a greater or lesser extent, meet the RAOs. The FS/proposed plan/ROD process may include the following elements:

- FS scoping activities and development,
- treatability studies,

- incorporation of NEPA values,
- coordination/oversight,
- interagency consultations regarding sensitive resources,
- proposed plan development, and
- ROD development.

4.2.1 Feasibility Study Scoping Activities and Development

Based on EPA and SAFER guidance, the following study elements will be developed and incorporated into the FS report:

- technology development,
- technology screening,
- assembly of retained technologies (i.e., representative process options) into alternatives,
- alternative screening,
- detailed description of retained alternatives,
- detailed analysis of retained alternatives, and
- comparative analysis of retained alternatives.

Screening of technologies and alternatives will be based on engineering determinations regarding effectiveness, implementability, and cost. Detailed analysis of the alternatives in the FS will be based on the EPA threshold criteria and primary balancing criteria listed below.

- Threshold criteria
    - overall protection of human health and the environment
    - compliance with ARARs
- Primary balancing criteria
    - short-term effectiveness
    - long-term effectiveness
    - reduction in toxicity, mobility, or volume through treatment
    - implementability
    - cost.

Submittal of the draft FS report to EPA and TDEC for review is an FFA milestone.

4.2.2 Treatability Studies

Treatability studies may be conducted, if necessary, to allow alternatives that include a treatment component to be fully developed and evaluated for selection of an alternative and for support of its RD.

4.2.3 National Environmental Policy Act Analysis

As part of the decision-making process, NEPA requires identification and evaluation of the impacts associated with, or resulting from, an action. NEPA's primary area of concern is the protection of environmental quality. NEPA analyses include, but are not limited to, consideration of impacts to sensitive resources, socioeconomics, transportation, and cumulative effects. Regulations for DOE's implementation of NEPA (10 *CFR* 1021) are further refined by DOE Order 5400.4, which instructs that NEPA and CERCLA be integrated to avoid duplication of efforts. Additionally, a policy statement issued by DOE on June 13, 1994, states that DOE will hereafter "rely on the CERCLA process for review of actions to be taken under CERCLA and will address NEPA values and public involvement" as further specified in the statement. In accordance with these regulations, guidance, and policy, NEPA values will be included in this FS, and the potential impacts of remedial alternatives discussed in the FS will be described and evaluated with respect to NEPA values as an integral part of the report.

4.2.4 Coordination/Oversight and Data Needs

Development of all elements of the FS will depend on data and on analyses performed by the RI team. Much of the information in the RI will be developed while the FS is under way. The objective of FS oversight activities is to provide technical input and review of RI activities and reports to ensure that data and information obtained and analyzed during the RI are adequate to support the FS process, justify and defend selection of the preferred alternative in the proposed plan, and support development of RODs.

The RI/RA should generally provide the following information for use in the FS:

- data analysis that identifies the nature and extent of contamination in the UEFPC CA within reasonable levels of uncertainty;
- analysis that associates that contamination to human health and ecological risk;
- groundwater- and contaminant-transport-predictive tool (i.e., model) for risk analysis of post-RA conditions; and
- information sufficient to allow evaluation of technologies, selection of actions appropriate to reduce or maintain risk at appropriate levels, and development and evaluation of remedial alternatives.

The following is a list of specific FS information needs that should be met by the RI and baseline RA. For each item of information provided, the RI and RA should include a qualitative or quantitative explanation of the associated uncertainty.

- Future contaminant levels at exposure points (e.g., Do nitrates or radioactive constituents ever reach the exposure points?)

- Consequences of human and ecological exposures to those contaminants (e.g., Does lithium pose a significant toxicity problem to off-site ecological receptors?)
- Estimates of groundwater flux and contaminant flux
  - — from Nolichucky to Maynardville
  - — from Nolichucky to UEFPC
  - — from Maynardville to UEFPC
  - — from Maynardville across DOE boundary
  - — from Nolichucky across DOE boundary
- Locations of sources of contamination
- Local setting for contributing on-site sources (e.g., surrounding soil characteristics, distance to groundwater, presence of underground utilities)
- COPCs [i.e., contaminants at concentrations that exceed risk-based or regulation-based guidelines (PRGs)]
- Probable average concentration (or concentration gradient) of COPCs at primary and secondary sources and reasonable deviations in concentration
- Probable extent and volume of contaminated media at source and in environmental media and reasonable deviations in extent and volume
- Probable mass of each contaminant at source and in environmental media and reasonable deviations in mass
- Contaminant- and source-specific contributions to risk at each receptor location (to prioritize RAs)
- Mass flux of each COPC from primary sources.

4.2.5 Proposed Plan Development

The UEFPC CA proposed plan will present DOE's preferred alternative to the public and regulators. The proposed plan documents the RI process, administrative and regulatory actions, and the remedial alternatives developed in the FS. The preferred alternative is expected to identify and prioritize discrete RAs based on the detailed analysis of alternatives in the FS. Issuing the proposed plan is a primary FFA milestone.

4.2.6 Record of Decision Development

The ROD is a legal document written in accordance with the statutory requirements of CERCLA. It describes the RAs, defines ARARs, and establishes a remediation schedule and monitoring plan for the UEFPC CA. The ROD will contain a decision summary outlining the nature and extent of contamination and associated risks at the site, the evaluation and analysis of alternatives considered, and an explanation of how the selected RAs will meet statutory requirements. It will also address the EPA-modifying criteria of state and community acceptance, providing a responsiveness summary addressing the comments obtained during public review of the proposed plan and administrative record. Upon EPA and TDEC approval of the ROD, RD, and RAs must begin on a prescribed schedule.

5. REMEDIAL DESIGN AND REMEDIAL ACTIONS

CERCLA Section 120(e)(2) requires that RAs begin within 15 months after a ROD is approved. Depending on the scope of the approved RAs, a longer time period may be required for preparation and approval of RDs for certain actions within the UEFPC CA. The following sections discuss the RD and RA processes.

5.1 REMEDIAL DESIGN

This section presents the scope of the RD effort required to prepare RD Work Plans, perform any required engineering studies, prepare Title I (30%) design packages, and prepare Title II (60%, 90%, and 100%) final design reports for each RA in the UEFPC CA.

5.1.1 Scope and Assumptions

The scope of the RD Work Plan for remediation of the UEFPC CA is to describe the technical approach for providing necessary supporting documents to implement each RA activity, including construction, operation, maintenance, and monitoring activities identified in the ROD. These documents require approval from DOE-ORO, DOE-Headquarters, TDEC, and EPA. The following sections present details of the scope of work and assumptions associated with remediation of the UEFPC CA.

5.1.2 Remedial Design Work Plan

RD Work Plans will provide the technical and management approach for RD work. A draft RD Work Plan will be prepared to define the technical approach for preparing final construction plans and specifications to implement the RAs defined in the ROD for a given action. Conceptual design documents prepared before the RD will highlight the design criteria, design options, and conceptual engineering details. The RD Work Plan will define the detailed design process and the schedule for the design effort and will be prepared in accordance with CERCLA and NEPA regulations. The RD contractor will incorporate comments from DOE (including appropriate subcontractors), EPA, and TDEC and will submit the final RD Work Plan for approval.

5.1.3 Remedial Design Work Plan Oversight Activities and Data Needs

During the preparation of the RD Work Plan, the DOE prime contractors will provide their review and technical input to ensure that the scope of work is adequately defined in accordance with the details for the action specified in the ROD and conceptual design report. Review of the draft RD Work Plan also will ensure that the selected technologies are consistent with the intent of the ROD and that the overall Work Plan meets all regulatory and administrative requirements.

RD data needs will be similar to those described for the FS in Chap. 4. The FS/proposed plan/ROD can develop, evaluate, and select alternative RAs even with uncertainty in the accuracy of site and contaminant data. Engineering design typically requires additional data collection to provide an additional level of detail and reduce the level of uncertainty. During and after preparation of the RD Work Plan, data needs should be evaluated and additional data collected as required. Data collection and analysis and RD (including Work Plan preparation) may also be performed in discrete packages over an extended schedule because RAs are expected to consist of discrete actions implemented in a designated sequence.

5.1.4 Remedial Design Report Title I Design

Based on the engineering studies and other information available from the RI/FS and additional studies performed during this design phase, the RD contractor will prepare a Title I (30%) design/construction report for each discrete RA showing the extent of remedial activities, design bases and criteria, preliminary cost estimates, site plans, process schematics and conceptual engineering details, and outline of specifications for the work involved. At this stage the RD contractor shall have field-verified existing conditions at the site to the extent feasible, outlined the technical requirements of the project, and gathered supporting data and documentation.

5.1.5 Remedial Design Report Title II Design

Upon approval of the Title I design document, the RD contractor will prepare Title II engineering designs, analyses, and calculations required for all civil, structural, mechanical, and electrical construction; construction drawings; technical specifications; and cost estimates. Other plans and supporting information required by the statement of work (such as an H&S Plan, an Operations and Maintenance Plan, a QAPjP, and a waste management plan) shall be submitted.

All documents will be submitted to LMES for comment at the 60%–completion stage. Upon resolution of comments, the 90% design package will be submitted to LMES and DOE for review and comments. Upon resolution of 90% comments, the final design report (100%) for remedial activities will be submitted to EPA and TDEC for review and approval. Agency comments will then be incorporated in the preparation of Title III design documents certified for construction.

5.1.6 Remedial Design Oversight Activities

During the review of the Title I and II design documents at 30%, 60% and 90%, all participants will provide their review and technical input in the given time frame prior to submittal of the final design document to TDEC and EPA for approval.

5.2 REMEDIAL ACTION

This section presents the scope of the RA activities required to prepare an RA Work Plan and implement RAs at the UEFPC CA. The risks, uncertainties, and interface issues for the remedial activities are also identified in this section.

5.2.1 Scope and Assumptions

The scope of the RAs for each discrete work package includes bid solicitation, review, and contract award; preparation of the RA Work Plan; implementation of the RAs (i.e., construction of the RD package); construction management; Title III construction oversight activities; construction support; periodic reporting; independent certification; verification; and RA and Operations and Maintenance reports.

5.2.2 Remedial Action Work Plan

The RA Work Plan will (1) define the scope and objectives of each discrete RA based upon the ROD and final RD; (2) document the specific construction components of the RA; and (3) present the RA schedule, subcontracting strategy, QA plan, H&S plan, waste management plan, and RA monitoring plan.

After comments from EPA and TDEC have been incorporated, the final RA Work Plan will be prepared for approval and implementation.

5.2.3 Remedial Action Work Plan Oversight Activities

The purpose of this activity is to provide technical input and review during the preparation of the RA Work Plan. During the preparation of the draft RA Work Plan, all of the DOE prime contractors will review the selected RAs. This review will ensure that the proposed construction efforts are consistent with the ROD and the final RD report. This oversight activity will also ensure that the bid process and implementation plans comply with administrative and regulatory requirements.

5.2.4 Remedial Action Integration

The objective of this element is to provide construction management, independent certification, Title III services, and construction support as required. An RA report that summarizes RA activities will be prepared.

RA integration for each discrete RA in the UEFPC CA includes the following tasks:

- ensuring that subcontracted work is performed on schedule, in accordance with all technical requirements, and in compliance with the Environmental Safety and Health Program, the QA Program, the Waste Management Program, and the Security Program; and
- performing field inspections, providing as-built drawings, approving Design Change Notices and Field Change Requests, as applicable, and ensuring that construction is accomplished according to final design requirements.

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