DOE/RL-2004-39
Draft A
Re-issue

200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation/Feasibility Study Work Plan and Engineering Evaluation/Cost Analysis

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

DOE/RL-2004-39
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Conference Location:							
Conference Sponsor:							
Published in:							
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Date Received for Clearance Process (MM/YY/DD) 06/04/28	**INFORMATION CLEARANCE FORM**
A. Information Category	B. Document Number DOE/RL-2004-39 Draft A Reissue
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APPROVED FOR RELEASE — OFFICIAL DOCUMENT — Date 06/28/2004

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A-6001-401 (12/00)

Sta. 15 JUN 28 2004 (20)

DOCUMENT PROCESSING AND APPROVAL SUMMARY FORM

DOCUMENT TITLE:	OWNING ORGANIZATION/FACILITY:
200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation Feasibility Study Work Plan And Engineering Evaluation/Cost Analysis	FH Groundwater Remediation

New Document? ◯ Yes ◉ No	Document Number: DOE/RL-2004-39 Dft A Re	Revision/Change Number

DOCUMENT TYPE *(Check Applicable)*

◯ Policy ◯ Requirements Document ◯ Procedure ◯ Management Plan
◯ Management Directive ◯ Guidance Document ◉ Other

DOCUMENT ACTION ◯ Revision ◯ Field Change No.
◯ Cancel ◯ Minor Change ◯ Major Change ◯ Periodic Review (next review date)

DOCUMENT LEVEL ◯ 1 ◯ 2 ◯ 3 | **ISMS** Implementing Mechanism? ◯ Yes ◯ No

TYPE OF REVIEW

◯ Standard ◉ Accelerated ◯ Extended ◯ Validation ◯ None (minor change only)

VALIDATION Validation Required? ◯ Yes ◯ No
Validation Method: ◯ Walk-through ◯ Reference ◯ Simulation ◯ Table Top

VALIDATION SIGNATURE ◯ Sat (No Comments) ◯ Unsat (Comments - See Attached)

______________________ Date: ______________________

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Sheet 2 of 2

Document Number: DOE/RL-2004-39 Dft A Re	Revision/Change Number

EFFECTIVE DATE

Upon Publication? ◯ Yes ◯ No If No, Date:

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Clearance Approval	Date	Release Approval (stamp)

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EXECUTIVE SUMMARY

This work plan supports the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*[1] remedial investigation/feasibility study (RI/FS) activities for the 200-UR-1 Unplanned Release Waste Group Operable Unit (OU). The 200-UR-1 OU waste sites are distributed throughout the Hanford Central Plateau area, near the center of the Hanford Site in south-central Washington State. The 200-UR-1 OU consists of 147 waste sites as defined in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (Implementation Plan).[2] One of the 147 sites is the BC Controlled Area located to the south of the 200 East Area. The BC Controlled Area encompasses a geographic area approximately equal to the extent of the 200 West and 200 East Areas combined. The unplanned release sites generally consist of small volume spills to the ground surface or subsurface, or disseminated radioactive particulates, plant materials, and/or animal feces. Many of the unplanned release sites in the 200 Areas resulted from loss of control of radioactive materials during waste containment in areas with process facilities or transport along roads and railroad lines. A small number of unplanned release sites are associated with burial grounds, trenches, and cribs. Causes for the releases are attributed to administrative failures, equipment failures, operator error, and vegetation or animal intrusion.

During the summer of 2003, the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Ecology committed to develop a streamlined process that would allow an option to expedite remedial decision making for a subset of the unplanned release waste sites. This process would focus on identifying a means of expediting cleanup of the small, low-risk surface contamination sites with minimal characterization by combining site characterization (screening surveys), remediation, waste disposal, and site verification activities into one streamlined field action. Continued discussions associated with the development of this work plan led to a further evaluation of a way to implement the observational approach for an

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[1] *Comprehensive Environmental Response, Compensation and Liability Act of 1980*, 42 USC 9601, et seq.

[2] DOE/RL-98-28, 1999, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

applicable subset of the 200-UR-1 OU waste sites. Sites identified for use of the observational approach would be candidates for remove/treat/dispose (RTD). Sites identified as potentially requiring remediation but did not appear appropriate for use of the observational approach would still be considered for application of the RI/FS process.

During the data quality objectives (DQO) process to support this work plan, the 147 unplanned release sites were evaluated and grouped for four proposed further actions. The sites were grouped according to key site attributes to allow for consistent and expedited decisions concerning the proposed action. The grouping categories and the number of applicable sites identified included the following:

- Candidate sites for rejection or no action (47 sites)
- Candidate sites for inclusion with another operable unit for completion of remedial action (34 sites)
- Candidate sites for remove/treat/dispose (RTD) (65 sites)
- Candidate sites for completion of the RI/FS process (one site – BC Controlled Area, UPR-200-E-83).

The work plan was developed to address the elements needed to complete the RI/FS process as well as inclusion of the specific content required by CERCLA to move to an early remedial response for the candidate RTD sites. Items presented in this unique and expanded work plan include the following:

- OU-specific background information
- A description and application of the site sorting process to identify the candidate sites for the four proposed future actions
- A description of the observational approach used for removal actions at candidate RTD sites
- Characterization and assessment activities for the RI/FS candidate site

- An engineering evaluation/cost analysis (EE/CA) for the candidate RTD sites that includes an evaluation of alternative and selection of the preferred remedy.
- A project schedule based on the framework established in the Implementation Plan that includes the steps required to complete the RI/FS process for the 200-UR-1 OU.

Completion of the EE/CA prepared for the 65 candidate RTD sites resulted in selecting the remedy of maintaining the existing soil cover/institutional controls/and monitored natural attenuation for 13 of the sites. The removal action remedy was identified for 52 sites. Cost estimates for removal were prepared, but have a great amount of uncertainty because of limited current site information and use of conservative assumptions.

A DQO process was conducted for the 200-UR-1 OU to define the chemical and radiological constituents to be characterized and to specify the number and type of samples to be collected at the sites within the OU. The DQO also addressed waste characterization requirements. The DQO process provides the basis for the sampling and analysis plan (SAP) included with this work plan. The SAP includes a quality assurance project plan and sampling design specifications for RTD and RI field activities.

The following four conceptual models were developed to depict contaminant distribution at the 200-UR-1 waste sites.

- Animal Droppings, Vegetation Material, and Windblown Particulates: These sites are characterized by radiologically contaminated non-liquid media (i.e., windblown particulates, plant material, and/or animal waste) occupying a thin interval on the surface. The vertical extent of contamination would not exceed 0.3 m (1 ft) in depth.
- Small Volume Leaks and Spills: These sites are associated with small volume liquid drips, leaks, or spills. Contaminant depth is not expected to exceed 0.3 m (1 ft) from the surface.
- Moderate Volume Leaks and Spills: These sites are characterized by moderate volume liquid waste releases generally resulting in very shallow surface contamination to a depth

of approximately 2.0 m (6.6 ft) below natural ground surface. Contamination is not expected to impact groundwater.

- Larger Volume Release Sites: These sites potentially received the largest liquid volumes. However, the release volume is small compared to the typical volumes received at most ponds, trenches, and cribs. These larger volume release sites are anticipated to have contaminant infiltration as deep as 4.6 m (15 ft) below native soil surface. These release sites are not expected to impact groundwater.

The following general conclusions were drawn regarding the conceptual contaminant distribution models for these waste sites.

- It is unlikely that the liquid release waste sites in the 200-UR-1 OU received sufficient waste volume to impact groundwater.

- Contamination migrated vertically beneath the waste sites after release. Given the generally low volume of the releases, low recharge rate from natural precipitation, and lack of nearby designated large volume liquid discharge sites, vertical migration of contaminants from these sites is expected to be extremely limited. For most sites, if contamination is present, it is expected to occur within less than 2 m (6.6 ft) of the ground surface.

- Contaminants such as cesium-137 and the plutonium isotopes, for example, normally adsorb strongly onto shallow zone Hanford Site sediments, because of their high distribution coefficients (K_d). These less mobile contaminants should be detected near points of release in the vadose zone and their concentrations are expected to decrease rapidly with depth. Contaminants with low K_d values (e.g., nitrate, tritium, technetium-99) are not readily adsorbed on soil particles and tend to migrate with the wetted front within the vadose zone.

- Contaminant mobility may have been enhanced at some sites where response actions performed in conjunction with the original release event included use of decontamination liquids. In some cases, complexing agents may have been added to increase the effectiveness of decontamination solutions. Complexing agents effectively lower the K_d values of some constituents, decreasing sorption onto the soil particles.

- Liquid release waste sites in the 200-UR-1 OU generally are single-event unplanned releases, with the main exception being drips/leaks/spills along railroad lines. After dissipation of an initial liquid spill, the natural recharge rate will be the primary contaminant transport driver unless influenced by a nearby high-volume discharge site.
- The direct exposure pathway has been eliminated at many of these surface release sites. A layer of clean soil has been added to stabilize or fix contaminated material in place.

Potential receptors (human and ecological) may be exposed to the affected media through several exposure pathways, including inhalation, ingestion, and direct exposure to external gamma radiation. Potential human receptors include current and future site workers, or inadvertent intruders. Potential ecological receptors include terrestrial plants and animals. With a few exceptions, the 200-UR-1 OU waste sites are located within the 200 Areas Central Plateau Core Zone Boundary. The most significant of these exceptions is the BC Controlled Area.

Characterization activities planned to collect the required data identified in the DQO process include radiological surveys and soil/media sampling. Confirmatory sampling will be performed as needed to support field screening data indicating no removal action is required. Verification sampling will be conducted to document completeness of the removal action and support site closure. An approved laboratory will conduct analyses under a contract-required quality program.

The SAP directs sampling and analysis activities that will be performed to characterize the vadose zone at the RTD and RI/FS sites. The data collected at RTD sites will be used, to direct removal actions, verify meeting PRGs, and to refine the conceptual contaminant distribution models. The data collected during the BC Controlled Area RI/FS will be used to refine the conceptual contaminant distribution models, support an assessment of risk, and evaluate a range of remedial alternatives for the site.

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TERMS

ABS	gastrointestinal absorption coefficient
AEA	alpha energy analysis
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
c/min	counts per minute
CA	Contamination Area
CAS	Chemical Abstracts Service
CD	Canyon Disposition
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CMS	corrective measures study
COC	contaminant of concern
CPP	CERCLA past-practice
CSM	conceptual site model
d/min	disintegrations per minute
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FC	Fixed Contamination
FS	feasibility study
GeLi	germanium-lithium
GRA	general response action
HAB	Hanford Advisory Board
HASP	health and safety plan
HCA	High Contamination Area
HEAST	Health Effects Assessment Summary Tables
HPGe	high-purity germanium
HSA	Historical Site Assessment
IAEA	International Atomic Energy Agency
IC	institutional control
ICRP	International Commission on Radiological Protection
IRIS	Integrated Risk Information System
ISVAC	Integrated Soil, Vegetation, and Animal Control
K_d	distribution coefficient
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual* (NUREG-1575, EPA/402/R-97/016, DOE/EH-0624)
MESC	maintain existing soil cover
MNA	monitored natural attenuation
N/A	not applicable
NRDWL	nonradioactive dangerous waste landfill

mg/kg-d	milligram(s) per kilogram-day
$(mg/kg\text{-}d)^{-1}$	per milligram per kilogram-day
NEPA	*National Environmental Policy Act of 1969*
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PFP	Plutonium Finishing Plant
PRG	preliminary remediation goal
PUREX	Plutonium-Uranium Extraction Plant
RAG	remedial action goal
RAO	remedial action objective
RAWP	remedial action work plan
RBA	Radiological Buffer Area
RCA	Radiological Controlled Area
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	remedial design report
REDOX	Reduction-Oxidation Plant
RESRAD	RESidual RADioactivity
RfD_{inh}	inhalation chronic reference dose
RfD_o	oral chronic reference dose
RFI	RCRA field investigation
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
RPP	RCRA past-practice
RTD	remove/treat/dispose
SAP	sampling and analysis plan
SCA	soil contamination area
SF_{inh}	inhalation slope factor
SF_o	oral slope factor
TBC	to be considered
TIC	tentatively identified compound
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Energy
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and/or disposal
UNH	uranyl nitrate hexahydrate
UO_3	Uranium Tri-Oxide Plant
UPR	unplanned release
URM	Underground Radioactive Material (area)
VCP	vitrified clay pipe or pipeline
WAC	*Washington Administrative Code*
WIDS	*Waste Information Data System*
WTP	Waste Treatment Plant

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

1.0 INTRODUCTION

This work plan supports the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/feasibility study (RI/FS) activities for the 200-UR-1 Unplanned Releases Waste Group Operable Unit (OU). The 200-UR-1 OU consists of sites scattered mainly within the 200 Areas near the center of the Hanford Site in south-central Washington State. A small subset of the 200-UR-1 waste sites is located in the surrounding 600 Area. The 200 Areas are within one of four areas on the Hanford Site that are on the U.S. Environmental Protection Agency's (EPA) National Priorities List under CERCLA. The general CERCLA RI/FS process is described in EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final)*. The application of the CERCLA RI/FS process in the 200 Areas is described in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (hereinafter referred to as the Implementation Plan); the Implementation Plan is summarized in Section 1.1 of this work plan.

The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) addresses the characterization and remediation of waste sites at the Hanford Site. The schedule of work at the Hanford Site is governed by Tri-Party Agreement milestones. The milestone controlling the schedule for preparing the 200-UR-1 OU RI/FS work plan is M-13-00N, "Submit Operable Unit Work Plan," which is due on June 30, 2004. All characterization work for 200 Areas OUs outside of the tank farms is scheduled for completion by December 31, 2008 (Tri-Party Agreement Milestone M-15-00C).

In July 2003, the Washington State Department of Ecology (Ecology) indicated that they would propose one of the streamlined approaches presented in the 200 Areas Implementation Plan (see Section 1.1.1) for the investigation and remediation of the 200-UR-1 OU. On July 22, 2003, Ecology recommended using an engineering evaluation/cost analysis (EE/CA) and Action Memorandum to address cleanup for many of the waste sites in this OU because they mainly are small, surface contamination sites. Ecology favored a "Bias for Action" for these small sites that showed forward remediation progress in the Central Plateau.

The U.S. Department of Energy, Richland Operations Office (RL) and the contractor project team met with Ecology on August 14, 2003, to discuss the Ecology proposal further. The discussions centered on a work plan that would be substantially different from previous work plans prepared for the Central Plateau waste sites. The work plan would address characterization needs for those sites where additional data are required and would recommend a streamlined approach for completion of remedial actions where appropriate.

RL scheduled a series of workshops with Ecology and EPA to develop the agreements required to implement the streamlined approach for selected 200 UR-1 waste sites. An annotated outline for the expanded work plan was developed as the framework for the discussions. The product of the meetings included an expanded work plan scope and objectives; an annotated outline for the 200-UR-1 work plan to support the scope and objectives; the documentation and resolution of regulator issues; and the decision logic and site-specific attributes (data needs) to support the sorting process for waste site rejection, reassignment, and remedial decisions.

1.1 EXPANDED WORK PLAN

The 200-UR-1 work plan has been developed with a significantly different and larger scope than previously completed work plans. The work plan contains the traditional elements needed for completion of the CERCAL RI/FS process and additional content developed to address other specific objectives. Unique elements of this work plan include the following:

- Presentation of the sorting process and the criteria developed to identify sites for proposed future actions, including site rejection, reassignment to other OUs, conducting a removal action using the observational approach, or completion of the RI/FS process.
- An EE/CA to support those sites identified for remove/treat/dispose (RTD). The EE/CA was prepared to meet CERCLA requirements for performing removal actions and is needed before issuance of an Action Memorandum. The Action Memorandum is comparable to the record of decision (ROD) in a remedial response.

1.1.1 200 Areas Implementation Plan

The Implementation Plan outlines a strategy that is intended to streamline the characterization and remediation of waste sites in the 200 Areas, including CERCLA past-practice (CPP) sites; *Resource Conservation and Recovery Act of 1976* (RCRA) past-practice (RPP) sites; and RCRA treatment, storage, and/or disposal (TSD) units. The plan outlines the framework for implementing assessment activities and evaluation of remedial alternatives in the 200 Areas to ensure consistency in documentation, level of characterization, and decision making.

The Implementation Plan consolidates much of the information normally found in an OU-specific work plan to avoid duplication of this information for each of the 23 OUs in the 200 Areas. The Implementation Plan also lists potential applicable or relevant and appropriate requirements (ARAR) and preliminary remedial action objectives (RAO), and contains a discussion of potentially feasible remedial technologies that may be employed in the 200 Areas. This work plan references the Implementation Plan for further details on several topics, such as general information on the physical setting and operational history of 200 Area facilities, ARARs, RAOs, and post-work plan activities.

The Implementation Plan established five approaches for streamlining the regulatory pathway for assessment and remediation of 200 Area past-practice waste sites, including the following:

- Analogous site concept
- Contingent remedy
- Plug-in approach
- Focus package
- Observational approach.

1.1.2 200-UR-1 Operable Unit Description

The 200-UR-1 OU consists of the 94 unplanned release (UPR) sites originally defined in the Implementation Plan. The list of sites presented in the Implementation Plan subsequently has been updated using information in the *Waste Information Data System* (WIDS), bringing the current total to 147 sites. The original set of waste sites assigned to this OU in the Implementation Plan has been revised by the addition of new waste sites and reclassification of accepted waste sites in accordance with RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)."

The 200-UR-1 OU includes waste sites resulting from the loss of control over a liquid, gaseous, or solid, radiological or hazardous material in the course of processing, handling, or shipping the materials onsite. All UPRs not specifically associated with a facility or infrastructure waste site were categorized under the UPR category described in the Implementation Plan. UPRs, which are associated with specific waste sites, are assigned to that group and will be characterized with the respective waste site. The Implementation Plan did not identify any representative or analogous sites for the 200-UR-1 OU.

The 200-UR-1 OU consists of past-practice units with Ecology as the lead regulatory agency. The OU does not include any TSD units. Document preparation and planning for potential future actions at 200-UR-1 past-practice waste sites are following the CERCLA regulatory process.

1.2 SCOPE AND OBJECTIVES

The expanded work plan scope developed for the 200-UR-1 OU meets several objectives, including the following:

- Defines and applies the sorting process used to identify sites for proposed further actions (i.e., rejection, inclusion with another remedial action, RTD, or RI/FS)
- Lists sites that meet the criteria for each proposed action
- Presents the work plan components needed to complete the RI/FS process for the selected site(s)
- Presents an EE/CA for sites identified for RTD, and includes an alternative analysis and selection of the preferred remedy.
- Includes a sampling and analysis plan (SAP) that describes sampling and analytical requirements for RTD and RI sites.

1.2.1 Site Sorting Categories

A summary of each of the site sorting categories is presented here and discussed further in Chapter 4.0. The sites in each group share characteristics that make them appropriate candidates for the specified action. The four proposed actions for UPR wastes sites are as follows:

1. Rejection. Criteria development is based on the logic developed for the process described in RL-TPA-90-0001, Guideline TPA-MP-14.

2. Reassignment. Criteria are established for the 200-UR-1 waste sites that would more appropriately be managed by inclusion with other OUs or project groupings where the cleanup is equivalent or more stringent. This would include sites that are located within or near the footprint of higher risk sites that will be remediated, or are within the footprint of an engineered barrier in another OU. Reassigned 200-UR-1 waste sites would include releases from underground pipelines, diversion boxes, and underground tanks and cribs, as well as releases within or adjacent to solid waste burial grounds. This waste site group would include the 200-UR-1 sites located within the U Plant area closure boundary and those that have been identified for closure under the ROD or Action Memorandum for that area.

3. Expedited RTD. Waste site characteristics are identified that support use of the observational approach for conducting a removal action. These sites would be candidates for a streamlined process that includes characterization and removal of contaminated media in a combined process. RTD waste sites would be considered contingency sites, with removal actions implemented when active remediation is initiated for the geographically based closure area in which they are located. An Action Memorandum would be required indicating regulatory approval for performing a removal action and would include the remedial action goals for the 200-UR-1 sites identified for RTD.

4. RI/FS. Criteria are identified for the site(s) that would be candidates for completion of the RI/FS process. Potential 200-UR-1 candidate sites generally would have large areal extent, complexity relating to contaminant distribution, multiple potential remedial alternatives, and/or possible high remediation costs associated with some remedies. Further site characterization would be needed for data evaluation as part of the RI. These sites may require a comprehensive analysis of remedial alternatives, evaluation of remedial technologies, and/or performance of treatability studies.

1.2.2 Action Memorandum

Preparation of an Action Memorandum is proposed for those sites identified for completion of a removal action using the observational approach. The memorandum addresses the remedy selected, completion schedule, and timing of the removal action. Because these sites are considered contingency sites, the cleanup schedule for 200-UR-1 RTD waste sites will be linked to the remediation schedule developed for the Central Plateau area. The 200-UR-1 waste sites identified for removal will be used for level loading of field remediation activities to optimize the use of resources. Flexibility in scheduling field operations for the UPR sites will be needed to increase efficiencies and reduce costs for removal of these low-risk sites.

A remedial design report/remedial action work plan (RDR/RAWP) will be prepared following issuance of the Action Memorandum. The removal actions completed under the Action Memorandum will be confirmed in the final ROD for the 200-UR-1 OU to allow for final closure of these sites. The Action Memorandum will fulfill the Tri-Party Agreement Milestone M-15 requirement for completion of the RI/FS process for RTD waste sites.

1.2.3 Work Plan Content

The work plan includes information pertaining to 200 Area facility operations, site-specific background data, the conceptual site models (CSM) that were developed, preliminary remediation goals, and data quality objectives (DQO).

The DQO process was conducted for the 200-UR-1 OU to identify the radiological and nonradiological constituents to be characterized, and to determine the number and types of samples to be collected at sites within the 200-UR-1 OU identified for RTD or RI/FS. WMP-19920, *Data Quality Objectives Summary Report for 200-UR-1 Operable Unit Unplanned Releases Waste Group* (pending), provides the basis for the associated SAP. The SAP contains a quality assurance project plan and a field sampling plan that describes the sampling objectives and sampling design developed for RTD and RI/FS sites.

Using the sorting categories developed for the 200-UR-1 waste sites, the number of sites currently associated with each category is as follows:

- Candidate sites for rejection or no action (47 sites)
- Candidate sites for inclusion with another remedial action (34 sites)
- Candidate sites for RTD (65 sites)
- Candidate sites for completion of the RI and FS process (one site [the BC Controlled Area]).

Chapter 5.0 presents the EE/CA prepared for the candidate RTD sites. The alternative analysis performed as part of the EE/CA results in determining the preferred remedy for the candidate RTD sites. Chapters 4.0 and 6.0 present the plan for completing the RI and FS elements for the current candidate site (BC Controlled Area).

Four appendices are provided with supporting documentation and include: Appendix A, 200-UR-1 Operable Unit Waste Site Information; Appendix B, Sampling and Analysis Plan; Appendix C, Cost Estimate Supporting Documentation; Appendix D, Potential Applicable or Relevant and Appropriate Requirements.

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2.0 BACKGROUND AND SETTING

Waste site information and the hydrogeologic conditions framework associated with the 200-UR-1 OU are described in this chapter to provide a fundamental understanding of the physical setting and potential impacts on the environment. The information presented addresses the physical setting, waste site description and history, and waste generating processes and release mechanisms for the UPRs. Appendix A provides UPR site summary information on all 200-UR-1 OU waste sites. Site background and facility process information presented in this chapter has been compiled from a number of sources, the most significant of which are as follows:

- DOE-RL-96-81, *Waste Site Grouping for 200 Areas Soil Investigations*
- DOE/RL-98-28 (Implementation Plan)
- DOE/RL-92-04, *PUREX Plant Source Aggregate Area Management Study Report*
- DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*
- DOE/RL-91-60, *S Plant Source Aggregate Area Management Study Report*
- DOE/RL-91-61, *T Plant Source Aggregate Area Management Study Report*
- DOE/RL-92-18, *Semiworks Source Aggregate Area Management Study Report*
- PNNL-14187, *Hanford Site Groundwater Monitoring for Fiscal Year 2002*
- BHI-01119, *Hanford Site Atlas*
- WIDS.

2.1 PHYSICAL SETTING

The following is a summary of the geology and hydrology associated with the 200 Areas inclusive of the 200-UR-1 OU. Figure 2-1 shows the 200 Areas in relation to the remainder of the Hanford Site.

2.1.1 Topography

The 200-UR-1 OU includes waste sites located in and adjacent to the 200 East, and the 200 West Areas on the 200 Area Central Plateau. The Central Plateau is the common reference used to describe the broad, flat area that constitutes a local high area in the 200 Areas at the Hanford Site. The plateau was formed approximately 13,000 years ago during the cataclysmic Missoula floods. The northern boundary of the 200 Area Plateau is defined by an erosional channel that runs east-southeast before turning south just east of the 200 East Area. This erosional channel formed during the waning stages of flooding as floodwaters drained from the basin. The northern-half of the 200 East Area lies within this ancient flood channel. A secondary flood channel running southward off the main channel bisects the 200 West Area. The buried former river and flood channels may provide preferential pathways for groundwater and contaminant movement.

Waste sites in the 200 West Area are situated in a relatively flat region in a secondary flood channel. Surface elevations at the UPR sites range from approximately 205 m (673 ft) to 217 m

(712 ft) (datum is the *North American Vertical Datum of 1988* [NAVD88]). The surface topography slopes gently to the west.

Waste site surface elevations in the 200 East Area and vicinity range from approximately 189 m (620 ft) NAVD88 in the northern portion of the 200 Areas to 230 m (755 ft) at waste sites just south of the 200 East Area. The surface topography within the 200 East Area slopes gently to the northeast.

2.1.2 Geology

The 200-UR-1 OU is located within the Pasco Basin on the Columbia Plateau. It is underlain by basalt of the Columbia River Basalt Group and a sequence of suprabasalt sediments. From oldest to youngest, major geologic units of interest are the Elephant Mountain Basalt Member, the Ringold Formation, the Cold Creek unit, and the Hanford formation. Figure 2-2 shows a generalized stratigraphic column for the 200 East and 200 West Areas.

The Elephant Mountain Basalt Member is medium- to fine-grained tholeiitic basalt with abundant microphenocrysts of plagioclase (DOE/RW-0164, *Consultation Draft, Site Characterization Plan, Reference Repository Location, Hanford Site, Washington*). The basalt is overlain by the Ringold Formation throughout most of the 200 East Area and all of the 200 West Area. The Ringold Formation consists of an interstratified sequence of unconsolidated clay, silt, sand, and granule to cobble gravel deposited by the ancestral Columbia River. The fluvial-lacustrine Ringold Formation is informally divided into several units; these are (from oldest to youngest) the fluvial gravel and sand of unit A, the buried soil horizons and lake deposits of the lower mud sequence, the fluvial sand and gravel of unit E, and the lacustrine mud of the upper Ringold Formation.

The Ringold Formation is overlain by the Cold Creek unit (formerly, Plio-Pleistocene unit, early "Palouse" soil) in the 200 West Area (DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold Formation Sediments Within the Central Pasco Basin*). In the 200 East Area, near the B, BX, BY Tank Farms, the Cold Creek unit overlies basalt where the Ringold Formation is not present. In the 200 East Area, the Cold Creek unit previously was interpreted to be the Hanford formation or the underlying Plio-Pleistocene unit (HNF-5507, *Subsurface Conditions Description of the B-BX-BY Waste Management Area*). The Hanford Formation/Plio-Pleistocene unit was interpreted to be equivalent or partially equivalent to the Plio-Pleistocene unit in the 200 West Area or represent the earliest ice age flood deposits overlain by a locally thick sequence of fine-grained nonflood deposits by HNF-5507. In DOE/RL-2002-39, the Cold Creek unit is divided into five facies. Table 2-1 provides a description of the five facies, depositional environments, and associated with previous site nomenclature. A detailed description of each facies of the Cold Creek unit is presented in DOE/RL-2002-39.

The Hanford formation overlies the Cold Creek unit in the 200 Areas. Where the Ringold Formation and Cold Creek unit are not present in the 200 East Area, the Hanford formation overlies basalt. The Hanford formation consists of unconsolidated gravel, sand, and silts deposited by cataclysmic floodwaters. These deposits consist of gravel- and sand-dominated facies. The gravel-dominated facies consist of cross-stratified, coarse-grained sands and granule to boulder gravel. The gravel is uncemented and matrix poor. The sand-dominated facies consists of well-stratified fine- to coarse-grained sand and granule gravel. Silt in these facies is variable and may be interbedded with the sand. Where the silt content is low, an open-framework texture is common. An upper and lower gravel unit and a middle sand facies are present in the study area.

The cataclysmic floodwaters that deposited sediments of the Hanford formation also locally reshaped the topography of the Pasco Basin. The floodwaters deposited a thick sand and gravel bar that constitutes the higher southern portion of the 200 Areas, informally known as the 200 Area Plateau. In the waning stages of the ice age, these floodwaters also eroded a channel north of the 200 Areas in the area currently occupied by Gable Mountain Pond. These floodwaters removed all of the Ringold Formation from this area and deposited Hanford formation sediments directly over basalt.

Holocene-aged deposits overlie the Hanford formation and are dominated by eolian sheets of sand that form a thin veneer across the site, except in localized areas where the deposits are absent. Surficial deposits consist of very fine- to medium-grained sand to occasionally silty sand. Silty deposits less than 1 m (approximately 3 ft) thick also have been documented at waste sites where fine-grained windblown material has settled out through standing water over many years.

2.1.3 Vadose Zone

The vadose zone in the 200 East Area is approximately 104 m (340 ft) thick in the southern part of the 200 East Area and thins to the north to as little as 0.3 m (1 ft) near West Lake. Sediments in the vadose zone are dominated by the Ringold Formation and Hanford formation. The Cold Creek unit is present only in a small area immediately above the basalt beneath the B-BX-BY Tank Farms. Because erosion during cataclysmic flooding removed much of the Ringold Formation north of the central part of the 200 East Area, the vadose zone is predominantly composed of Hanford formation sediments between the northern part of the 200 Areas and Gable Mountain. Areas of basalt also project above the water table north of the 200 East Area.

In the 200 West Area, the vadose zone thickness ranges from 79 m (261 ft) in the southeast corner to 102 m (337 ft) in the northwest corner. Sediments in the vadose zone are the Ringold Formation, the Cold Creek unit, and the Hanford formation. Erosion during cataclysmic flooding removed some of the Ringold Formation and Cold Creek unit.

Perched water historically has been documented above the Cold Creek unit at locations in the 200 West Area. While the liquid waste disposal facilities were operating, many localized areas of saturation or near saturation were created in the soil column. With the reduction of artificial recharge in the 200 Areas, the downward flux of liquid in the vadose zone beneath these waste sites has been decreasing. However, the moisture in the vadose zone is expected to remain elevated over pre-operational conditions for some time. As unsaturated conditions are reached, the liquid flux at these disposal sites becomes increasingly less significant as a source of recharge and contaminant movement to groundwater. In the absence of artificial recharge,

recharge from natural precipitation becomes the more dominant driving force for moving contamination remaining in the vadose zone to groundwater.

2.1.4 Groundwater

The unconfined aquifer in the 200 Areas occurs within the Cold Creek unit, the Hanford formation, or the Ringold Formation, depending on location. Groundwater in the unconfined aquifer flows from recharge areas where the water table is higher (west of the Hanford Site) to areas where it is lower, near the Columbia River (PNNL-13116, *Hanford Site Groundwater Monitoring for Fiscal Year 2002*). In the northern half of the 200 East Area, the water table is present within the Hanford formation, except in areas where basalt extends above the water table. Near the B-BX-BY Waste Management Area, the water table occurs within the Cold Creek unit. In the central and southern sections of the 200 East Area, the water table is located near the contact of the Ringold and Hanford Formations.

Depth to the water table in the 200 East Area and vicinity ranges from about 54 m (177 ft) near B Pond to more than 104 m (340 ft) in the southern portion of the area. The water table across the 200 East Area is very flat (Figure 2-2), making it difficult to determine groundwater flow direction exclusively based on water level measurements from monitoring wells. However, configuration of the contaminant plumes indicates that groundwater flows to the northwest in the northern half of the 200 East Area and to the east/southeast in the southern half of the 200 East Area. Identification of the specific location of the groundwater divide between the northern and southern sections is hampered by the flat water table. Highly transmissive Hanford formation sediments are the cause of the flat water table in the 200 East Area (PNNL-13116). The water table has been declining rapidly, at a rate of about 0.19 m/yr (0.6 ft/yr), based on measurements collected between March 2001 and March 2002 (PNNL-14187).

Groundwater beneath the 200 West Area occurs primarily in the Ringold Formation. Depth to water varies from about 50 m (164 ft) to greater than 100 m (328 ft). Groundwater flow is predominately to the east (Figure 2-3). Between March 2001 and March 2002, the surface elevation of the water table beneath the 200 West Area was observed to be declining at a rate of 0.36 m/yr (1.2 ft/yr) (PNNL-14187).

Recharge to the unconfined aquifer within the 200 Areas is from artificial and possibly natural sources. Any natural recharge originates from precipitation. Estimates of recharge from precipitation range from 0 to 10 cm/yr (0 to 4 in/yr) and are largely dependent on local soil texture and the type and density of vegetation. Artificial recharge occurred when effluent such as cooling water was discharged to the ground. PNL-5506, *Hanford Site Water Table Changes 1950 Through 1980, Data Observations and Evaluation*, reports that between 1943 and 1980, 6.33×10^{11} L (1.67×10^{11} gal) of liquid waste was discharged to the soil column. Most sources of artificial recharge have been halted. The artificial recharge that does continue is largely limited to liquid discharges from sanitary sewers; 2 state-approved land disposal structures; and 140 small-volume, uncontaminated, miscellaneous streams. One of the approved land disposal structures, the Treated Effluent Disposal Facility (a liquid waste disposal facility), is located 600 m (2,000 ft) east of the 216-B-3C lobe and receives, treats, and discharges liquid wastes from the 200 East and 200 West Area facilities.

2.2 UNPLANNED RELEASE WASTE SITES AND 200 AREA FACILITY OPERATING HISTORIES

Waste sites assigned to the 200-UR-1 Waste Group OU consist of UPRs. The 200-UR-1 OU consists of 147 waste sites located mainly within the Central Plateau Core Zone boundary in the Hanford Site's 200 East and 200 West Areas. Twelve of the sites comprising this OU are located outside the Central Plateau Core Zone boundary. Plate 1 shows the locations of 200-UR-1 waste sites located outside the 200 Areas and their position with respect to the Central Plateau Core Zone boundary as defined in DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Environmental Impact Statement* and HAB 132, "Exposure Scenarios Task Force on the 200 Area," respectively. Plates 2 and 3 show the locations of the individual 200-UR-1 waste sites in and adjacent to the 200 East and 200 West Areas. The UPRs generally consist of small-volume spills to the ground surface or subsurface, or disseminated radioactive particulates, plant materials, and/or animal feces. Many of the UPR sites in the 200 Areas resulted from loss of control of radioactive materials during waste transfer or containment in areas with process facilities, roads, railroad lines, or tank farms. A small number of UPR sites are associated with burial grounds, trenches, and cribs. Causes for the releases are attributed to administrative failures, equipment failures, operator error, and vegetation or animal intrusion.

The early definition of a UPR was exclusively a release of radioactive material. These releases were given site numbers beginning with the prefix UPR. More recently, releases of nonradiological, hazardous materials also have become part of the criteria defining UPRs. New releases, whether radiological or hazardous, usually are cleaned up shortly after they occur. Those not cleaned up are numbered, submitted to the WIDS Database as a "Discovery Item," and evaluated for acceptance as waste sites. The numbers assigned to recent UPRs no longer include the UPR prefix. Appendix A, Table A-1 presents a listing of all the 200-UR-1 OU waste sites. This list includes the site code, site name, site location description, site status, and the facility closure zone in which the site is located.

2.2.1 200 Area Plant History

The 200 Areas have been the center of activity for processing plutonium at the Hanford Site since the mid-1940s. Five general plant process groupings exist: (1) fuel processing, (2) plutonium isolation, (3) uranium recovery, (4) cesium/strontium recovery, and (5) waste storage/treatment. The following subsections discuss plant facilities, operations, processes and generated materials, and subsequent waste streams that may be associated with some of the 200-UR-1 spilled/released materials.

2.2.1.1 200 West Area Plant Histories

U Plant. U Plant (221-U) was constructed in 1944, based on the same design as the T and B Plants. U Plant initially was used to train personnel who would conduct bismuth-phosphate plutonium separation and purification operations at the T and B Plant facilities. During the training phase, only water was used in the systems. No waste streams were generated. In 1951, U Plant was modified for the uranium recovery process. The bismuth-phosphate process discarded uranium to the tank farms as waste. From 1952 through 1958, U Plant recovered the uranium stored in the single-shell tanks. The uranium was reused to create new fuel rods for Hanford Site reactors. The process later was refined to include "scavenging." Additional chemicals were added to the process to precipitate (or scavenge) the long-lived radionuclides out of the process waste before being discharged to the soil column in cribs and trenches.

The Uranium Tri-Oxide (UO_3) Plant was the final step of the process. This process took place in the 224-U Building, located adjacent to U Plant. It operated from 1958 through 1972 and resumed operations in 1984 through 1988. The liquid uranyl nitrate hexahydrate (UNH) was converted to a solid, powder form in the UO_3 facility. Liquid UNH from the Reduction-Oxidation (REDOX) Plant was transported to the 224-U Building through aboveground pipelines. UNH from the Plutonium-Uranium Extraction (PUREX) Plant (also known as "A Plant") was transported in tanker trucks. The powdered uranium was packaged and shipped offsite to be used in nuclear fuel rod production.

Waste streams from U Plant and the UO_3 facility included aqueous and organic solvent waste process drainage, process distillate drainage, storm water drainage and offgas condensates from the 291-U-1 Stack, waste treatment condensers, nitric acid, and solvent recovery process waste storage vaults.

T Plant. T Plant was constructed in 1944. From 1945 to 1956, T Plant operations consisted of a batch-wise, inorganic chemical separation of weapons-grade plutonium from irradiated uranium. This was known as the bismuth phosphate/lanthanum fluoride process. In 1957, the 221-T Building was converted to a decontamination and equipment refurbishment facility. The facility provided services in radioactive decontamination, reclamation, and decommissioning of process equipment. It still serves the Hanford Site in this capacity. A series of testing programs by Pacific Northwest National Laboratory and the Westinghouse Hanford Company also occurred intermittently from 1964 to 1990 (DOE/RL-91-61, DOE/RL-92-05, and DOE/RL-92-04). The 222-T Laboratory supported operations at the 221-T Building from 1945 to 1956. After 1956, all laboratory analyses of T Plant operations were sent to the 222-S Laboratory. The liquid waste stream generated from the laboratory facility included sample disposal waste and hood and hot cell cleanup waste. Sampling and testing equipment, gloves, empty containers, and other materials were buried as solid waste (DOE/RL-2000-60, *200-PW-2 Uranium Rich Process Waste Group Operable Unit RI/FS Work Plan and Process Waste RCRA TSD Unit Sampling Plan*).

REDOX Plant. The REDOX Plant (also known as "S Plant") was the first continuous plutonium separation operation at the Hanford Site. Not only did REDOX separate weapons-grade plutonium from the irradiated fuel rods, but it recovered the uranium as well. REDOX was a solvent extraction process that used hexone and aluminum nitrate nonahydrate in nitric acid to complete these separations. Historically, waste streams from the facility mainly were aqueous and organic solvent extraction wastes from several REDOX Plant operations, including process drainage, process distillate drainage, and miscellaneous offgas condensates from the silver filter, air sparger, ruthenium tetraoxide scrubber, waste treatment condensers, solvent recovery, and 240 and 241 Vault (waste treatment/storage) waste streams. Plant operations began in 1952 and continued until 1967 (DOE/RL-91-60).

The 222-S Laboratory is one of the primary waste generators in the S Plant Aggregate Area. It was constructed during 1950 and 1951 and is located immediately south of the 202-S Building. The laboratory provides high- and low-level radiological and nonradiological analytical services for operations in the 200 Areas. It continues to support Hanford Site operations with emphasis on waste management, offsite shipment certification, chemical processing, and environmental monitoring programs throughout the 200 West and 200 East Areas including B Plant, U Plant, the tank farms, 242-A and 242-S Evaporators, Waste Encapsulation and Storage Facility, PUREX Plant, and Plutonium Finishing Plant (PFP) ("Z Plant") (DOE/RL-2002-01, *Fiscal Year 2001 Annual Summary Report for the In Situ REDOX Manipulation Operations*).

PFP (formerly the Z Plant Complex). From 1945 until 1990, the Z Plant complex was used to isolate and purify plutonium solutions, produce metallic plutonium and plutonium oxides, and recover plutonium and americium from plutonium scrap materials. Throughout its lifetime, the Z Plant Complex (PFP) received different types of processed (uranium and fission products removed) plutonium solutions from each of the separations facilities in the 200 Areas. Beginning in 1944, plutonium from T and B Plants was refined and converted to a nitrate paste in the 231-Z Building before shipment offsite. In 1949, after the 234-5Z Building was constructed and operating, plutonium nitrate pastes no longer were produced. The 231-Z Building then was converted into a plutonium metallurgy laboratory and operated in this capacity during the 1950s until the 1970s. The research included tensile strength, stress testing, coating, and other material science properties of plutonium and plutonium alloys. Beginning in the 1960s, the U.S. Atomic Energy Commission's Division of Military Application began design, development, and fabrication of experimental weapons that supported the weapons testing program at the Nevada Test Site. Other projects, including "state-of-the-art" sampling methods for plutonium buttons, new coating processes, and development work in reactor fuels containing plutonium and other alpha-emitting materials, also were completed at the 231-Z Building in the late 1960s and early 1970s. In 1975, the Division of Military Application experimental work was phased out (DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan, Includes: 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*).

Tank Farms. Tank farms are located in the 200 West Area associated with the processing facilities. Tank sizes range up to approximately 1,900,000 L (500,000 gal). The tanks were used to manage liquid waste and sludge. The tanks are arranged in groups for usage of the settling cascade concept in which waste solutions were passed through a series of tanks. Cooling and precipitation occurred in each tank causing the bulk of the radionuclides to collect in the bottom of the tank. Tank farms located within the 200 West Area include 241-U, 241-T, 241-TX, and 241-TY.

2.2.1.2 200 East Area Plant Histories

B Plant. B Plant was constructed in 1944. From 1945 to 1952, B Plant operations consisted of a batch-wise, inorganic chemical separation of weapons-grade plutonium from irradiated uranium. This was known as the bismuth phosphate/lanthanum fluoride process. From 1952 to 1965, B Plant was used for various waste treatment operations. In 1963, the 221-B Building began recovering strontium, cerium, and rare earth metals using an acid-side, oxalate-precipitation process as part of the Phase I processing for the 221-B Building waste fractionization project.

Phase I processing at the 221-B Building ended in June 1966 to accommodate Phase III construction. The Phase III waste fractionization processing began at the 221-B Building in 1968. This process separated the long-lived radionuclides strontium-90 and cesium-137 from high-level PUREX and REDOX Plant wastes and stored a concentrated solution of strontium-90 and cesium-137 at the 221-B Building. In 1968, B Plant underwent renovations, and the Waste Encapsulation Storage Facility was added. Waste fractionization and encapsulation efforts continued until 1986.

Semiworks Plant. The 201-C Process Building was the main processing facility for the Semiworks Plant. During its history, the 201-C Process Building went through three distinct operational modes. The 201-C Process Building was constructed in 1949 as a pilot plant for reprocessing reactor fuel using the REDOX (S Plant) chemical process and later the PUREX chemical process in 1954. In 1961, it again was converted to recover strontium from fission product waste. Cerium, technetium, and promethium, as well as minor amounts of americium and curium in the final production run, also were extracted. This facility operated until 1967. The facility remained in safe storage mode until decommissioning began in 1983. The 276-C Solvent Handling Facility and the 215-C Gas Preparation Building have been decontaminated for reuse. The 2707-C Storage and Change House and the 271-C Aqueous Makeup and Control Building have been decontaminated and dismantled. Portions of the 201-C Process Building and the 291-C Ventilation System have been dismantled, while other portions have been entombed on site. The initial base layer of bottom ash has been put in place; however, construction was suspended in 1989 when CERCLA activities superseded decommissioning activities at the Semiworks Plant (DOE/RL-92-18).

PUREX Plant. The PUREX Plant replaced the REDOX Plant's separation process. This new process used a recoverable salting agent (nitric acid) that proved to be economically more feasible, generated less waste, and operated more safely than the REDOX process. The construction of the PUREX Plant was completed in late 1955. The PUREX Plant operated continuously from November 1955 until 1972, separating weapons-grade plutonium and depleted uranium products from irradiated fuel. The PUREX Plant was placed in standby mode from 1972 until 1983. In 1983, the PUREX Plant was restarted and continued operating until 1985 when it was deactivated. Since initial operation of the PUREX Plant, it has been modified to reprocess several types of fuel to obtain various products, including zirconium alloy (zircaloy)-clad fuel with several different enrichments ranging from 0.72 to 2.1 percent of uranium-235 exposed at various durations (300 to approximately 3,000 megawatt days/ton of uranium) to obtain fuel-grade plutonium, slightly enriched uranium and neptunium, uranium metals, uranium and plutonium oxides, and several thoria targets. The 202-A Laboratory supported PUREX operations at the 202-A Building from 1955 to 1972, and again from 1983 to 1988. However, other samples from the PUREX facility also were sent to the 222-S Laboratory for analysis (DOE/RL-92-04 and DOE/RL-2001-01).

Waste was generated in the 202-A, 203-A, 206-A, 293-A, 294-A, and 295-A Buildings. Waste streams mainly were aqueous and organic solvent extraction wastes from several PUREX Plant operations, including process drainage, process distillate drainage, and miscellaneous offgas condensates from the acid absorbers, ammonia scrubber, nitric acid fractionalization, waste treatment condensers, solvent recoveries, nitric acid storage, and waste treatment/storage waste streams.

BC Cribs and Trenches. Six cribs and sixteen trenches were constructed in an area south of the 200 East Area to receive liquid waste from the uranium recovery process conducted in U Plant from 1952 through 1958. The U Plant waste was transferred through the underground cross-site transfer line to the 241-BY Tank Farm. After the waste cascaded through a series of settling tanks, it was transferred to the BC Area via an underground pipeline. The cribs were fed after the waste passed through the 216-BC-201 Siphon Tank. The trenches were filled via an aboveground pipeline that connected to the underground feed line. Four additional trenches were added to the area in the 1960s to receive liquid laboratory waste from the 300 Area via tanker trucks.

The cribs are shallow, square excavations supported by wood or concrete structures and filled with gravel or rock. The trenches are shallow, long, narrow, unlined excavations. Both were designed to allow the waste to percolate into the soil column. When the specific retention capacity was met at each crib or trench, the waste was diverted to an adjacent, unused crib or trench.

Tank Farms. Tank farms are located in the 200 East Area associated with the processing facilities. Tank sizes range up to approximately 1,900,000 L (500,000 gal). The tanks were used to manage liquid waste and sludge. The tanks are arranged in groups for usage of the settling cascade concept in which waste solutions were passed through a series of tanks. Cooling and precipitation occurred in each tank causing the bulk of the radionuclides to collect in the bottom of the tank. Tank farms located within the 200 East Area include 241-A, 241-AN, 241-AP, 241-AW, 241-AX, 241-AY, 241-AZ, 241-B, 241-BX, 241-BY, and 241-C.

2.2.2 Process Information

As mentioned previously, the UPRs generally consist of small-volume spills to the ground surface or subsurface, or disseminated radioactive particulates, plant materials, and/or animal feces. Many of the UPR sites in the 200 Areas resulted from loss of control of radioactive materials during waste containment in areas with process facilities or transport along roads and railroad lines. A small number of UPR sites are associated with burial grounds, trenches, and cribs. Causes for the releases are attributed to administrative failures, equipment failures, operator error, and vegetation or animal intrusion.

The 200-UR-1 OU sites are contaminated with wastes generated by 200 Area processes, including the following:

- Bismuth/phosphate and lanthanum/fluoride (B and T Plants)
- Uranium recovery and scavenging operations (U Plant)
- REDOX (S Plant)
- PUREX
- Strontium/cesium separations, recovery, and storage operations (Semiworks)

- Plutonium/americium scrap recovery processes (RECUPLEX, Plutonium Recovery Facility, and americium recovery) along with several experiments including tritium production, uranium, plutonium, and thorium studies (PFP/Z Plant)
- Tank farm tank condensate
- 200 Area decontamination wastes, which included wastes from the T Plant Complex after it was converted to a decontamination and equipment refurbishment facility in 1957. The 2706-T Building was used to steam clean heavy equipment and vehicles.

The processes conducted in the 200 Area facilities (i.e., B/T, REDOX, PUREX, and the PFP/Z Plant Complex) that generated the primary waste streams into the 200-UR-1 OU waste sites included the processes discussed in the following paragraphs.

B and T Plants. The bismuth/phosphate process was an inorganic, step-wise, precipitation process that separated plutonium from uranium and fission products. This process occurred in the 221-B/T Canyon Building and used sodium hydroxide to remove the aluminum cladding and concentrated nitric acid to dissolve the fuel rods. Bismuth phosphate and bismuth oxynitrate were used to support precipitation of plutonium, while hydrogen peroxide, sodium dichromate, ferrous hydroxide, and ferrous ammonium sulfates were used to change the plutonium valence during the oxidation reactions. Phosphoric, sulfuric, and nitric acids were added to dissolve the precipitants formed. The bismuth/phosphate process preferentially attracted plutonium from the solution and, as a precipitate, was physically separated by centrifuging.

The lanthanum/fluoride process was performed in the 224-B/T Building and further purified the dilute plutonium solution created in the last step of the bismuth/phosphate process. The dilute plutonium nitrate supernatant was oxidized with sodium metabismuthate. Phosphoric acid was added to precipitate impurities and the resulting solution treated with oxalic and hydrofluoric acids and lanthanum salt. As a result, lanthanum fluoride and plutonium fluorides were co-precipitated. The lanthanum and plutonium fluoride solids then were converted to hydroxides by the addition of a hot potassium hydroxide solution. The hydroxides were washed with water, dissolved in nitric acid, and heated to form a concentrated plutonium nitrate solution. This solution was sent to the isolation building (231-Z) for further purification treatments and evaporation. A concentrated plutonium nitrate paste was the final product. For every batch (760 L [200 gal]) of dilute, unpurified plutonium solution entering the 224-B/T Building, an estimated 30 L (8 gal) of purified concentrated weapons-grade plutonium was produced (HW-10475, *Hanford Engineer Works Technical Manual [T/B Plants]*). Laboratory liquid wastes were directed to other waste sites in the waste category from 1945 to 1952.

REDOX. The REDOX process was a solvent-extraction process that extracted plutonium and uranium from dissolved fuel rods into a methyl isobutyl ketone (or hexone) solvent. The solvent-extraction process was based on the preferential distribution of uranyl nitrate and the nitrates of plutonium between an aqueous phase and an immiscible organic phase (DOE-RL 91-60). The REDOX process included fuel decladding with boiling sodium hydroxide/sodium nitrate solution or a boiling solution of ammonium fluoride and ammonium nitrate. Feed dissolution using concentrated nitric acid and plutonium oxidation was completed simultaneously with potassium permanganate and sodium dichromate. The prepared feed entered the packed counter-current solvent extraction column where acidified hexone was fed to the bottom of the column and the aqueous phase (aluminum nitrate nonahydrate scrub solution or salting agent) was fed to the column from the top. The aqueous solubility of the uranium and plutonium nitrates was reduced by increasing the nitrate concentration in the aqueous phase. The uranium and plutonium were extracted into the organic phase and routed to the second extraction column while the fission products remained in the aqueous phase. Uranium and plutonium (present in the organic phase) were chemically separated in the second extraction column using ferrous sulfamate solution containing aluminum nitrate nonahydrate to reduce the plutonium to the +III valence state. Further purification cycles of uranium and plutonium were conducted during operations using the same chemical constituents. The solvent was recovered and recycled back into the process after sampling and analysis. Waste generated in the 202-S Building also was treated and routed to cribs after sampling and analysis. Radioactive and radioactive mixed liquid wastes from the laboratory were treated in the 219-S Waste Handling Facility. Laboratory wastewater (along with wastewater from the 291-S Stack Complex and 219-S Waste Handling Facility) then was directed through the 207-SL Retention Basin and ultimately to the 216-S-26 Crib and other sites in the waste category. The 222-SA Chemical Standards Laboratory contributed nonradiological, nonhazardous wastewater downstream of the 207-SL Retention Basin.

PUREX. The PUREX process was an advanced solvent extraction process that replaced the REDOX process. PUREX used a recyclable salting agent, nitric acid (which greatly lessened costs and amount of waste generated), and tributyl phosphate in a normal paraffin hydrocarbon solution as a solvent. The main purpose of the PUREX facility (202-A) was to extract, purify, and concentrate plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors. Fuel decladding was performed with a boiling sodium hydroxide/sodium nitrate solution or a boiling solution of ammonium fluoride and ammonium nitrate. Feed dissolution used concentrated nitric acid and aluminum nitrate nonahydrate. The prepared feed entered the pulsing, counter-current solvent extraction column where tributyl phosphate in a normal paraffin hydrocarbon diluant was fed to the bottom of the column and the aqueous phase (sodium nitrite/nitric acid salting agent solution) was fed to the column from the top. Dilute nitric acid, ferrous sulfamate, and sulfamic acid descended from the top of the second column to remove uranium and neptunium from plutonium. Chemical separation processes were based on conducting multiple purification operations on the resulting aqueous nitrate solution containing each of the separated products. The driving forces for the separations consisted of varying partition coefficients between aqueous and organic phases; controlled by valence state changes of the element of interest (DOE-RL-92-05). The solvent and salting agent (nitric acid) were recovered, treated, and recycled back into the process operations. An analytical laboratory also was located within the 202-A facility.

PFP/Z Plant Plutonium Isolation Facility (231-Z). The 231-Z Building had several missions throughout its operation. From 1945 to 1949, it further decontaminated plutonium product from T and B Plants before shipment offsite. This process consisted of adding ammonium nitrate to the plutonium nitrate solution and thus changing the valence state. Next, sulfates and peroxide were added to the mixture, causing plutonium to precipitate as plutonium peroxide. Nitric acid was added to this precipitate, forming a more concentrated plutonium nitrate solution. This product was placed in small shipping containers and boiled using hot air to form a wet plutonium nitrate paste before shipment offsite. In 1949, the 231-Z Building was converted into a plutonium metallurgy laboratory and operated in this capacity from the 1950s until the 1970s. The research included tensile strength, stress testing, coating, and other material science properties of plutonium and plutonium alloys. Beginning in the 1960s, the U.S. Atomic Energy Commission's Division of Military Application began design, development, and fabrication of other experimental weapons that supported the weapons testing program at the Nevada Test Site. Other projects, including "state-of-the-art" sampling methods for plutonium buttons, new coating processes, and development work in reactor fuels containing plutonium and other alpha-emitting materials were also completed at the 231-Z Building in the late 1960s and early 1970s.

Semiworks. The 201-C Process Building and 209-E Critical Mass Laboratory comprise the Semiworks Plant. During its history, the 201-C Process Building went through three distinct operational modes. These operations included pilot-plant testing for REDOX, PUREX, and the strontium recovery process. The strontium recovery process was performed via solvent extraction using a complexant di-2-ethyl-hexyl phosphoric acid to extract strontium from acid solutions of waste fuels.

200 Area Decontamination Wastes. The decontamination of heavy equipment and vehicles was conducted in the 200 West Area. Contamination of heavy equipment, railcars, and vehicles usually consisted of fission product (e.g., cesium and strontium) particles. These particles were drawn into the radiator and other engine components as well as becoming attached to oily surfaces of the heavy equipment. To allow continued use of this equipment, a decontamination facility was established at the 269-W Garage. Removal of contamination was accomplished using commercial cleaners (Actresol, Kerful Cleaner, and Aeso Wash) and a steam jet spray on the radiators, engines, and undercarriages. Painted automobile surfaces and all interior surfaces and materials were hand cleaned using mild detergents such as Calgon.[1] Sometimes external surfaces required more stringent methods, such as aggressive chemicals like Kleeno Bowl and other harsh acids and caustics, and occasional sandblasting (HW-63110, *Decontamination*).

During the course of equipment decontamination and refurbishment operations at the various facilities, numerous chemical compounds were used. WHC-EP-0172, *Inventory of Chemicals Used at Hanford Site Production Plants and Support Operations*, provides a listing of compounds that were used at the 221-T Building or at U Plant over the period from 1961 through 1980. It is assumed that similar compounds were used before this effort at other decontamination sites and at other facilities such as 2706-T. Records from decontamination activities that took place at the operating reactor facilities in the 100 Areas identify a similar list of compounds. While consumer products such as Tide[2] or SANI-FLUSH[3] Toilet Bowl Cleaner were used, they are not included in this discussion because the quantities are expected to be small. In addition, only when chemicals in commercial products can be identified are they included in screening of potential contaminants of concern (COC).

Tank Farms. The Tank Farms received waste streams from the various 200 Area chemical separation processes. The streams included metal waste, bismuth phosphate plutonium

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[1]Calgon is a trademark of Calgon Corporation, Pittsburgh, Pennsylvania.

[2]Tide is a trademark of Procter & Gamble Company, Cincinnati, Ohio.

[3]SANI-FLUSH is a trademark of Reckitt & Colman Subsidiary Corporation, Wilmington, Delaware.

extraction process waste, by-product cake solution, first-cycle decontamination waste, cladding waste, PUREX organic wash waste, various waste streams from the thorium campaigns, and evaporator/crystallizer waste streams.

2.2.3 Waste Site-Specific Information

Grouping of the 147 UPR waste sites, based on key site attributes, was performed to allow for consistent and expedited decisions concerning further actions. Chapter 4.0 presents the sorting criteria that were used to group the sites. Table 2-2 breaks out and identifies each of the 147 waste sites by group category. Site-specific information is presented in the tables that have been prepared for each grouping category (see Appendix A). Contaminant release information and site characteristics pertaining to each UPR waste site are presented in Appendix A tables as follows:

- Candidate sites for rejection or no-action (Table A-2)
- Candidate sites for inclusion with another remedial action (Table A-3).
- Candidate sites for RTD (Table A-4).

The following subsections provide a general description of the characteristics of the UPR sites and the special attributes of the candidate RI/FS site.

2.2.3.1 Waste Site Characteristics of Unplanned Release Sites.

The physical setting of the UPR sites includes railroads, storage yards, open areas, roads, pipelines, and diversion boxes. Primary contaminant release mechanisms include leaks, spills, and aerosol emissions. Contaminant redistribution has occurred in some cases as the result of animal burrowing and fecal discharge, plant uptake, and/or wind erosion. Radiological constituents are reported in WIDS as being associated with all but one of the UPRs. In some cases, subsequent radiometric and Global Positioning System surveys that were conducted following the report of the release provide the information used to delineate the lateral extent of the radiological contamination.

The lateral extent of contaminated areas varies from several square meters to thousands of square meters. The aerial distribution of contamination that resulted at many of the one-time liquid spill locations generally was small. However, root intrusion associated with tumbleweed growth, along with animal activities such as burrowing, has brought contaminated media to the surface at some waste sites.

The vertical extent of contamination at the 200-UR-1 sites, where redistribution of the radioactive media has occurred, is generally shallow and is present within inches to less than a foot of the surface. Windblown material may consist of tumbleweed parts, animal feces, flakes or granular residue from the exteriors of some above-ground storage tanks, and/or soil. Information concerning the depth of infiltration that occurred at some of the liquid-release sites is documented in occurrence reports that describe the cleanup action and/or sampling that occurred in response to the reported release. None of the liquid releases associated with the 200-UR-1 sites appear to involve a volume that would result in vertical contaminant infiltration greater than approximately 4 to 5 m in depth.

2.2.3.2 Waste Site Characteristics of the BC Controlled Area

The BC Controlled Area site (UPR-200-E-83) is unique because of its size and diverse contamination levels. The area comprises approximately 12 mi^2 south of the BC Cribs and Trenches that is posted as a soil contamination area. The primary source of the contamination is the 216-B-28 Trench where animals burrowed into the radioactive salts beginning in the late 1950s and subsequently excreted contamination over a wide area. Mobilization of contaminated tumbleweeds also has contributed to the spread of radiologically contaminated tumbleweed parts. Once the burrows were covered with asphalt in 1964, only minor contamination spread continued. A 1960 event at PUREX also contributed to the contamination of the general area. The vertical contaminant distribution over the majority of the BC Controlled Area site is within the upper 0.3 m (1 ft) of the soil, based on previous soil profiling investigations. However, anecdotal evidence indicates that radioactive material may occur deeper than 0.3 m (1 ft) in certain locations.

Prior airborne radiolometric surveys indicate the highest radiation levels occur in a zone occupying an approximately 1/4 mi^2 area south of the BC Cribs and Trenches (WMP-18647, *Historical Site Assessment of the Surface Radioactive Contamination of the BC Controlled Area* [pending]). Prevailing south and southeast winds and animal activities have spread the radioactive contamination further south. In the distal southern portion of the BC Controlled Area, contamination is not pervasive.

Strontium-90 and cesium-137 are the primary contaminants. The original animal and plant sources (urine, feces, and plant matter) generally are not observable, having been absorbed by the soil. Using existing historical radiometric survey data, a preliminary conceptual site model (CSM) for the BC Controlled Area has been developed with three separate zones displaying different radiological contamination characteristics (Figure 2-4). Zone A, adjacent to the BC Cribs and Trenches, shows the highest level of radiological activity, with a nearly continuous lateral dissemination of contamination. Zone B is a transitional zone, with intermixed contaminated and non-contaminated regions. Zone C, the most extensive area, is mainly uncontaminated. This CSM delineates lateral changes in radiological contaminant density and activity. The BC Controlled Area was identified as the only 200-UR-1 site that would require completion of an RI and FS. As discussed in the sorting criteria presented in Chapter 4.0, attributes identified for candidate RI/FS sites include extensive size, high variability in contaminant levels across the site, additional characterization data required before initiating cleanup, and the anticipated need to conduct an FS before selecting one or more potential remedies.

Figure 2-1. Location of the Hanford Site and Map Coverage Provided for 200-UR-1 Operable Unit Sites.

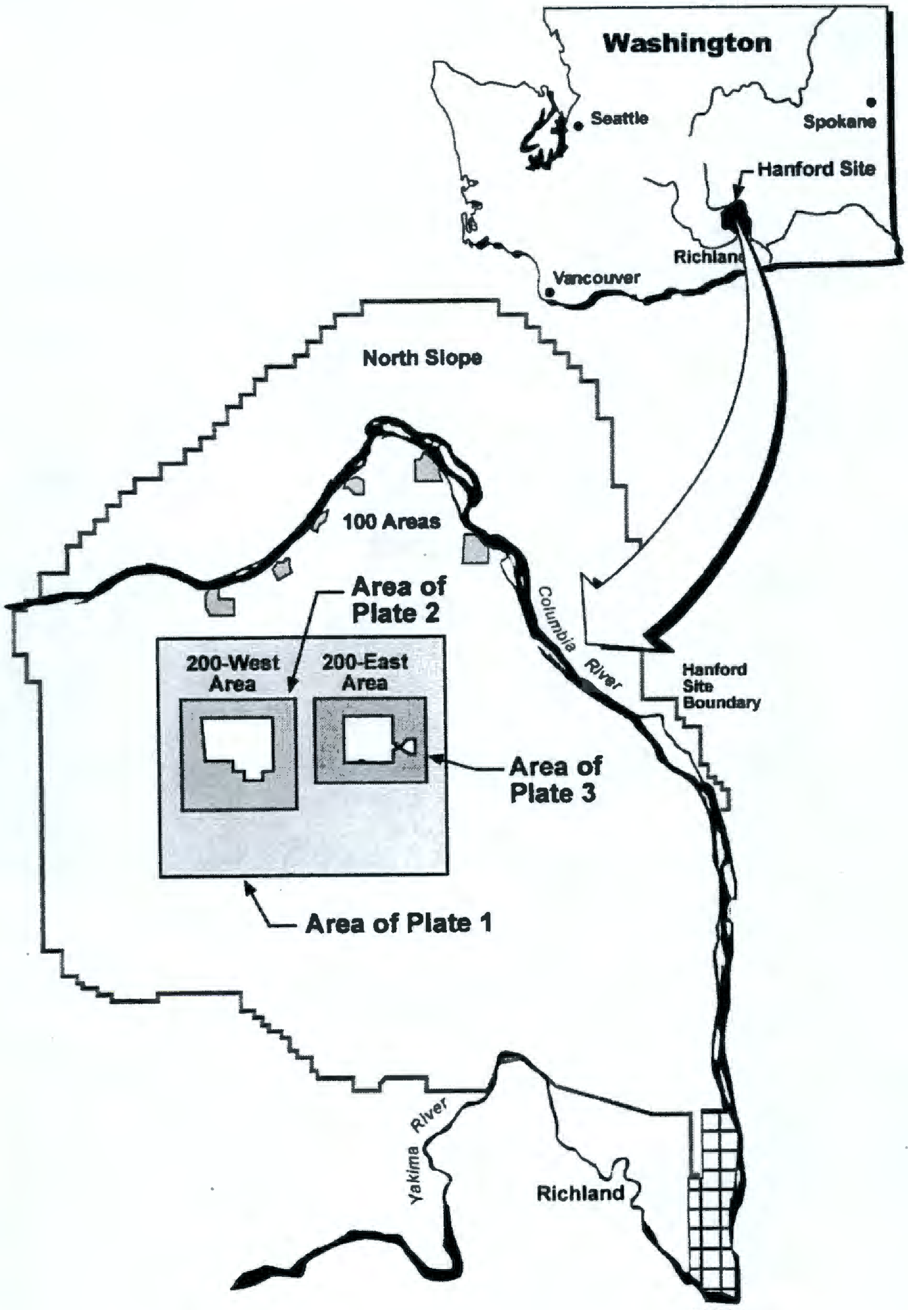


Figure 2-2. Generalized Stratigraphic Column for the 200 Areas.

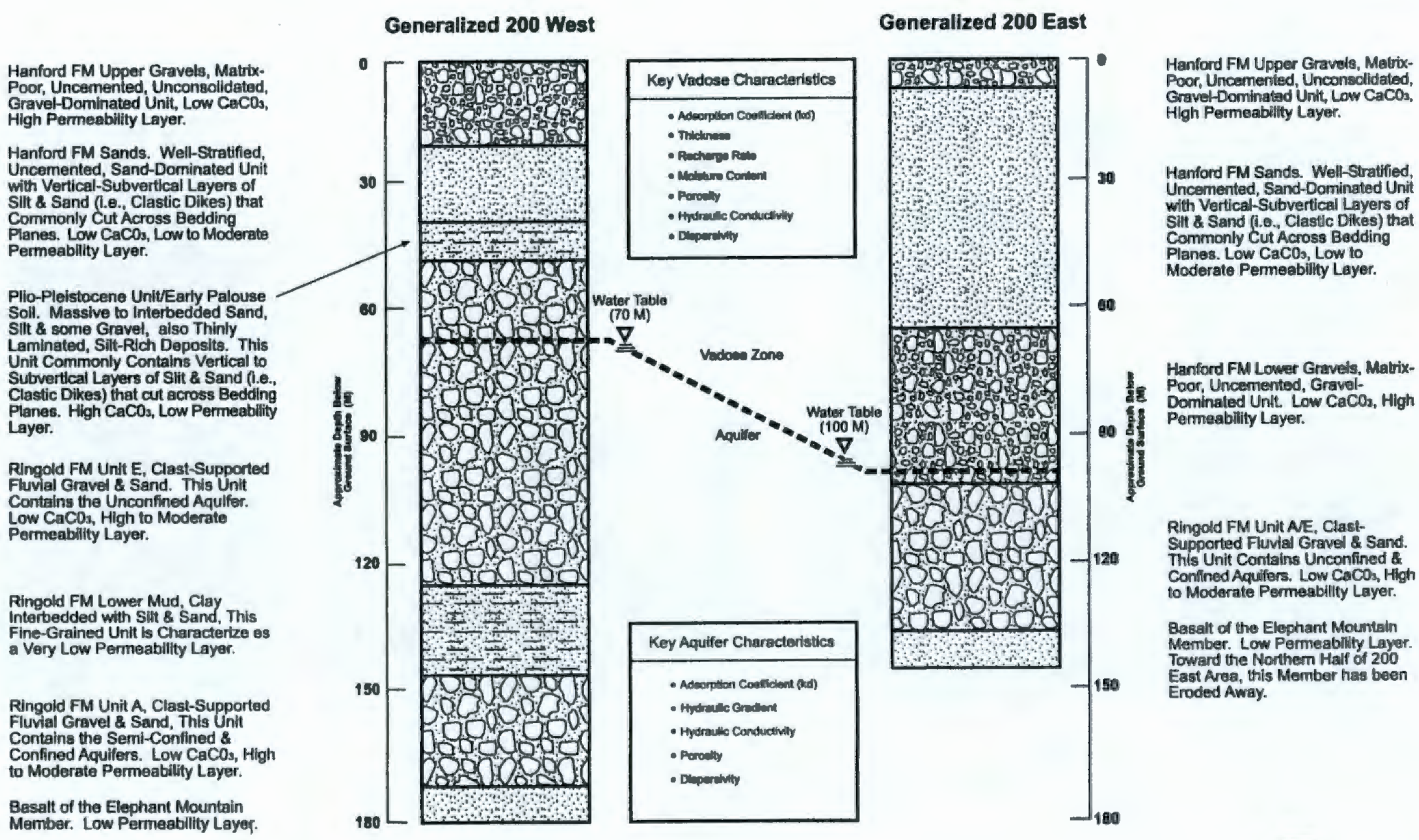
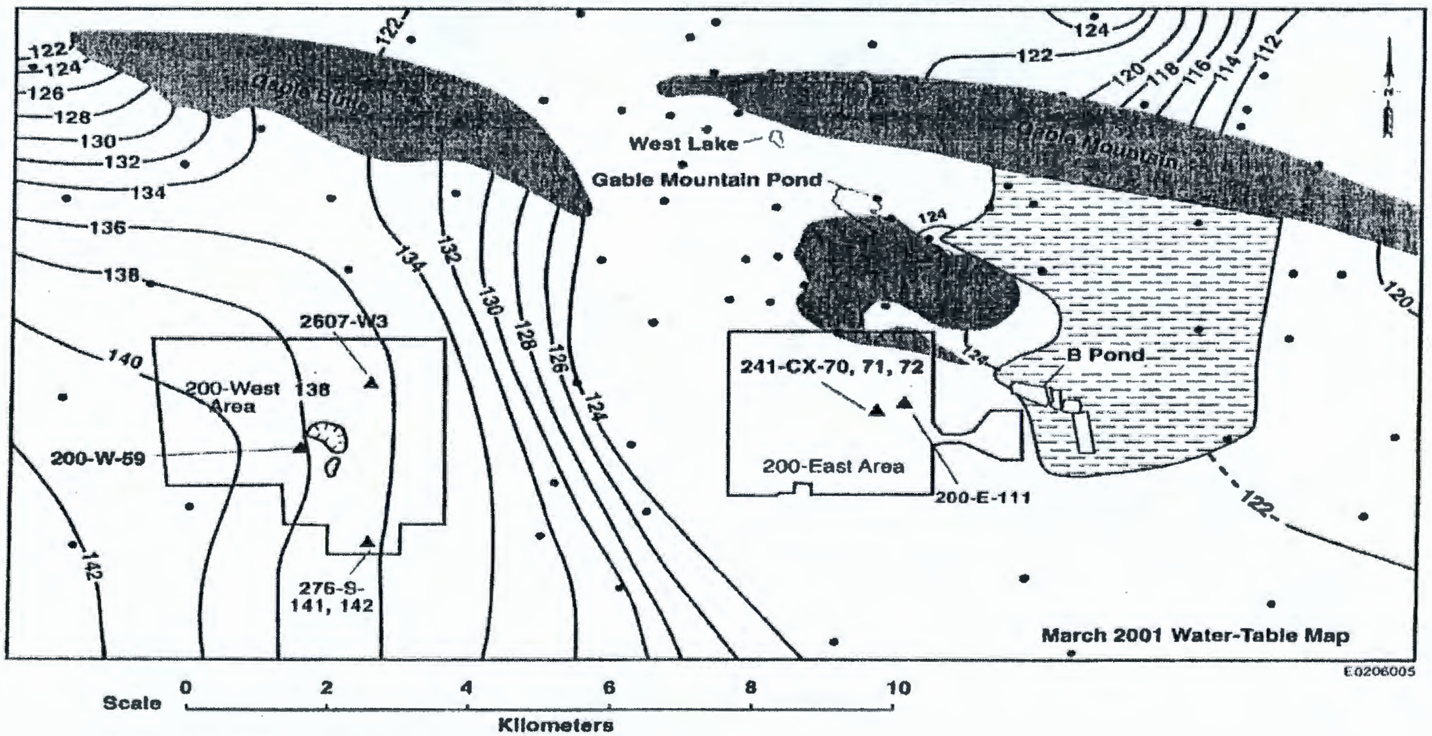


Figure 2-3. Groundwater Table Around the 200 East and 200 West Areas, March 2003.



Estimated Basalt Outcrop Above Water Table

100 Water-Table Elevation (meters), Dashed Where Inferred

Ringold Formation Lower Mud Above Water Table

● Monitoring Well ▲ Representative Sites

Vertical Datum: North American Vertical Datum of 1988 (NAVD88)

Figure 2-4. Conceptual Site Model Showing Contamination Zones Within the BC Controlled Area.

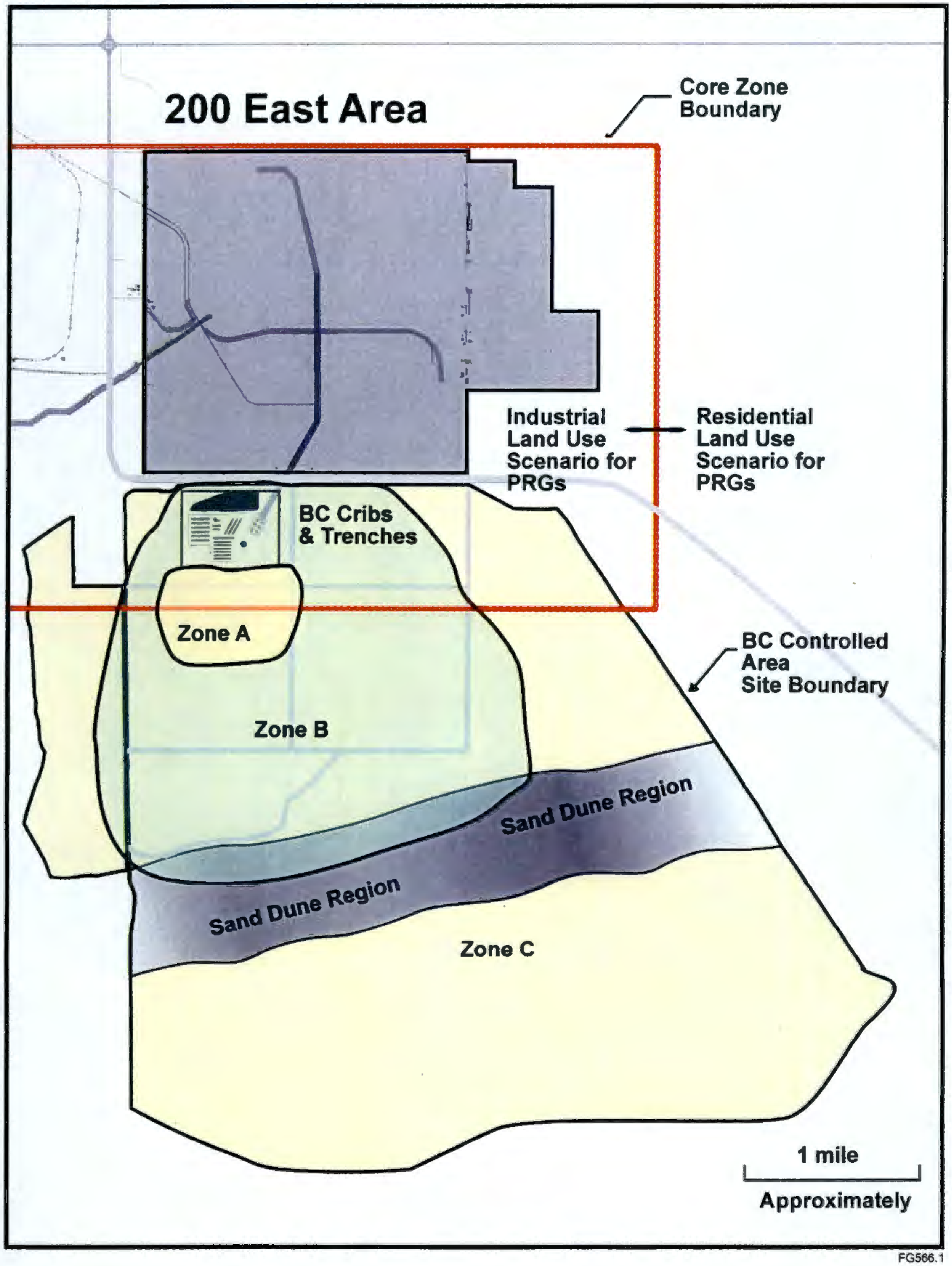


Table 2-1. Lithofacies of the Cold Creek Unit (Based on DOE/RL-2002-39).

Lithofacies	Environment of Deposition	Previous Site Nomenclature
Fine-grained, laminated to massive. Consists of a brown to yellow, very well sorted, cohesive, compact, massive to laminated and stratified fine-grained sand and silt. It is moderately to strongly calcareous with relatively high natural background gamma activity.	Fluvial-overbank and eolian	Palouse soil, early "Palouse" soil, Hanford formation/ Plio-Pleistocene unit silt.
Fine- to coarse-grained, calcium carbonate cemented. Consists of basalitic to quartzitic gravels, sands, silts and clay that are cemented with one or layers of secondary, pedogeic calcium carbonate.	Calcic palesol	Highly weathered subunit of the Plio-Pleistocene unit/ caliche, calcrete.
Coarse-grained, multi-lithic. Consists of rounded, quartzose to gneissic clast-supported pebble- to cobble-size gravel with a quartzo-feldspathic sand matrix.	Mainstream alluvium	Distantly derived subunit of the Plio-Pleistocene unit/ pre-Missoula flood gravel.
Coarse-grained, angular, basaltic. Consists of angular, clast- to matrix-supported basaltic gravel in a poorly sorted mixture and sand and silt with no stratification. Calcic paleosols may be present.	Colluvium	New facies designation for the Pasco Basin.
Coarse-grained, round basaltic lithofacies.	Sidestream alluvium	Locally derived subunit of the Plio-Pleistocene unit

DOE/RL-2002-39, *Standardized Stratigraphic Nomenclature for Post-Ringold Formation Sediments Within the Central Pasco Basin.*

Table 2-2. Listing of Sites by Grouping Category.

Waste Site Grouping	Site Code
Candidate Sites for Rejection or No Action	200-E-11, 200-E-42, 200-E-54, 200-E-8, 200-W-54, 200-W-66, 200-W-72, 200-W-73, 200-W-91, 600-256, 600-260, UPR-200-E-114, UPR-200-E-140, UPR-200-E-141, UPR-200-E-142, UPR-200-E-2, UPR-200-E-22, UPR-200-E-37, UPR-200-E-49, UPR-200-E-55, UPR-200-E-58, UPR-200-E-60, UPR-200-E-63, UPR-200-E-90, UPR-200-E-92, UPR-200-E-93, UPR-200-E-97, UPR-200-W-127, UPR-200-W-159, UPR-200-W-165, UPR-200-W-42, UPR-200-W-52, UPR-200-W-57, UPR-200-W-68, UPR-200-W-71, UPR-200-W-74, UPR-200-W-75, UPR-200-W-77, UPR-200-W-83, UPR-200-W-85, UPR-200-W-86, UPR-200-W-87, UPR-200-W-88, UPR-200-W-89, UPR-200-W-90 , UPR-200-W-91, UPR-200-W-10
Candidate Sites for Inclusion with Another Operable Unit for Remedial Action	600-37, 200-E-56, 200-E-57, 200-E-101, 200-E-103, 200-E-107, 200-E-123, 200-E-135, 200-W-9, 200-W-77, 200-W-85, 200-W-87, 200-W-89, UPR-200-E-28, UPR-200-E-52, UPR-200-E-54, UPR-200-E-79, UPR-200-E-98, UPR-200-E-103, UPR-200-W-14, UPR-200-W-39, UPR-200-W-43, UPR-200-W-48, UPR-200-W-51, UPR-200-W-55, UPR-200-W-56, UPR-200-W-60, UPR-200-W-61, UPR-200-W-78, UPR-200-W-99, UPR-200-W-101, UPR-200-W-117, UPR-200-W-118, UPR-200-W-162
Candidate Sites for Remove/Treat/Dispose	200-E-105, 200-E-109, 200-E-110, 200-E-115, 200-E-117, 200-E-121, 200-E-124, 200-E-125, 200-E-128, 200-E-129, 200-E-130, 200-E-139, 200-E-29, 200-E-43, 200-E-53, 200-W-106, 200-W-14, 200-W-53, 200-W-63, 200-W-64, 200-W-67, 200-W-80, 200-W-81, 200-W-83, 200-W-86, 200-W-90, 600-275, UPR-200-E-10, UPR-200-E-101, UPR-200-E-11, UPR-200-E-112, UPR-200-E-12, UPR-200-E-143, UPR-200-E-144, UPR-200-E-20, UPR-200-E-33, UPR-200-E-36, UPR-200-E-43, UPR-200-E-69, UPR-200-E-88, UPR-200-E-89, UPR-200-N-1, UPR-200-N-2, UPR-200-W-116, UPR-200-W-123, UPR-200-W-166, UPR-200-W-23, UPR-200-W-3, UPR-200-W-4, UPR-200-W-41, UPR-200-W-44, UPR-200-W-46, UPR-200-W-58, UPR-200-W-65, UPR-200-W-67, UPR-200-W-69, UPR-200-W-73, UPR-200-W-96, UPR-600-12, 200-E-26, 200-W-15, 600-262, UPR-600-21, UPR-200-E-50, UPR-200-E-62,
Candidate Site for Remedial Investigation/ Feasibility Study	UPR-200-E-83

3.0 INITIAL EVALUATION OF SITES

The purpose of this chapter is to describe the nature and extent of contamination at the 200-UR-1 OU sites. A discussion of exposure pathways and potential receptors also is included. In addition, this chapter discusses available information regarding waste site contaminant inventory, release volumes, radiological survey data, soil sampling data, and the current understanding of the distribution of contamination.

3.1 KNOWN AND SUSPECTED CONTAMINATION

Only general information concerning the primary source of waste unintentionally released to the environment exists for the majority of the sites in this OU. Consequently, many of the radionuclide and nonradiological contaminants released at the 200-UR-1 OU waste sites are not documented in historical records. Information regarding the characteristics of the contamination at these sites is derived mainly from descriptions in WIDS. Available contaminant information consists primarily of observations made during and/or following to the release event, and the screening-level radiological survey results presented in occurrence reports that are summarized in WIDS. Waste site information was obtained from the following sources:

- WIDS
- The aggregate area management study reports for the 200 Areas (e.g., DOE/RL-92-05)
- Implementation Plan (DOE/RL-98-28)
- DOE-RL-96-81.

Very little sampling characterization data are available that define the lateral and vertical extent of contamination associated with these UPRs.

3.2 ENVIRONMENTAL INFORMATION

This section discusses current environmental monitoring at the Hanford Site and introduces the *Central Plateau Ecological Evaluation* (DOE/RL-2001-54), which serves as the basis for ecological evaluation activities in the Central Plateau. (The Central Plateau includes the 200 East, 200 West, and 200 North industrial areas and portions of the largely undisturbed 600 Area.) This section also summarizes existing OU-specific environmental information.

3.2.1 Environmental Monitoring

Current environmental monitoring at the Hanford Site consists of effluent monitoring, groundwater and vadose zone monitoring, and environmental surveillance. The environmental surveillance is conducted for the following media:

- Air
- Surface water and sediments

- Drinking water
- Farm and farm products
- Soil and vegetation
- External radiation.

Air, soil, vegetation, and external radiation are routinely evaluated in the 200 Areas as part of the Hanford Site near-facility and environmental monitoring programs. Results of the near-facility and environmental monitoring programs are presented in annual reports (PNNL-13910, *Hanford Site Environmental Monitoring Report for Calendar Year 2001* and PNNL-13910, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 2001*). PNNL-13910, Appendix 2 focuses on monitoring activities near facilities that have the potential to or have discharged, stored, or disposed of radioactive or hazardous materials, including those facilities within the 200 East and 200 West Areas. PNNL-13910 covers the entire Hanford Site, including those areas not associated with operations (such as the 600 Area). This annual report examines the resources associated with the Hanford Site, including those media listed above as well as groundwater. The potential impacts of 200-UR-1 OU waste site contamination on human health and the environment are discussed in Section 3.5 of this work plan.

Groundwater is routinely monitored site-wide. More than 600 monitoring wells are sampled annually to characterize groundwater quality, analyze concentrations of radionuclides and nonradiological constituents, and record water table elevation. Results of groundwater monitoring and remediation are presented in annual reports, the most recent of which is PNNL-14187. The groundwater monitoring reports also summarize vadose zone characterization activities conducted on the Hanford Site through other projects.

Investigative sampling of soil and biota is conducted as part of the Hanford Site environmental monitoring program to confirm the absence or presence of radioactive and/or hazardous contaminants where known or suspected contaminants are present, or to verify radiological conditions at specific project sites. Media sampled include soil, vegetation, nests (bird, wasp, ant), mammal feces (rabbit, coyote), mammals (mice, bats), and insects (fruit flies). Investigative wildlife samples are used to monitor and track the effectiveness of measures designed to deter animal intrusion. Wildlife-related materials, including nests, carcasses, and feces, are collected as part of the integrated pest management program, or when encountered during a radiological survey. Samples are analyzed for radionuclides and/or other hazardous substances, with disposal contingent on the level of contamination present. Results of investigative sampling are reported in the annual *Hanford Site Environmental Monitoring Report* (PNNL-13910, latest version).

3.2.2 Central Plateau Ecological Evaluation Report

The *Central Plateau Ecological Evaluation Report* (DOE/RL-2001-54) has been prepared to support ecological evaluations under the RI/FS process for Central Plateau waste sites. DOE/RL-2001-54 completes a screening-level ecological risk assessment for the Central Plateau in accordance with the eight-step EPA ecological risk assessment process presented in EPA/540/R-97/006, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, (Interim Final)*. The first two steps of the process, the screening-level assessment, are presented in the document (see Figure 1-1 in DOE/RL-2001-54).

DOE/RL-2001-54 contains a compilation and evaluation of ecological sampling data that have been collected over many years from undisturbed and disturbed habitats in the Central Plateau. The ecological evaluation document helps answer questions about the ecological resources in the Central Plateau that are important to preserve and protect. The document also identifies ecological data needs that can be addressed in future ecological sampling activities on the Central Plateau.

DOE/RL-2001-54 includes descriptions of the habitats in the Central Plateau, including sensitive habitats, and the plants and animals that inhabit them. The document identifies potential species of concern, including threatened and endangered species and new-to-science species. The Ecological Compliance Assessment Project conducted a detailed survey of the Central Plateau in 2000 and 2001 and it is incorporated into DOE/RL-2001-54. The information from the survey provides a detailed description of the ecological setting of the Central Plateau and augments the ecological information presented in this work plan.

3.2.3 200-UR-1 Operable Unit-Specific Environmental Information

The 200-UR-1 OU waste sites are scattered mainly throughout the 200 Areas, with a few sites located in the adjacent 200 North and 600 Areas. The 200-UR-1 OU also includes the BC Controlled Area located south of the 200 Area. With the exception of the BC Controlled Area, the UPRs are small-scale waste sites when compared to waste sites in other OUs. As a result, sampling and long-term monitoring of sites in the 200 Areas has focused on larger waste sites that are generally recognized as a potential threat to human health and the environment. A summary of ecological resources for the 200 Areas is provided in Appendix F and Chapters 8.0 and 9.0 of the Implementation Plan (DOE/RL-98-28). Available information pertaining to sampling of vegetation and biota within the 200 Areas waste sites is presented in this section to summarize existing ecological data and as input to Section 3.5 on potential impacts to human health and the environment.

Eighty-five environmental monitoring records of wildlife and vegetation at the 200 East and 200 West Areas taken since 1965 were reviewed and summarized in WHC-MR-0418, *Historical Records of Radioactive Contamination in Biota at the 200 Areas of the Hanford Site*. About 4,500 individual cases of monitoring for radionuclide uptake or transport in biota in the 200 Areas environs were included in the documents reviewed in WHC-MR-0418. Approximately 2,400 samples were collected from near the operations areas, and only about 120 samples (i.e., approximately 5 percent) exceeded radionuclide concentrations of 10 pCi/g. Roughly 2,100 biotic samples were collected during special investigations at known or suspected contaminated sites and about 1,800 (i.e., approximately 86 percent) exceeded concentrations of 10 pCi/g, indicating that radionuclide contamination has remained relatively localized even though it has spread beyond intended waste site boundaries. WHC-MR-0418 further states that the routine monitoring is targeted to detect potential radioactive contamination at nuclear facilities and waste sites, and the special investigative samples usually are targeted at known incidents of biotic uptake and transport. Therefore, both results are biased toward detection of radioactivity. These radionuclide transport or uptake cases were distributed among 45 species of animals (mostly small mammals), feces, and 30 species of vegetation.

Wildlife species most commonly associated with uptake of radioactive contamination in the 200 Areas historically have been house mice and deer mice, but other animals such as birds (including waterfowl), coyotes, cottontail rabbits, mule deer, and elk have been sampled (WHC-MR-0418; PNNL-12088, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 1998*). Deer or elk and rabbits routinely are monitored outside the fence in the vicinity of the 200 East and 200 West Areas as part of the Surface Environmental Surveillance program identified in DOE/RL-91-50, *Environmental Monitoring Plan United States Department of Energy Richland Operations Office*.

Plant species potentially may be exposed to contaminated soils and/or groundwater present in the vadose zone soil. Radionuclide uptake by plants within the 200 Areas was demonstrated in WHC-MR-0418. Plants live in direct contact with the soil and can take up contaminants through biological processes. Exposure is a function of the plant species, root depth, physical nature of the contamination, and the contaminant concentrations and distributions in the soil. Plants generally are tolerant of ionizing radiation (IAEA 332, *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards*), but potentially present a contaminant pathway to wildlife through the consumption of contaminated seeds, leaves, roots, or stalks. The vegetative species most commonly associated with the contamination was the Russian thistle. As described in WHC-MR-0418, vegetation samples were collected at the 216-A-37-1, 216-C-5, and 216-C-10 Cribs. Unspecified levels of radionuclide contamination were detected in Russian thistle at the 216-A-37-1 Crib. Field screening revealed activities of 10,000 and 40,000 c/min in Russian thistle at the 216-C-5 and 216-C-10 Cribs, respectively (WHC-MR-0418). The largest numbers and levels of radionuclide uptake or transport occurred at the 216-Z Ditches, 216-B-3 Ditches, 216-BC Cribs, B Tank Farm, and the BX/BY Tank Farms. Much of this information was collected before stabilization activities began at the individual waste sites. Noticeable improvements in reducing the uptake and transport of radionuclide contaminants by biota were observed in areas where interim stabilization activities have taken place (WHC-MR-0418).

In 1993 and 1994, a sampling effort to collect ecological samples at four sites within the 200 Areas was summarized (BHI-00032, *Ecological Sampling at Four Waste Sites in the 200 Areas*). The basis of the sampling strategy was to select some worst-case sites for sampling, to focus future biota sampling activities. Control samples were collected from a site on the Saddle Mountain Wildlife Refuge. Soil, vegetation, small mammal, and insect samples were collected and analyzed for the EPA's Target Analyte List constituents, strontium-90, total uranium, and gamma-emitting radionuclides using gamma spectroscopy. Soil and vegetation samples also were analyzed for technetium-99.

Radionuclides detected in vegetation included strontium-90 (in both Russian thistle samples and both grass samples), cesium-137 (in one Russian thistle sample and both grass samples), and total uranium in one grass sample. Chromium and cobalt were detected in one grass sample, but both analytes also were present in the associated sample blanks. Copper was detected in one Russian thistle sample and both grass samples. However, copper also was present in the associated sample blanks for those samples, and the concentration of copper present in one grass sample was an estimate. Zinc was detected in two Russian thistle samples and in one of the grass samples.

Analytes detected in small mammal (pocket mouse) samples included strontium-90 (three out of four samples), cesium-137 (two out of four samples, both values estimated), arsenic (one out of four samples, with an estimated concentration), lead (three out of four samples, with all concentrations estimated, and lead present in two of the sample blanks), and selenium (four out of four samples, with two concentrations estimated, and selenium present in all sample blanks). Strontium-90 was the only analyte detected in the composite insect sample. The following constituents were undetected in all samples: technetium-99, cobalt-60, cadmium, cyanide, mercury, nickel, and silver (BHI-00032).

BHI-00032 concludes that Russian thistle is the preferred vegetative indicator for radionuclide and metal uptake, and pocket mice are the preferred mammalian indicators of contaminant uptake at terrestrial sites.

In a 2001 sampling effort described in PNNL-13910, 57 soil samples and 49 vegetation samples were collected in the 200/600 Areas. Soil samples consisted of a composite of five plugs of soil, each 2.5 cm (1 in) deep and 10 cm (4 in) in diameter, from each sampling location. Perennial vegetation samples consisted of the current year's growth of leaves, stems, and new branches collected from sagebrush and rabbitbrush. Surveillance of perennial vegetation in 1998 generally confirmed observations of past sampling efforts. Radionuclide analysis indicated that cobalt-60, strontium-90, cesium-137, plutonium-239/240, and uranium consistently were detectable in both soil and vegetation. Fission products were most common in the 200 Areas. Thirty-one site-wide investigative vegetation samples were analyzed for radionuclides in 2001. Of the samples analyzed, 27 showed measurable levels of activity. Eight tumbleweed fragments showed elevated field readings, with five of these eight samples originating from the 218-E-12B Burial Ground (part of the 200-SW-2 OU) in the 200 East Area (PNNL-13910).

As reported in PNNL-12088, Appendix 2; PNNL-13230, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data report for Calendar Year 1999*; PNNL-13487, Appendix 2, *Hanford Site Near-Facility Environmental Monitoring Data Report for Calendar Year 2000*; and PNNL-13910, Appendix 2, for calendar years 1998 through 2001, soil and vegetation samples were collected throughout the 200/600 Areas. The exact locations of these samples are shown in the referenced documents. Surface surveys are conducted annually at the waste sites and include vegetation, animal burrows, and feces. Surveys are conducted with vehicles equipped with radiation detection instruments or hand-held field instruments. Special surveys also are conducted at these sampled waste sites if conditions warrant (i.e., growth of deep-rooted vegetation is observed). A more detailed discussion of the annual monitoring can be found in DOE/RL-91-50.

Investigative wildlife sampling was used to monitor and track the effectiveness of measures designed to deter animal intrusion. Wildlife-related materials, including nests, carcasses, and feces, were collected as part of the integrated pest management program or when encountered during a radiological survey. Samples were analyzed for radionuclides and/or other hazardous substances, with disposal contingent on the level of contamination present. In 2001, five wildlife samples were submitted for analysis. The maximum radionuclide activities in 2001 were in mouse feces collected near the 241-TX-155 Diversion Box (part of the 200-IS-1 OU) in the 200 East Area. Contaminants included strontium-89/90, cesium-137, europium-154, plutonium-238, and plutonium-239/240 (PNNL-13910). The number of animals found to be contaminated with radioactivity, their radioactivity levels, and the range of radionuclide activities were within historical levels (PNNL-13910).

Biological transport of contamination by ants is a source of concern on the Hanford Site. Harvester ants, which are present on the disturbed soils associated with waste sites, have shown extreme resistance to radioactive sources (Gano 1980, "Mortality of the Harvester Ant (Pogonomyrmex owyheei) After Exposure to 137Cs Gamma Radiation"). In a contamination area, ants are capable of bringing radioactive materials to the surface, where they potentially could become available to other means of transport by wind, plant uptake, birds, or mammals. The biological transport of contamination by harvester ants was noted during an annual radiological survey at the UPR-200-E-64 site in 1985. The source of contamination was assumed to be a small-diameter pipe visible on the west side of the 216-B-64 Basin, near the 270-E-1 tank. In 1985, the pipe had a dose rate of 30 mrad/h. Surrounding contamination was transported to the surface by harvester ants and further spread by wind. The size of the area of contamination in 1995 was approximately 8100 m^2 (2 acres), and it currently is posted as a soil contamination area. Additional contaminated soil and ant hills were identified both north and south of 7th Street and around the 241-ER-151 Diversion Box in September 1998.

3.3 NATURE AND EXTENT OF CONTAMINATION

The primary sources of contamination at UPR waste sites were the major facilities (e.g., U Plant, REDOX, PUREX, B Plant, Hot Semiworks Facility) and support operations in the 200 East and 200 West Areas. Releases to the environment from primary sources have resulted in secondary contaminant sources associated with the unintentional releases of liquid to the ground surface, and subsurface (i.e., spills) and airborne releases of particulate matter to the ground. The secondary contaminant sources from stacks, pipeline diversion boxes, cribs, and transportation equipment (trains, truck) are the UPR waste sites in the 200-UR-1 OU.

Because these were UPRs, there is often little quantitative information regarding the nature and volume of the waste released. Radioactive releases were identified generally with initial visual observation of the release event followed by a gross radiological survey. Areas identified with radiological activity above background count levels at the surface were sometimes interim stabilized without further characterization. Given the limited information available pertaining to many of the releases, contaminant distribution at the sites has been estimated based on descriptions of the events, the documented or inferred volume of a release, and the physical state of the waste released (i.e., liquid or solid). Waste release sites have been classified based on the potential depth interval of contamination (i.e., 0 to 0.3 m [1 ft], 0 to 2 m [6.6 ft], or 0 to 4.6 m [15 ft]). Estimated depth of contamination is directly attributed to the quantity and duration of the release. Lateral extent of contamination is related to the primary release mechanism and to secondary redistribution processes. For example, sites that are the result of wind dispersion tend to be larger than liquid release sites. Disseminated solid contaminant material (e.g., radioactive animal feces, tumbleweed parts, and particulates) is most often laterally discontinuous and of shallow depth. Liquid release sites are characterized as being localized with more continuous lateral extent. The following section provides additional discussion regarding factors relating to contaminant distribution and development of 200-UR-1 conceptual site models.

3.4 PHYSICAL CONCEPTUAL MODELS

Contaminant distribution models are constructed to illustrate the nature and vertical extent of contamination resulting from a release. The resulting contaminant distribution depends on the following factors:

- **The physical state the waste released**: The waste is either liquid or solid.
- **Point of release:** Surface or subsurface release.
- **Volume and Inventory**: The total volume and inventory of waste released bears a direct relationship to the resulting distribution. Liquid releases have greater potential for vertical migration as discharge volumes increase.
- **Vadose Zone Physical Properties**: The physical characteristics of the soil such as grain-size distribution (texture), porosity, moisture content, etc., control how liquid waste releases disperse in the vadose zone.
- **Distribution Coefficient (K_d)**: Distribution coefficient for specific constituents is a complex value dependent upon the physical properties of the soil that reflects how much of the constituent will be adsorbed onto soil particles as it moves through the soil matrix. In effect, it is a measure of the contaminant's mobility in the soil. Constituents with high K_d values (i.e., plutonium, americium, cesium) strongly sorb onto the soil and would be expected to remain close to the point of release. Constituents with low K_d values (i.e., technetium, nitrate, tritium) are weakly sorbed onto the soil particles and thus exhibit high mobility. The presence of complexing agents may increase the mobility of normally high K_d constituents.
- **Infiltration Rate:** Beyond the initial release volume, the dispersion of contamination vertically within the vadose zone is dependent upon the moisture infiltration rate. Natural precipitation and intentional liquid discharges are the two primary sources of recharge at the Hanford Site. None of the 200-UR-1 waste sites are located near historical large volume discharge sites. Natural precipitation is the primary driver for continued vertical movement of contaminants at these sites.
- **Time:** The longer the elapsed time from the release, the deeper the contaminants may have migrated depending on constituents and natural precipitation infiltration rates. However, given the relatively small release volumes at these waste sites and historically low infiltration rates, dispersion of contaminants within the vadose zone is expected to occur very slowly.

Four conceptual models have been developed to depict the contaminant distribution at the 200-UR-1 waste sites. Figures 3-1, 3-2, 3-3, and 3-4 illustrate the conceptual contaminant distribution models for the 200 Areas UPR sites, which include the following.

- Animal Droppings, Vegetation Materials, Windblown Particulates (Figure 3-1.): These sites are characterized by a thin surface layer (several centimeters to no greater than 0.3 m [1 ft] in depth) of radiologically contaminated non-liquid media (i.e., generally tumbleweed parts, animal wastes, and/or windblown particulates consisting of flakes or specks).

- Small Volume Leaks and Spills (Figure 3-2): Sites characterized by localized contamination resulting from small volume liquid waste leaks or spills. Contaminant vertical extent is assumed not to exceed 0.3 m (1 ft) in depth.

- Moderate Volume Leaks and Spills (Figure 3-3): These sites are characterized by moderate volume liquid waste releases generally resulting in very shallow surface contamination to a depth of approximately 2.0 m below natural ground surface. These release sites are not expected to impact groundwater.

- Larger Volume Release Sites (Figure 3-4): These sites potentially received the largest effluent volume in the OU. However, the effluent volume is very small compared to the typical volumes received at most pond, trench, and crib sites. Within the OU, the vertical extent of contamination is expected to be greater at the larger volume release sites. These larger volume release sites are anticipated to have contaminant infiltration as deep as 4.6 m (15 ft) below native soil surface. These release sites are not expected to impact groundwater.

Cover materials have been placed over many of the release locations in order to fix or stabilize surface contamination that may be present. Cover materials generally are 1 to 2 ft in thickness and consist of soil and/or gravel. Some locations, particularly roads where spills have occurred, may have an asphalt cover. Both solid and liquid releases have been surface stabilized. The lateral extent of the stabilization cover generally is equal to or slightly larger than the area that was impacted by the release. Because of prescribed response requirements for reported releases, some UPR sites have had a stabilization cover placed on top of the release location after cleanup operations, such as decontamination and/or soil removal, were performed.

The following general conclusions can be drawn regarding the conceptual contaminant distribution models for these waste sites:

- UPR sites that are the result of redistribution of solid, radiologically contaminated materials, such as animal feces, tumbleweed parts, flakes and particulates, or stack releases, have resulted in a contaminant zone that generally only occupies a very thin interval (several centimeters) at the surface.

- It is unlikely that waste sites in the 200-UR-1 OU received sufficient liquid waste volume to impact groundwater.

- Contamination may have migrated a short distance vertically beneath the waste sites after release. Given the generally low volume of the liquid releases, low recharge rate from natural precipitation, and lack of nearby designated large volume liquid discharge sites, vertical migration of contaminants at these sites is expected to be extremely limited and extend no greater than 4.6 m (15 ft) from the original ground surface. The majority of contaminated media is expected to occur at depths less within 2 m (6.6 ft).

- Potential contaminants such as cesium-137 and the plutonium isotopes, for example, normally adsorb strongly onto shallow zone Hanford Site soils. These less mobile contaminants should be detected near points of release in the vadose zone and their concentrations should decrease rapidly with depth. Contaminants with low K_d values (e.g., nitrate, tritium, technetium-99) are not readily adsorbed on soil particles and tend to migrate with the wetted front within the vadose zone.

- Contaminant mobility may have been enhanced at some waste sites where decontamination operations were performed following the release. This would be the result of complexing agents added to increase the effectiveness of decontamination solutions. Complexing agents effectively lower the K_d value of a particular constituent, decreasing the amount that adsorbs onto the soil particles.

- Liquid-release waste sites in the 200-UR-1 OU generally are the result of single events, with the exception of buried pipeline leaks and some railroad site releases.

- For liquid releases, after dissipation of the initial spill volume, the natural recharge rate will be the primary contaminant transport driver unless influenced by a nearby high-volume discharge site.

- Approximately one-half of the sites identified for a removal action have been stabilized and covered with clean soil/material reducing the potential for direct exposure.

3.5 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This section presents and discusses the conceptual exposure model developed to identify potential impacts to human health and the environment from waste sites in the 200-UR-1 OU. Existing information pertaining to contaminant sources, release mechanisms, transport media, exposure routes, and receptors is discussed to develop a preliminary conceptual understanding of potential risks and exposure pathways. This information will be used to support further evaluation of potential human health and environmental risk based on the RI results as part of the RI and FS documents for the 200-UR-1 OU (discussed in more detail in Chapter 6.0).

3.5.1 Contaminant Sources and Release Mechanisms

As mentioned previously in Section 3.3, the primary sources of contamination at the UPR waste sites were the major facilities (e.g., U Plant, REDOX, PUREX, B Plant, Hot Semiworks Facility) and support operations in the 200 East and 200 West Areas. These UPRs from primary sources have resulted in secondary contaminant sources associated with the unintentional releases of liquid to the ground surface, and subsurface (i.e., spills) and airborne releases of particulate matter to the ground. The secondary contaminant sources from stacks, pipeline diversion boxes, cribs, and transportation equipment (trains, truck) are the UPRs that define the 200-UR-1 OU waste sites. Secondary releases can occur through infiltration (movement of wastewater through the soil), resuspension of contaminated soil (erosion or mechanical disturbances), volatilization (movement of organic chemicals through the soil and into the air), biotic uptake (plant uptake or animal ingestion), leaching (contaminant release from rain or snowmelt exposure), and external radiation (gamma). The dominant mechanism of vertical contaminant transport in the 200-UR-1 OU is from infiltration and leaching, with rainwater or snowmelt as driving forces. However, because the volumes of liquids discharged at the UPR sites were very small, it is not likely that groundwater was impacted.

3.5.2 Potential Human and Ecological Receptors

Potential receptors (human and ecological) may be exposed to the affected media through several exposure pathways, including the following:

- Ingestion of contaminated soils, sediments, or biota
- Inhalation of contaminant dusts, vapors, or gases
- Dermal contact with contaminated soils or sediments
- Direct exposure to external gamma radiation in site soils and sediments.

Potential human receptors include site workers (current and future) and site visitors (occasional users). Site worker and visitor exposure pathways primarily would involve incidental soil/sediment ingestion, inhalation of contaminants, dermal contact with contaminated soils/sediments, and external gamma radiation. Potential ecological receptors include terrestrial plants and animals using the sites. More details on these specific receptors are presented in Section 3.5.3. Site biota exposures primarily would involve incidental soil/sediment ingestion, biota ingestion (e.g., coyotes eating prey that live on the site or deer consuming plants growing on the site), dermal contact with contaminated soils/sediments, and external gamma radiation. A summary of the contaminant types, exposure mechanisms, and principle receptors for the 200-UR-1 OU is provided in Table 3-1. Figure 3-5 shows the conceptual exposure pathway model.

3.5.3 Potential Impacts

This section discusses potential impacts to human and ecological receptors based on existing information. Potential contaminant exposures and health impacts to humans largely are dependent on land use. The land use for the 200 Areas selected by the DOE through the *National Environmental Policy Act of 1969* (NEPA) process (DOE/EIS-0222-F) and documented in 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)" is industrial (exclusive). Outside the 200 Areas boundary, the selected land use is conservation (mining). Most of the 200-UR-1 OU waste sites are located within the 200 Areas Central Plateau Core Zone boundary. Therefore, based on the land-use decision for the 200 Areas, potential impacts, from the waste site contaminants within the

200 Areas, would be to current and future site workers and to terrestrial biota using the sites. The land use for the few UPR sites outside the Core Zone boundary focuses on preservation, recreation, conservation, fill material grazing, or industrial depending on the location (DOE/EIS-0222-F).

A screening-level ecological risk assessment for the Central Plateau waste sites was developed in 2002. Based on the results of the screening-level ecological risk assessment, the full EPA eight-step ecological risk assessment process was initiated in 2003. The DOE expects to complete the ecological risk assessment in conjunction with the ongoing RI/FS processes for the 200 Areas. The ecological risk assessment process may identify additional characterization needs. Those needs could include soil sampling and analysis, biological studies (including sampling and analysis), or other studies. Any data needs may apply to one or more OUs. Ecological receptors have been identified and potential impacts to those receptors have been evaluated at waste sites in the 200 Areas (PNNL-13230; PNL-2253, *Ecology of the 200 Area Plateau Waste Management Environs: A Status Report*; WHC-SD-EN-TI-216, *Vegetation Communities Associated with the 100-Area and the 200-Area Facilities on the Hanford Site*). The vegetation cover on the Central Plateau predominantly is a rabbitbrush-cheatgrass and sagebrush-cheatgrass association with the incidental presence of herbaceous and annual species. Many areas are disturbed and void of vegetation or sparsely populated with annuals and weedy species such as Russian thistle. The contamination pathways to ecological exposures for the waste sites are minimized by the stabilization activities that have been conducted.

Ecological risks associated with exposure of the Great Basin pocket mouse to chemical and radiological contaminants were evaluated as part of the limited field investigation for the 200-UP-2 OU (DOE/RL-95-13, *Limited Field Investigation for the 200-UP-2 Operable Unit*). The evaluation was conducted based on biological monitoring data (WHC-MR-0418) and modeling results using relative risks to evaluate the sites.

3.6 DEVELOPMENT OF CONTAMINANTS OF CONCERN

The development of the list of COCs for the 200-UR-1 OU was one of the main objectives of the DQO process conducted to support this work plan. The COCs identified for the UPR sites represent the complete set of radiological, organic, and inorganic contaminants that were, or could have been, discharged to the 200-UR-1 OU waste sites based on the 200 Areas plant operations, as identified in DQO documents for the 200 Areas OUs, including 200-CW-1, 200-CS-1, 200-CW-5, 200-LW-1, 200-LW-2, 200-MW-1, 200-PW-1, 200-PW-2, 200-PW-4, 200-TW-1, and 200-TW-2, and as outlined in the Implementation Plan (DOE/RL-98-28). The final list of COCs is presented in Table 3-2.

The majority of the waste generated by the 200 Areas plant operations and contamination associated with the 200-UR-1 waste sites can be described as originating from a variety of liquid effluents, all containing large amounts of uranium. The pH of the waste ranges from acidic, neutral, to basic. The plant operations wastes may have contained various constituents including radionuclides, metals, inorganic chemicals, and semivolatile and volatile organic chemicals. The analytical approach employed for this project generally targets the significant risk drivers that are representative of the waste constituents present. The general suite-type analytical techniques yield results for many metals and organic compounds, providing a cost-effective approach for the known toxic materials that could be present. At liquid release UPR waste sites, radiological and chemical constituents are potential COCs. Because of the nature of the UPR sites that are the result of dispersion of radioactive solid contaminant media (i.e., animal droppings, tumbleweed parts, and other wind-dispersed particulates), only radionuclides are considered COCs.

The exclusion rationale used to eliminate contaminants of potential concern from the final list of COCs includes the following:

- Short-lived radionuclides with half-lives less than 3 years
- Radionuclides that constitute less than 1 percent of the fission product inventory and for which historical sampling indicates non-detection
- Naturally occurring isotopes that were not created as a result of Hanford Site operations
- Constituents with atomic mass numbers greater than 242 that represent less than 1 percent of the actinide activities
- Progeny radionuclides that build insignificant activities within 50 years and/or for which parent/progeny relationships exist that permit progeny estimation
- Constituents that would be neutralized and/or decomposed by facility processes
- Chemicals in a gaseous state that cannot accumulate in soil media
- Chemicals used in minor quantities relative to the bulk production chemicals consumed in the normal processes; these chemicals are not likely to be present in toxic or high concentrations
- Chemicals that are not persistent in the environment due to volatilization, biological degradation or other natural mitigating features
- Chemicals which are not persistent in the vadose zone due to high mobility and previous confirmatory sampling/analysis activities
- Standards that could be applicable from Ecology 94-145, *Model Toxics Control Act Cleanup Levels & Risk Calculations (CLARC Version 3.1)*, tables (November 2001) do not apply to chemical substances if they are not identified in the tables.

Figure 3-1. Conceptual Contaminant Distribution Model for Animal Droppings, Vegetation Material, and Windblown Particulate Waste Sites, 200 Area Unplanned Releases.

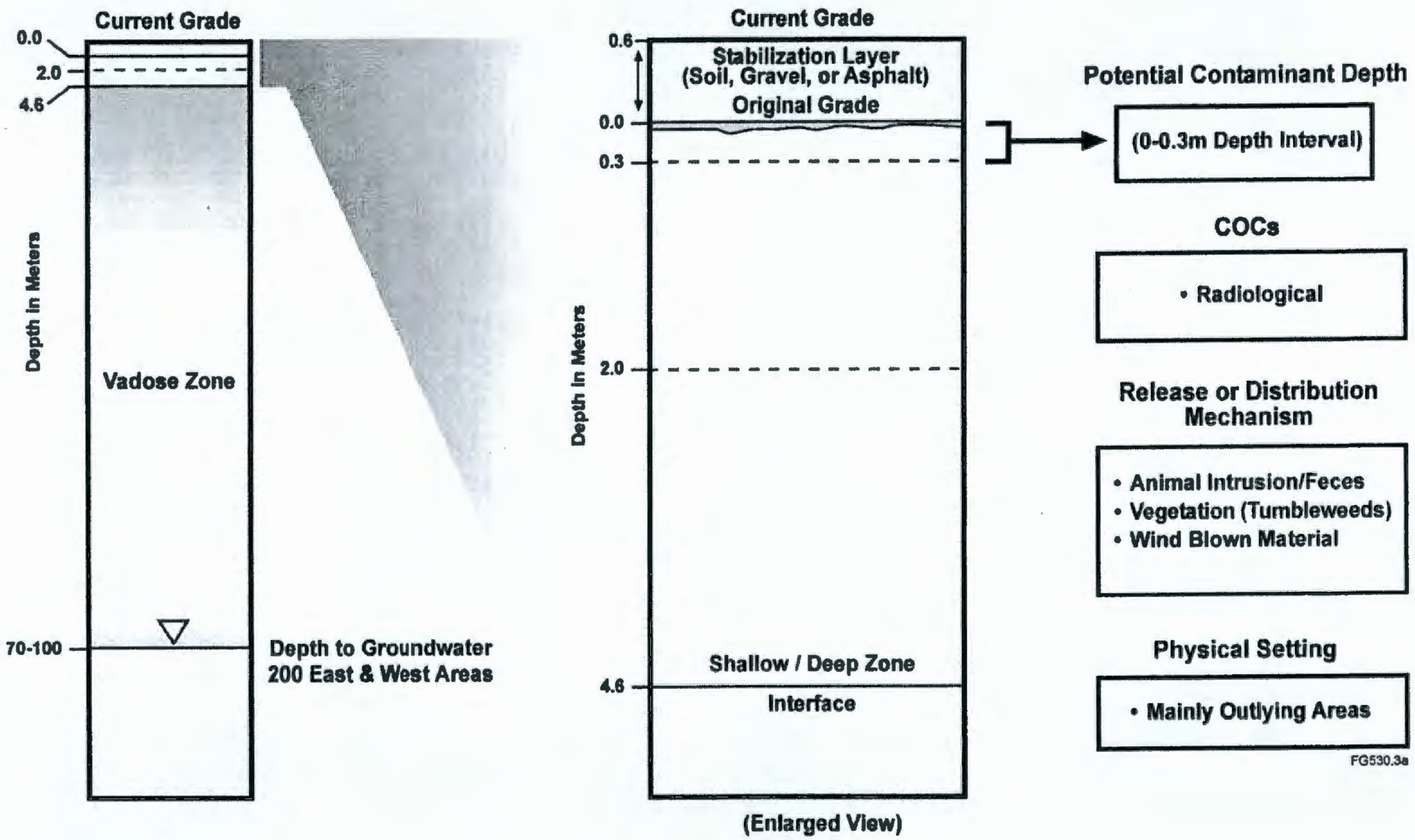


Figure 3-2. Conceptual Contaminant Distribution Model for Small Leak/Spill Waste Sites, 200 Area Unplanned Releases.

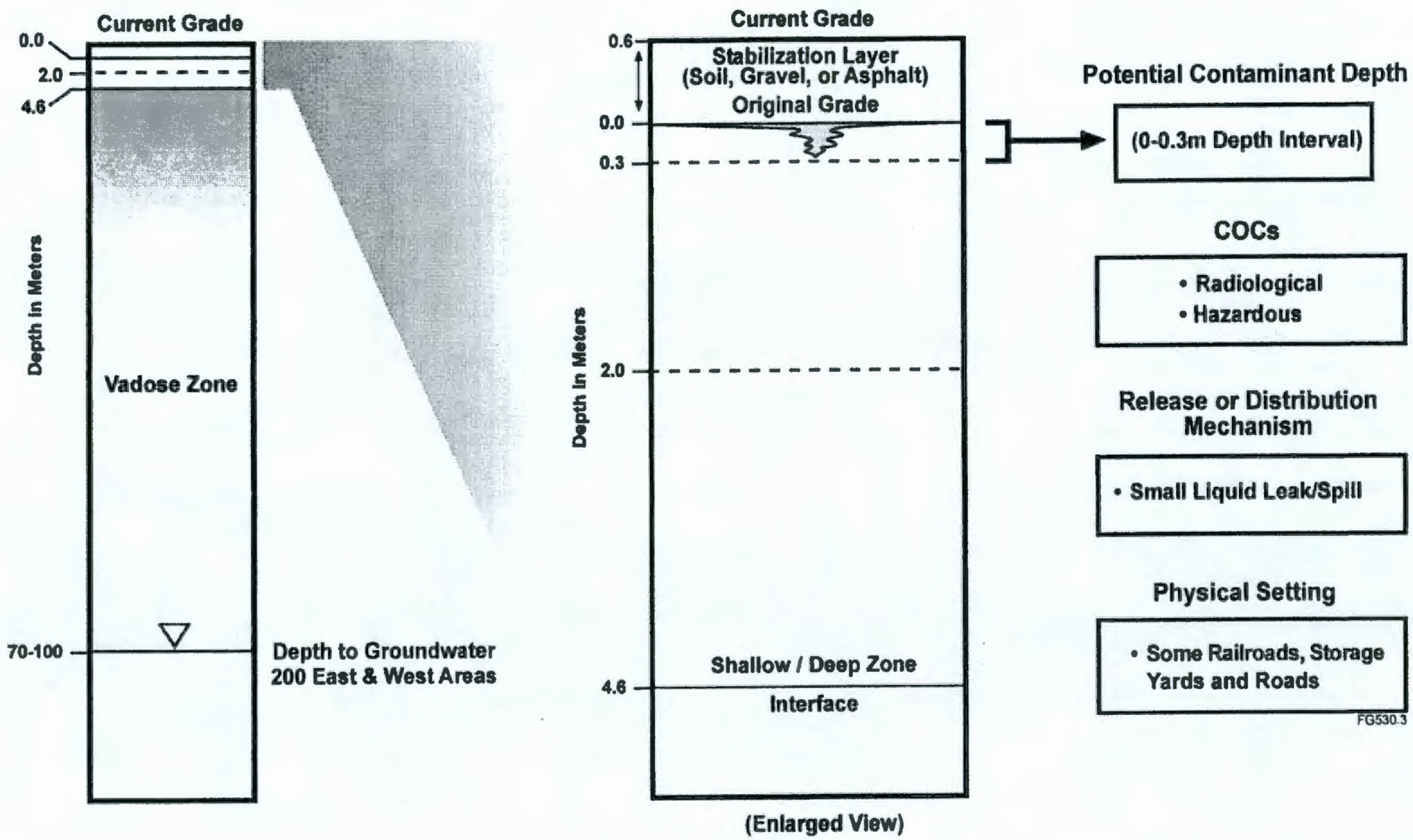


Figure 3-3. Conceptual Contaminant Distribution Model for Moderate Leak/Spill Waste Sites, 200 Area Unplanned Releases.

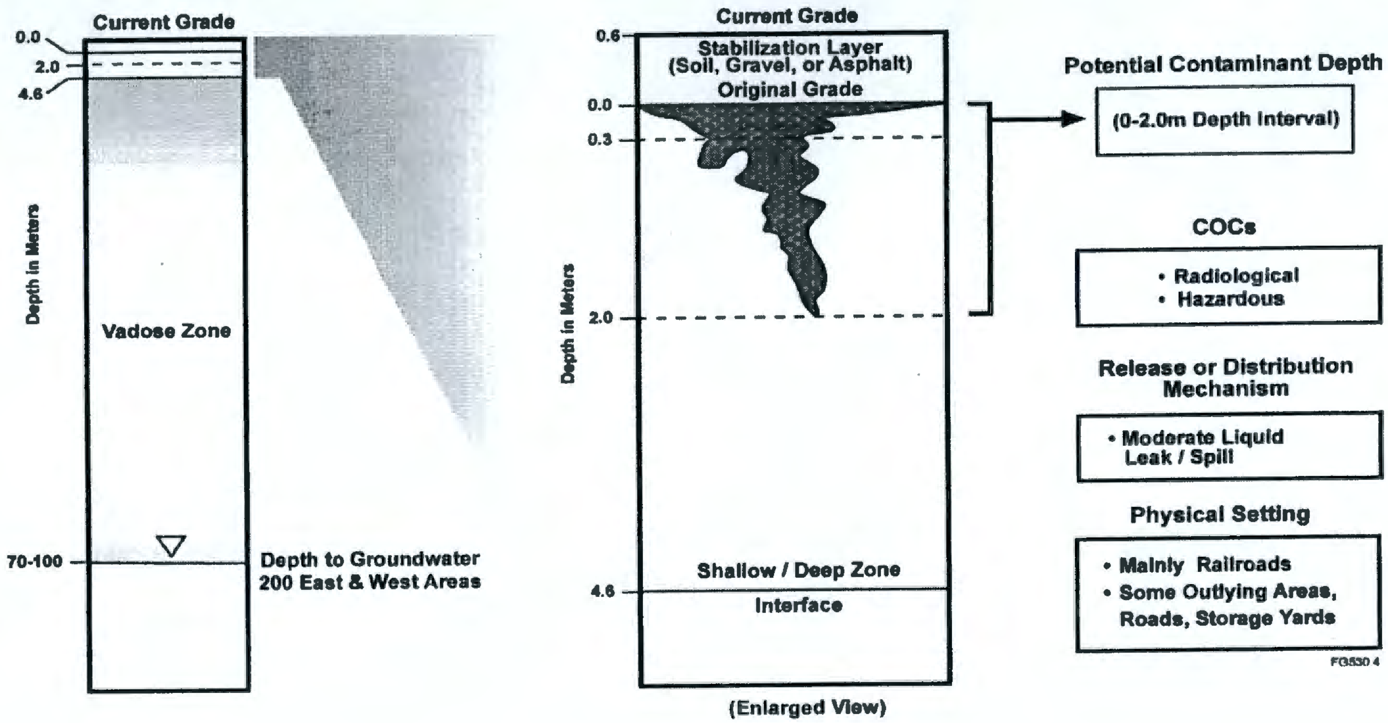


Figure 3-4. Conceptual Contaminant Distribution Model for Larger Leak/Spill Sites, 200 Area Unplanned Releases.

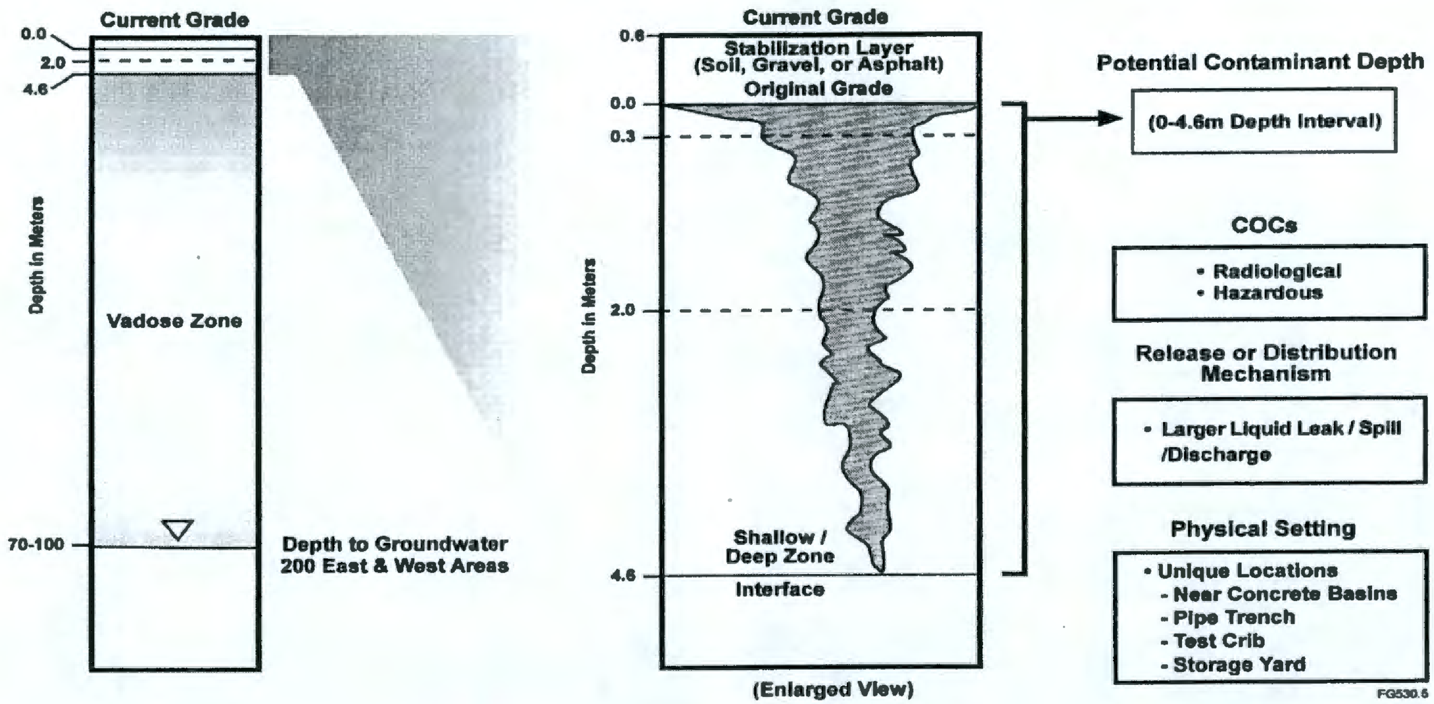


Figure 3-5. Conceptual Exposure Pathway Model.

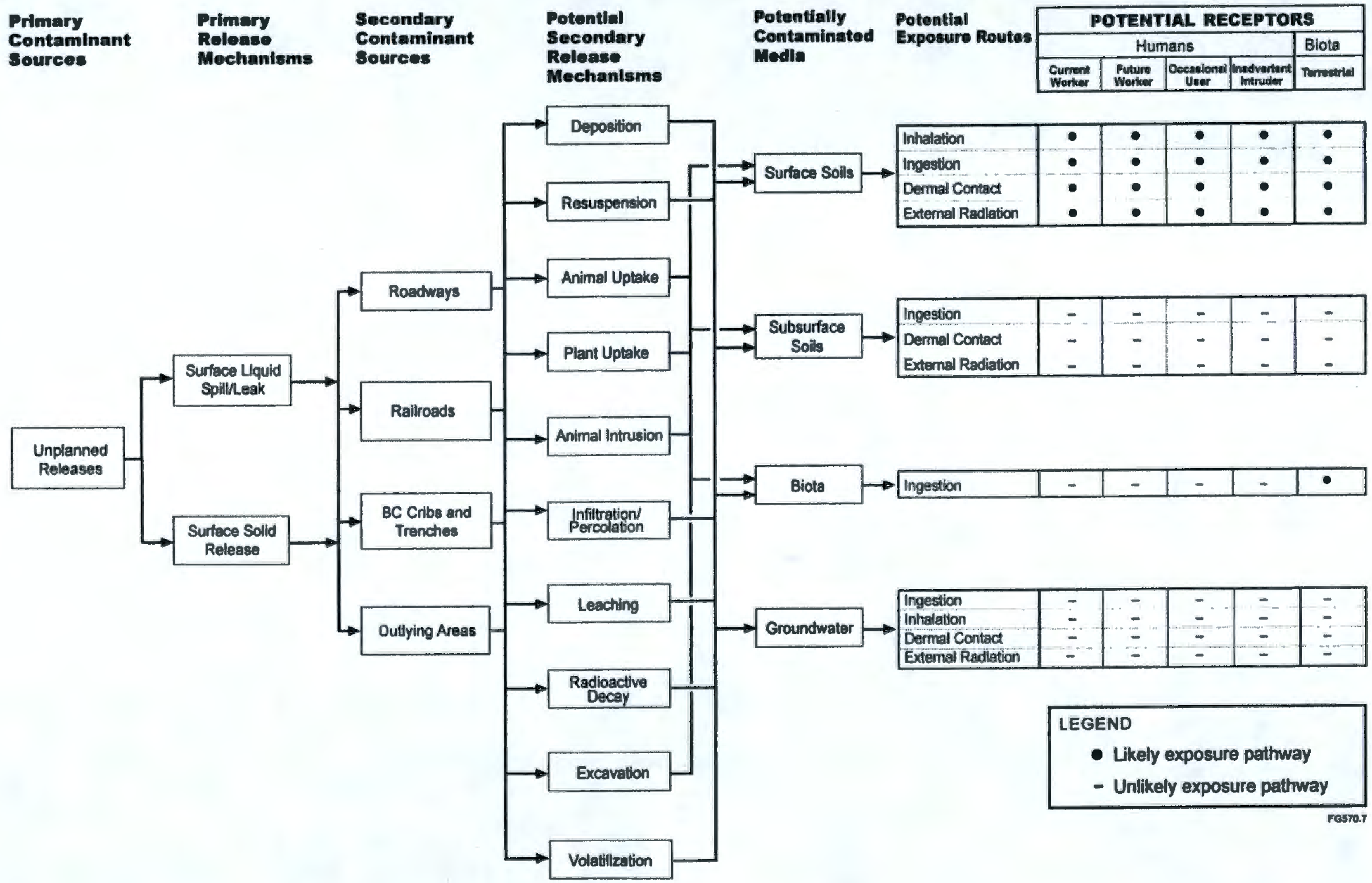


Table 3-1. Summary of Contaminants, Sources, Receptors, and Exposure Mechanisms for the 200-UR-1 Operable Unit.

Contaminant Category	Sources	Potential Exposure Mechanisms	Receptors
Radionuclides	Soil	Ingestion, inhalation (fugitive dust), direct dermal contact, and external exposure	Workers, visitors, plants, and animals
Metals	Soil	Ingestion and inhalation (fugitive dust)	Workers, visitors, plants, and animals
Organic compounds (volatile and semivolatile compounds)	Soil, air	Ingestion, inhalation	Workers, visitors, plants, and animals

Table 3-2. List of 200-UR-1 Operable Unit Contaminants of Concern. (2 Pages)

Radioactive Constituents	
Americium-241	Niobium-94[a]
Carbon-14	Plutonium-238
Cesium-137	Plutonium-239/240
Cobalt-60	Strontium-90
Europium-152	Technetium-99
Europium-154	Tritium[b]
Europium-155	Uranium-233/234
Neptunium-237	Uranium-235/236
Nickel-63	Uranium-238
Chemical Constituents - Metals	
Antimony	Lead
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium	Vanadium
Hexavalent chromium	Zinc
Copper	--
Chemical Constituents - Other Inorganics	
Cyanide	Nitrate/nitrite
Fluoride	Sulfate

Table 3-2. List of 200-UR-1 Operable Unit Contaminants of Concern. (2 Pages)

Chemical Constituents - Volatile Organics	
Acetone	Halogenated hydrocarbons
Acetonitrile	Hexane
Benzene	Methyl isobutyl ketone (MIBK)
1-Butanol (n-butyl alcohol)	Perchloroethylene
2-Butanone (MEK)	Tetrahydrofuran
Carbon tetrachloride	Toluene
Chlorobenzene	1,1,1 Trichloroethane (TCA)
Cis-1,2-dichloroethylene	1,1,2 Trichloroethane
Cyclohexane	Trans-1,2-dichlorotheylene
1,1-dichloroethane	Tetrachloroethylene (PCE)
1,2-dichloroethane	Trichloroethylene (TCE)
Dichloromethane (methylene chloride)	Vinyl chloride
Ethylbenzene	Xylene
Chemical Constituents – Semivolatile Organics	
AMSCO[c] Tributyl phosphate dilutant	Normal paraffin hydrocarbon
Cyclohexanone	Paint thinner
Diesel fuel	Phenol
Dodecane	Polychlorinated biphenyls
Hydraulic Fluids (greases)	Shell E-2342 (napthalene and paraffin)
Kerosene	Soltrol-170 ($C_{10}H_{22}$ to C_6 to H_{34}; purified kerosene)
Naphthylamine	Tributyl phosphate and derivatives (mono, bi)

[a]Contaminant of concern applicable only to the Plutonium Finishing Plant closure zone.
[b]Constituent only will be retained at liquid spill sites.
[c]Product of Allen Maintenance Supply Company, Inc.

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4.0 WORK PLAN APPROACH AND RATIONALE

During the planning meeting conducted to develop the 200-UR-1 work plan strategy, Ecology proposed applying one of the streamlined approaches identified in the 200 Areas Implementation Plan to the investigation and remediation of this OU. Ecology recommended using an engineering evaluation/cost analysis and Action Memorandum as part of the CERCLA regulatory process to expedite cleanup of the waste sites in this OU. A "Bias for Action" approach was preferred for remediating these small sites and to demonstrate remedial action progress in the Central Plateau. Up to this point, 200 Areas RI/FS work plans had been developed using the Analogous Site Concept. A shift from the use of the Analogous Site Concept to the observational approach was agreed to because of the suspected diversity in site conditions and variability in the specific COCs associated with each release. Use of the observational approach endorses a very streamlined process to clean up the sites with minimal characterization. This approach combines site characterization (generally screening surveys), remediation, waste disposal, and verification sampling activities into one streamlined field action.

Criteria needed to be established to identify the candidate sites that were appropriate for use of the observational approach and would proceed with a streamlined removal action. To identify the candidate sites, a sorting process was developed as part of the 200-UR-1 DQO process and is summarized in this work plan. Through application of the sorting procedure, 200-UR-1 waste sites were identified for four proposed future actions:

- Rejection or no action
- Reassignment to another OU for inclusion with an equivalent or more stringent cleanup
- Use of the observational approach to conduct RTD
- Completion of an RI/FS.

Chapter 4.0 presents the sorting criteria that were developed and attributes of the sites comprising each of the future action categories. The characterization approach is discussed for both the candidate sites selected for RTD and for the one 200-UR-1 site (BC Controlled Area) that was identified for completion of an RI and FS. Sampling and analysis approach for waste designation determinations is also summarized.

Chapter 5.0 presents the results of the EE/CA that was prepared for the sites that were identified in the sorting process as candidates for conducting RTD. The EE/CA was prepared to support the CERCLA process for selection of a preferred remedy without the need to conduct an RI/FS. The EE/CA identifies the objectives of the removal action and analyses the effectiveness, implementability, and cost of removal in comparison to other alternatives. Thus the EE/CA serves an analogous function to, but is more streamlined than, the FS conducted for remedial actions. The results of the EE/CA and the regulatory response decision are summarized in the Action Memorandum. The preferred remedy identified for the candidate sites are identified in Chapter 5.0 as part of the EE/CA.

4.1 SUMMARY OF DATA QUALITY OBJECTIVE PROCESS

The data needs for the evaluation of waste sites in the 200-UR-1 OU were developed in accordance with the DQO process (EPA/600/R-96/055, *Guidance For the Data Quality Objectives Process*; CP-GPP-EE-01-1.2, *Data Quality Objectives*, Procedure 1.2). The DQO process is a seven-step planning approach that is used to develop a data collection strategy consistent with data uses and needs. The goals of the process are to provide the data needed to refine the preliminary conceptual contaminant distribution models and support remedial decisions.

The DQO process was implemented by a team of subject matter experts and key decision makers. Team members provided input on regulatory issues, the history and physical condition of the sites, and sampling and analysis methods. Key decision makers from the DOE, Ecology, and the EPA participated in the process to develop the characterization approach outlined in WMP-19920 (pending). Use of the DQO process with involvement of the team of experts and decision makers provides a high degree of confidence that the right type and quality of data are collected to fulfill the informational needs for the 200-UR-1 remedial decision process. Representatives from RL as well as contractor personnel from the various core projects, were involved in the DQO for this work plan; elements from the integrated DQO have been incorporated into the work plan and the SAP. Data collected under this work plan will be used by other Hanford Site projects as appropriate to their particular needs.

One outcome of the 200-UR-1 DQO process was development of the criteria with which to identify sites for the four proposed future action. Specification of the criteria needed to support the proposed action, along with application of the sorting process, was used to group the sites. During development of the sorting process, it became evident that sites that did not require remediation or would be more appropriately handled through actions planned with another Remediation Group or OU, should be identified first. From the remaining list, those sites that would be candidates for RTD would be identified. In the final step of the sort, any remaining site(s) that did not meet the previously applied sort criteria would be a candidate for completion of the RI/FS process. The following sections present a review of the sorting process prepared in the 200-UR-1 DQO and the criteria established for the site groupings. It was determined that the existing site data were sufficient to conduct a streamlined cleanup at the proposed RTD sites using the observational approach. The BC Controlled Area (site code UPR-200-E-83), located south of the 200 East Area and adjacent to the BC Cribs and Trenches, was identified for completion of an RI.

4.1.1 Overview of 200-UR-1 Site Sorting Methodology

A thorough review and evaluation of the history and physical characteristics of each waste site was undertaken to identify important attributes that could be used to sort and group sites. The information available for the 200-UR-1 Operable Unit shows that certain groups of sites share common characteristics. The occurrence report(s) that normally accompanies a documented release often provides sufficient information with which to determine the general site conditions. These reports, and other information that has been added to the *Waste Information Data System*

(WIDS) after subsequent visits to the sites, provide a major portion of the data that are available to determine the attributes of the site.

Attributes used for site groupings included physical setting (e.g., railroad, storage yard, open area, road, pipeline, or diversion box), primary contaminant release mechanism (leak, spill, aerosol emission), and contaminant redistribution mechanism (animal burrowing and fecal discharge, plant uptake, and/or wind erosion). The potential or known volume of the release also was identified as a key information element. Radiological constituents were reported present in nearly all the unplanned releases. In some cases, subsequent radiometric and Global Positioning System surveys that were conducted following the report of the release provide the information used to delineate the lateral extent of the radiological contamination.

Grouping of the sites based on the key attributes is performed to allow for consistent and expedited decisions concerning further actions. The 200-UR-1 sites that have been grouped together share a sufficient number of common characteristics, that a recommended proposed action can be specified for the group rather than on a site-by-site basis.

Figure 4-1 presents the general decision logic developed for determining which further action should be proposed for a site. The following sections describe the criteria that were used for inclusion of a site with the proposed action.

4.1.2 Criteria for Selecting 200-UR-1 OU Waste Sites as Candidates for Reclassification in Waste Information Data System to "Rejected" or "No Action"

The Tri-Party Agreement Handbook Management Procedures (Guideline Number TPA-MP-14) describes the requirements and site characteristics that qualify "accepted" sites (i.e., "waste management units") listed in WIDS for consideration as reclassified to "rejected" or "no action."

The decision flow diagram provided in TPA-MP-14 (Figure 2-1, page 23) for determination of "Accepted," "Rejected," and "No Action" Site Classification/Reclassification outlines the process used to identify these sites.

Seventeen 200-UR-1 sites were proposed for reclassification in WIDS to "rejected" and submitted to Ecology for consideration in March 2000. This submission followed the procedures outlined in TPA-MP-14. Appendix A, Table A-2 identifies the 200-UR-1 sites that were included this March 2000 Group 7 submission to Ecology. In addition, two sites (200-E-8 and UPR-200-E-114) are currently classified in WIDS as rejected, along with three sites (200-W-54, 200-W-91, and UPR-200-W-127) that have been reclassified to "rejected (consolidated)." The rejected consolidated sites previously identified in Table A-2 have been determined to represent duplicate descriptions of the same site identified with two different site codes and for tracking purposes have been consolidated with the other site. Rejected consolidated sites also may represent a site that lies within another site and cannot be differentiated from the surrounding site. The smaller site encompassed by the larger site is thereby rejected and consolidated in the WIDS tracking system.

The 47 sites listed in Table A-2 share common site rejection or no-action criteria as identified in TPA-MP-14. After being reported, these sites were immediately, or later, cleaned up through a decontamination or removal action. As appropriate, radiometric surveys and/or samples were collected to verify the completeness of the cleanup. For releases containing radiological constituents, no radiation warning signs or postings were required following the cleanup because the actions taken resulted in acceptable exposure levels (i.e., generally corresponding to background). These sites should not be considered waste management units because there is no longer evidence of an actual or potential hazardous substance release. As such, the sites in Table A-2 are proposed for reclassification as rejected or no action under CERCLA or other regulatory authority. If a site is not approved by Ecology for rejection or no action based on existing information, additional follow-on activities will need to occur. Concurrence with Ecology will be pursued concerning identification of the activity to be conducted to reclassify the site. This may include searching historical records for radiological survey information relating to prior cleanup or decontamination activities, collecting current characterization data using field-screening surveys, or performing sampling and laboratory analyses to complete the approval process. Following review of any additional site data that are collected, it could be appropriate to reassign the site for inclusion with another remediation group or though very unlikely, conduct a cleanup in conjunction with the other 200-UR-1 removal actions.

4.1.3 Criteria for Selecting 200-UR-1 Waste Sites as Candidates for Inclusion with Another Operable Unit for Remedial Action

Some 200-UR-1 sites are identified as candidates for completing additional characterization, remedial actions, or removal as part of another remediation group's activities. Criteria for reassigning 200-UR-1 sites to another remediation group include the following:

- The UPR site is associated with a larger, more significant structure or feature that will require remediation. For example, several UPR sites are leak locations adjacent to process pipelines or diversion boxes. Cleanup of the contaminated pipeline/diversion box and any associated UPRs should be conducted as a single remedial action. UPRs directly associated with tanks/lines/pits/diversion boxes should be addressed with the 200-IS-1 Tank Waste Group OU.

- The site is not a UPR, but is related to an operation or activity. These sites should be reassigned to the appropriate waste group (e.g., 200 Area Miscellaneous Waste Group).

- The UPR site lies within the U Plant closure zone and already is being addressed as part of the U Plant Closure Area initiative.

- The UPR site lies within the footprint of a proposed barrier. The 200-UR-1 sites that lie within the footprint of proposed or potential barriers systems, such as a Canyon Disposition Initiative barrier, should be addressed under a more inclusive remedial action.

Table A-3 lists information pertaining to the 34 sites that are proposed candidates for inclusion with another OU for conducting remedial action. The locations of the 200-UR-1 sites and the currently planned barrier systems within each of the 200 Area closure zones are included in the SAP (Appendix B) and shown on Figures B-1 through B-14.

Reassignment of 200-UR-1 waste sites will require coordination and agreement among OU project leaders, Ecology, and/or EPA. Remedial activities that are planned to be conducted in the new OU that would include the UPR site, will need to meet regulatory reporting and schedule requirements for site closure. Upon agreement among the decision makers to reassign the selected sites, designation of the new OU associated with the site will be documented within WIDS and Appendix C of the TPA.

4.1.4 Criteria for Selecting 200-UR-1 Waste Sites as Candidates for Remove/Treat/Dispose

Primary criteria for selection of candidate sites for conducting a streamlined removal action using the observational approach included the following.

- The maximum depth of contamination is not expected to exceed 4.6 m (15 ft).
- Radionuclides are one of the COCs.
- Radiological surveys and/or other field-screening characterization techniques could be used to determine the level and the extent of contamination during the removal action.
- Removal of contamination media could be completed by hand digging or using heavy equipment to scrape off surfaces or perform shallow excavations to a depth not expected to exceed approximately 4.6 m (15 ft).
- All waste materials could go to the Environmental Restoration Disposal Facility (ERDF).

These criteria were used for the identification of the RTD candidate sites. Further evaluation of available data resulted in additional subdivision of the sites into depth-related categories based on the potential maximum vertical extent of contaminant migration. During this evaluation, the following three contaminant depth intervals were defined.

- <u>0 to 0.3 m Depth Interval</u>: The vertical extent of contamination is expected to occur within a zone from the ground surface to a maximum depth of approximately 0.3 m (1 ft). These sites are characterized by localized and disseminated liquid and solid releases. The solid release sites contain only radiological contamination resulting from the redistribution of material caused by wind erosion, animal intrusion and fecal dispersion, and mobilized vegetation (i.e., tumbleweeds). Contamination resulting from liquid releases potentially could include radionuclides and chemical constituents.
- <u>0 to 2 m Depth Interval:</u> This site group includes UPRs where the vertical extent of the contamination is expected to be equal to or less than 2 m (6.6 ft) in depth. These sites are characterized by liquid waste leaks or spills.

- <u>0 to 4.6 m Depth Interval:</u> The vertical extent of the contamination for this site category is not expected to exceed approximately 4.6 m (15 ft) below the ground surface. Historical information about the release suggests the depth of contamination may be greater than 2 m (6.6 ft). Sites where deeper vertical contaminant migration is suspected often do not have a well-defined lateral extent. If contamination is discovered with COC concentrations exceeding action levels at a depth greater than 4.6 m, RL and Ecology would be contacted for guidance.

Table A-4 presents the list of the 65 sites that are candidates for RTD. A general description of the observational characterization approach proposed for candidate RTD sites is presented later in this chapter, with sampling specifications provided in the SAP in Appendix B. The proposed regulatory process for moving to site closure for 200-UR-1 RTD sites is presented in Chapter 6.0.

4.1.5 Criteria for Selecting 200-UR-1 Waste Sites as a Candidate for Conducting a Remedial Investigation and Feasibility Study

As presented in Section 4.1.1, determination of candidate UPR sites that would require completion of the RI/FS process entails the initial use of the sorting process. Through a process of elimination, after identifying the candidate sites that are appropriate for being proposed for rejection/no action, reassignment to another OU project for equivalent or more stringent remedial action, or are a candidate for conducting RTD using the observational approach, the remaining site(s) not fitting into one of theses categories would be a candidate for an RI/FS. Criteria developed for 200-UR-1 sites to be considered a candidate for completing an RI/FS include the following:

- Additional characterization data are required to fully assess the nature and extent.
- A diverse and complex contaminant distribution exists at the site.
- Extensive site size and/or a potentially large volume of contaminated media exists that could require remedial action.
- Multiple potential remedies could be used to address site closure.
- Treatability studies may be required to evaluate and select a remedy.

For the 200-UR-1 OU, the BC Controlled Area was the only waste site identified for completion of an RI/FS. The characterization approach proposed for the BC Controlled Area is discussed later in this chapter. Content of the RI report and proposed pathway for completion of the regulatory pathway for the BC Controlled Area are presented in Chapter 6.0.

4.1.6 Data Uses

Data generated during characterization of the candidate RTD sites will consist mainly of radiologic survey results with supplemental soil screening analytical data. These data will be used to define the nature and lateral/vertical extent of radiological and chemical contamination during the active removal process. After completion of excavation operations, verification samples will be collected and analyzed to support attainment of preliminary remediation goals (PRG) levels.

The BC Controlled Area is the only site identified to undergo the RI/FS process. Data generated during characterization of the BC Controlled Area will consist of radiologic survey and laboratory analytical data. These data will be used to verify or refine the conceptual model for contaminant distribution, support treatability studies, select a remedial approach, and develop the remedial design. The data also will be used to support an initial assessment of risk (e.g., RESidual RADioactivity [RESRAD] dose model or other risk modeling, as required).

4.1.7 Data Needs

Information has been presented in Chapters 2.0 and 3.0 regarding the 200-UR-1 waste sites. Existing data were sufficient to develop an initial conceptual understanding of radiological and chemical contaminant distribution for the sites within the OU.

For the RTD candidate sites, data needs focus on gathering sufficient data with which to determine the lateral and vertical extent of contamination, identification of the contaminants present, and verification that the contamination was removed subsequent to the removal action. Determination of contaminant levels present and verification of remediation effectiveness will be accomplished through radiological surveys and analytical laboratory analysis of soil samples.

Data collection is needed for the BC Controlled Area to perform human health, ecological, and remedial cost-benefit evaluations. Because of the size of the area and complexity of the decisions concerning potential remedial alternatives, a phased data collection strategy will be used for the BC Controlled Area. Scoping data will be needed to refine the current conceptual site model (CSM) and contaminant nature and extent. If additional data collection requirements for completing a treatability study as part of the FS are identified, a separate DQO will be prepared.

4.1.8 Data Quality

Data quality was addressed during the DQO process for candidate RTD and RI/FS waste sites. COCs were identified based on data previously collected for other work plans in the 200 Areas. The process of identifying potential COCs is summarized in Section 3.6. PRGs and analytical performance requirements were established by evaluating potential ARARs and remedial action goals that are protective of human health and the environment. The chemical and radionuclide contaminants from UPRs in the 200-UR-1 OU are expected to be located within 4.6 m (15 ft) of the ground surface and not a threat to groundwater. Because there are no RODs for the Central Plateau OUs, remedial action goals have not been established. Therefore, PRGs are assigned that are consistent with the planned land uses for the Central Plateau. Tables that summarize the PRGs for the 200-UR-1 OU waste sites are provided in the SAP (Appendix B). To provide the necessary data quality, detection limits should be lower than PRGs. Analytical detection limit tables provided in the SAP define the minimum detection limit, human health action levels, quantitation limit, precision, and accuracy requirements for each analytical method. Cleanup levels protective of ecological receptors also are defined in the tables to verify that analytical detection limits can meet additional potential data collection requirements. Additional data quality is gained by establishing the specific policies and procedures to be followed, and specifying field quality assurance/quality control requirements. These procedures and requirements are discussed in detail in the SAP in Appendix B.

4.1.9 Data Quantity

Data quantity refers to the number of samples collected. For the candidate RI site, the BC Controlled Area, a sufficient number of samples and/or radiological survey locations are needed to refine the CSM and make remedial decisions. For candidate RTD sites, sample quantity requirements need to be defined for two purposes. A sufficient number of samples need to be collected to document COC concentrations within any removed stabilization cover for verification of the material's use, if appropriate, in backfilling the site after the excavation is completed. To document that contaminated material has sufficiently been removed and PRGs have been met, a second group of samples will be collected to verify completeness of the removal action. Determination of the number of verification samples required at RTD sites was assessed and documented during the DQO process. Because radiological survey results will provide a significant amount of onsite data, the number of samples needed for laboratory analysis can be reduced. The sample quantities currently defined for collection during scoping of the BC Controlled Area and at the candidate RTD sites are presented in the SAP in Appendix B.

4.2 CHARACTERIZATION APPROACH

This section provides an overview of characterization approaches planned to meet the data needs for RTD and RI/FS sites as determined during the DQO process. For RTD sites, the characterization activities include radiological screening surveys, in-process soil sampling during the excavation to determine waste designation and disposal requirements, and final verification sampling and analysis. The characterization approach for the BC Controlled area is focused on collection of data needed to complete the nature and extent of the evaluation and risk assessment prepared in the RI, and to assist in selecting potential remedial alternatives and applicable cleanup technologies during the FS. Sample analyses will be conducted by offsite and/or onsite laboratories.

4.2.1 Remove/Treat/Dispose Candidate Sites: Use of the Observational Approach

Under the observational approach, site characterization and cleanup decisions are streamlined for candidate RTD sites using the following process elements:

- Determination of the site location and boundaries in the field using available historical data, site posting and fencing (if present), and a walkover inspection
- Excavation and radiological field screening of soil stabilization cover materials to expose the soil surface existing at the time of the release
- A radiological survey of the site to determine the surface extent of contamination and location of hot spots, if present
- Sampling and analysis of soils at the location with the highest level of contamination for waste characterization and disposal decisions
- Identification and excavation of the contaminated media (soil, wood, steel, concrete, asphalt, etc.) using field screening techniques
- A verification radiological survey and subsequent verification soil sampling and laboratory analysis to document the successful removal of contaminated media to levels below PRGs.

Because of the relatively small volume of liquid releases involved with these UPRs, it is anticipated that excavation depths will be limited to less than 4.6 m (15 ft) below ground surface (bgs). Based on this assumption, all sites identified for RTD can use the observational approach to concurrently characterize and make removal decisions. There should be no need to undergo the RI/FS process to make any additional remedial decisions, unless the encountered contaminant distribution extensively exceeds the assumed lateral dimensions of the site and extends to depths far below 4.6 m. Figure 4-2 shows the work process flow for the cleanup of RTD sites using the observational approach.

One of the project technical issues identified during preparation of the DQO is that some 200-UR-1 sites identified in WIDS may not be able to be located in the field. Most of the UPR sites being tracked in WIDS have resulted from documentation produced in conjunction with preparation of a radiological occurrence report. Many of the release events and associated occurrence reports are decades old and the site boundaries do not have surveyed coordinates or current postings in the field. Prior responses to reported occurrences often included decontamination and cleanup actions. Verification of decontamination and/or cleanup activities generally was limited to evaluations using field survey instrumentation (i.e., radiological meters). Because in many instances, only general, non-specific descriptions of the release locations are provided, current site locations and/or boundaries are indeterminate. A number of the sites involved very small volume releases resulting in extremely localized areas of potential contamination. Because of one or a combination of possible factors, including poor site descriptions and/or prior cleanup activities, the locations of some 200-UR-1 sites may not be able to be determined.

Site locations that cannot be identified in the field will be documented along with all available historical data concerning the reported release and any decontamination operations, the site location description, and field activities performed attempting to locate the site. This information will be relayed to the RL program manager for subsequent reporting to Ecology in preparation for discussions to determine the regulatory path forward for closing the site.

Current levels of contamination will need to be determined for the candidate RTD sites. For sites with a soil stabilization cover, the contaminant nature and extent will not be known until the cover material is removed to expose the surface on which the release originally occurred. Because of past cleanup or decontamination operations, COC levels may be below PRGs or at background concentrations underlying the stabilization cover. At other candidate RTD sites, because of poor documentation concerning the level of prior cleanup activities or the extent of potential contamination, all or part of the site may have no COCs present, or the COCs occur at levels below PRGs. The initial radiological surveys performed at these sites will be used to indicate whether radiological levels occur above background and/or PRGs. If radiological survey results indicate a removal action is not required, confirmatory samples will be collected to support a no-action determination. Based on survey and sampling results, for those sites that become candidates for no action, the TPA-MP-14 process would be initiated for site reclassification and regulatory concurrence.

At some site locations, anomalous conditions may require development of a site-specific sampling plan, with sampling locations and number of samples required for site closeout determined on a statistical basis. Site-specific sampling plans will be developed in coordination with Ecology. Sites confirmed to not require a removal action will be proposed for no action through the TPA-MP-14 process. The SAP presents the sampling design proposed at candidate RTD sites and scoping sampling within the BC Controlled Area.

4.2.2 Recommended Characterization Approach for the BC Controlled Area

The preliminary CSM for the BC Controlled Area identifies three distinct areas: an essentially clean area south of the dunes and including most of the dunes (Zone C), a slightly contaminated area between the dunes and the area near the liquid disposal sites (Zone B), and an extensive contaminated area in the vicinity of the cribs and trenches that is inside the fire break roads (Zone A).

Because of the nature and extent of contamination in the BC Controlled Area, a unique, phased characterization and sampling design is proposed using a combination of scoping sampling and NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) survey techniques. Characterization of the BC Controlled Area will take place in five phases. In Phase I, the initial site evaluation characterization objectives are developed and focus on determination of current contaminant levels, development of the preliminary CSM, and determination of initial sampling and radiological survey specifications for a limited field investigation. The project currently is conducting Phase I activities. During Phase II, a limited field investigation will be conducted with data collection objectives directed toward refining the CSM further and the remedial alternative assessment that is conducted as part of the FS. Phase III focuses on evaluating and documenting the survey and analytical results generated in Phase II. During Phase IV, characterization data are used to specify MARSSIM survey requirements for contaminant Zones B and C. This activity will support the release of Zone C from further remedial action. Phase V will focus on treatability testing to evaluate remedial technology identified for the remediation of Zone A.

Characterization data collection as part of a treatability study may be required before completing the FS for the BC Controlled Area. Site-specific sampling and analysis are discussed in the SAP in Appendix B.

4.2.2.1 Phase I – Initial Site Evaluation

Phase I activities focus on the following.

- Compilation of all historic BC Controlled Area characterization studies and information. Available records and data are documented in a Historical Site Assessment (HSA) report. The HSA will be incorporated into the RI report. Data presented in the HSA also will be used to determine requirements for additional site characterization activities and remedial decisions. The HSA provides the basis for the preliminary CSM (Figure 2-4) and initial assignment of MARSSIM area classifications (Classes 1, 2, or 3). MARSSIM area classifications that apply to the BC Controlled area include the following:

  - **Class 1 Area** – Areas containing contamination in excess of the Derived Concentration Guideline Level.

  - **Class 2 Area** – Areas with a potential for radioactive contamination or known contamination, but are not expected to exceed the Derived Concentration Guideline Level.

  - **Class 3 Area** – Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the Derived Concentration Guideline Level.

  The current CSM equates Zone A as being a Class 1 area, Zone B as a Class 2 area, and Zone C as a Class 3 area.

- Development of initial scoping sampling and radiological survey specifications for a limited field investigation. This involves designing focused sampling and radiological surveys for refining the contaminant zone boundaries, evaluating the contaminant extent within each zone, and estimating maximum and average surface radiation levels in each zone.

4.2.2.2 Phase II – Characterization Activities

Phase II involves conducting characterization activities including initiating the limited field investigation to gather data needed for designing MARSSIM surveys and initial RI data collection. Phase II is organized into three parts.

Part 1

- Perform radiological surveys and collect soil samples for radiochemical analysis to support refinement of the preliminary BC Controlled Area CSM.
- Perform the limited field investigation to obtain data to support MARSSIM area classifications. This would involve focused radiological surveys/sample collection conducted in key areas (based on HSA documentation) using MARSSIM survey techniques.
- Collect samples to verify radionuclide ratios and use of surrogate (target) radionuclide (i.e., Cesium-137) for final status surveys.

Part 2

- Collect initial characterization samples needed for the RI. Samples are collected in key areas to determine radionuclide distribution in the soil profile.
- Perform radiochemical analyses on the collected samples.

Part 3

- In-process review of radiological survey and radiochemical results as they are available. Reposition of zone boundaries if needed and further refine characteristics of zones.
- Determine if sufficient data available to estimate maximum and average surface radiation levels in each zone.
- Collect additional data to fill gaps as needed.

4.2.2.3 Phase III – Data Assessment

Phase III entails evaluating and documenting the survey and analytical results generated in Phase II. This data assessment would be conducted as part of the preparation of the RI report. During this phase, the following will be performed.

- Refine the CSM to reflect current radiological conditions in the BC Controlled Area.
- Present characterization data supporting MARSSIM area classifications: Zone C as Class 3, Zone B as Class 2, and Zone A as Class 1.
- Develop general estimates of the maximum and average surface radiation levels and radiological exposure concentrations in each zone.
- Identify additional data collection required to address any data deficiencies.
- Present all current characterization analytical results in conjunction with the HSA data as part of the RI report.

4.2.2.4 Phase IV – MARSSIM Final Status Survey Design

During Phase IV, MARSSIM final status survey requirements for Zones B and C of the BC Controlled Area will be developed. This activity will require presentation of data supporting MARSSIM classifications for these zones and development of survey requirements specific to MARSSIM Class 2 and 3 areas.

A MARSSIM statistical radiological survey plan will be prepared to verify that Zone C is not radiologically contaminated. Removal of "hot spots" identified during the survey would be included as part of the planning process. Activities conducted during this phase include the following:

- Develop DQO document for MARSSIM statistical survey and sample collection requirements for the release of Zone C (Class 3 final status survey requirements) and Zone B (Class 2 final status survey requirements). This DQO will include evaluation of potential ecological action levels and specify waste characterization and disposal requirements.
- Specify procedures and requirements for down-posting Zone C.
- Develop a plan for hot-spot removal during survey implementation if logistically manageable and cost efficient.

4.2.2.5 Phase V – Final Remedial Investigation Data Collection and Treatability Investigation

Phase V will be directed toward treatability testing to evaluate remedial technologies identified for the remediation of for Zone A. Activities will include the following.

- Develop the DQO document for the treatability test plan.
  - Determine data collection requirements for assessment of potential treatment technologies or remedial actions.
  - Define regulatory drivers, PRGs (ecological and/or human health), and habitat issues that will affect cleanup requirements and implementability of treatment technologies.
- Collect samples/material from the site and perform the treatability test(s).
- Prepare the treatability report.
- Incorporate data into the RI and/or FS report.

Conducting MARSSIM final status surveys within Zones C and B will not be performed until completion of the FS for Zone A. The proposed plan for the BC Controlled Area would address actions for all the zones. If a removal action is selected for Zone A, an RAWP, including verification survey/sampling requirements for site closure, would be required. A separate

RAWP addressing waste disposal requirements would be prepared for the MARSSIM surveys and any hot-spot soil removal actions conducted in Zones B and C.

4.2.3 Characterization Methodologies for Remove/Treat/Dispose and Remedial Investigation/Feasibility Study Sites

4.2.3.1 Radiological Survey Methods

NaI detectors, beta-gamma detection instrumentation, or other approved/appropriate radiation detectors will be used for determining the initial lateral extent of contamination and hot spots before the start of excavation at candidate removal sites. These surveys will be conducted using hand-held or rad-rover equipment depending on the site size. This instrumentation also will be used during excavation as part of the observational approach for remediation of RTD sites and for final confirmation screening before collecting verification samples to support site closure. Sampling and analysis will be performed as needed to establish the correlation between detector response and concentrations of target radionuclides. Analyses also may be conducted to establish the activity ratios among the principle isotopes.

4.2.3.2 MARSSIM Survey Methodology

MARSSIM surveys will be used to demonstrate compliance for sites with residual radioactivity using a final status survey technique that integrates the remedial design/remedial action step of the CERCLA remedial process. Survey instrumentation will be selected with scan capabilities that are appropriate for minimum detectable concentration criteria. Survey criteria will meet the agreed-to Derived Concentration Guideline Level set for the BC Controlled Area (UPR-200-E-83).

4.2.3.3 Test Pit Excavation and Sampling

Test pits may be excavated in areas identified as hot spots as part of the characterization and removal activities at RTD sites. These pits typically will be excavated using mechanized equipment such as a backhoe; however, they may be dug with a shovel depending on the anticipated depth of contamination and size of the site. Test pits may be dug to evaluate the vertical extent of soil staining or anomalous contamination.

4.2.3.4 Field Screening

Field screening analyses will be used to guide excavation operations. Radiological screening will be the primary method to determine excavation progress in removal of contamination at RTD sites. Other screening techniques that are appropriate for detection of volatile organic compounds, selected metals, polychlorinated biphenyls, and petroleum hydrocarbons also may be used at liquid release sites. A list of the screening techniques identified for use at UPR sites is presented in the SAP in Appendix B.

4.2.3.5 Analysis of Soil

Soil samples will be collected for chemical and radionuclide analysis and for the determination of select soil properties. A broad and comprehensive list of analytes for laboratory analyses has been developed for this project. The analyte list is based on an evaluation of all COCs identified in the DQO documents developed to date for the other OUs in the 200 Areas. The list of COCs for the 200-UR-1 OU is presented in Table B-2 in the SAP (Appendix B). Tables B2-6 and B2-7 of the SAP show the analytical methods and detection limits in comparison to PRGs for human and ecological receptors. A limited number of samples also may be analyzed to determine soil physical properties, such as moisture content and particle size.

At candidate RTD sites, laboratory analyses will be performed principally in conjunction with collection of samples used to document that clean excavated material may be used for backfill and to verify the effectiveness of any removal action. Verification analyses will provide the data needed to complete site closure documentation. The assumed nature of the release is an important element in the development of the conceptual models for the 200-UR-1 waste sites and in the determination of analytical requirements for verification samples. Site cleanup verification analyses where contamination is the result of windblown materials, animal droppings, and vegetation fragments (i.e., CSM 1) only will require analysis for radionuclides. At liquid release waste release sites (i.e., CSMs 2, 3, and 4), because less may be known about the composition of the liquid, verification sampling conducted following completion of the removal of contaminant soil will include analysis of radiological and nonradiological COCs.

4.2.4 Waste Designation Sampling for Sites Identified for Remove/Treat/Dispose and Remedial Investigation/Feasibility Study

The DQO effort identified use of judgmental sampling for waste designation decisions. This approach targets the most contaminated material for determination of COCs and contaminant concentrations. Wastes that require characterization at sites include untreated and/or treated waste material/media that that cannot be designated without characterization and may require special handling for human exposure protection or waste acceptance. Anomalous material/media have been included in this category even though the probability is small that this type of waste will be encountered during the removal actions at the 200-UR-1 sites.

Sampling for waste profile/designation of the material/media will be focused in two areas. Sampling of herbicides and pesticides will be performed near the material/media surface where these constituents are most likely to be present. Sampling of material/media also will be performed in the most highly contaminated areas as determined through field-screening techniques.

Proposed field-screening methods (i.e., radiological surveys, organic vapor analysis, and X-ray fluorescence) will provide detection of the radiological and chemical COCs that pose waste designation concerns; however, certain COCs are not covered by these field-screening techniques (including mercury and semivolatile organic compounds). In addition, the X-ray fluorescence detection capabilities for cadmium and selenium are not within the desired range (i.e., land disposal restricted threshold totals values), but these limitations do not prevent the use of field-screening methods.

Field-screening results that exceed radiological and dangerous/hazardous waste limits will initiate additional sampling for laboratory analysis. If additional laboratory analysis is required for waste characterization, one sample will be collected from the location with the highest field-screening readings. The results of the laboratory analysis will be used to determine if the material/media is designated as dangerous/hazardous waste. In addition to the COCs identified for human health or ecological consideration, specific analyses for selected COCs are needed for waste designation and disposal decisions. The sampling design and COC list developed for waste disposal decisions is presented in the SAP. Other site-specific waste sampling and analysis requirements may be required to meet waste acceptance at ERDF. The proposed waste characterization and analyses that will be performed for each RTD site will be reviewed with ERDF before initiating removal operations.

Figure 4-1. Decision Logic for Site Grouping.

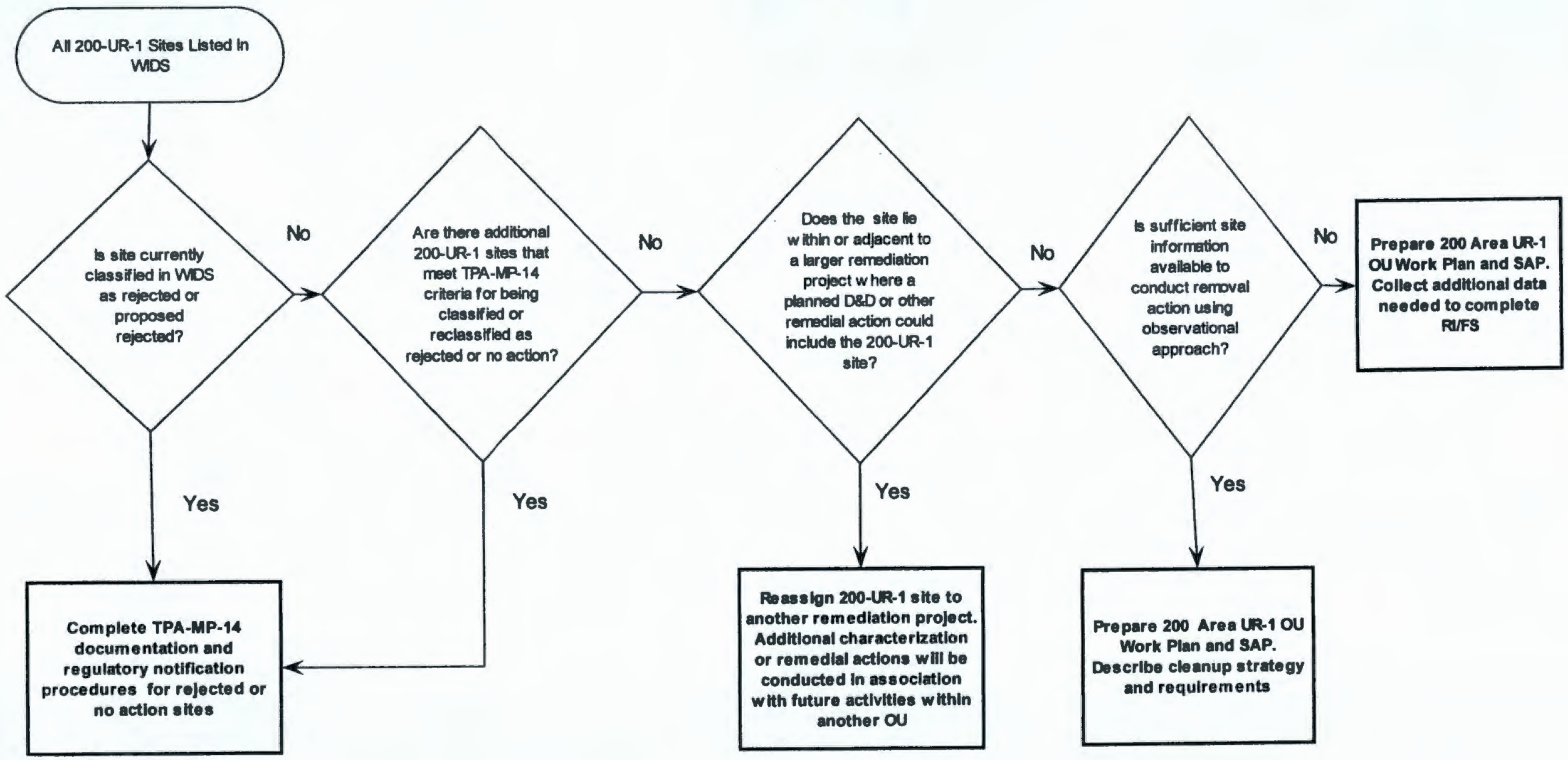
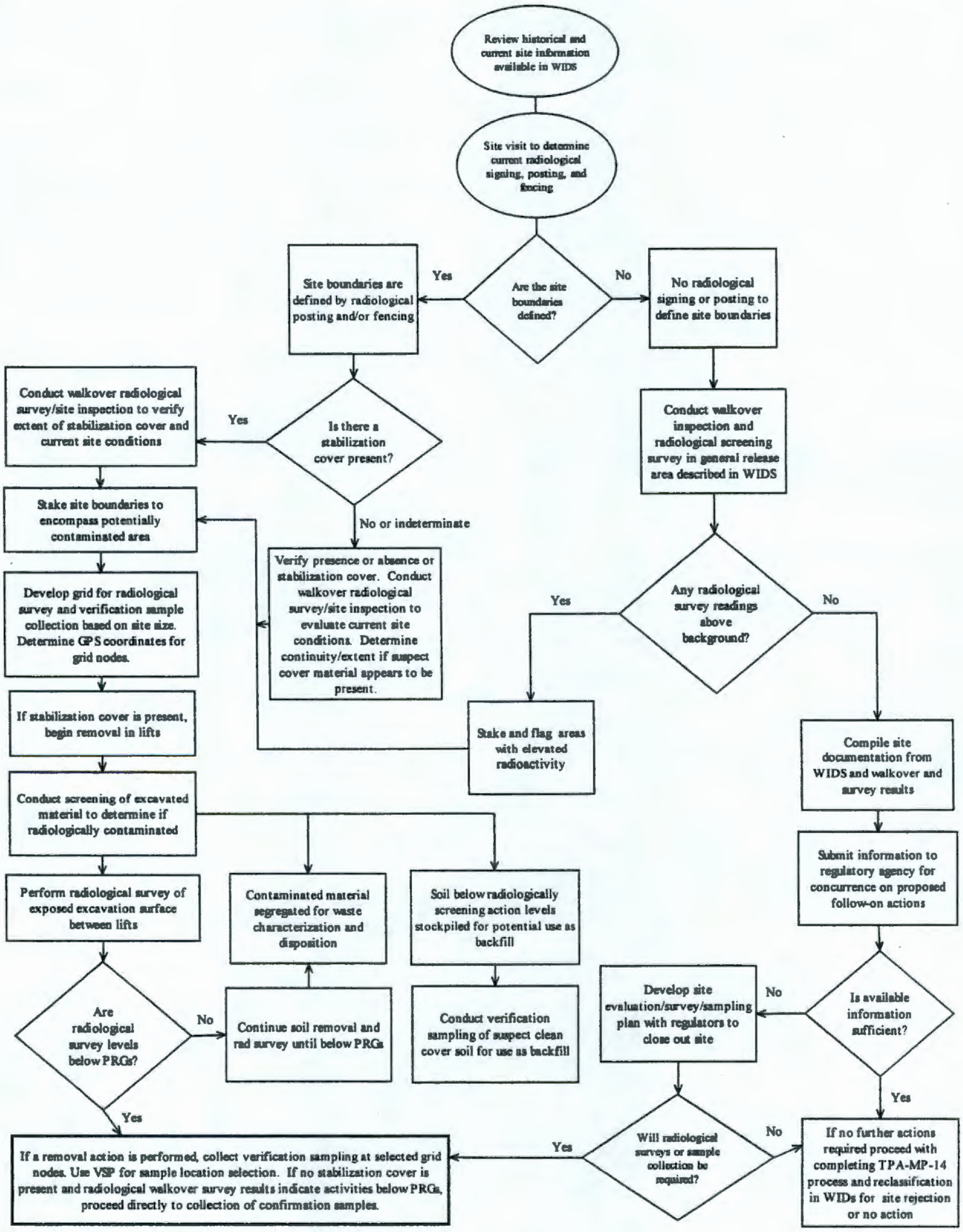


Figure 4-2. Work Process Flow for the Cleanup of Remove/Treat/Dispose Sites using the Observational Approach.



5.0 ENGINEERING EVALUATION/COST ANALYSIS

The 200-UPR-1 waste sites identified as candidates for performing a removal action using the observational approach were selected based on the site sorting criteria discussed in Chapter 4.0. This initial sorting was performed to organize the (147) 200-UR-1 waste sites into appropriate groupings for potential future actions. Completion of the sort resulted in identification of 65 waste sites as candidates for a removal action. The characteristics of these sites allow for the consideration of a remedy without the need to perform a complete RI/FS.

The next step in the CERCLA process for early action responses is the completion of an EE/CA. The contents of this chapter, in conjunction with the site information provided in Chapters 2.0, 3.0, and 4.0 contain all the elements needed for an EE/CA. Chapter 5.0 presents removal action objectives, a qualitative risk analysis for the candidate removal sites, identification and comparison of removal alternatives, and an analysis of the effectiveness, implementability, and cost of each of the alternatives. A comparative analysis is presented that evaluates the relative performance of each of the alternatives to each other. Currently available information in WIDS for individual sites was reviewed in conjunction with completion of the alternatives analysis and identification of the preferred remedy specified for each site.

Estimated costs for implementation of each alternative are provided as required for completion of the EE/CA. Site characteristics regarding the nature and extent of contamination used in the cost models are based on information available in WIDS. A great deal of uncertainty is associated with the current extent and potential volume of contaminated material present at each candidate RTD site, because in many cases, little to no supporting radiological survey or analytical data are available.

Historically, cleanup efforts were conducted at many of the sites in response to release events. Because analytical sampling data generally are not available, the sufficiency of these past interim cleanup or decontamination activities with respect to achieving PRGs is unknown. The vertical and lateral extent of contamination that was used in the cost models, as inferred using WIDS site information, generally is assumed to be a worst case scenario and may be significantly less when actual current site conditions are determined.

5.1 RISK EVALUATION AND SITE CONDITIONS THAT JUSTIFY REMOVAL ACTIONS

5.1.1 Site Conditions that Justify Removal Actions

Section 300.415(b)(2) of 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP), provides several criteria for evaluating the need for and selection of removal actions. If conditions at a site satisfy the conditions of one or more of these criteria, the NCP indicates that a removal action may be appropriate. Conditions regarding contamination at the 200-UR-1 waste sites satisfy four of these criteria, thereby justifying the performance of a removal action:

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants
- High levels of hazardous substances or pollutants or contaminants in soils, largely at or near the surface, that may migrate
- Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released
- Other situations or factors that may pose threats to public health or welfare of the United States or the environment.

Insufficient information related to contaminants and their concentrations is available to quantify risk associated with the UPR sites. Because of the overall uncertainty and inability to generalize across sites, this document does not provide quantitative estimates of human health or ecological exposure. However, this document does provide a qualitative discussion of the COCs, potential receptors, and the potential risks posed by these COCs to help assist in decision making related to corrective actions taken at sites.

5.1.2 Qualitative Risk Evaluation

Risk is considered in terms of the potential of a hazard to cause harm to a receptor. The harm can be measured in immediate and long-term effects based on a receptor's exposure to the hazards. The important elements involved in risk will vary during different phases of the project and are specific to the receptor. Potential human receptors include current and future site workers and site visitors. Potential ecological receptors include terrestrial plants and animals using the sites. Potential receptors (i.e., human and ecological) may be exposed through the following pathways:

- Ingestion of contaminated soils (including dust inhalation), sediment, or biota
- Inhalation of contaminated dusts, vapors, or gases
- Dermal contact with contaminated soils or sediment
- Direct exposure to external gamma radiation in site soils and sediments.

Because of insufficient information available related to the COCs and concentrations of the COCs and in an effort to simplify the evaluation of the various removal actions, three risk hazard categories have been defined and are discussed in detail below. These risk categories include the following:

- Near-term risk
- Long-term risk
- Ecosystem risk.

In addition, the COCs identified for the 200-UR-1 UPR sites were evaluated for toxicity (the potential for a particular contaminant to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the likelihood and/or severity of adverse effects) and the degradation rate (i.e., half-life) of a constituent. Tables 5-1 and 5-2 list the COCs and the values for the available toxicological information. The toxicological values for radiological COCs presented in Table 5-1 were obtained from EPA 402-R-99-001, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*. The toxicological values for the nonradiological COCs presented in Table 5-2 were obtained from the Integrated Risk Information System (IRIS) (EPA 2003) and the Health Effects Assessment Summary Tables (HEAST) (EPA 2001).

5.1.2.1 Near-Term Risk

Near-term risk refers to those potential risks where the release of radionuclides and chemical contaminants to the receptor could occur in the current state or during the removal actions. The relevant exposure pathways for near-term release are the inhalation, ingestion, and dermal contact with the COCs. The primary human receptors are the current and future site workers and site visitors. A secondary receptor is the environment where release of contamination to the environment introduces a source term that may eventually migrate through the soil to the groundwater and to a receptor. Such releases would be considered long-term risks and are discussed in Section 5.1.2.2. The harms that may be inflicted on the receptors include near-term and/or immediate effects (acute) caused by contamination and long-term effects (chronic) caused by the contamination residing within the body.

Near-term risk is characterized by a relatively low likelihood of occurrence with moderate to high consequences but a moderate to low likelihood of release. The timeframe of interest is during current operations or removal of the contaminated media. During removal activities, incremental risks due to fugitive dust emissions could create exposure routes of concern. Removal operations will need to be designed to minimize the potential for such hazards. In general, hazards during removal will be dominated by risks to workers and direct harm to the ecosystem rather than through exposure routes to site visitors.

5.1.2.2 Long-Term Risk

Long-term risk includes those mechanisms that release contaminants slowly over a very long period (e.g., hundreds of years). Typically, exposures will be relatively low concentrations over extended periods, just the opposite of the near-term release hazards. These long-term risks generally are associated with groundwater contamination. The removal objective is to prevent long-term releases and exposures to the public and the environment that exceed acceptable levels. In today's current state, these hazards are managed or controlled through access and use restrictions on land and groundwater. In the future, these restrictions may change or may no longer exist.

For long-term risk, the principal exposure pathway of concern is public consumption of groundwater. Contaminants fall within three categories: (1) those that are long lived and mobile (technetium-99, iodine-129, neptunium-237, carbon-14, carbon tetrachloride, and nitrate); (2) those that are long-lived and relatively immobile, but of such quantity as to create an exposure through intrusion scenarios (e.g., plutonium isotopes); and (3) those that are of such large quantity to warrant attention (e.g., strontium-90 and cesium-137).

5.1.2.3 Ecosystem Risk

Ecosystem risk includes the contamination of plants and animal wildlife from chemicals and radionuclides and the physical disruption of natural habitats. Receptors considered primarily are plants and animal species. Exposure routes include direct ingestion and inhalation of contaminated material and uptake from surface water.

Regarding the 200-UR-1 UPR waste sites, most of the sites have been stabilized, thereby limiting ecological access. The decisions to stabilize and remediate waste sites must balance the potential disruption to the ecosystem at and adjacent to the waste sites as well as from a distant location (e.g., borrow source sites).

The exposure pathways expected at most of the 200-UR-1 UPR sites include the following:

- Direct contact with, or ingestion of, soil by invertebrates (e.g., beetles, ants) and burrowing mammals
- Uptake of contaminants in soil by vegetation
- Bioaccumulation through ingestion of food items (e.g., food chain effects) consumed by wildlife that may forage at the waste sites.

Consistent with this approach, WAC 173-340-7490(3)(b), "Terrestrial Ecological Evaluation Procedures," specifies that for industrial or commercial properties, current or potential for exposure to soil contamination only need be evaluated for terrestrial wildlife protection. Plants and biota need not be considered unless the species is protected under the federal *Endangered Species Act of 1973*. Surveys before field activities will confirm the presence of protected species.

5.2 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The potential ARARs for the 200-UR-1 OU waste sites are identified in Appendix D.

5.3 REMOVAL ACTION OBJECTIVES

This section describes the removal action objectives used to evaluate the 200-UR-1 OU removal action alternatives. These objectives provide the basis for evaluating the capability of a specific removal alternative to achieve compliance with potential ARARs and/or an intended level of risk protection for human health and/or the environment. Specific removal action objectives for this work plan were defined based on the fate and transport of contaminants, projected land use for the 200 and 600 Areas, and the conceptual exposure models. The removal action objectives for the 200-UR-1 UPR sites are as follows.

- Prevent or reduce negative impacts to human health, ecological receptors, and natural resources associated with exposure to soil or wastes contaminated above ARARs or risk-based criteria by removing the source or eliminating the pathway.
- Prevent migration of contaminants that would result in groundwater contamination.
- Prevent plants and animals from creating a migration pathway for the contamination.
- Meet all ARARs, standards, and criteria defined under federal and/or state environmental laws.
- Prevent or reduce occupational health risks associated with physical, chemical, and radiological hazards to workers performing removal actions.
- Minimize the general disruption of ecological and cultural resources caused by remediation and prevent adverse impacts to cultural resources and threatened or endangered species.
- Provide conditions suitable for future industrial land use inside the Central Plateau Core Zone boundary and residential land use outside the Core Zone.
- Minimize the amount of all types of waste generated from remediation in order to minimize waste management and disposal costs, transportation impacts, and the potential for environmental release.

5.4 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Significant efforts and evaluations have contributed to defining applicable technologies and process options that address the 200-UR-1 waste sites. The Implementation Plan (DOE/RL-98-28) provides initial information on identification and screening of remedial action technologies that have proven effective and implementable at industrial waste sites and the Hanford Site. A general description of three alternatives that were chosen to address the 200-UR-1 sites is provided below. Detailed discussions of each alternative are presented in Section 5.5.

5.4.1 Description of Alternatives

This section provides a description of the alternatives considered for evaluation in this work plan and includes the following:

- Alternative 1: No Action
- Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation
- Alternative 3: Remove/Treat/Dispose.

5.4.1.1 Alternative 1: No Action

The NCP requires that a no-action alternative be evaluated as a baseline for comparison with other alternatives. The no-action alternative represents a situation where no legal restrictions, access controls, or active removal measures are applied to the site. No action implies "walking away from the waste site" and allowing the wastes to remain in their current configuration, affected only by natural processes. No maintenance or other activities would be instituted or continued. Selecting the no-action alternative would require that a UPR site pose no unacceptable threat to human health or the environment.

5.4.1.2 Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation

Under this alternative, existing soil covers would be maintained and/or augmented as needed to provide protection from intrusion by biological receptors, along with legal barriers (such as deed restrictions and excavation permits) and physical barriers (such as fencing) that would mitigate contaminant exposure. Radioactive contaminants remaining beneath the clean soil cover would be allowed to decay in place (i.e., attenuate naturally).

A clean soil cover could be represented either as clean backfill or as a surface stabilization layer of clean soil, or both in combination. This alternative may be preferable in the following circumstances:

- When contaminant concentrations are very close to remedial goals
- For contaminants that naturally attenuate and are not mobile in the environment
- When the cost to remediate does not gain a comparable amount of risk reduction, and/or
- When the cost for active remediation (e.g., remove and dispose) is prohibitive.

Based on literature searches regarding the root and burrowing depths of vegetation and animals present on the Hanford Site, a sufficient soil thickness to prevent biological intrusion generally would be 2.4 to 3.0 m (8 to 10 ft). WAC 173-340 also specifies a conditional point of compliance for ecological receptors of 1.8 m (6 ft) bgs with institutional controls.

Natural attenuation relies on natural processes to lower contaminant concentrations until cleanup levels are met. Monitored natural attenuation would include sampling and/or environmental monitoring, consistent with EPA guidance (EPA/540/R-99/006, *Radiation Risk Assessment At CERCLA Sites: Q & A*, Office of Solid Waste and Emergency Response (OSWER)

Directive No. 9200.4-31P), to verify that contaminants are attenuating as expected and to ensure that contaminants remain isolated (e.g., will not lead to degradation of groundwater or be released to air or biota).

5.4.1.3 Alternative 3: Remove/Treat/Dispose

Structures (i.e., railroads) and soil with contaminant concentrations above the PRGs would be removed using conventional techniques and would be disposed at an approved disposal facility (ERDF). Special precautions would be used to minimize the generation of onsite fugitive dust. The depth, and therefore the volume, of soil removed depend on the vertical contamination profile.

The remediation of sites under this RTD alternative would be guided by the observational approach. The observational approach is a method of planning, designing, and implementing a removal action that relies on information (e.g., field screening and sampling) collected during removal to guide the direction and scope of the effort. Data collected are used to assess the extent of contamination and to make "real time" decisions in the field.

Removal technologies do not require that the precise extent of contamination be known before excavation. Rather, the extent of contamination is assessed as the excavation proceeds, and the extent of remediation is adjusted accordingly. In this alternative, soils will be removed until the PRGs are achieved.

After the clean cover and contaminated soil are removed and the PRGs are met, uncontaminated soil would be used to backfill the excavation. The backfill material could be found at a variety of sources, including local borrow pits and the noncontaminated overburden material.

5.5 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The three removal action alternatives will be evaluated individually with respect to effectiveness, implementability, and cost (EPA 1993). Effectiveness is assessed based on the components of (1) overall protectiveness of human health and the environment; (2) short-term effectiveness; (3) long-term effectiveness; (4) reduction of toxicity, mobility, or volume; and (5) compliance with ARARs. Implementability is addressed based on the components of technical feasibility and administrative feasibility.

This section presents the detailed analysis of the three alternatives under an industrial (exclusive) land-use scenario within the Core Zone and a residential land-use scenario for those sites outside the Core Zone.

5.5.1 Detailed Analysis of Alternative 1: No Action

Alternative 1, the no-action alternative, is retained for detailed analysis as a baseline description of the effects of taking no action and is required by CERCLA regulations.

5.5.1.1 Effectiveness

For the 200-UR-1 waste sites, the no-action alternative would fail to provide overall protection of human health and the environment and would not meet the potential ARARs where contaminants at concentrations above the PRGs would remain onsite. No short-term risks would be associated with the no-action alternative, because removal activities would not be conducted. Current risks to workers are not an issue because of protective soil covers over most of the waste sites and appropriate safety measures for work activities. In addition, this alternative would not be effective in the long term, because contaminants would remain in the majority of the waste sites without controls to maintain the existing soil cover. This assumes that the existing soil covers would fail before the PRGs were met at the sites.

Reduction of toxicity, mobility, or volume would occur in the form of natural attenuation. Natural attenuation is a process that results in a reduction of toxicity, mobility, or volume through natural processes such as radioactive decay. Most of the contaminants identified during characterization would be influenced by the radioactive decay process. Radioactive decay is a well-understood natural attenuation process based on a first-order rate reaction. Radioactive decay is calculated easily using the half-lives of the individual radionuclides present. EPA/540/R-99/009, *Use of Monitored Natural Attenuation at Superfund RCRA Corrective Action and Underground Storage Tank Sites November 1997*, OSWER 9200.4-17P, acknowledges that natural attenuation can be an appropriate treatment for contaminated soil. Because of uncertainties in the science of natural attenuation processes, the EPA considers source control and performance monitoring to be fundamental components of the option. However, the no-action alternative does not use any control or monitoring.

5.5.1.2 Implementability

Alternative 1, the no-action alternative, is technically feasible to implement, could be implemented immediately, and would not be dependent on the availability of services and materials.

5.5.1.3 Cost

The no-action alternative would not involve any cost.

5.5.2 Detailed Analysis of Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation

5.5.2.1 Effectiveness

Under Alternative 2, Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation, contaminants would remain in the UPR sites, with controls to prevent inadvertent human and biological intrusion into the areas until contaminant concentrations beneath the existing soil cover reach acceptable levels. This alternative would rely on natural attenuation (e.g., radioactive decay) to decrease contaminants until concentrations reached levels that would be protective of human health and the environment. Alternative 2 possibly could provide overall protection of human health and the environment for sites that show protection of groundwater and achieve human health and environmental protection within approximately 130 years. Because of insufficient information related to the COCs and concentrations of the COCs, it is assumed that all UPR sites exceed the human-health protection criteria when evaluated without considering the existing soil cover and would not comply with the potential ARARs. Presently, however, approximately one-half of the waste sites have an existing soil stabilization cover and may be protective of human health and environment through maintenance of the existing soil cover. Confirmatory sampling would be used to determine the appropriate timeframe for decay of the constituents to acceptable levels.

Under this alternative, reduction of toxicity, mobility, and volume of the contaminants would occur only through natural attenuation processes (e.g., radioactive decay). The progress and effectiveness of natural attenuation may be monitored, as appropriate.

Near-term risks are expected for this alternative and are associated with monitoring and maintenance activities. Experienced workers using appropriate safety precautions would conduct these activities. For sites with radioactive contamination, the risk may decrease with time as the radionuclides decay. If institutional controls were to fail, risks to intruders and/or ecological receptors could be at unacceptable levels, depending on when the failure occurred.

Presently, access to the UPR sites is controlled through Hanford Site access control, with chain-link fencing and/or signage. The Hanford Site has a thorough and comprehensive radiation area access-control program, operated by the Hanford Site contractors. Currently, the majority of the UPR sites are in a surveillance and maintenance program. The program generally involves an annual surface radiation survey for sites that have been stabilized or a perimeter survey for sites that have not been stabilized. If the survey identifies areas of surface contamination, additional controls are applied to the affected area, or the area is stabilized or augmented with clean soil. Sites are kept clear of deep-rooted plant species, using herbicide and manual plant removal.

5.5.2.2 Implementability

Alternative 2 could be implemented easily and would not present significant technical problems. This alternative currently is being implemented through Hanford Site access controls, surface and subsurface radiation area work and access controls, the waste site/radiation area surveillance and maintenance program, and is being coordinated with RCRA and CERCLA monitoring programs. It is acknowledged that technical difficulties may arise with equipment failure and associated replacement. However, these difficulties can be managed effectively.

5.5.2.3 Cost

Estimates for the alternative were developed based on existing costs for similar activities currently conducted on the Hanford Site. The input parameters used in these estimates are the best available at this time, but in many cases, the data on COCs, site locations, and site dimensions are limited. Despite these uncertainties, the cost estimates are of sufficient quality to fulfill the primary objective, which is to aid in selecting preferred removal alternatives.

Table 5-3 shows the cost estimates of the alternative for each applicable waste site. This alternative would involve costs for activities similar to current activities that involve periodic surveillance of the waste sites for evidence of contamination and biologic intrusion, herbicide application or other activities to control deep-rooted plants, maintenance of signs and/or fencing, maintenance of the existing soil cover (including an assumed periodic addition of soil), and administrative controls. The present-worth costs assume a 3.5 percent discount rate (based on current Office of Management and Budget information) and the estimated number of years for natural attenuation to meet the PRGs for monitoring and maintenance.

5.5.3 Detailed Analysis of Alternative 3: Remove/Treat/Dispose

5.5.3.1 Effectiveness

Alternative 3 would remove contaminated waste and soil from the UPR sites to a maximum depth of up to 4.6 m (15 ft) bgs to meet the PRGs. This would eliminate the potential exposure pathways for receptors from soils located at depths between the surface and 4.6 m (15 ft) bgs. Depending on the depth of contamination, soils may be removed to protect human and ecological receptors (up to 4.6 m [15 ft]) from direct contact with contaminants. Clean excavated soil would be used as backfill, and contaminated soil would be disposed of at the ERDF.

This alternative is implementable and considered protective of human health and the environment for those sites that do not have groundwater protection concerns. Many of the UPR sites are small, with shallow contamination anticipated. The risk reduction achieved at the sites is considered high, based on the understanding that the majority of the contamination is near surface.

Because the COCs would be removed from a UPR site and placed in an approved disposal facility under this alternative, failure of this alternative is not likely. Confirmation sampling will be used to verify that residual contamination levels do not pose unacceptable risks. Risks associated with the failure of the disposal facility are not evaluated here, but are evaluated as part of the permitting process for the facility.

Alternative 3 would comply with all potential ARARs by removing soil in the shallow zone or near surface that exceeds the PRGs.

In addition, this alternative would be effective over the long term and would be a permanent solution, because source term with concentrations above acceptable levels would be removed from the UPR sites. EPA and Ecology cleanup authorities prescribe that remedies use permanent solutions to the maximum extent practicable and where cost effective.

Excavation and transportation of waste and structures would disturb areas beyond the waste site boundaries during the implementation period. These areas would need to be revegetated after disturbance, but would not be adversely affected in the long term or permanently.

The removal of buried materials from the 200 East, 200 West, and 600 Areas for redisposal at the ERDF transfers the long-term impact of buried waste from individual UPR sites to one consolidated disposal facility. The ERDF is designed for long-term management of buried waste.

The RTD alternative does not include treatment to reduce toxicity, mobility, or volume; however, radiological decay ultimately results in reduction of toxicity and volume. Waste is assumed to meet the ERDF waste acceptance criteria (BHI-00139, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*); therefore, no treatment would be performed. If waste does not meet waste acceptance criteria, it may be treated for chemical contaminants to reduce toxicity, mobility, or volume for acceptance and disposal at the ERDF. Movement of the waste to the ERDF could result in some minor reduction of mobility. The ERDF could provide some additional protection against remobilization of contaminants over their current location, but this would be applicable only for extremely wet years or significant spills.

Alternative 3 would be effective immediately and would not require surface controls or monitoring activities following remediation, unless deep contaminants were left at the waste sites at concentrations that exceed groundwater protection. As noted, some of the sites may have deeper contamination that would require additional measures beyond the remove-and-dispose alternative. However, the majority of the UPR sites are small, with anticipated shallow contaminants.

Near-term risks of this alternative would be associated primarily with worker safety during waste excavation, transportation, and disposal to the ERDF. Physical disruption of the waste sites during excavation, increased human activity and noise, and generation of fugitive dust could affect local biological resources. Short-term impacts to vegetation and animals at these sites would be low because these sites currently are poor wildlife habitats and have little or no vegetation growing on them.

Transportation activities in the area would increase as a result of bringing construction equipment to the site, transporting contaminated soils to the ERDF, and bringing clean fill to the excavated sites.

Construction and waste excavation activities would be expected to require several days for small sites to years for larger, more complicated sites. Potentially large volumes of fill soil would be transported from borrow areas located on or near the Hanford Site. Air monitoring around the waste sites would be used to monitor potential air releases (e.g., waste or fill material particulates) that could affect the public and the environment.

The removal action goals would be achieved as soon as the excavation of the sites was completed unless deeper contamination was left on site.

5.5.3.2 Implementability

The excavation of contaminated soils would be expected to be technically implementable and would allow for greater flexibility in future land use. Limited coordination with other agencies and local governments would be necessary after approval of the alternative. Excavation and disposal would require coordination with state agencies to assess matters relative to storm water control and the potential for radioactive air emissions.

Other waste sites and operations in the vicinity of the waste sites could influence the implementability of this alternative at a particular site. Some of the UPR sites are located near existing facilities. Implementing removal actions at these sites would require coordination with operations personnel and could preclude or postpone certain removal alternatives.

This alternative would not be easily implemented and/or cost effective for those sites with contaminants at significant depth. However, this condition is not expected in the 200-UR-1 waste sites.

5.5.3.3 Cost

Table 5-3 shows the estimated costs of Alternative 3 for each applicable UPR site; additional detail regarding the cost basis can be found in Appendix C. Included in the costs are mobilizing personnel and equipment; monitoring, sampling, and analysis; and excavating, transporting the waste to the ERDF, disposing of the waste at the ERDF, backfilling with onsite resources, additionally backfilling from a local stockpile, revegetating, and performing contractor oversight. Site-specific monitoring and maintenance costs are included for the institutional control sites. The costs associated with additional institutional controls are included for those sites that are anticipated to require additional monitoring because they contain contaminants at depth.

Costs are based on the use of standard excavation equipment (e.g., hydraulic excavators, front-end loaders, tractor-trailers). The costs are based on the assumption that a subcontractor will do the work, with oversight performed by contractor personnel. The cost estimate assumes that the subcontractor personnel are wearing Level C personnel protective equipment (i.e., coveralls and air filter respirators).

5.6 COST ANALYSIS ASSUMPTIONS AND UNCERTAINTIES

As stated in the introduction to this chapter, there is a great deal of uncertainty associated with the costing that was performed as part of this evaluation. This uncertainty is related to completeness of the site information that is currently available and how the information should be used in specifying present site conditions. The site information provided in WIDS was used to estimate potential site size and contaminant removal volume requirements. Many of the sites may be currently much smaller in size and more limited in contaminant extent than when they were originally identified and delineated. Prior cleanup actions conducted in response to the historical release occurrence may have been sufficient to meet PRGs, but are not fully documented.

Because of the uncertainty concerning the sufficiency of historical decontamination and cleanup activities, the costs calculated for this evaluation used the maximum extent of the site reported in WIDS. The cost model also had a number of uncertainties in the assumptions used pertaining to the level of effort, equipment requirements, and duration required for completion. No efficiencies were assumed in the removal actions such as timing activities in coordination with other Central Plateau remedial actions to reduce costs for personnel training, mobilization, and demobilization (Table 5-4). Estimated waste volumes are linked to sampling and analysis costs and ERDF disposal costs. Because a conservative approach was used in defining the site areas and potential contaminant lateral and vertical extent, large sites generally have large waste volumes. The large waste sites have accompanying high estimated disposal costs. As site characterization activities are conducted using the observational approach at the candidate removal sites, the completeness of historical cleanup activities will be determined. For some sites, final cleanup requirements may be limited, with removal costs reduced significantly from the conservative estimates presented here.

5.6.1 Cost Summary

The cost estimates generally were made for individual waste sites, but in some cases where several UPR sites were within the same area and a distinction could not be made between the sites (i.e., UPR sites along the railroad tracks), the sites were costed as one UPR site. Further detail regarding additional assumptions used in the costing are included in Appendix C.

The cost estimates to implement each of the three alternatives are presented in Table 5-3. Alternative 1 has no cost associated with it and has no additional benefit to human health or the environment over current risks. Alternative 2 generally protects human health and the environment at low cost because it is minimally invasive and does not include labor-intensive activities. Alternative 2 maintains institutional controls until the PRGs are met (for an estimated 130 years). Alternative 3 groups the sites into one of three contaminant depth interval groupings (i.e., 0 to 0.3 m, 0 to 2.0 m, or 0 to 4.6 m), for a conservative cost-estimating approach. For shallow, low-volume UPR sites, Alternatives 2 and 3 are comparable in cost. However, for larger sites with greater volume, RTD costs increase significantly.

Unit costs for Alternative 2, Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation, is assumed to be the same as the current unit cost for surveillance and maintenance activities done annually on the waste sites at the Hanford Site and is based on the area of the individual UPR sites and a unit cost per area. A breakdown of the costs developed for Alternative 3, Remove/Treat/Dispose, is provided in Table 5-4. The discriminating factors for Alternative 3 includes those costs, which are based on the size of the site, the volume of material excavated, and the ERDF disposal costs.

5.7 COMPARATIVE ANALYSIS OF ALTERNATIVES

The purpose of the comparative analysis is to identify the advantages and disadvantages of the alternatives when compared with each other, based on the detailed analyses described in Sections 5.5.1, 5.5.2, and 5.5.3. This comparative analysis allows identification of items that can be evaluated by decision makers during the final selection of a proposed alternative.

Table 5-5 summarizes the comparative analysis of Alternatives 1, 2, and 3 based on effectiveness, implementability, and cost.

5.8 PREFERRED REMEDY AND JUSTIFICATION

The alternatives that met the removal action goals were evaluated according to the broad criteria of effectiveness, implementability, and cost. The UPR sites are not a threat to groundwater and mainly consist of surface radioactive contamination caused by small leaks/spills, windblown particulates, tumbleweed parts, and intrusion by animals. Approximately half of the release locations have been stabilized by a placement of a clean soil cover over the site. Generally, placement of a soil stabilization cover was followed a decontamination or cleanup action. All available information in WIDS concerning the UPR sites was reviewed in detail as part of the selection of the preferred alternative. Many of the sites that are the result of windblown radiological contamination, and have an existing stabilization cover, were associated with the preferred remedy of maintaining the existing soil cover/institutional controls/and monitored natural attenuation (MESC/IH/MNA).

Railroad sites were identified as the primary candidates for the RTD remedy. Those railroad sites with a soil stabilization cover were also biased for removal because a liquid release may have been involved and there is potential for higher contamination levels and presence of longer-lived radionuclides. Sites where interim cleanup actions may have been performed at some point in the past, but do not have a soil stabilization cover, were also identified for removal of any residual contamination that may be present. A listing of sites and the general justification for selection of the preferred remedy is presented in Table 5-6. Additional site-specific information used to justify the selection is presented on Table 5-7.

Table 5-1. Summary of Carcinogenic[a] Characteristics of Radiological Contaminants of Concern the 200-UR-1 Unplanned Release Sites. (2 Pages)

Radiological COCs	Half-Life (years)	Risk Coefficient - Water Ingestion (Risk/pCi)[b,c]	Risk Coefficient - Food Ingestion (Risk/pCi)[b,c]	Critical Effects from Ingestion	Risk Coefficient - Inhalation (Risk/pCi)[b,c]	Critical Effects from Inhalation	Risk Coefficient - External Exposure (Risk/yr/pCi/g)[b,c]
Americium-241	432	1.04E-10	1.34E-10	--	2.81E-08	Lung cancer	2.76E-08
Carbon-14	5730	1.55E-12	2.00E-12	--	7.07E-12	--	7.83E-12
Cesium-137	30.2	3.04E-11	3.74E-11	--	1.19E-11	Lung cancer	5.32E-10
Cobalt-60	5.27	1.57E-11	2.23E-11	--	3.58E-11	Lung cancer	1.24E-05
Europium-152	13.3	6.07E-12	8.70E-12	--	9.10E-11	--	5.30E-06
Europium-154	8.8	1.03E-11	1.49E-11	--	1.15E-10	--	5.83E-06
Europium-155	4.96	1.90E-12	2.77E-12	--	1.48E-11	--	1.24E-07
Neptunium-237	2.14E+6	6.18E-11	8.29E-11	Colon cancer	1.77E-08	Bone/Lung cancer	5.36E-08
Nickel-63	96	6.70E-13	9.51E-13	Colon cancer	1.64E-12	Lung cancer	0
Niobium-94	2.03E+4	7.77E-12	1.11E-11	Colon cancer	3.77E-11	Lung cancer	7.29E-06
Plutonium-238	87.7	1.31E-10	1.69E-10	Liver cancer	3.36-08	Liver/Lung cancer	7.22E-11
Plutonium-239	2.41E+4	1.35E-10	1.74E-10	Liver cancer	3.33E-08	Liver/Lung cancer	2.00E-10
Plutonium-240	6560	1.35E-10	1.74E-10	Liver cancer	3.33E-08	Liver/Lung cancer	6.98E-11
Strontium-90	29	5.59E-11	6.88E-11	Leukemia	1.05E-10	Lung cancer Leukemia	4.82E-10
Technetium-99	2.13E+5	2.75E-12	4.00E-12	Colon cancer	1.41E-11	Lung/colon cancer	8.14E-11
Tritium	12.3	--	--	None	--	None	--
Uranium-233	1.59E+5	7.18E-11	9.69-11	Colon cancer	1.16E-08	Lung cancer	9.82E-10
Uranium-234	2.45E+5	7.07E-11	9.55E-11	Colon cancer	1.14E-08	Lung cancer	2.52E-10

Table 5-1. Summary of Carcinogenic[a] Characteristics of Radiological Contaminants of Concern the 200-UR-1 Unplanned Release Sites. (2 Pages)

Radiological COCs	**Half-Life (years)**	**Risk Coefficient - Water Ingestion (Risk/pCi)[b,c]**	**Risk Coefficient - Food Ingestion (Risk/pCi)[b,c]**	**Critical Effects from Ingestion**	**Risk Coefficient - Inhalation (Risk/pCi)[b,c]**	**Critical Effects from Inhalation**	**Risk Coefficient - External Exposure (Risk/yr/pCi/g)[b,c]**
Uranium-235	7.04E+8	6.96E-11	9.44E-11	Colon cancer	1.01E-08	Lung cancer	5.18E-07
Uranium-236	2.34E+7	6.70E-11	9.03E-11	Colon cancer	1.05E-08	Lung cancer	1.25E-10
Uranium-238	4.47E+9	6.40E-11	8.66E-11	Colon cancer	9.32E-09	Lung cancer	4.99E-11

-- Risk information for these radionuclides and pathways is not specified in EPA 402-R-99-001.

[a]The U.S. Environmental Protection Agency classifies all radionuclides as Group A (known human) carcinogens.

[b]Lifetime excess total cancer risk per unit intake or exposure.

[c]Radiological risk coefficients are calculated by the U.S. Environmental Protection Agency's Office of Radiation and Indoor Air to Assist Health Effects Assessment Summary users with risk-related evaluations and decision-making at various stages of the remediation process. The values presented are taken from EPA 402-R-99-001.

EPA 402-R-99-001, *Cancer Risk Coefficients for Environmental Exposure to Radionuclides.*

COC = contaminant of concern.

Table 5-2. Toxicological Parameter Values of Nonradiological Contaminants of Concern at the 200-UR-1 Unplanned Release Sites. (4 Pages)

Contaminant	RfD_o (mg/kg·d)[b,c]	Confidence[a]	RfD_{inh} (mg/kg·d)[b,c]	Confidence[a]	SF_o $(mg/kg\cdot d)^{-1}$ [b,c]	SF_{inh} $(mg/kg\cdot d)^{-1}$ [b,c]	Cancer Class[d]	ABS
Inorganic Constituents								
Antimony	4.0E-04	L	--	--	--	--	--	0.41
Arsenic	3.0E-04	M	--	--	1.50	15.1	A	--
Barium	7.0E-02	M	1.43E-04	M	--	--	D	0.07
Beryllium	2.0E-03	L/M	5.71E-06	M	4.30	8.40	B1	0.01
Bismuth	--	--	--	--	--	--	--	--
Boron	9.0E-02	M	5.71E-03	M	--	--	--	0.9
Cadmium	1.0E-03	H	--	--	--	6.30	B1	0.01
Chromium	1.5	L	--	--	--	4.10E+01	D	0.005
Copper	4.0E-02	L	--	--	--	--	D	0.3
Hexavalent chromium	3.0E-03	L	2.86E-05	L	--	4.20E+01	A	0.02
Lead	--	--	ND	--	--	--	B2	0.15
Mercury	3.0E-04	--	8.6E-05	M	--	--	D	0.07
Molybdenum	5.0E-03	M	--	--	--	--	--	0.38
Nickel	2.0E-02	M	--	--	--	--	--	0.27
Selenium	5.0E-03	H	--	--	--	--	D	0.44
Silver	5.0E-03	L	--	--	--	--	D	0.18
Thallium	--	--	--	--	--	--	--	0.15
Vanadium	7.0E-03	L	--	--	--	--	--	0.01
Zinc	3.0E-01	M	--	--	--	--	D	0.2
Chloride	--	--	--	--	--	--	--	1
Cyanide	2.0E-02	M	--	--	--	--	D	0.17

Table 5-2. Toxicological Parameter Values of Nonradiological Contaminants of Concern at the 200-UR-1 Unplanned Release Sites. (4 Pages)

Contaminant	RfD_o (mg/kg-d)[b,c]	Confidence[a]	RfD_{inh} (mg/kg-d)[b,c]	Confidence[a]	SF_o $(mg/kg\text{-}d)^{-1}$ [b,c]	SF_{inh} $(mg/kg\text{-}d)^{-1}$ [b,c]	Cancer Class[d]	ABS
Fluoride	6.0E-02	H	--	--	--	--	--	0.97
Nitrate	1.6	H	--	--	--	--	--	0.5
Sulfate	--	--	--	--	--	--	--	0.2
Organic Constituents								
Acetone	9.0E-01	M	--	--	--	--	D	0.83
Acetonitrile	6.0E-03	L	1.71E-02	M	--	--	D	0.80
Benzene	4.0E-03	M	8.57E-03	M	5.50E-02	2.73E-02	A	0.97
Benzyl alcohol	3.0E-01	L	--	--	--	--	--	0.66
Bromodichloromethane	2.0E-02	M	--	--	6.20E-02	--	B2	0.98
n-butyl benzene	--	--	--	--	--	--	--	--
n-butyl alcohol (1-butanol)	1.0E-01	L	--	--	--	--	--	--
Carbon tetrachloride	7.0E-04	M	--	--	1.30E-01	5.25E-02	B2	0.65
Chlorobenzene	2.0E-02	M	5.71E-03	L	--	--	D	0.32
Chloroform (trichloromethane)	1.0E-02	M	--	--	1.0E-02	8.05E-02	B2	0.2
Cis/Trans-1,2-dichloroethylene	--	--	--	--	--	--	D	--
Creosote/tar	--	--	--	--	--	--	B1	0.5
Cyclohexanone	5	M	1.71	M	--	--	--	--
1,1-Dichloroethane	1.0E-01	L	1.43E-01	L	--	--	C	1
1,2-Dichloroethane	--	--	--	--	9.10E-02	2.60E-02	B2	1
1,1-Dichloroethylene	5.0E-02	M	5.71E-02	M	6.00E-01	5.0E-02	C	1
Dichloromethane	6.0E-02	M	--	--	7.5E-03	--	B2	--
p-Dichlorobenzene	--	--	--	--	--	--	--	--

Table 5-2. Toxicological Parameter Values of Nonradiological Contaminants of Concern at the 200-UR-1 Unplanned Release Sites. (4 Pages)

Contaminant	RfD_o (mg/kg·d)[b,c]	Confidence[a]	RfD_{inh} (mg/kg·d)[b,c]	Confidence[a]	SF_o $(mg/kg·d)^{-1}$ [b,c]	SF_{inh} $(mg/kg·d)^{-1}$ [b,c]	Cancer Class[d]	ABS
Ethanol	--	--	--	--	--	--	--	--
Ethylbenzene	1.0E-01	L	2.86E-01	L	1.1E-03	3.85E-03	D	0.97
Ethyl ether	2.0E-01	L	--	--	--	--	--	0.8
Hexane	6.0E-02	L	5.71E-02	L	--	--	--	0.8
Hexanone	--	--	--	--	--	--	--	--
Hydroquinoline, 1,2,3,4-Tetra-	--	--	--	--	--	--	--	--
Methyl ethyl ketone	6.0E-01	L	1.43	M	--	--	--	0.8
Methyl isobutyl ketone	8.0E-02	L	3.57E-01	L/M	--	--	--	0.8
Perchloroethylene (tetrachloroethene)	1.0E-02	L	6.0E-01	L	5.2E-02	5.8E-04	C	1
Phenol	3.0E-01	M/H	--	--	--	--	D	0.9
Pseudo cumenen (1,2,4 trimethyl benzene)	5.0E-02	L	1.71E-03	L	--	--	--	0.8
Tetrahydrofuran	--	--	--	--	--	--	--	--
Toluene	2.0E-01	M	1.14E-01	M	--	--	D	0.8
1,1,1-Trichloroethane	2.0E-01	M	6.29E-01	L	--	--	D	0.9
1,1,2-Trichloroethane	4.0E-03	M	--	--	5.70E-02	5.60E-02	C	0.81
Trichloroethylene	3.0E-04	M	1.14E-02	M	4.00E-01	4.00E-01	--	0.15
Tri-n-octylamine	--	--	--	--	--	--	--	--
Vinyl chloride	3.0E-03	M	2.86E-02	M	1.5	3.08E-02	A	1
Xylenes	2.0E-01	M	2.86E-02	M	--	--	--	0.92

Table 5-2. Toxicological Parameter Values of Nonradiological Contaminants of Concern at the 200-UR-1 Unplanned Release Sites. (4 Pages)

Contaminant	RfD_o (mg/kg·d)[b,c]	Confidence[a]	RfD_{inh} (mg/kg·d)[b,c]	Confidence[a]	SF_o $(mg/kg\cdot d)^{-1}$ [b,c]	SF_{inh} $(mg/kg\cdot d)^{-1}$ [b,c]	Cancer Class[d]	ABS

[a]Confidence associated with IRIS (EPA 2003) database values. Confidence: L = low; M = medium; H = high.
[b]Toxicological parameter values from IRIS electronic database (EPA 2003).
[c]Toxicological parameter value from HEAST (EPA 2001).
[d]EPA weight-of-evidence classification system for carcinogenicity (EPA 1989) taken from IRIS (EPA 2003):

A = Human carcinogen.
B1 = Probable human carcinogen; limited human data are available.
B2 = Probable human carcinogen; sufficient evidence in animals and inadequate or no evidence in humans.
C = Possible human carcinogen.
D = Not classifiable as a human carcinogen.
E = Evidence of noncarcinogenicity for humans.

EPA 1989, *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.
EPA, 2001, *Health Effects Assessment Summary Tables* database.
EPA, 2003, *Integrated Risk Information System* (IRIS) database.

ABS = gastrointestinal absorption coefficient.
COC = contaminant of concern.
EPA = U.S. Environmental Protection Agency.
HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
mg/kg-d = milligram(s) per kilogram-day.
$(mg/kg\text{-}d)^{-1}$ = per milligram per kilogram-day.
RfD_{inh} = inhalation chronic reference dose.
RfD_o = oral chronic reference dose.
SF_{inh} = inhalation slope factor.
SF_o = oral slope factor.
-- = information not available.

Table 5-3. Net Present Worth Cost Estimates. (2 Pages)

Waste Site/Group	Alternative 1: No Action	Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation	Alternative 3: Remove/Treat/ Dispose*
200-E-105	--	$42,350	$305,500
200-E-109	--	$413,300	$3,014,400
200-E-110	--	$42,350	$226,200
200-E-115	--	$42,350	$207,100
200-E-117	--	$42,350	$204,300
200-E-121	--	$169,400	$517,600
200-E-124	--	$42,350	$617,900
200-E-125	--	$42,350	$204,600
200-E-128	--	$42,350	$207,800
200-E-129	--	$42,350	$204,400
200-E-130	--	$42,350	$203,500
200-E-139	--	$169,400	$904,400
200-E-29	--	$169,400	$576,700
200-E-43	--	$42,350	$1,595,000
200-E-53	--	$169,400	$869,900
200-W-106	--	$42,350	$219,800
200-W-14	--	$42,350	$348,600
200-W-53	--	$169,400	$869,900
200-W-63	--	$42,350	$353,000
200-W-64	--	$42,350	$564,300
200-W-67	--	$42,350	$329,200
200-W-80	--	$42,350	$215,000
200-W-81 and UPR-200-W-58	--	$169,400	$1,925,100
200-W-83	--	$42,350	$471,800
200-W-86	--	$42,350	$204,300
200-W-90	--	$42,350	$211,400
600-275	--	$323,875	$625,816
UPR-200-E-10, UPR-200-E-11, UPR-200-E-12, UPR-200-E-20; UPR-200-E-33	--	$225,000	$12,854,700
UPR-200-E-101	--	$42,350	$219,600
UPR-200-E-11	--	See UPR-200-E-10	See UPR-200-E-10
UPR-200-E-112	--	$293,600	$8,814,400
UPR-200-E-12	--	See UPR-200-E-10	See UPR-200-E-10
UPR-200-E-143	--	$169,400	$218,911
UPR-200-E-144	--	$169,400	$ 1,032,800

Table 5-3. Net Present Worth Cost Estimates. (2 Pages)

Waste Site/Group	Alternative 1: No Action	Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation	Alternative 3: Remove/Treat/ Dispose*
UPR-200-E-20	--	See UPR-200-E-10	See UPR-200-E-10
UPR-200-E-36	--	$393,750	$15,655,400
UPR-200-E-50	--	$42,350	$381,600
UPR-200-E-43	--	$42,350	$958,500
UPR-200-E-62	--	$42,350	$205,000
UPR-200-E-69	--	$169,400	$6,727,900
UPR-200-E-88	--	$169,400	$3,351,000
UPR-200-E-89	--	$169,400	$1,491,400
UPR-200-N-1	--	$42,350	$423,500
UPR-200-N-2	--	$42,350	$205,600
UPR-200-W-116	--	$169,400	$598,100
UPR-200-W-123	--	$42,350	$204,200
UPR-200-W-166	--	$169,400	$563,600
UPR-200-W-23	--	$42,350	$199,300
UPR-200-W-3, UPR-200-W-4, UPR-200-W-65; UPR-200-W-73	--	$506,050	$21,233,700
UPR-200-W-4	--	See UPR-200-W-3	See UPR-200-W-3
UPR-200-W-41	--	$229,060	$9,507,800
UPR-200-W-44	--	$42,350	$278,100
UPR-200-W-46	--	$42,350	$800,700
UPR-200-W-58	--	See 200-W-81	See 200-W-81
UPR-200-W-65	--	See UPR-200-W-3	See UPR-200-W-3
UPR-200-W-67	--	$42,350	$204,300
UPR-200-W-69	--	$169,400	$1,048,200
UPR-200-W-73	--	See UPR-200-W-3	See UPR-200-W-3
UPR-200-W-96	--	$42,350	$252,500
UPR-600-12	--	$42,350	$220,900
UPR-600-21	--	$1,286,000	$9,086,700
200-E-26	--	$42,350	$524,700
200-W-15	--	$42,350	$240,700
600-262	--	$42,350	$211,700

*Costs are rounded to the nearest $100.

Table 5-4. Alternative 3: Remove/Treat/Dispose Cost Summary. (3 Pages)

Waste Site/Group	Mobilization	Monitoring and Sampling	Solids Collection	Queue Area Operations	ERDF Disposal	Site Restoration	Revegetation	Demobilization	Construction Staff	Project Management	Miscellaneous Costs*	Total Present Net Worth Cost
Conceptual Site Model (0 – 0.3 m contaminant depth interval)												
200-E-29	$39,990	$125,414	$21,138	$45,503	$234,935	$15,718	$14,716	$8,894	$14,787	$47,313	$8,299	$576,707
200-E-53	$41,531	$167,772	$70,984	$44,604	$404,831	$29,802	$21,617	$7,967	$17,851	$54,636	$8,299	$869,909
200-E-105	$37,968	$94,705	$6,356	$13,579	$72,915	$4,716	$6,204	$8,588	$11,846	$40,283	$8,299	$305,459
200-E-109	$47,558	$579,076	$144,059	$311,794	$1,586,226	$107,280	$75,915	$10,036	$38,997	$105,182	$8,299	$3,014,422
200-E-110	$36,456	$94,256	$2,193	$4,501	$22,284	$5,193	$6,521	$8,360	$7,710	$30,398	$8,299	$226,171
200-E-115	$35,773	$94,258	$938	$2,642	$6,532	$5,183	$6,521	$8,257	$7,888	$30,823	$8,299	$207,114
200-E-117	$35,773	$94,258	$686	$2,309	$4,282	$5,177	$6,521	$8,257	$7,887	$30,819	$8,299	$204,268
200-E-121	$42,147	$113,466	$34,778	$21,748	$198,931	$13,375	$15,396	$9,219	$14,230	$45,982	$8,299	$517,571
200-E-124	$46,875	$94,356	$13,410	$6,349	$24,534	$1,921	$3,221	$7,895	$23,132	$387,927	$8,299	$617,919
200-E-125	$35,773	$94,256	$862	$1,951	$5,407	$5,179	$6,521	$8,257	$7,710	$30,398	$8,299	$204,613
200-E-129	$35,773	$94,257	$733	$2,354	$4,282	$5,179	$6,521	$8,257	$7,887	$30,820	$8,299	$204,362
200-E-130	$35,783	$93,980	$627	$300	$6,532	$276	$1,397	$8,259	$10,625	$37,364	$8,299	$203,442
200-E-139	$44,794	$173,926	$40,452	$81,021	$414,957	$29,591	$26,716	$9,619	$18,590	$56,404	$8,299	$904,369
UPR-200-E-50	$40,115	$95,341	$22,687	$13,987	$129,172	$8,611	$10,600	$8,912	$9,421	$34,486	$8,299	$381,631
UPR-200-E-62	$36,380	$94,259	$743	$2,278	$4,282	$5,187	$6,521	$8,349	$7,889	$30,825	$8,299	$205,012
UPR-200-E-89	$52,979	$250,872	$191,565	$72,617	$648,986	$80,498	$32,630	$9,321	$38,831	$104,785	$8,299	$1,491,383
UPR-200-E-101	$36,197	$94,260	$2,761	$2,699	$16,658	$5,191	$6,521	$8,321	$7,890	$30,828	$8,299	$219,625
UPR-200-E-143	39,335	113,361	33,142	20,813	191,055	12,728	12,162	8,795	13,981	45,387	$8,299	$ 499,058
UPR-200-E-144	$43,033	$197,635	$86,816	$54,528	$493,717	$33,316	$28,081	$9,353	$19,485	$58,542	$8,299	$1,032,805
200-W-53	$41,531	$167,772	$70,984	$44,604	$404,831	$27,241	$23,019	$9,126	$17,851	$54,636	$8,299	$869,894
200-W-63	$43,510	$94,194	$44,197	$7,836	$65,039	$3,992	$3,123	$8,333	$18,422	$56,002	$8,299	$352,947
200-W-64	$44,136	$94,568	$108,041	$19,140	$153,925	$9,757	$5,058	$8,427	$29,774	$83,138	$8,299	$564,263
200-W-67	$38,787	$95,424	$20,561	$8,060	$76,291	$9,326	$7,142	$8,712	$13,170	$43,448	$8,299	$329,220
200-W-80	$35,937	$94,311	$2,657	$2,546	$12,158	$5,380	$6,521	$8,282	$7,946	$30,960	$8,299	$214,997
200-W-81; UPR-200-W-58	$86,244	$155,123	$259,484	$76,291	$468,964	$29,673	$51,864	$14,341	$225,018	$549,828	$8,299	$1,925,129

Table 5-4. Alternative 3: Remove/Treat/Dispose Cost Summary. (3 Pages)

Waste Site/Group	Mobilization	Monitoring and Sampling	Solids Collection	Queue Area Operations	ERDF Disposal	Site Restoration	Revegetation	Demobilization	Construction Staff	Project Management	Miscellaneous Costs*	Total Present Net Worth Cost
200-W-83	$45,691	$94,016	$7,558	$2,202	$15,533	$1,307	$1,916	$8,221	$16,122	$270,963	$8,299	$471,828
200-W-86	$35,773	$94,257	$722	$2,278	$4,282	$5,179	$6,521	$8,257	$7,887	$30,820	$8,299	$204,275
200-W-90	$35,995	$94,259	$1,789	$2,469	$9,908	$5,187	$6,521	$8,291	$7,889	$30,825	$8,299	$211,432
200-W-106	$36,216	$94,260	$2,877	$2,699	$16,658	$5,191	$6,521	$8,324	$7,890	$30,828	$8,299	$219,763
UPR-200-W-46	$57,456	$94,416	$86,750	$26,181	$159,133	$6,680	$14,258	$9,997	$96,035	$241,521	$8,299	$800,742
UPR-200-W-67	$35,773	$94,256	$693	$2,278	$4,282	$5,175	$6,521	$8,257	$7,886	$30,817	$8,299	$204,237
UPR-200-W-69	$42,224	$197,743	$88,691	$55,913	$506,093	$33,975	$27,493	$9,231	$19,624	$58,875	$8,299	$1,048,161
UPR-200-W-116	$39,701	$121,495	$61,239	$24,008	$219,183	$27,750	$13,819	$8,850	$18,215	$55,506	$8,299	$598,065
UPR-200-W-166	$39,644	$120,124	$45,734	$24,008	$219,183	$18,937	$13,548	$8,841	$15,707	$49,512	$8,299	$563,537
UPR-600-21	$57,205	$1,764,392	$447,472	$969,988	$4,927,886	$333,356	$220,340	$11,492	$98,585	$247,617	$8,299	$9,086,632
UPR-200-N-2	$35,773	$94,256	$895	$2,316	$5,407	$5,175	$6,521	$8,257	$7,886	$30,817	$8,299	$205,602
Conceptual Site Model (0 – 2 m contaminant depth interval)												
200-E-43	$48,685	$151,313	$112,612	$148,236	$880,764	$71,227	$10,709	$8,673	$42,059	$112,501	$8,299	$1,595,078
200-E-128	$35,677	$94,055	$1,605	$570	$8,782	$751	$1,346	$8,243	$10,752	$37,668	$8,299	$207,748
UPR-200-E-10; UPR-200-E-11; UPR-200-E-12; UPR-200-E-20; UPR-200-E-33	$156,643	$990,327	$1,304,338	$1,148,682	$6,109,281	$510,157	$173,059	$24,966	$712,908	$1,716,034	$8,299	$12,854,694
UPR-200-E-36	$48,001	$1,356,591	$1,779,648	$1,106,974	$9,957,253	$686,088	$73,317	$10,103	$182,022	$447,055	$8,299	$15,655,351
UPR-200-E-43	$60,831	$107,302	$32,178	$11,751	$1,125	$945	$373,724	$146,924	$7,710	$207,673	$8,299	$958,462
UPR-200-E-69	$55,386	$584,645	$448,497	$690,246	$4,148,165	$294,729	$31,826	$9,684	$131,085	$324,300	$8,299	$6,726,862
UPR-200-E-88	$53,181	$253,342	$224,504	$276,854	$2,072,048	$133,089	$20,741	$9,351	$84,820	$214,712	$8,299	$3,350,941
UPR-200-E-112	$78,974	$659,072	$592,787	$740,294	$5,552,015	$331,721	$58,379	$13,244	$226,420	$553,180	$8,299	$8,814,385
200-W-14	$36,890	$95,337	$21,317	$11,630	$107,795	$8,654	$6,521	$8,436	$9,377	$34,381	$8,299	$348,637
UPR-200-W-3; UPR-200-W-4; UPR-200-W-65; UPR-200-W-73	$95,727	$1,808,026	$2,181,522	$1,469,629	$12,962,496	$924,714	$125,157	$15,773	$480,880	$1,161,416	$8,299	$21,233,657
UPR-200-W-23	$35,388	$93,949	$202	$120	$4,282	$79	$957	$8,199	$10,560	$37,210	$8,299	$199,245

Table 5-4. Alternative 3: Remove/Treat/Dispose Cost Summary. (3 Pages)

Waste Site/Group	Mobilization	Monitoring and Sampling	Solids Collection	Queue Area Operations	ERDF Disposal	Site Restoration	Revegetation	Demobilization	Construction Staff	Project Management	Miscellaneous Costs*	Total Present Net Worth Cost
UPR-200-W-41	$55,338	$820,670	$1,021,611	$652,349	$5,822,371	$474,629	$48,644	$9,677	$171,743	$422,484	$8,299	$9,507,815
UPR-200-W-44	$45,614	$94,256	$8,890	$3,430	$26,785	$3,326	$15,017	$8,209	$15,421	$48,829	$8,299	$278,076
UPR-200-W-96	36,100	94,504	8,163	3,744	36,911	3,539	2,049	8,307	11,489	39,430	$8,299	252,535
UPR-200-W-123	$35,773	$94,257	$676	$2,278	$4,282	$5,179	$6,521	$8,257	$7,887	$30,820	$8,299	$204,229
600-275	$40,173	$126,772	$40,014	$24,979	$286,393	$9,289	$14,349	$8,921	$16,122	$50,505	$8,299	$625,816
UPR-600-12	$36,014	$94,186	$3,476	$1,414	$16,658	$1,570	$1,811	$8,293	$10,978	$38,208	$8,299	$220,907
UPR-200-N-1	$48,213	$95,297	$35,083	$12,810	$90,918	$9,571	$5,227	$8,602	$28,740	$80,665	$8,299	$423,425
Conceptual Site Model (0 – 4.6 m contaminant depth interval)												
200-E-26	$37,314	$97,538	$33,885	$39,617	$204,556	$22,485	$4,547	$8,490	$16,509	$37,314	$8,299	$524,670
200-W-15	$36,332	$94,724	$9,843	$1,991	$21,159	$5,010	$2,451	$8,341	$11,957	$36,332	$8,299	$240,656
600-262	$35,966	$94,571	$4,125	$2,316	$5,407	$6,356	$6,521	$8,286	$8,231	$35,966	$8,299	$211,720

*Miscellaneous cost includes personnel training cost.

Table 5-5. Comparative Analysis of Alternatives.

Parameter	Alternative 1 (No Action)	Alternative 2 (Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation)	Alternative 3 (Remove/Treat/Dispose)
Effectiveness			
• Protects human health and the environment	No	Possible	Yes (permanent protection)
• Complies with ARARs	No	Possible	Yes
• Provides long-term protection	No	Yes (with maintenance of existing soil covers)	Yes
• Provides short-term effectiveness	Possible (only for sites with existing soil covers)	Yes (if controls fail, risk to intruders and/or ecological receptors could be at unacceptable levels)	Yes (unless deep contamination is left at sites at concentrations that exceed groundwater protection)
• Reduces toxicity, mobility, volume	Yes (through natural attenuation such as radioactive decay)	Yes (through natural attenuation such as radioactive decay)	Not applicable
• Time to achieve protection	130 years	130 years	11 days (small sites) to 4 years (larger sites)
Implementability			
• Technical feasibility	Yes	Yes (currently being implemented)	Yes
• Administrative feasibility (government approval, public acceptance)	Unknown	Possible	Yes
Cost	$0	$42,000 to $1,300,000	$200,000 to $21,200,000

Table 5-6. General Decision Justification used for Selection of Preferred Remedy. (2 Pages)

200-UR-1 Waste Sites		Preferred Remedy	Justification
200-E-139 200-E-29 200-W-67 200-W-80 200-W-86 UPR-200-E-101 UPR-200-E-144	UPR-200-W-116 UPR-200-W-166 UPR-200-W-23 UPR-600-12 200-E-26 200-W-15	MESC/IC/MNA	• Protective of human health and the environment. • Removal cost does not support low risk posed by site. • Maintaining and/or augmenting existing soil stabilization cover eliminates direct exposure pathway. Radioactive contaminants remaining beneath the soil cover will decay in place. • Because the covered UPR sites are associated with solid particulate radiological contaminants or small volume liquid releases, groundwater is not impacted. Confirmatory sampling of the potentially contaminated soil below the stabilization cover will be conducted to determine the nature of the contaminants. If radionuclides occur at levels where decay would not reduce concentrations below preliminary remediation goals in 130 years or less, the site would be cleaned up through the RTD remedy.
200-E-105 200-E-109 220-E-110 220-E-115 200-E-117 200-E-121 200-E-124 200-E-125 200-E-128 200-E-129 200-E-130 200-E-43 200-E-53 200-W-106 200-W-14 200-W-53 200-W-63 200-W-64 200-W-81 200-W-83 200-W-90 600-275 UPR-200-E-10 UPR-200-E-11 UPR-200-E-112 UPR-200-E-12 UPR-200-E-143	UPR-200-E-20 UPR-200-E-33 UPR-200-E-36 UPR-200-E-43 UPR-200-E-69 UPR-200-E-88 UPR-200-E-89 UPR-200-N-1 UPR-200-N-2 UPR-200-W-123 UPR-200-W-166 UPR-200-W-3 UPR-200-W-4 UPR-200-W-41 UPR-200-W-44 UPR-200-W-46 UPR-200-W-58 UPR-200-W-65 UPR-200-W-67 UPR-200-W-69 UPR-200-W-73 UPR-200-W-96 600-262 UPR-600-21 UPR-200-E-50 UPR-200-E-62	RTD*	• Protective of human health and the environment. • Provides a permanent solution based on criteria to reduce toxicity, mobility, and/or volume of waste. • Cleanup can be completed using observational approach. • Eliminates the need to conduct remedial investigation/feasibility study. • Can be cost effective and efficient if integrated as part of the overall implementation strategy for remedial activities in the Central Plateau.

Table 5-6. General Decision Justification used for Selection of Preferred Remedy. (2 Pages)

200-UR-1 Waste Sites	Preferred Remedy	Justification
None at this time	No Action	No candidate RTD sites have been identified for this alternative. As field-screening characterization activities are performed at RTD or MESC/MNA sites, candidate sites for No Action may be identified. Field investigation/sampling results indicating that a No Action response is appropriate would be presented for regulatory concurrence through the TPA-MP-14 process.[b]

[a]Site criteria that provide bias for selection of the RTD remedy alternative include the following:

- UPR sites with no soil stabilization cover.
- Railroad UPR sites. Because rail cars were used extensively to carry radiologically contaminated equipment and/or waste fluids, and known release locations have been identified, these UPR sites have a potential for undocumented contamination. Long-lived radionuclides may be present.

[b]In accordance with RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)."

IC = institutional control.
MESC = maintain existing soil cover.
MNA = monitored natural attenuation.
RTD = remove/treat/dispose.
UPR = unplanned release.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
1	200-E-105	200-E-105, Soil Contamination Area on the 216-B-61 Crib	B Farm	Crib	Vegetation (tumbleweeds)	S	0.3	1,716	Radioactive	N	SCA, CA		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Estimated cost is for removal of entire upper 0.3 m (1 ft) of site area, but probably only hot spot removal of radiologically contaminated tumbleweed parts and underlying soil will be required. Removal of contaminated tumbleweeds at this site is being conducted as part of Hanford Site surveillance and maintenance operations.
2	200-E-109	200-E-109, Contamination Spread in Northeast Corner of 200 East Area	WTP/ETF/A/C	Roadway/Outlying Area	Vegetation (tumbleweeds)	S	0.3	39,492	Radioactive	N	CA, RBA, HCA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Estimated cost is for removal of entire upper 0.3 m (1 ft) of site area, but probably only hot spot removal of radiologically contaminated tumbleweed parts and underlying soil will be required. Removal of contaminated tumbleweeds in the area is being conducted as part of Hanford Site surveillance and maintenance operations.
3	200-E-110	200-E-110, Contaminated Tumbleweed Dump Site	WTP/ETF/A/C	Outlying Area	Vegetation (tumbleweeds)	S	0.3	469	Radioactive	N	CA, RCA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Estimated cost is for removal of entire upper 0.3 m (1 ft) of site area, but probably only hot spot removal of radiologically contaminated tumbleweed parts and underlying soil will be required.
4	200-E-115	200-E-115; Contamination Area East of 241-C Tank Farm	WTP/ETF/A/C	Outlying Area	Unknown	S	0.3	84	Radioactive	N	CA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	No radiological survey data available to provide information about the radiological conditions inside the fenced and posted area.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
5	200-E-117	200-E-117, Contamination South of B Plant	B Plant	Outlying Area	Unknown	S	0.3	9	Radioactive	N	CA		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	The site is a small posted contamination area. The reason it is posted is unknown, but a survey in 2000 identified radiologically contaminated valves inside the posted area.
6	200-E-121	200-E-121, Soil Contamination Area East and West of Baltimore Avenue	B Farm	Roadway/Outlying Area	Windblown Particulates	S	0.3	4,876	Radioactive	N	SCA, FC		X	No stabilization cover present. Selected remedy of removal is most protective of potential receptors (human and ecological)	Estimated cost is for removal of entire site area. The surface of this waste site has been scraped off in the past; probably only hot spot removal will be needed.
7	200-E-124	200-E-124, URM on East Side of 275-EA	PUREX	Railroad	Leak/Spill	S	0.3	294	Radioactive	Y	URM		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy.	Railroad loading and unloading area. Historically, surface radiological contamination resulting from leaks/spills from railroad cars was common.
8	200-E-125	200-E-125, Contamination Area Northwest of 244-AR Building	PUREX	Outlying Area	Unknown	Unknown	0.3	30	Radioactive	N	CA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	The site is delineated with fencing and radiological posting as Contamination Area. No radiological survey information is available.
9	200-E-128	200-E-128, Radioactive Contamination "Hot Spot" Under Gravel Road	Solid Waste	Roadway	Unknown	Unknown	2	0.02	Radioactive	N	URM		X	No stabilization cover is present so the direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological).	The radiological contamination has been detected under the surface of a gravel road. Radiation monitors have noted increased radiological activity when driving over this section of road. Digging below this section of road revealed increased levels of radioactivity. Removed soil was replaced and the area posted as URM.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
10	200-E-129	200-E-129, Stabilized Area on East Side of B Plant Railroad Cut	B Plant	Outlying Area	Unknown	Unknown	0.3	22	Radioactive	Y	URM		X	Potential for long-lived radionuclides at railroad sites. Removal action provides permanent remedy.	Site consists of a small area of radiological contamination identified near the north end of the B Plant Railroad Cut berm. The site appears to be associated with the B Plant railroad contamination. This site has been stabilized with a layer of clean soil.
11	200-E-130	200-E-130, Stabilized Area on West Side of B Plant Chemical Spur	B Plant	Railroad	Unknown	Unknown	0.3	60	Radioactive	Y	URM		X	Potential for long-lived radionuclides at railroad sites. Removal action provides permanent remedy.	No radiological survey or other reports available to determine what the radiological conditions were at the time the site was posted. This site location is along the B Plant railroad spur.
12	200-E-139	200-E-139, Contamination Area North of C Farm	WTP/ETF/A/C	Outlying Area	Unknown	Unknown	0.3	7,880	Not specified	Y	URM	X		Stabilization cover eliminates direct exposure pathway.	Large posted URM area. Site is fenced and contains growing rabbit brush and tumbleweeds. No information concerning radiological conditions or reason for posting.
13	200-E-29	200-E-29, Unplanned Release from 241-ER-152 Diversion Box	B Plant	Diversion Box	Biological Intrusion/Animal Feces	S	0.3	4,609	Radioactive	Y	URM	X		Cleanup of contaminated animal materials performed in the past. Stabilization cover eliminates direct exposure pathway if any residual contamination is present.	Biointrusion site surrounding diversion box. Large site area indicated in WIDS. Contamination consisting of animal materials (carcasses, urine, feces, and ant hill) has been removed. Diversion box is likely source of contamination.
14	200-E-43	200-E-43, Tank Car Storage Area, Regulated Equipment Storage Area, TC-4 Spur Tank Car Storage Area	200-E Admin	Railroad	Leak/Spill	L	2	3,275	Unknown	Y	URM		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy.	Historically, surface contamination resulting from railroad cars was common. The area was used as a staging area for tank cars transporting liquid waste. Entire site area defined in WIDS was used in cost model with assumption of potentially 2 m (6.6 ft) depth of contamination. Probable actual contaminant soil/material volume is lower because only hot spots may be present.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
15	200-E-53	200-E-53, Contaminated Adjacent to 218-E-12B and 218-E-8	Solid Waste	Outlying Area	Biological Intrusion/Animal Feces	S	0.3	10,000	Radioactive	N	SCA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Large area with spotty animal feces contamination. Cleanup probably only would entail hot spot removal.
16	200-W-106	200-W-106, Soil Contamination Area Adjacent to 200-W-55	200-W Pond	Outlying Area	Unknown	Unknown	0.3	330	Not specified	N	SCA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Contaminant source is unknown. Fifteen small separate contaminant areas identified within site boundary.
17	200-W-14	200-W-14, 200 West Heavy Equipment Storage Area	PFP	Storage Yard	Leak/Spill	L	2	360	Hazardous	N	None		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Equipment storage yard (currently still active?). Several areas with hydrocarbon-contaminated soil.
18	200-W-53	200-W-53, UPR-200-W-166, UN-216-W-31	T Farm	Outlying Area; Other (retention basin)	Windblown Particulates	S	0.3	14,494	Mixed	N	URM		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Original site area consisted of specks of radiologically contaminated particulates that had blown across the ground surface from the adjacent 241-T Tank Farm. The contaminated soil was scraped off in 1997. Sufficiency of prior removal unknown. Potential extent of any current contamination, if present, is assumed to be considerably less than originally defined site boundary. Scraped soil was placed inside the 207-T Retention Basins. The scraped area is currently posted as URM Area.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
19	200-W-63	200-W-63, Contaminated Concrete Pad	T Farm	Other (concrete pad)	Not specified	L	0.3	585	Radioactive	Y	URM		X	Distribution of contaminants in cracks is unknown. Potential for long-lived radionuclides in foundation pad. Removal action provides permanent remedy.	Current area is concrete pad that was used for aboveground tanks. Tanks have been removed and pad covered with gravel. A 1997 radiological survey confirmed beta/gamma and alpha contamination.
20	200-W-64	200-W-64, 2724-W Contaminated Laundry Facility Building Foundation	T Plant	Other (concrete pad/foundation)	Not specified	L	0.3	1,344	Radioactive	N	URM, FC		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Contamination is part of remaining portion of building foundation. Extent of contamination in cracks is unknown.
21	200-W-67	200-W-67, Contaminated Soil at the Corner of Cooper and 16th Street	S/U Farm	Roadway	Biological Intrusion/Animal Feces; Windblown Particulates	S	0.3	1,800	Radioactive	Y	URM	X		Stabilization cover eliminates direct exposure pathway.	Specks of windblown radiological contaminant assumed to be from adjacent tank farm. A contaminated ant hill also was found. Area was surface stabilized in 1998.
22	200-W-80	200-W-80; Mound of Contaminated Soil Southwest of T Plant	T Plant	Outlying Area	Other (Soil mound)	S	0.3	218	Radioactive	Y	URM	X		Stabilization cover eliminates direct exposure pathway.	Former soil mound containing pieces of asphalt. May be remnants of T Plant parking lot expansion. No contamination associated with the mound based on a radiological survey conducted in 1999. In 2000, the mound of soil was flattened and covered with a clean layer of soil.
23	200-W-81	200-W-81; Contaminated Tumbleweed Fragments Along Railroad Track East of 218-W-3AE	WM	Railroad	Vegetation (tumbleweeds)	S	0.3	394	Radioactive	N	CA		X	No stabilization cover so direct exposure pathway is present. Preferred remedy of removal is most protective of potential receptors (human and ecological). This site has been grouped with UPR-200-W-58 for costing purposes.	The site is located on the railroad tracks east of the burial grounds in the 200 West Area. Windblown radioactive tumbleweeds and tumbleweed fragments were identified along the tracks. It is suspected that the radioactive tumbleweeds came from the south end of Site 218-W-3A. Cleanup action may simply require picking up contaminated tumbleweed parts.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
24	200-W-83	200-W-83, Contamination Area North of 2727-W	PFP	Railroad	Unknown	Unknown	0.3	139	Radioactive	N	CA		X	No stabilization cover present. Railroad track sites have potential for process waste liquid leaks/drips from tanker cars. Preferred remedy of removal is most protective of potential receptors (human and ecological)	A radiological problem report for this area was issued in March 1990. The current extent of contaminated media is unknown.
25	200-W-86	200-W-86, Contamination Area Around Light Pole	U Plant	Railroad/roadway	Unknown	Unknown	0.3	9	Radioactive	Y	URM	X		Stabilization cover eliminates direct exposure pathway. Very small area of contamination currently defined. Exposure potential is small.	Site is associated with area formerly posted as SCA. After removal of a utility pole, the area was covered with clean backfill and posted as URM.
26	200-W-90	200-W-90, Underground Radioactive Material Areas posted along 23rd Street in 200 West Area	WM/T Farms	Outlying Area	Unknown	Unknown	0.3	56	Radioactive	N	URM		X	No stabilization cover is present. No information on subsurface contaminant characteristics. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Site consists of three similar-sized posted URM areas. No radiological survey information exists concerning why the site was posted.
27	600-275	600-275, 218-W-14, Igloo Site, Army Ammo Site, Regulated Storage Area	None	Storage Yard	Leak/spill	S/L	2	15,750	Mixed	N	None		X	No stabilization cover is present. No information on subsurface contaminant characteristics. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Site consists of rectangular mounds of soil where seven storage igloos had been located. Plutonium scrap had once been stored in barrels of carbon tetrachloride in one of the igloos. Potential and extent of any contamination has high uncertainty. Entire former footprint area of igloos used in costing.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
28	UPR-200-E-10	UPR-200-E-10, Contaminated PUREX Railroad Spur, UN-200-E-10	PUREX	Railroad	Leak/Spill	S	2	Not specified	Radioactive	N	Not separately posted from other postings on the railroad tracks		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Radiological contamination occurred in 1957 from failed waste concentrator tube bundles. Contamination removed from railroad tunnel by excavation and flushing. Some fixed contamination may remain. Sufficiency of decontamination efforts to meet PRGs unknown. Cost estimate grouped associated PUREX railroad sites (UPR-200-E-10, UPR-200-E-11, URP-200-E-12, UPR-200-20, UPR-200-E-33).
29	UPR-200-E-101	UPR-200-E-101, UN-216-E-30, UN-216-E-101, UN-200-E-101, Radioactive Spill Near 242-B Evaporator	B Farm	Outlying Area	Vegetation (tumbleweeds); Windblown Particulates	S	0.3	312	Radioactive	Y	URM	X		Stabilization cover eliminates direct exposure pathway. Exposure potential is small.	Radiological contamination is suspected to be the result of windblown particulates from adjacent tank farm and contaminated tumbleweeds.
30	UPR-200-E-11	UPR-200-E-11, Railroad Track Contamination Spread, UN-200-E-11	Solid Waste/B Plant/Semi-Works/PUREX	Railroad	Leak/Spill	L	2	Not specified	Radioactive	Y	URM (portions of the TC spur and sections of track south of burial grounds)		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy.	Long section of rail line that is part of track system extending from PUREX to the burial grounds. Historical documentation of dripping fission products on the track system when PUREX facility was active. Existing contamination, if present, may be only spotty but disseminated over a great distance. Cost estimate grouped associated PUREX railroad sites (UPR-200-E-10, UPR-200-E-11, URP-200-E-12, UPR-200-20, UPR-200-E-33).
31	UPR-200-E-112	UPR-200-E-112, UN-200-E-112, Contaminated Railroad Track from B Plant to the Burial Ground	Solid Waste/B Plant	Railroad	Leak/Spill	L	2	Not specified	Mixed	N	None		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological)	Long section of rail line that is part of track system extending from B Plant to the burial grounds. Historical documentation of radiological contaminant dripping onto tracks. Previous decontamination efforts were conducted. Cost estimate included the complete length of the tracks. Existing contamination, if present, may be only spotty but disseminated over a great distance.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
32	UPR-200-E-12	UPR-200-E-12, Contaminated PUREX Railroad Spur, UN-200-E-12	PUREX	Railroad	Leak/Spill	L	2	Not specified	Radioactive	Y	Portions of the track posted with URM		X	Potential for long-lived radionuclide liquid releases. Removal action provides permanent remedy.	Site is part of rail line track system extending from PUREX to the burial grounds. Historical documentation of dripping fission products on the track system when PUREX facility was active. Existing contamination, if present, may be only spotty but disseminated over a great distance. Cost estimate grouped associated PUREX railroad sites (UPR-200-E-10, UPR-200-E-11, URP-200-E-12, UPR-200-20, UPR-200-E-33).
33	UPR-200-E-143	UPR-200-E-143, Contamination Adjacent to 244-A Lift Station, UN-216-E-43	PUREX	Outlying Area	Biological Intrusion, Animal Feces; Windblown Particulates	S	0.3	Not specified	Radioactive	No for UPR site (contaminated soil that was removed from UPR-200-E-143 was placed in 216-A-40 Retention Basin and surface stabilized)	The release is not separately marked or posted. Various radiological postings exist in the vicinity.		X	Removal action needed for radiologically contaminated animal feces in this area should be a reduced level of effort because of prior cleanup activities.	No defined site boundaries. A series of radiological surveys and cleanup operations have been performed in the site area to remove radiologically contaminated rabbit feces. In 1994 a large area of surface contamination associated with this site was scraped and placed into the 216-A-40 Retention Basin before the basin was backfilled and surfaced stabilized. Current contaminant distribution at site is uncertain. Locations adjacent to tank farm are problematic because of continued potential for animal intrusion/ radiological feces production and windblown particulates.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended) MESC/IC/MNA	RTD	Justification	Key Site Information
34	UPR-200-E-144	UPR-200-E-144, Soil Contamination North of 241-B, UN-216-E-44	B Farm	Outlying Area	Windblown Particulates	S	0.3	12,141	Radioactive	Y	URM (for soil pile created by scraping site area)	X		Stabilization cover eliminates direct exposure pathway.	Original 25-acre site was scraped to remove windblown radioactive particulate specks on the surface that were assumed to have originated from adjacent tank farm. Contaminated soil was consolidated into a 3 to 4 acre soil pile. Clean soil has been used to surface stabilize the consolidated soil. Current site is defined as the surface-stabilized soil pile. Scraped area was released from radiological controls based on radiological survey and 218 analytical sampling results.
35	UPR-200-E-20	UPR-200-E-20, Contaminated PUREX Railroad Spur, UN-200-E-20	PUREX	Railroad	Leak/Spill	L	2	Not specified	Radioactive	N	The release is not separately marked or posted from other railroad sites. Various radiological postings exist in the vicinity.		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological). Because of their proximity and associated site characteristics, PUREX railroad sites (UPR-200-E-10, UPR-200-E-11, URP-200-E-12, UPR-200-20, UPR-200-E-33) were grouped together for costing purposes.	Site is associated with an occurrence reported in 1959 relating to leaking PUREX tube bundles in transit for burial. There is no reference to any cleanup activity at this site.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
36	UPR-200-E-33	UPR-200-E-33, Contaminated PUREX Railroad tracks, UN-200-E-33	PUREX	Railroad	Leak/Spill	L	2	Not specified	Mixed	N	None		X	No stabilization cover present. Preferred remedy of removal is most protective of potential receptors (human and ecological). Because of their proximity and associated site characteristics, PUREX railroad sites (UPR-200-E-10, UPR-200-E-11, URP-200-E-12, UPR-200-20, UPR-200-E-33) were grouped together for costing purposes.	Site is associated with a leaking tube bundle burial box that contaminated a portion of the railroad in 1964. It is reported that decontamination activities were successful but no details are provided.
37	UPR-200-E-36	UPR-200-E-36, Road Contamination North of Semiworks, UN-200-E-36	Semi-Works	Roadway/Outlying Area	Leak/Spill	L	2	37,626	Radioactive	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if site is located and contaminants are identified.	No site boundaries are defined. Site is approximately located. UPR-200-E-36 is described as contamination in a fan-shaped area on the road and north of the A Cell at the strontium Semiworks resulting from a release while removing two pumps from the A Cell. The roadways were flushed with water.
38	UPR-200-E-43	UPR-200-E-43, Road Contamination near 241-BY Tank Farm, UN-200-E-43	B Farm	Roadway	Leak/Spill	L	2	Not specified	Radioactive	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if site is located and contaminants are identified.	No site boundaries are defined. Site is approximately located. Contamination is associated with leaking pump being transported between areas. Decontamination of roadway was documented but no record or effectiveness of cleanup was found.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
39	UPR-200-E-69	UPR-200-E-69, UN-216-E-69, Railroad Car Flush Water Radioactive Spill, UN-200-E-69	B Plant	Railroad	Leak/Spill	L	2	Not specified	Radioactive	Y	URM		X	Potential for long-lived radionuclide liquid releases. Removal action provides permanent remedy.	No site dimensions specified in WIDS. Site area estimated based on boundaries defined in Graphic Information System database (approximately extent of soil-stabilized track area). Reported contamination is associated with a liquid release event along rail line. May be only hot spot contamination from drips rather than continuous lateral contamination.
40	UPR-200-E-88	UPR-200-E-88, TC-4 Spur Contaminated Railroad Track, UN-216-E-88, UN-216-E-16, UN-200-E-88, Ground Contamination Around the Western PUREX Railroad Spur	200-E Admin	Railroad/Outlying Area/Storage Area	Vegetation (tumbleweeds); Windblown Particulates	L	2	Not specified	Radioactive	Y	URM		X	Potential for long-lived radionuclide liquid releases. Removal action provides permanent remedy.	Railroad spur intended for short-term parking of railroad cars used for transporting radioactive liquids. Surface contamination identified in the rail area. May be only hot spot contamination from drips rather than continuous lateral contamination. Radioactive tumbleweeds also have accumulated along the fenced area and have been cleaned up in the past. The site was surface stabilized in 1998.
41	UPR-200-E-89	UPR-200-E-89, UN-216-E-17, UN-200-E-89, Contamination Migration to the North, East, and West of BX-BY Tank Farms	B Farm	Outlying Area/Other (concrete pad)	Vegetation (tumbleweeds); Windblown Particulates	S	0.3	12,141	Mixed	Y	URM (this posting is for soil removed from the site, placed on the 216-B cribs, and covered with a soil stabilization layer)		X	Some remaining hot spots of surface contamination may require removal to eliminate the direct exposure pathway	Airborne particulate matter suspected as originating from the adjacent tank farm resulted in original contaminant distribution. In 1991, the contaminated area was scraped. The removed soil was placed on top of the 216-B-43 through 216-B-50 Cribs and was surface stabilized with a cover of clean soil. Following scraping of the site, 83 soil samples were collected and screened for total alpha and total beta. All samples were below release limits. If any additional soil removal is required, it is suspected to be limited to hot spot removal.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
42	UPR-200-N-1	UPR-200-N-1, Unplanned Release at the 212-R Railroad Spur	200-E Pond	Railroad	Leak/Spill	L	2	223	Radioactive	N	CA, Radiation Area, SCA,		X	No soil stabilization cover is present. Removal performed to eliminate direct exposure pathway.	Historically used as a maintenance area for repair of contaminated rail cars. Various radiological postings have been used, depending on contaminant levels of the rail cars parked in the area. Over time, movement of rail cars has caused the track to become contaminated.
43	UPR-200-N-2	UPR-200-N-2, 200-N-2, Unplanned Release near Well Pumphouse No. 2, Well Pumphouse East of 212-R	200-E Pond	Outlying Area	Unknown	Unknown	0.3	37	Unknown	N	URM		X	Removal performed to eliminate potential exposure.	Small area containing two open wood-lined holes with values inside. Area surrounded by lightweight chain barrier. Nature of contamination is unknown.
44	UPR-200-W-116	UPR-200-W-116, UN-216-W-26, Ground Contamination North of 202-S, UN-200-W-116	REDOX	Railroad/Outlying Area	Windblown Particulates	S	0.3	8,094	Radioactive	Y	URM (This applies to portion of site consisting of scraped soil that has been consolidated and stabilized with a clean soil cover)	X	X (applies to portion of site that consists of the chemical spur railroad track that has been soil stabilized).	Stabilization cover eliminates direct exposure pathway to scraped soil. The covered portion of the site consisting of the chemical spur railroad track should be remediated.	Original radiological contamination is suspected to be the result of windblown particulates from the waste storage tank exhaust and a railroad tanker car unloading station. The area of windblown soil contamination has been scraped, consolidated, and surface stabilized with clean soil. A portion of the adjacent chemical spur railroad track has a soil stabilization cover.
45	UPR-200-W-123	UPR-200-W-123, 204-S Unloading Facility Frozen Discharge Line, UN-200-W-123	REDOX	Railroad	Leak/Spill	L	2	Not specified	Mixed	Y	None		X	Potential for long-lived radionuclide liquid releases. Removal action provides permanent remedy.	No specified site dimensions in WIDS. The small liquid release to the ground was reported as being cleaned up. This railroad loading station was decontaminated and dismantled in 1983. The area was covered with a layer of clean soil.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended) MESC/IC/MNA	RTD	Justification	Key Site Information
46	UPR-200-W-166	UPR-200-W-166, Contamination Migration from 241-T Tank Farm, UN-216-W-31	T Farm	Outlying Area	Windblown Particulate	S	0.3	14,569	Radioactive	N	None for area of site that has been scraped. URM (This applies to portion of site consisting of scraped soil that has been consolidated and stabilized with a clean soil cover)	X (applies to soil that was removed from site, placed along trenches and in retention basin, and then covered with clean soil)	X	No stabilization cover present on scraped area. Preferred remedy of removal is most protective of potential receptors (human and ecological)	The site originally consisted of spotty particulate specks of radiological contamination suspected to have originated from the adjacent 241-T Tank Farm. The areas of soil contamination were scraped off in 1996 and consolidated onto the west slope of the 216-T-14 through 216-17 Trenches and into the 207-T Retention Basin. Scraped and consolidated soil has been surface stabilized. The scraped area was radiologically surveyed, sampled, and released from radiological posting. Extent of any residual contamination, if present, is suspected to be small.
47	UPR-200-W-23	UPR-200-W-23, Waste Box Fire at 234-5Z, UN-200-W-23	PFP	Outlying Area	Other (Fire)	S	2	28	Mixed	Y	None currently. In 1953 posted with "Danger-Do Not Excavate In This Area Without SWP Permission."	X		Stabilization layer eliminates direct exposure pathway. Site no longer can be located.	The site originated because of a release associated with a fire in a waste box. The fire caused spread of plutonium contamination. In 1953, the site was covered with blacktop. The site is no longer marked or posted and cannot be located.
48	UPR-200-W-3	UPR-200-W-3, Railroad Contamination, UN-200-W-3	T Plant	Railroad	Unknown	Unknown	2	3	Mixed	N	CA		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway. Because of its proximal location and potential contaminant relationships, this site was grouped with UPR-200-W-4, UPR-200-W-65, UPR-200-W-73 for costing.	The site is a small posted area near the railroad cut and T Plant fence. Suspected to be associated with railroad track contamination.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
49	UPR-200-W-4	UPR-200-W-4, Railroad Contamination, UN-200-W-4	T Farm	Railroad	Unknown	Unknown	0.3	Not specified	Mixed	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway. Because of its proximal location and potential contaminant relationships, this site was grouped with UPR-200-W-3, UPR-200-W-65, UPR-200-W-73 for costing.	This site is not marked or posted and includes the section of railroad line extending from T-Plant Canyon Building to the Burial Grounds. Site is associated with radiological contamination that resulted from a release from a burial box transported from the 221-T Canyon Building to the Heavy Equipment Burial Ground. Decontamination activities reportedly were conducted.
50	UPR-200-W-41	UPR-200-W-41, Railroad Contamination, UN-200-W-41, REDOX Railroad Cut Contamination	REDOX	Railroad	Leak/Spill	L	2	Not specified	Mixed	Y	URM		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy.	Current site area defined by a soil stabilization cover. Contaminated portion of site is the railroad line that has been buried by addition of clean soil and by pushing in the berms of the former railroad cut walls. Contaminated railroad track resulted from transportation of contaminated materials in and out of the REDOX facility.
51	UPR-200-W-44	UPR-200-W-44, Railroad Track Contamination, UN-200-W-44	REDOX/U Plant/SU Farm/T Plant	Railroad	Leak/Spill	S	2	46	Mixed	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if site is located and contaminants are identified.	Exact site location is not specific. Radiological releases occurred at unknown locations along the railroad line used between REDOX and T Plant.
52	UPR-200-W-46	UPR-200-W-46, Contaminated Railroad Track, H-2 Centrifuge Burial, UN-200-W-46	REDOX	Railroad	Leak/Spill	S	0.3	Not specified	Mixed	Y	URM		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy.	Site is associated with radiological contaminant releases that occurred along the railroad line coming out of the REDOX facility. This track section has been stabilized with a layer of clean soil.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
53	UPR-200-W-58	UPR-200-W-58, Railroad Track Contamination, UN-200-W-58	WM	Railroad	Leak/Spill	S	0.3	Not specified	Mixed	N	Not separately posted from other postings on the railroad tracks		X	Composition of liquid releases is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy. Because of its proximal location and potential contaminant relationships, this site has been grouped with 200-W-81 for costing purposes.	Site is associated with radiological contaminant releases that occurred along the railroad line used between T Plant and the 200 West Burial Ground. This UPR is not separately posted from other postings on the railroad track.
54	UPR-200-W-65	UPR-200-W-65, Contamination in the T Plant Railroad Cut, UN-200-W-65	T Plant	Railroad	Unknown	S	0.3	114	Mixed	N	CA		X	Composition of release(s) is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy. Because of its proximal location and potential contaminant relationships, this site has been grouped with railroad sites UPR-200-W-3, UPR-200-W-4, UPR-200-W-73 for costing purposes.	Site is associated with radiological contaminant release that occurred along the railroad line used for T Plant. Contaminated equipment was sent to T Plant on railcars for repair and decontamination. Spots of contamination noted in 1969 reportedly were cleaned up.
55	UPR-200-W-67	UPR-200-W-67, Contamination near 2706-T, UN-200-W-67	T Plant	Storage Yard	Other (Contamination from vehicle)	S	0.3	7	Mixed	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if site is located and contaminants are identified.	Site location is indeterminate. This UPR site is associated with ground contamination identified below a contaminated electric lift. The site is not marked or posted. A very small area is reported as part of the surface contamination identified in 1970. No information on prior cleanup activities.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m²)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
56	UPR-200-W-69	UPR-200-W-69, Railroad Contamination, UN-200-W-69	REDOX	Outlying Area	Windblown Particulates	L	0.3	Not specified	Mixed	N	Not separately posted from other postings on the railroad tracks		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if site is located and contaminants are identified.	No site dimensions specified in WIDS. Potential site extent was estimated based the description of contaminant distribution provided in WIDS. Radiological contamination resulted from windblown material from a contaminated drain pit. Cleanup activities have been conducted in the past. Extent of any residual contamination is unknown, but suspected to be only hot spots.
57	UPR-200-W-73	UPR-200-W-73, Contaminated Railroad Track at 221-T, UN-200-W-73	T Plant	Railroad	Leak/Spill	L	2	2,231	Mixed	N	CA		X	Composition of release(s) is unknown. Potential for long-lived radionuclides. Removal action provides permanent remedy. Because of its proximal location and potential contaminant relationships, this site has been grouped with railroad sites UPR-200-W-3, UPR-200-W-4, UPR-200-W-65 for costing purposes.	Site is associated with radiological contaminant releases that occurred on the railroad track near the 221-T Building tunnel. Contamination spread from a leaking multi-purpose transfer box in 1974. The occurrence report did not report any cleanup of the railroad tracks or ground. This UPR is not separately posted from other postings on the railroad track.
58	UPR-200-W-96	UPR-200-W-96, UN-216-W-4, 233-S Floor Overflow, 233-SA Floor Overflow	REDOX	Adjacent to Building	Leak/Spill	L	2	Not specified	Radioactive	Y	URM		X	Liquid release may have contained long-lived radionuclides. Removal action provides permanent remedy if contamination is found.	Release is described as plutonium- contaminated water that backed up the drain in the 233-SA Filter House and overflowed out to a low spot on the ground. The ground was covered with clean gravel and later with an asphalt roadway. WIDS describes the site as the floor of the 233-SA Filter Exhaust building, the electric motor concrete pad, and the ground surface outside the filter exhaust building.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
59	UPR-600-12	UPR-600-12, UN-600-12, UNH Spill to Route 4S	NRDWL/BC Control	Roadway	Leak/Spill	L	2	16	Mixed	Y	URM	X		Stabilization cover eliminates direct exposure pathway.	This site is the result of a tractor trailer that overturned and spilled uranium nitrate hexahydrate solution onto the road and shoulder in 1954. Cleanup activities were conducted following the occurrence. In 1998, an area of contamination was identified near the reported spill location. In late 1999, the area was covered with clean material and posted as URM.
60	200-E-26	200-E-26, Heavy Equipment Storage Area, Diesel Fuel Contaminated Soil	B Plant	Storage Yard	Leak/Spill	L	4.6	334	Hydrocarbon	Y	None	X		Stabilization cover eliminates direct exposure pathway.	The site is an equipment staging area for trucks, backhoes, compressors, and other heavy equipment. Soil staining and diesel fuel odor have been reported. Crushed gravel has been added to the area possibly covering some hydrocarbon-contaminated soil. An electrical receptacle marks each end of the site.
61	200-W-15	200-W-15, S-Plant Project W-087 Hexone Discovery	REDOX	Other (Pipe trench)	Leak/Spill	L	4.6	30	Hazardous	Y	None	X		Stabilization cover eliminates direct exposure pathway.	Excavation of a trench to install a new pipe in 1995 resulted in exposing hexone- and surfactant-contaminated soil. The hexone soil was returned to the trench after installing the pipe. There is no visual evidence of the excavation and the area is now under asphalt.
62	600-262	600-262, West Lake Test Crib	600	Outlying Area	Other (Test Crib Experiment)	L	4.6	59	Hazardous	N	None		X	Remove crib and abandon wells as precautionary action because of shallow depth of groundwater in this area.	Model test crib used for infiltration and tracer testing intermittently since 1959. Numerous observation/monitoring wells are also situated around the crib. One documented test reported using a short-lived radionuclide (Sr-85) and highly soluble calcium nitrate. No current contamination is likely, but wells should be removed or abandoned to eliminate path to groundwater. Depth to groundwater is 12 ft.

Table 5-7. Key Waste Site Information and Justification for Preferred Remedy Identified for each Unplanned Release Site. (18 Pages)

	Site Code	Site Name	Facility Area	Physical Setting	Release Mechanism Reported in WIDS	Release Type Reported in WIDS (Liquid/Solid)	CSM Potential Vertical Extent (m)	Site Area Reported in WIDS (m^2)	Potential Contaminants Reported in WIDS	Stabilization Cover Present (Y/N)	Site Posting	Preferred Remedial Alternative (X=recommended)		Justification	Key Site Information
												MESC/IC/MNA	RTD		
63	UPR-600-21	UPR-600-21, Contamination found Northeast of 200 East Area, UN0216-E-31	200 East Ponds	Outlying Area	Vegetation (tumbleweeds); Windblown Particulates	S	0.3	121,406	Radioactive	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if any contaminants are identified.	The site had been as large as approximately 30 acres and contained radiologically contaminated tumbleweeds and possibly specks from PUREX. Over the years, the majority of the contamination has been removed using radiological surveys and cleanup with shovels and buckets. All radiological postings were removed in 1991. If any residual contamination is present, it is assumed to be very limited and sporadic.
64	UPR-200-E-50	UPR-200-E-50, Soil Contamination at the Overground Equipment Storage Yard, UN-200-E-50	WTP/ETF/A/C	Outlying Area	Vegetation (tumbleweeds); Windblown Particulates	S	0.3	3,135	Radioactive	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if any contaminants are identified.	In 1994, surface soil contamination resulted from windblown radioactive material scattered downwind of a radioactive equipment storage area. Some area decontamination was performed and small particles and broken tumbleweeds were removed. Some decontamination required digging to 0.3 m (1 ft). The site is not covered or posted.
65	UPR-200-E-62	UPR-200-E-62, Transportation Spill near 200-E Burning Ground, UN-216-62,UN-200-E-62	Solid Waste	Roadway	Leak/Spill	L	2	2	Radioactive	N	None		X	No soil stabilization cover is present. Preferred remedy of removal performed to eliminate direct exposure pathway if the site can be located and any contaminants are identified.	In 1982, radioactive liquid spilled from a pressure test assembly while in transit. The small area of ground contamination was cleaned up to background and contaminated soil was placed in drums. The site is not marked or posted and its location is uncertain.

CA = Contamination Area.
ETF = Effluent Treatment Facility.
FC = Fixed Contamination.
HCA = High Contamination Area.
PFP = Plutonium Finishing Plant.
PRG = preliminary remediation goal.
PUREX = Plutonium-Uranium Extraction Plant.
RBA = Radiological Buffer Area.
RCA = Radiological Controlled Area.
SCA = Soil Contamination Area.
URM = underground radioactive material.
WIDS = *Waste Information Data System.*
WTP = Waste Treatment Plant.

6.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROCESS

Of the 147 UPR sites, only the BC Controlled Area was identified for evaluation through the full RI/FS process.

The regulatory path for the BC Controlled Area and RTD sites is presented in Figure 6-1. This two-pathway approach leads toward the completion of the ROD for RTD and RI/FS waste sites. The process follows the CERCLA format with modifications to accommodate use of an Action Memorandum for RTD candidate sites. Section 6.1 discusses the regulatory process further.

Section 6.2 outlines the tasks to be completed in conjunction with RTD and RI activities, including planning, conducting field sampling activities, and preparing data result reports. These tasks are designed to effectively manage the work, satisfy the DQOs (identified in Chapter 4.0), document the results of removal actions or RI sampling, and manage the waste generated during field activities.

The RTD site activities are conducted to characterize and remediate in one streamlined field activity. The purpose of the RI for the BC Controlled Area is to characterize the nature, extent, concentration, and potential transport of contaminants at this very large, complex site and to provide the data needed to support remedial decision making. Sampling and analysis information that will be collected in association with these tasks is presented in the SAP (see Appendix B).

Additional tasks planned for the BC Controlled Area include treatability testing to assess potential treatment technologies or remedial actions (Section 6.1), an FS (Section 6.4), a proposed plan, a ROD (Section 6.5), and post-ROD activities (Section 6.6).

Project management occurs throughout the RTD and RI/FS processes. Project management is used to direct and document project activities (so that the objectives of the work plan are met) and to ensure that the project is kept within budget and on schedule. The initial project management activity will be to assigned individuals to roles established in Section 7.2 of the Implementation Plan (DOE/RL-98-28). Other project management activities include day-to-day supervision of and communication with project staff and support personnel; meetings; control of cost, schedule, and work; records management; progress and final reports; quality assurance; health and safety; and community relations.

Appendix A of the Implementation Plan provides the overall quality assurance framework that was used to prepare the 200-UR-1-quality assurance project plan presented in conjunction with the SAP (Appendix B, Chapter B2.0). Appendix C of the Implementation Plan provides an overview of data management activities that are applicable to the 200-UR-1 OU RI/FS and describes the process for the collection/control of data, records, documents, correspondence, and other information associated with OU activities.

6.1 REGULATORY PROCESS

By applying CERCLA authority requirements, planned activities will be addressing all regulatory and environmental obligations at the 200-UR-1 OU, including compliance with the WAC 173-340, as effectively and efficiently as possible. CERCLA regulations should allow for sufficient options for disposal of removal action wastes at the ERDF. By allowing flexibility in final disposal options, disposal costs can be minimized as much as possible, while remaining fully protective of human health and the environment.

The 200-UR-1 OU is using this multifunctional work plan in combination with the Implementation Plan to satisfy CERCLA requirements for preparation of the planning document needed for initiating an RI/FS and conducting a removal action. This work plan includes general facility background information, potential ARARs, PRGs, and potential remedial technologies identified in the Implementation Plan. Following regulatory approval of the work plan, RI activities will be initiated to satisfy CERCLA requirements.

6.1.1 Remove/Treat/Dispose Regulatory Pathway

Upon review and acceptance of this work plan, an ACTION MEMORANDUM (or in other terms, an interim action ROD) will be issued for the RTD sites. Upon issuance of the Action Memorandum by Ecology, an RAWP and remedial design report will be developed for the RTD sites and removal actions can be planned for initiation on a facility closure zone basis. The Action Memorandum will be incorporated into the final ROD for the 200-UR-1 OU (see Figure 6-1).

6.1.2 Remedial Investigation/Feasibility Study Regulatory Pathway

An RI will conducted for the BC Controlled Area. The results of the characterization activities will be presented in the RI report. After the RI is complete, a treatability test plan will be developed for assessment of potential treatment technologies or remedial actions (Figure 6-1). The test plan also will include data collection needs to assess ecological impacts from potential remedial actions. Remedial alternatives and closure strategies subsequently will be developed and evaluated against performance standards and evaluation criteria. The evaluation of remedial alternatives includes preparing an FS and a proposed plan. The FS also will include further evaluation and refinement of ARARs that were identified in the Implementation Plan (DOE/RL-98-28).

CERCLA closure options include alternatives that leave contaminants in place above WAC 173-340 Method B cleanup standards in soil, debris, or groundwater, but below WAC 173-340 Method C. A clean closure option requires that all contaminated material and media be removed and decontaminated to levels below WAC 173-340 Method B.

The decision-making process for the 200-UR-1 OU will be based on the use of a proposed plan and a ROD. Based on the FS, a proposed plan will be prepared that identifies the preferred remedial alternative for the BC Controlled Area. The CERCLA ROD will document the remedy for all the 200-UR-1 waste sites. The lead regulatory agency (Ecology) will prepare the ROD following completion of the public involvement process for the proposed plan, which, after signature by the signatories to the Tri-Party Agreement, will authorize the selected remedial action(s). Public involvement, including public notices and an opportunity to comment, will be enhanced, as necessary, to satisfy CERCLA requirements. The public also will be able to review and comment on the FS and any proposed conditions that will be contained in the proposed plan. The proposed plan will be issued for a minimum 45-day public review and comment period. Supporting documents, including the FS, also will be made available to the public for review at this time. A combined public meeting/public hearing may be held during the comment period to provide information on the proposed action and to solicit public comment.

6.2 REMOVE/TREAT/DISPOSE AND REMEDIAL INVESTIGATION ACTIVITIES

This section summarizes the planned tasks that will be performed during the RTD and RI phase for the 200-UR-1 OU, including the following:

- Planning
- Field investigation
- Management of investigation-derived waste
- Laboratory analysis and data verification
- Data evaluation and reporting.

These tasks and subtasks reflect the work structure that will be used to manage the work and develop the project schedule provided in Chapter 7.0.

6.2.1 Planning

The planning subtask includes activities and documentation that must be completed before field activities can begin. These include the preparation of a site-specific health and safety plan (HASP) in accordance with 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," and a preliminary hazard classification. If required, a final hazard classification and safety analysis will be performed in accordance with approved procedures. Radiological work permits, excavation permits, supporting surveys (e.g., cultural, radiological, wildlife, and utilities), work instructions, personnel training, and the procurement of materials and services (e.g., excavation, drilling, and geophysical logging services) also will be required. In addition, site and characterization locations will be located using a global positioning satellite system.

Appendix B of the Implementation Plan (DOE/RL-98-28) provides a general HASP that outlines health and safety requirements for RI activities. A site-specific HASP will be prepared for characterization activities, following requirements of the general HASP. Initial surface radiological surveys will be performed to document any radiological surface contamination and background levels in and around the sampling locations. This information will be used to document initial site conditions.

6.2.2 Field Investigation

The field investigation task involves data-gathering activities performed in the field that are required to satisfy the project DQOs. The field characterization approach is summarized in Section 4.2 and detailed in the SAP (see Appendix B). The scope includes soil sampling and analysis to characterize the vadose zone at the 200-UR-1 OU RTD and RI/FS waste sites. Major subtasks associated with the field investigation include the following:

- Soil sampling, and collection of data from radiological surveys.
- Preparation of a field report.

6.2.2.1 Soil Sampling, and Collection of Data from Radiological Surveys

Soil samples will be collected from backhoe buckets, test pits, or shallow shovel excavations depending on the size of the site and the depth of contamination. The samples will be packaged for shipment to a laboratory. Other activities include work zone setup, mobilization and demobilization of equipment, equipment decontamination, and field analyses. Planned field analyses include radiological field screening. All excavated soil at RTD sites will be field screened for radionuclides to provide additional characterization data used in waste disposition decisions and identification of hot spots at the site. Radiological data also will be used to establish radiation control measures, and to ensure worker health and safety. Radiological screening surveys will be used to locate sites and to gather in situ radiological data as specified in the SAP.

6.2.2.2 Preparation of a Field Report

At the completion of the field investigation, or in the case of the RTD site, completion of the removal action, a field report will be prepared to summarize activities performed and information collected in the field. The report will include radiological survey data collection locations, the number and types of samples collected and associated Hanford Environmental Information System numbers, an inventory of investigation-derived waste containers, and any chemical field-screening results.

6.2.3 Management of Project-Generated Waste

Waste-designation requirements were established during the DQO process supporting this work plan to ensure that the information collected during the field effort supports disposition decisions for project waste generated during RI sampling and RTD removal actions. During development of WMP-19920 (pending), listed waste issues were resolved. Sampling and analytical requirements or specific analytes needed to support designation activities were identified and the requirements noted in WMP-19920.

Waste generated during the RTD and RI activities will be managed in accordance with a waste control plan to be prepared for the OU. Site-specific waste characterization requirements for some RTD sites may be required by ERDF. Waste profiles will be developed during the removal process. The Implementation Plan, Appendix E, provides general waste management processes and requirements for the waste and forms the basis for activity-specific waste control plans. The site-specific waste control plan addresses the handling, storage, and disposal of remediation and investigation-derived waste generated during the RTD or RI characterization operations. Furthermore, the plan identifies governing procedures and discusses types of waste expected to be generated, the waste designation process, and the final disposal location. The waste management task begins when project waste is first generated at the start of the field program through waste designation and disposal.

6.2.4 Laboratory Analysis and Data Validation

Soil samples collected will be analyzed for a suite of radiological and nonradiological constituents identified as COCs during the DQO and defined in the SAP. The SAP lists the analytes, methods, and associated target detection limits. This task includes the laboratory analysis of samples, the compilation of laboratory results into data packages, and the validation of a representative number of laboratory data packages.

6.2.5 Cleanup Verification Report for Remove/Treat/ Dispose Waste Sites

This section summarizes data evaluation and documentation subtasks leading to the production of the cleanup verification report for RTD sites. The primary activities include a data quality assessment, documenting the removal action including the location, nature, extent, and concentration of contaminants encountered based on radiological field screening and sampling results; documenting the extent of contaminated soil removed from the site and disposed of at ERDF; documentation of the verification radiological survey and sampling results; and documentation of excavation backfill, compaction, and final surface restoration (grading and revegetation) of the site.

6.2.5.1 Data Quality Assessment of Verification Data

A data quality assessment will be performed on the analytical data to determine if they are the right type, quality, and quantity for their intended use. The data quality assessment completes the data life cycle of planning, implementation, and assessment that began with the DQO process. In this task, the data will be examined to see if they meet the analytical quality criteria outlined in the DQO and are adequate to evaluate the decision rules in the DQO.

This task will include evaluating the information collected during the investigation. Radiological and nonradiological data will be compiled, tabulated, and statistically evaluated.

If contaminants not identified as COCs are detected during laboratory analysis, the data will be evaluated against regulatory standards, or risk-based levels if exposure data are available, and existing process knowledge in support of remedial action decision making.

6.2.5.2 Documentation of Removal Actions

Each removal action will be documented in its entirety starting with confirmation of the site location and concluding with final site restoration subsequent to excavation backfill and compaction. The report shall contain the following:

- Historical background information on the site
- A site plan showing the location of the site
- A site map showing the grid for the initial and verification radiological survey and the surface contamination delineated during the initial radiological survey
- A discussion of removal action including hot-spot sampling, excavation, field screening the excavation surfaces for continued presence of radiological contamination, soil screening, verification radiological surveys and sampling results, waste characterization, management and disposition, excavation backfill, compaction, and final grading
- A final refined CSM that reflects the actual contaminant distribution encountered at the site.

6.2.6 Remedial Investigation Report

This section summarizes data evaluation and interpretation subtasks leading to the production of an RI report. The primary activities include a data quality assessment; evaluating the nature, extent, and concentration of contaminants based on sampling results; assessing contaminant fate and transport; refining the CSM; and evaluating risks through a risk assessment. These activities will be performed as part of the RI report preparation task.

6.2.6.1 Remedial Investigation Data Quality Assessment

A data quality assessment will be performed on the analytical data to determine if they are the right type, quality, and quantity for their intended use. The data quality assessment completes the data life cycle of planning, implementation, and assessment that began with the DQO process. In this task, the data will be examined to see if they meet the analytical quality criteria outlined in the DQO and are adequate to evaluate the decision rules in the DQO.

6.2.6.2 Data Evaluation and Conceptual Model Refinement

This task will include evaluating the information collected during the investigation. The nonradiological and radiological data will be compiled, tabulated, and statistically evaluated to gain as much information as possible to satisfy data needs. Data evaluation tasks may include the following:

- Graphically evaluating the data for vertical distribution of contamination.

- Stratifying the data and computing basic statistical parameters such as mean and standard deviation for individual levels when sufficient data are available. This evaluation can provide an indication of contaminant distribution.
- Constructing contour diagrams and variograms to evaluate spatial correlations within each stratum. This evaluation will indicate whether contamination is concentrated in a particular area (e.g., near the release source).
- Performing statistical tests on the data to evaluate the presence or absence of contamination. There are many facets to this step, including determining the distribution of the data and selecting the appropriate statistical tests. The initial screening for contamination should evaluate the data with respect to background, by using simple comparisons of an upper bound of the data to background concentrations and with appropriate cleanup levels.

All of these statistical evaluations will aid in refining the conceptual model for the BC Controlled Area and selecting the remedial alternative. If contaminants not identified as COCs are detected during laboratory analysis, the data will be evaluated against regulatory standards or risk-based levels if exposure data are available and existing process knowledge in support of remedial action decision making.

6.2.6.3 Risk Assessment

The Tri-Parties undertook the task of developing a risk framework to support risk assessments in the Central Plateau. This included a series of workshops with representatives from the DOE, EPA, Ecology, the Hanford Advisory Board (HAB), the Tribal Nations, the State of Oregon, and other interested stakeholders. The workshops focused on the different programs involved in activities in the Central Plateau and the need for a consistent application of risk assessment assumptions and goals. The results of the risk framework are documented in HAB Advice #132 (HAB 132), in the Tri-Parties response to the HAB advice ("Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area" [Klein et al. 2002]), and in the *Report of the Exposure Scenarios Task Force* (HAB 2002). The following items summarize the risk framework description from the Tri-Parties response to the HAB.

1. The Core Zone (200 Areas including part of the BC Controlled Area, B Pond [main pond] and S Ponds) will have an industrial scenario for the foreseeable future.
2. The Core Zone will be remediated and closed allowing for "other uses" consistent with an industrial scenario (environmental industries) that will maintain active human presence in this area, which in turn will enhance the ability to maintain the institutional knowledge of waste left in place for future generations. Exposure scenarios used for this zone should include a reasonable maximum exposure to a worker/day user, to possible Native American users, and to intruders.
3. The DOE will follow the required regulatory processes for groundwater remediation (including public participation) to establish the points of compliance and RAOs. It is anticipated that groundwater contamination under the Core Zone will preclude beneficial use for the foreseeable future, which is at least the period of waste management and

institutional controls (150 years). It is assumed that the tritium and iodine-129 plumes beyond the Core Zone boundary will exceed the drinking water standards for the period of the next 150 to 300 years (less for the tritium plume). It is expected that other groundwater contaminants will remain below, or be restored to, drinking water levels outside the Core Zone.

4. No drilling for water use or otherwise will be allowed in the Core Zone. An intruder scenario will be calculated for in assessing the risk to human health and environment.

5. Waste sites outside the Core Zone but within the Central Plateau (200 North Area, Gable Mountain Pond, BC Crib Controlled Area) will be remediated and closed based on an evaluation of multiple land-use scenarios to optimize land use, institutional control cost, and long-term stewardship.

6. An industrial land-use scenario will set cleanup levels on the Central Plateau. Other scenarios (e.g., residential, recreational) may be used for comparison purposes to support decision making, especially for the following:

   - The post-institutional controls period (>150 years)
   - Sites near the Core Zone perimeter to analyze opportunities to "shrink the site"
   - Early (precedent-setting) closure/remediation decisions.

7. This framework does not deal with the tank retrieval decision.

These items form the basis for the OU risk assessments to be conducted in the RI and FS reports.

6.2.6.3.1 Human Health Risk Assessment

For the 200-UR-1 OU, a quantitative, baseline human health risk assessment will be prepared, as part of the RI report, to evaluate risk to human receptors from potential exposure to contaminants in accessible surface and shallow subsurface soils. The risk assessment also will evaluate the potential for contaminants currently in the vadose zone beneath the waste sites to impact groundwater in the future. Risks from current groundwater contamination will not be evaluated; this evaluation will be conducted as part of the RI/FS process for the groundwater OUs.

The risk assessment for the BC Controlled Area will follow the risk guidelines identified through the Risk Framework workshops as documented in the Tri-Parties response to HAB Advice #132 (Klein et al. 2002).

The human health risk assessment will be conducted in accordance with appropriate subsections of WAC 173-340 and with the following DOE and EPA guidance documents:

- DOE/RL-91-45, *Hanford Site Risk Assessment Methodology*

- EPA/540/1-89/002, *Risk Assessment Guidance for Superfund (RAGS), Volume I -- Human Health Evaluation Manual, Part A (Interim Final)*

- OSWER Directive 9285.6-03, *Risk Assessment Guidance for Superfund, Vol. I Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors, (Interim Final)*
- EPA/600/P-95/002Fa, *Exposure Factors Handbook*
- EPA/540/R-99/005, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim*
- EPA/600/P-92/003C, *Proposed Guidelines for Carcinogen Risk Assessment*
- OSWER Directive 9285.7-081, *Supplemental Guidance to RAGS: Calculating the Concentration Term.*

Risks initially will be evaluated by comparison to risk-based standards such as WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties." Contaminants present at concentrations exceeding these risk-based standards will be considered further in the risk assessment process. Risks from nonradiological noncarcinogens will be evaluated by calculating hazard quotients for individual constituents and a hazard index for cumulative risk. Risks from nonradiological carcinogens and radionuclides will be evaluated by calculating incremental cancer risks for individual constituents and a cumulative cancer risk.

The computer program RESRAD (ANL/EAD-4, *User's Manual for RESRAD, Version 6*) will be used to obtain risk and dose estimates from direct-contact exposure to radiological constituents present in the shallow zone of the waste sites. The RESRAD model also will be used to obtain risk and dose estimates for the protection of the groundwater pathway. The results obtained from the RESRAD model for the groundwater protection model are limited to screening purposes only. Additional analysis will be performed using an appropriate fate and transport model (e.g., STOMP [PNNL-11216, *STOMP -- Subsurface Transport Over Multiple Phases: Application Guide*]) to assess impact to the groundwater from chemicals and radionuclides in the vadose zone.

The BC Controlled Area is located to the south of the 200 East Area boundary. Currently the BC Controlled Area is bisected by the Control Zone boundary. Because the BC Controlled Area lies outside of the 200 Areas, risk assessment will be performed for a residential exposure scenario to establish the baseline risk to be consistent with past risk assessment practices. As part of the FS, additional risk assessment may be performed to evaluate other scenarios, such as a Native American scenario or an intruder scenario, to evaluate post-remediation residual risks.

The characterization data are intended to provide sufficient information to select remedies for the BC Controlled Area. However, site-specific data gathered through a treatability test also may be needed to verify that the selected remedial alternative is appropriate. Treatability tests will be performed as needed to support the FS technology evaluation process. Following the decision in the ROD, additional sampling would be conducted as needed to confirm the selected remedy for the BC Controlled Area and to collect data to support remedial design. Following remedial action, an additional data collection activity would be conducted as needed to verify achievement of cleanup goals.

6.2.6.3.2 Ecological Risk Assessment

The screening-level ecological risk assessment in DOE/RL-2001-54 is meant to be a conservative evaluation of risk to ecological receptors from stressors, in this case, introduction of contaminants and habitat elimination. The screening-level ecological risk assessment identifies pathways for ecological receptors to be exposed to the contamination and evaluates potential risk from those exposures. The following describes the information found in specific sections of DOE/RL-2001-54.

Chapter 2.0 of DOE/RL-2001-54 describes the physical and ecological setting of the Central Plateau and identifies important aspects of the ecology and the condition of the waste sites to consider during the ecological risk assessment. For instance, while most waste sites are in a disturbed habitat with little vegetation to support wildlife, the nearby shrub-steppe offers a more habitable location for wildlife and needs protection in this region due to encroachment and elimination of this habitat in other parts of eastern Washington. Individual species whose populations are limited and are designated as sensitive species also must be protected. Recent surveys of the biological diversity on the Hanford Site have identified a number of new-to-science species and the protection status of these species has not yet been determined. More information is needed to help with this determination. Regarding the waste sites, most of the waste in the waste sites has been stabilized, thereby limiting ecological access. The decisions to stabilize and remediate waste sites must balance the potential disruption to the ecosystem both at and adjacent to the waste sites as well as from a distant location (e.g., borrow source sites).

The CSM in DOE/RL-2001-54, Chapter 3.0, provides an understanding of the ecological resources and the ways that receptors may be exposed. It shows where chemicals and radionuclides from the waste sites are likely to come into contact with receptors in the environment. The exposure pathways that are expected to be complete at most waste sites include the following:

- Direct contact with, or ingestion of, soil by invertebrates (e.g., beetles, ants) and burrowing mammals
- Uptake of contaminants in soil by vegetation
- Bioaccumulation through ingestion of food items (e.g., food chain effects) consumed by wildlife that may forage at the waste sites.

Chapter 4.0 of DOE/RL-2001-54 discusses the toxicity values that are available for contaminants believed to be present in the Central Plateau. Contaminants were identified from preliminary sampling data available from a subset of waste sites. These contaminants then were screened, primarily with respect to the likelihood to be present in the environment (i.e., half-life and persistence). A literature search for bird and mammalian toxicity values was performed. Toxicity values are not available for some contaminants. A risk management decision will be needed to determine how contaminants that do not have toxicity values will be handled during the risk assessment for each OU.

Chapter 5.0 of DOE/RL-2001-54 presents the exposure parameters used for estimating the exposure in a quantitative manner. In a screening-level ecological risk assessment, most exposure parameters are set conservatively at 100 percent. The only organism-specific factor necessary will be body weight, and these data are available in the literature. This section further evaluates the exposure pathways and constructs a food chain exposure model for wildlife specific to the Central Plateau. The wildlife are shown in the food chain and habitat model in DOE/RL-2001-54.

DOE/RL-2001-54, Chapter 6.0, is the screening-level risk calculation for the Central Plateau. The state and the DOE provide contaminant-specific numerical values (WAC 173-340-900 and biota concentration guides) to potential risks. These are conservative numbers designed to address all possibilities without leaving potential risks out of consideration. Data are available for a subset of the Central Plateau waste sites. These maximum concentrations of contaminants detected at the waste sites were compared with the state and DOE screening-level values. For chemicals, 12 metals, pentachlorophenol, and 4-dinitrophenol were detected at a maximum concentration above the screening level. The high number of metals presenting a risk requires closer examination. Site-specific bioavailability data would be helpful for understanding whether this is a reflection of the conservative nature of the screening assessment or an actual risk to the ecosystems at the waste sites. For radionuclides, cesium-137, radium-226, radium-228, and strontium-90 were above acceptable limits in the soil samples. It is important to recognize the limitations and uncertainty associated with risks identified by screening-level assessments. The risk calculations are useful for determining relative risks between waste sites, not site-specific risk. The information should be considered carefully along with actual biological evidence from the waste site area to determine if a hazard exists. Data are available for hundreds of waste sites in the Central Plateau (see Appendix C of DOE/RL-2001-54). These data include soil from the waste site, vegetation, and soil invertebrates. As each OU quantifies its risk using the exposure models available, these data will be useful in verifying the mathematical estimates.

The screening-level ecological risk assessment in DOE/RL-2001-54 leads to the problem formulation stage of a baseline ecological risk assessment. During problem formulation, the risk managers and others consider the toxicity evaluation, conceptual model exposure pathways, and assessment endpoints to support cleanup decisions. As a result, they then are able to better define the initial risks and determine direction for the DQO process, if needed. The DQO process will include the following activities.

- Establish the level of effort needed to assess ecological risk at a particular site or OU.
- Identify relevant and available data.
- Design a conceptual model of the ecological threats at a site and measures to assess those threats.
- Select methods and models to be used in the various components of the risk assessment.

- Develop assumptions to fill data gaps for toxicity and exposure assessments based on logic and scientific principles.
- Interpret the ecological significance of observed or predicted effects.

Ecological risk will be evaluated using the eight-step Ecological Risk Assessment Guidance for Superfund process developed by EPA (EPA 1997). DOE/RL-2001-54 serves as the screening-level assessment for the Central Plateau for Steps 1 and 2 of the eight-step process. For the 200-UR-1 OU, DOE/RL-2001-54 provides the starting point for an OU-specific ecological evaluation that will include a screening-level evaluation based on the data collected during the RI and other existing data as available, which will be compared to screening-level concentrations protective of wildlife. Because most of the waste sites in this OU are within the core zone, generally only terrestrial wildlife risks will need to be evaluated. Consistent with this approach, WAC 173-340-7490(3)(b) specifies that for industrial or commercial properties, current or potential for exposure to soil contamination need only be evaluated for terrestrial wildlife protection. Plants and biota need not be considered unless the species is protected under the federal *Endangered Species Act of 1973*. Surveys before field activities will confirm the presence of protected species.

For radionuclides, screening levels have been developed in DOE/STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*. The international community has been involved for more than 20 years in evaluating the effects of ionizing radiation on plants and animals. The International Atomic Energy Agency (IAEA) issued a study in 1992, IAEA 332, endorsing the 1977 International Commission on Radiological Protection (ICRP) reports *Recommendations of the International Commission on Radiological Protection* (ICRP Publication 26 and ICRP Publication 60) and stating that chronic radiation dose rates below 0.1 rad/d will not harm plant and animal populations and that radiation standards for human protection also will protect populations of nonhuman biota. The report implies that dose limits of 0.1 rad/d for animals and 1 rad/d for plants will protect populations, but additional evaluation of effects may be needed if sensitive species are present.

Effects of Ionizing Radiation on Terrestrial Plants and Animals: A Workshop Report (ORNL/TM-13141) presents information from a DOE-sponsored workshop held in 1995. The workshop was attended by 12 experts in radioecology and ecological risk assessment. The goal of the workshop was to evaluate the adequacy of current approaches to radiological protection, as exemplified by the IAEA report. The attendees reviewed DOE's perspective and responsibilities, rationales underlying the IAEA conclusions, and a summary of ecological data from the former Soviet Union. The consensus of the workshop participants was that the 0.1-rad/d limit for animals and the 1-rad/d limit for plants recommended by the IAEA are adequately supported by the available scientific information. However, they concluded that guidance on implementing the limits is needed and that the existing data support application of the recommended limits for populations of terrestrial and aquatic organisms to representative rather than maximally exposed individuals.

In response to the workshop findings, the DOE produced DOE/STD-1153-2002, which provides a graded approach to ecological risk assessment for radionuclides and screening-level biota concentration guides. For radiological constituents, no promulgated screening or cleanup levels are available. The biota concentration guides from DOE/STD-1153-2002 will be used in the ecological evaluation of radiological constituents.

DOE/RL-2001-54 was foundational to the Central Plateau ecological evaluation DQO process conducted in fiscal year 2003. This DQO process addressed data gaps identified in DOE/RL-2001-54 and identified data needs for the Central Plateau to support remedial decision making. An ecological evaluation SAP will be prepared and implemented for the Central Plateau, either on an area-wide basis or by OU, depending on the actual data needs.

Based on the results of the DQO and the screening-level evaluation, additional risk assessment activities, including a baseline ecological risk assessment, will be conducted completing the eight-step process. The evaluation will be conducted based on soil data collected during the RI, existing soil and ecological data, and if identified during the Central Plateau ecological evaluation DQO, newly collected ecological data.

6.3 FEASIBILITY STUDY

After the RI is complete, remediation alternatives and closure strategies will be developed and evaluated against performance standards and evaluation criteria in the FS. The FS process consists of the following steps:

1. Defining RAOs
2. Identifying GRAs to satisfy RAOs
3. Identifying potential technologies and process options associated with each GRA
4. Screening process options to select a representative process for each type of technology based on its effectiveness, implementability, and cost
5. Assembling viable technologies or process options into alternatives representing a range of treatment and containment plus a no-action alternative
6. Evaluating alternatives and presenting information needed to support remedy selection.

Appendix D of the Implementation Plan (DOE/RL-98-28) identifies the following remedial action alternatives as potentially applicable to the 200-UR-1 OU:

- No-action alternative (no institutional controls)
- Engineered multimedia barrier
- Excavation and disposal of waste
- In situ vitrification of soil
- In situ grouting or stabilization
- Monitored natural attenuation (with institutional controls).

During the detailed analysis, each alternative will be evaluated against the following CERCLA criteria (40 CFR 300.430, "Remedial Investigation/Feasibility Study and Selection of Remedy"):

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance.

One additional modifying criterion, community acceptance, will be applied following the FS at the proposed plan and ROD phase.

NEPA values also will be evaluated as part of DOE's responsibility under this authority. These values include impacts to natural, cultural, and historical resources; socioeconomic aspects; and irreversible and irretrievable commitments of resources.

The FS also will include supporting information needed to complete the detailed analysis and meet regulatory integration needs, including the following.

- Summarize the RI, including the nature and extent of contamination, the contaminant distribution models, and an assessment of the risks to help establish the need for remediation and to estimate the volume of contaminated media.

- Refine the conceptual exposure pathway model to identify pathways that might need to be addressed by remedial action.

- Provide a detailed evaluation of potential ARARs, beginning with potential ARARs identified in the Implementation Plan (DOE/RL-98-28, Chapter 4.0).

- Refine potential RAOs and PRGs identified in the Implementation Plan (DOE/RL-98-28, Chapter 5.0) based on the results of the RI, ARAR evaluation, and current land-use considerations.

- Refine the list of remedial alternatives, identified in the Implementation Plan (DOE/RL-98-28, Appendix D) and in this section, based on the RI.

6.4 PROPOSED PLAN AND RECORD OF DECISION

The decision-making process for the 200-UR-1 OU will be based on the use of a proposed plan and ROD. During the RI/FS process, a number of options for development of the proposed plan and ROD will be evaluated. Remedial decisions may proceed on an OU-by-OU basis, but it also is possible that remedial alternatives identified for other waste sites in the Central Plateau may be appropriate for the BC Controlled Area. Following the completion of the FS, a plan will be prepared that identifies the preferred remedial alternative for the BC Controlled Area. In addition to identifying the preferred alternative, the proposed plan will serve the following purposes.

- Summarize the completed RI/FS.
- Provide criteria by which waste sites within the OU not previously characterized will be evaluated after the ROD. Contingencies to move a waste site to a more appropriate waste group also will be developed.
- Identify performance standards and ARARs applicable to the OUs.

After the public review process is complete, Ecology (as the lead regulatory agency), in concert with the RL and EPA, will make a final decision on the remedial action to be taken, which is documented in a ROD. If alternative decision-making strategies are employed, lead agency realignments may be considered in consultations between EPA and Ecology.

Three alternatives to the OU-by-OU remediation approach have been identified to provide flexibility in the decision-making process, facilitate early action, and remediate and close specific areas or zones. Examples of these alternatives are presented below.

6.4.1 High-Risk Waste Sites Identified for Early Action

This alternative accelerates the start of remedial actions and closure of waste sites that present an ongoing or expected future threat to groundwater. Some Central Plateau high-risk sites already have been identified for early actions within the BC Controlled Area (i.e., BC Cribs and Trenches) and near U Plant, PUREX, and PFP. These sites will be included in proposed plans and RODs that promote early action.

6.4.2 Regional Site Closure

Waste site remedial decision-making may be realigned under a regional closure strategy that places waste sites into groups defined by geographical zones. For example, all of the 200-UR-1 OU waste sites within the 200 Areas are within one of the currently proposed geographic closure zones (see Figures B-1 through B-14 in Appendix B). Inclusion of the 200-UR-1 RTD sites in the respective area closures could be considered in the proposed plan and ROD.

6.4.3 Waste Site Grouping by Characteristics or Hazards

A third example of remedial decision-making strategies would be based on specific characteristics of the waste and the selected remedial alternative. For example, some waste sites in other OUs are suspected to contain contaminants of equivalent type and concentrations.

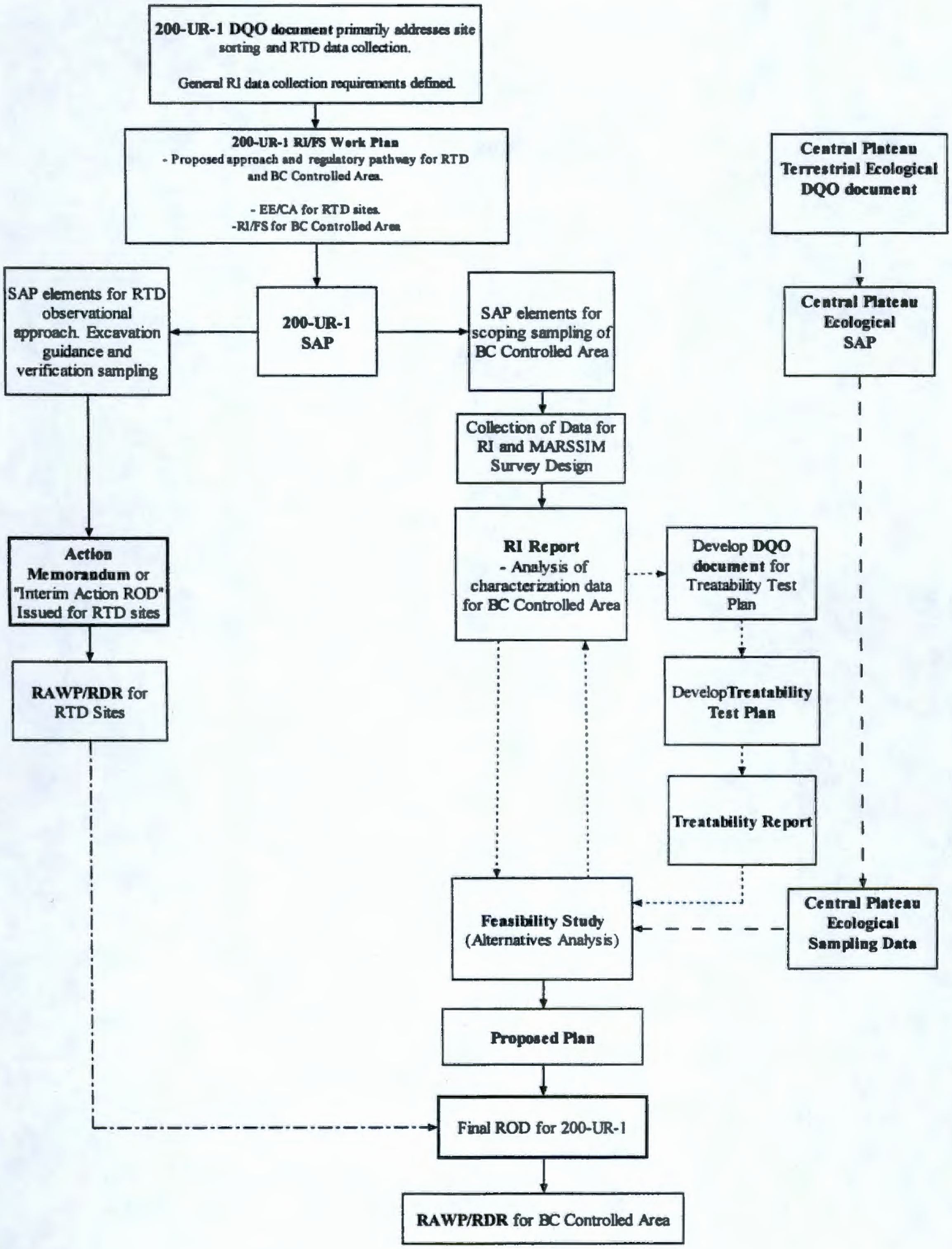
Grouping waste sites with other similarly contaminated soil sites in other OUs could streamline the decision-making process and tailor the requirements and alternatives to these specific hazards.

6.5 POST-RECORD OF DECISION ACTIVITIES

After the ROD, a remedial design report and RAWP will be prepared to detail the scope of the selected remedial action(s). As part of this activity, a DQO will be established and a SAP will be prepared to direct confirmatory and verification sampling and analysis efforts. Before remediation begins, confirmation sampling will be performed to ensure that sufficient characterization data are available to confirm that the selected remedy is appropriate for the BC Controlled Area, to collect data necessary for the remedial design, and to support final cumulative risk assessment. Verification sampling will be performed after the remedial action is complete to determine if ROD requirements have been met and if the remedy was protective of human health and the environment. Additional guidance for confirmatory and verification sampling is provided in Section 6.2 of the Implementation Plan (DOE/RL-98-28).

The remedial design report and RAWP will contain an integrated schedule of remediation activities for the BC Controlled Area. Following the completion of the remediation effort, site closure activities will be performed as specified in the ROD and remedial design report and RAWP.

Figure 6-1. 200-UR-1 Operable Unit Document Preparation and Regulatory Path for Remove/Treat/Dispose Sites and BC Controlled Area.



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7.0 PROJECT SCHEDULE

7.1 REMOVE/TREAT/DISPOSE SITES

The timing for implementation of remedial response actions performed at the 200-UR-1 OU waste sites identified for RTD will be based on the Central Plateau remediation schedule. Flexibility in scheduling these removal actions will be needed to optimize use of manpower and other cost reduction efficiencies that can be gained through overall project coordination as Central Plateau remediation activities are conducted.

7.2 BC CONTROLLED AREA REMEDIAL INVESTIGATION/FEASIBILITY STUDY

The project schedule for RI/FS activities discussed in this work plan is shown in Figure 7-1. This schedule will serve as the baseline for the work planning process and will be used to measure the progress of implementing this work plan. The schedule for preparing, reviewing, and issuing the RI report and FS closure plan is shown in Figure 7-2. The schedule concludes with the preparation of a ROD. The *Hanford Facility RCRA Permit* will be modified after the ROD is issued during Ecology's annual modification process.

The portion of the schedule most germane to this work plan and the SAP (Appendix B) is fiscal year 2005. One Tri-Party Agreement milestone that is associated with this work plan is:

> "M-013-00N: Submit one 200 NPL RI/FS (RFI/CMS) Work Plan for the 200-UR-1, Unplanned Release OU by June 30, 2004."

The following are proposed project milestone completion dates for key activities:

- Submit RI report for regulatory review: January 31, 2007[1]
- Submit FS/closure plan for regulator review: January 16, 2008[1]
- Submit proposed plan/permit modification for regulator review: January 16, 2008.[1]

Interim milestones to be designated under the Tri-Party Agreement will be established through negotiations among the DOE, Ecology, and the EPA.

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[1]Target project milestone.

Figure 7-1. 200-UR-1 Remedial Investigation/Feasibility Study Project Schedule.

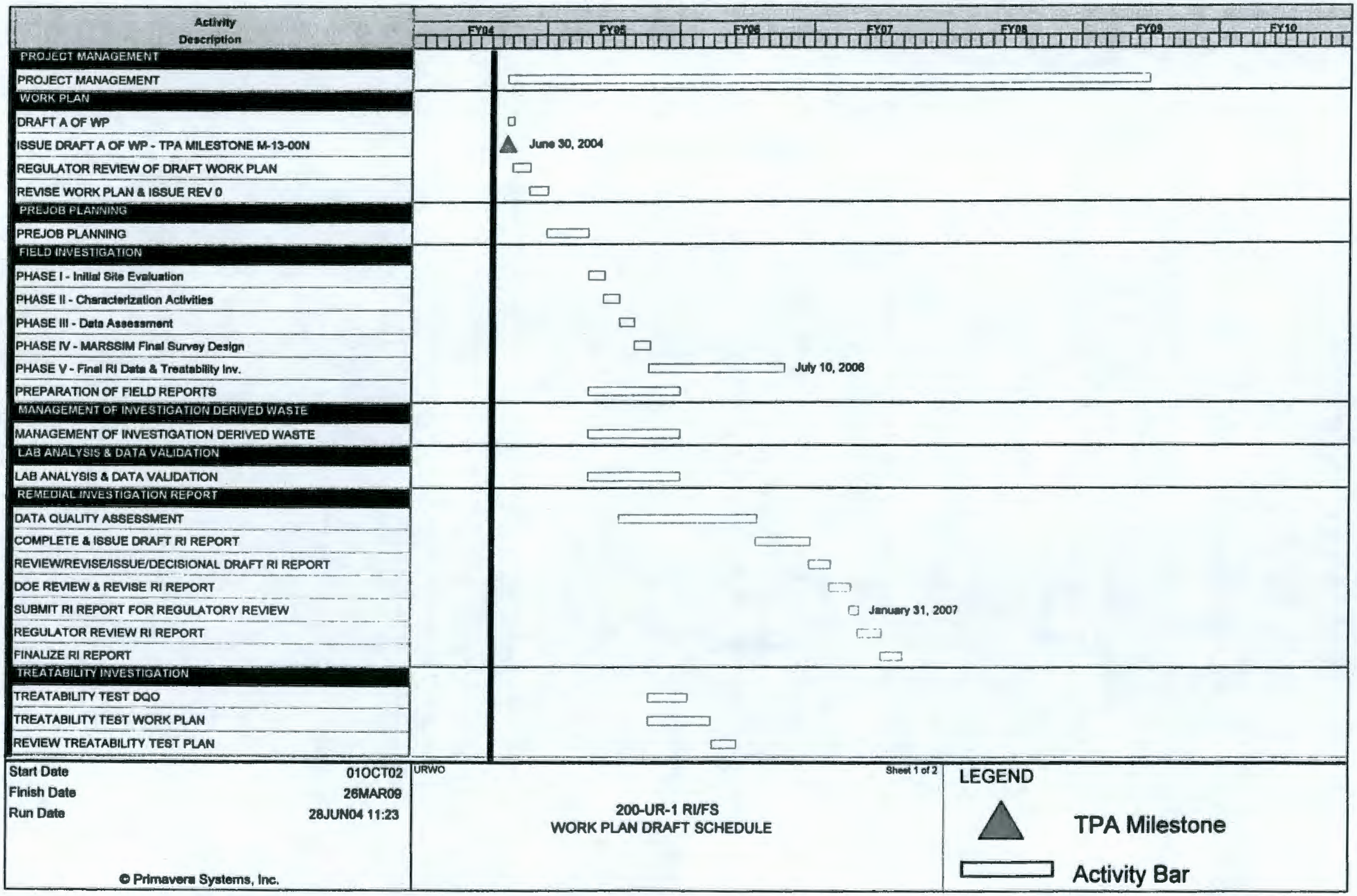
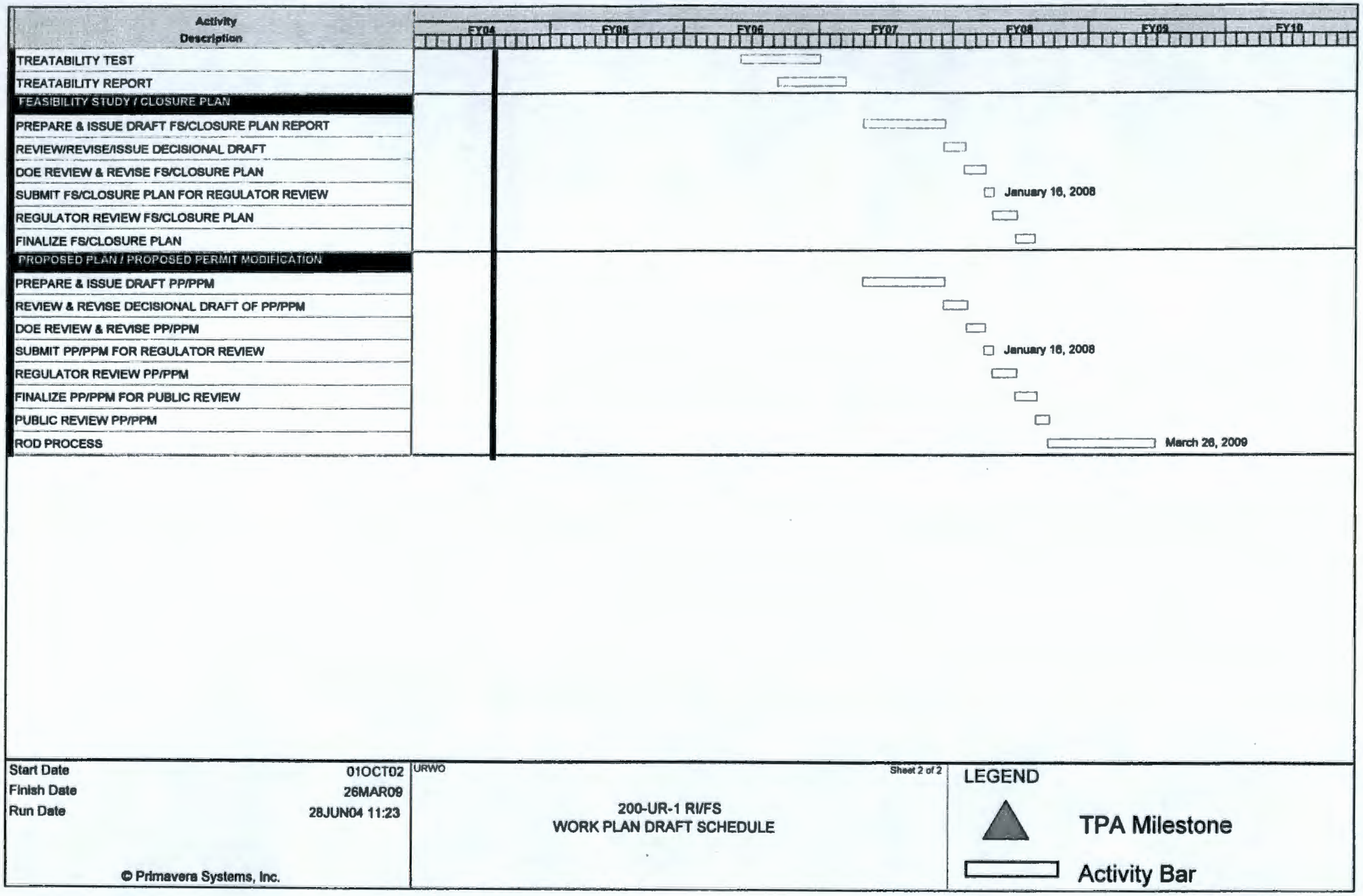


Figure 7-2. BC Controlled Area Remedial Investigation/Feasibility Study Project Schedule.



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