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Proposed Plan for the 200-UW-1 Operable Unit

Date Published
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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

J. D. Aardal 4/29/2005
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TABLE OF CONTENTS

APPENDICES

United States
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United States
Environmental Protection
Agency

Washington State
Department of Ecology

DOE/RL-2003-24
REV 0, April 29, 2005

PROPOSED PLAN FOR THE

200-UW-1 OPERABLE UNIT

HANFORD SITE
RICHLAND, WASHINGTON

INTRODUCTION

The U Plant Area, located on the Central Plateau of the Hanford Site, contains numerous contaminated waste sites, structures, and facilities that pose a potential risk to human health and the environment. To reduce these risks, the waste sites and facilities will be cleaned up (i.e., remedial actions will be implemented). The U Plant Area has been divided (shown in Figure 1) into five distinct components. The following five components make up the U Plant Area:

- 221-U Facility[1] (to be addressed by the Canyon Disposition Initiative [CDI])
- Facilities that are ancillary or related to the 221-U Facility
- Underground pipelines
- Soil waste sites (such as the 200-UW-1 Operable Unit [OU])
- Groundwater underlying the area (200-UP-1 OU).

Within the 200 West Area, the U Plant Area is approximately 0.84 km^2 (0.32 mi^2) and consists of the 221-U Facility, facilities that are ancillary or related to the facility, underground pipelines, soil waste sites, and the groundwater underlying the area.

The 200-UW-1 OU addresses 33 soil waste sites located within the U Plant Area. These sites primarily are liquid-waste disposal sites with a few solid waste sites, as summarized in Table B-1, Appendix B.

Components other than the 200-UW-1 OU will be addressed in separate approved decision documents (Action Memos or Records of Decision [ROD]).

As individual cleanup strategies are developed for each of the above components, decisions proposed for each component will be presented to the public for feedback. This document presents the Proposed Plan (Plan) for the 200-UW-1 OU.

Waste Sites
Sites that are contaminated or potentially contaminated from past operations. Contamination may be contained in environmental media (e.g., soil, groundwater) or in manmade structures or solid waste (e.g., debris).

CDI
Canyon Disposition Initiative

OU
Operable Unit

ROD
Record of Decision
The document that sets forth the selected remedial measure and provides the rationale for its selection.

Proposed Plan
The plan provided by the responsible parties that presents the preferred alternatives for remedial action of waste sites and other alternatives analyzed to the public. The proposed plan is based on, and essentially is a summary of, the feasibility study.

HOW YOU CAN PARTICIPATE

The "Public Participation" section of this document provides dates for the public review period and other information regarding public involvement.

The Tri-Parties will accept written comments on the Proposed Plan from May 16 through June 30, 2005. Comments should be sent to John Price at the Washington State Department of Ecology via:

- **mail: ATTN: Mr. John Price, 3100 Port of Benton Blvd., Richland, WA 99354-1670**
- **fax: (509) 372-7971**
- **email: jpri461@ecy.wa.gov**

[1] The 221-U Facility includes the 271-U Support Services Building, the 276-U Solvent Handling Facility, and other surrounding structures and waste sites within the footprint of the CDI Barrier.

Plug-in Approach
Under this approach, a standard remedy is selected that applies to waste sites with similar attributes, rather than to a specific waste site.

Confirmatory Sampling
Sampling before or after the ROD, but before the remedial design is completed, to confirm the accuracy of the site conceptual model used for remedial decision making.

RCRA
Resource Conservation and Recovery Act of 1976

TSD
Treatment, storage, and/or disposal

TSD Unit
A facility used for treatment, storage, and/or disposal (TSD) of dangerous wastes.

CERCLA
Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as Superfund

WAC 173-303-840
"Procedures for Decision Making."

The DOE is performing other activities to reduce the driver for potential transport of contaminants to groundwater from natural and artificial recharge. These activities are being done at DOE's own initiative, independent of the remedies identified in this Plan:

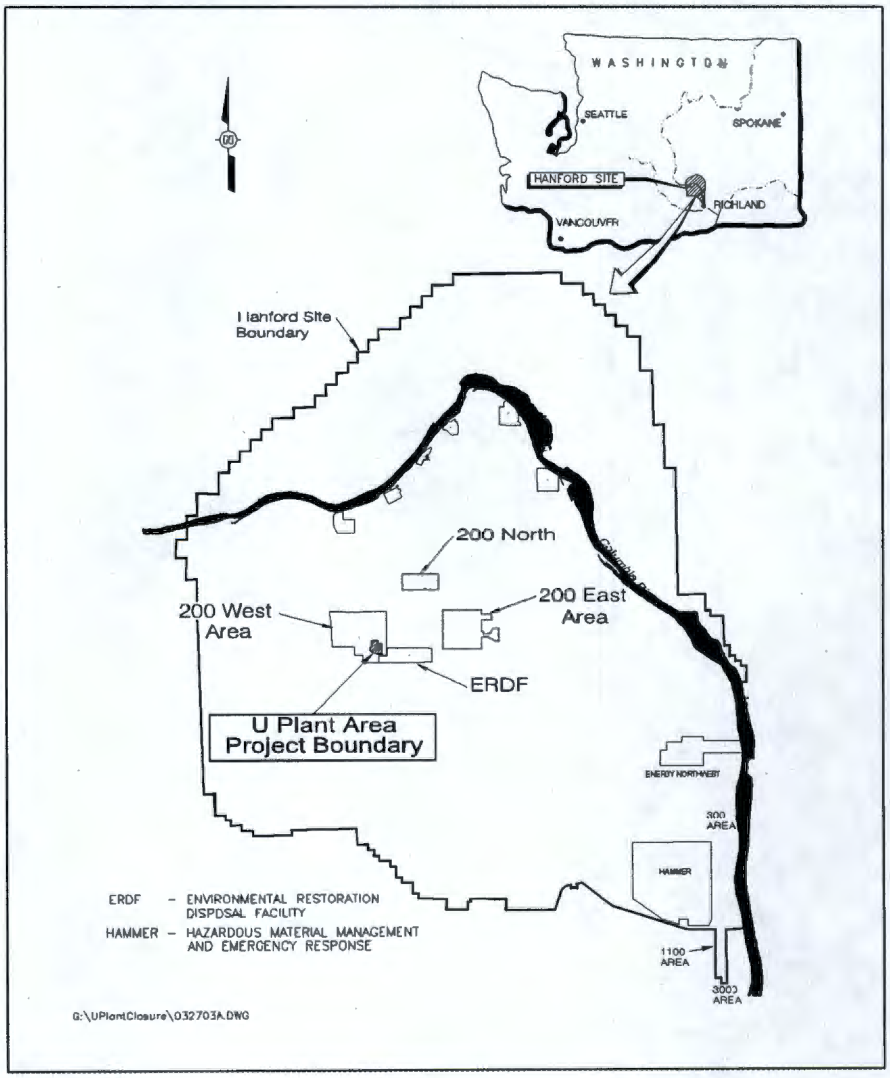
- DOE also initiated decommissioning of wells in compliance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." DOE will be required to decommission all unused wells in the U Plant Area as part of this remedy.
- Elimination of artificial recharge from septic systems and leaking water lines that may present a driving force for contaminants transport.
- Continuation of environmental monitoring.

The 33 waste sites have been categorized into 5 groups. This Plan describes how four cleanup alternatives were evaluated and identifies the preferred alternative for each group. In some cases, it was beneficial to pick individual preferred alternatives for individual sites. The preferred alternatives for the groups and sites have been consolidated into this single cleanup proposal. The evaluations of the four alternatives provide the basis for future "plug-in" approaches, which would apply when:

- Unknown waste sites are discovered in the future.
- Known waste sites could be reassigned from another OU.
- Confirmatory sampling indicates variations from the defined site conceptual model such that the selected alternative is no longer protective and a different alternative must be selected.

In addition, this Plan identifies how the closure of the 216-U-12 Crib, a *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal (TSD) unit, will be conducted in coordination with *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) remedial action. The closure performance standards can be found in WAC 173-303-610(2), "Dangerous Waste Regulations," "Closure and Post Closure," "Closure Performance Standard."

FIGURE 1. U PLANT AREA.



This Plan is issued by the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy (DOE). These three agencies - collectively known as the Tri-Parties - are proposing the preferred remedies for these waste sites under the authority of CERCLA, and in accordance with the *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement (Ecology et al. 1989). Also incorporated into this Plan are elements necessary to meet DOE's responsibilities under the *National Environmental Policy Act of 1969* (NEPA).

The Tri-Parties are issuing this Plan as part of the public participation responsibilities under Section 117(a) of CERCLA and 40 CFR 300.430(f)(3), "Selection of Remedy." Final remedies will be selected only after the public comment period has ended and the comments received have been reviewed and considered. The public is encouraged to review and comment on all of the alternatives presented in this Plan. The Tri-Parties will hold a public meeting to explain the content of this Plan and to obtain additional comments. Responses to comments will be presented in a responsiveness summary that will be part of the ROD.

Ecology is issuing a draft permit modification for closure of the 216-U-12 Crib RCRA TSD unit as required by WAC 173-303-840, "Procedures for Decision Making," in conjunction with this Plan. A combined public meeting/public hearing for the CERCLA Proposed Plan and RCRA draft Closure Plan will be held during the public comment period.

Throughout this Plan there are references or highlights to key information that can be found in greater detail in the focused feasibility study (FFS) (DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Operable Unit*) and other documents contained in the Administrative Record. These documents provide a more comprehensive understanding of the history, previous studies, and site descriptions considered in the evaluation of remedial alternatives and selection of preferred remedies.

The Tri-Party Agreement states that CERCLA and RCRA requirements should be integrated to achieve compliance with CERCLA, the corrective action requirements of WAC 173-303, "Dangerous Waste Regulations," and RCRA, and will meet or exceed applicable or relevant and appropriate federal and stated requirements to the extent required by CERCLA. This is accomplished by coordinating the TSD unit closure with the OU investigation and remediation to minimize overlap and duplication of work. Details of this integration are provided in Article IV and Sections 5.5 and 6.3 of the *Hanford Federal Facility Agreement and Consent Order Action Plan.*

Ecology will issue a separate draft permit modification for closure of the 216-U-12 Crib RCRA TSD unit. Ecology's proposed permit modification for the closure activities for the 216-U-12 Crib is based on the closure documentation presented in the FFS and Administrative Record. The closure will be accomplished in accordance with WAC 173-303. Coordination of the closure activities with the CERCLA actions will optimize timing and efficiency. CERCLA-RCRA integration is consistent with the provisions contained in the Tri-Party Agreement. Also, because of similarities in design and construction requirements for the CERCLA remedy and the 216-U-12 Crib closure, Ecology proposes to implement closure activities for the 216-U-12 Crib by using the Remedial Design/Remedial Action Work Plan for the CERCLA remedies.

EPA
U.S. Environmental Protection Agency

Ecology
Washington State Department of Ecology

DOE
U.S. Department of Energy

Tri-Parties
DOE, EPA, and Ecology

Hanford Federal Facility Agreement and Consent Order
An agreement and consent order between DOE, EPA, and Ecology that details the process to be used to address CERCLA, RCRA, and State requirements for cleaning up the Hanford Site. Also known as the Tri-Party Agreement.

NEPA
National Environmental Policy Act of 1969 (NEPA)

FFS
Focused feasibility study

Remedial Alternative
General or specific actions that are evaluated to determine the extent to which they can eliminate or minimize threats posed by contaminants to human health and the environment, comply with laws, and meet other selection criteria.

RCRA Closure Update
DOE is requesting an administrative closure per TPA Action Plan, Section 6.3.3, because the 216-U-12 Crib was classified as a TSD unit in Appendix C of the TPA but did not treat, store, or dispose of hazardous waste, including mixed waste, after February 1987.

Administrative Record
The files containing the documents used to select the remedial action.
The Administrative Record can be accessed through the Information Repositories (IR). For IR locations, see the Public Participation section at the end of this Plan.

Since preparation of the FFS, the 200-W-56 and 200-W-57 Dump in the 200-UW-1 OU were removed from the CERCLA process with no further actions required. Therefore, there are only 31 waste sites identified in this Plan. This removal is consistent with the Tri-Party Agreement and has been approved by the Tri-Parties.

RAOs
Remedial action objectives

Overview of the Proposed Plan

This Plan proposes remedial actions for the 200-UW-1 OU waste sites. These remedial actions are proposed for liquid-waste disposal sites and a few solid waste sites associated with the 221-U Facility operations. The liquid-waste disposal sites include cribs, trenches, french drains, septic systems, unplanned release sites, one underground settling tank, and one underground pipeline. The solid waste sites include debris piles and a burial trench.

Table 1 provides a summary of the key contaminant information (based on existing information) associated with several of the waste sites in this Plan. Table 1 includes information on risk-based concerns, contaminants, their maximum concentrations, and distribution below ground surface. Table 1 also identifies the period of time for the natural radiological decay to occur such that the remedial action objectives (RAO) are met with No Action other than the radiological decay.

TABLE 1. SUMMARY OF CONTAMINANTS AND RISK INFORMATION FROM REPRESENTATIVE SITES AND 200-W-42 VCP/UPR-200-W-163.[a]

Waste Site	Risk-Based Concern	Contaminant	Maximum Concentration and Associated Depth Below Ground Surface		Depth of Contaminant Below Ground Surface[c] (ft)	Timeframe to meet RAOs if No Action is taken (yr)
			(pCi/g or mg/kg)[b]	(ft)		
216-U-1 and 216-U-2 Cribs	Direct Contact	Cesium-137	259	6	0 – 13	128
	Groundwater Protection	Technetium-99	350	43	0 – 168	> 1,000
		Antimony	11.4	0.5	0 – 182	0
		Uranium	32,700	29.5	0 – 182	0
216-U-8 Crib	Direct Contact	Cesium-137	429	2	0 – 6	141
	Groundwater Protection	Uranium	280	189	0 – 199	> 1,000
		Nitrogen as nitrate and nitrite	304	199	0 – 199	> 1,000
		Antimony	11.2	0.5	0 – 199	0
216-U-12 Crib	Groundwater Protection	Nitrogen as nitrate and nitrite	197	212	4 – 233	> 1,000
		Arsenic	8.6	6	4 – 6	0
		Uranium	5.1	40.6	4 – 233	0
216-U-4 Reverse Well/ 216-U-4A French Drain	Direct Contact	Cesium-137	342	5	4 – 14	125
	Groundwater Protection	Mercury	4.7	6.2	4 – 193	0
		Uranium	12.5	62	4 – 193	0
Unplanned Release UPR-200-W-19	Direct Contact	Cesium-137	259	6	0 – 13	129
	Groundwater Protection	Antimony	11.4	0.5	0 – 12.5	0
200-W-42 VCP / UPR-200-W-163.[a]	Direct & Ecological Contact	Cesium-137	40,081	11	5 – 13	831
	Groundwater Protection	Arsenic	19.1	12	5 – 13	0
		Nitrogen as nitrate and nitrite	116	12	5 – 13	0
		Uranium	160	7.5	5 – 13	0

a. Although this site is not a representative site (described on page 8), enough data have been collected to determine site-specific risk and contaminant distribution.
b. Concentrations for radionuclides are shown as picocurie per gram (pCi/g); concentrations for chemicals are shown as milligrams per kilogram (mg/kg).
c. Depth to groundwater is approximately 255 feet; samples were collected below the maximum depth of contamination identified.

RAO = remedial action objective (described on page 11).
VCP = vitrified clay pipeline.

Crib
A near-surface underground structure designed to receive liquid waste that can percolate directly into the soil.

Reverse / Injection Well
A well (sometimes drilled into the water table) designed to receive liquid wastes that percolate into the deep vadose zone.

To select preferred remedies, the Tri-Parties evaluated the following alternatives:

- Alternative 1 – No Action
- Alternative 2 – Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation
- Alternative 3 – Removal, Treatment, and Disposal
- Alternative 4 – Engineered Barrier (includes Monitored Natural Attenuation for short-lived radioisotopes at shallow depth that are principal threat wastes).

These alternatives are described in "Summary of Remedial Alternatives" on page 15 of this Plan. This Plan presents a preferred remedy, or a combination of remedies, for each waste site. The evaluation of alternatives was conducted based on the CERCLA criteria.

Given the varied nature and extent of the contamination across the waste sites, no single alternative was selected as preferred for all the waste sites.

Table 2 provides an overview of the selected alternative for each site along with estimated present-worth costs. Figure 2 provides a graphical summary of the preferred alternatives.

The combined present-worth cost for implementing the 200-UW-1 OU preferred alternatives and the RCRA TSD Closure is estimated to be approximately $18 million, based on the CERCLA requirement of +50% / -30% accuracy. Present-worth costs for each of the waste sites are provided in Appendix A.

The remaining sections of this Plan provide information on the following:

TABLE 2. PREFERRED ALTERNATIVES FOR INDIVIDUAL WASTE SITES.

Alternative 3 – Removal, Treatment, and Disposal	
Number of waste sites associated with the Preferred Remedy	15
Estimated total cost of this Preferred Remedy ($1,000) [a]	$6,553
Associated Waste Sites	
200-W-42 VCP and UPR-200-W-163	UPR-200-W-48
	UPR-200-W-55
216-U-5 Trench	200-W-77
216-U-6 Trench	200-W-85
216-U-15 Trench	200-W-87
216-U-4B French Drain	200-W-89 Foundation
UPR-200-W-33	UPR-200-W-117 and UPR-200-W-60
Alternative 4 – Engineered Barrier	
Number of waste sites associated with the Preferred Remedy	5
Estimated total cost of this Preferred Remedy ($1,000) [a]	$9,725
Associated Waste Sites	
216-U-1 Crib / 216-U-2 Crib	216-U-8 Crib
241-U-361 Settling Tank	216-U-12 Crib (RCRA TSD closure) [b]
Alternative 2 – Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation	
Number of waste sites associated with the Preferred Remedy	9
Estimated total cost of this Preferred Remedy ($1,000) [a]	$1,377
Associated Waste Sites	
216-U-16 Crib	2607-W5 Septic Tank and Tile Field
216-U-17 Crib	200-W-71 Pit
216-U-4 Reverse Well / 216-U-4A French Drain	UPR-200-W-118
UPR-200-W-19	UPR-200-W-78
Alternative 1 – No Action	
Number of waste sites associated with the Preferred Remedy	2
Estimated total cost of this Preferred Remedy ($1,000) [a]	$ 0
Associated Waste Sites	
2607-W7 Septic Tank and Tile Field	UPR-200-W-8 Burning Ground

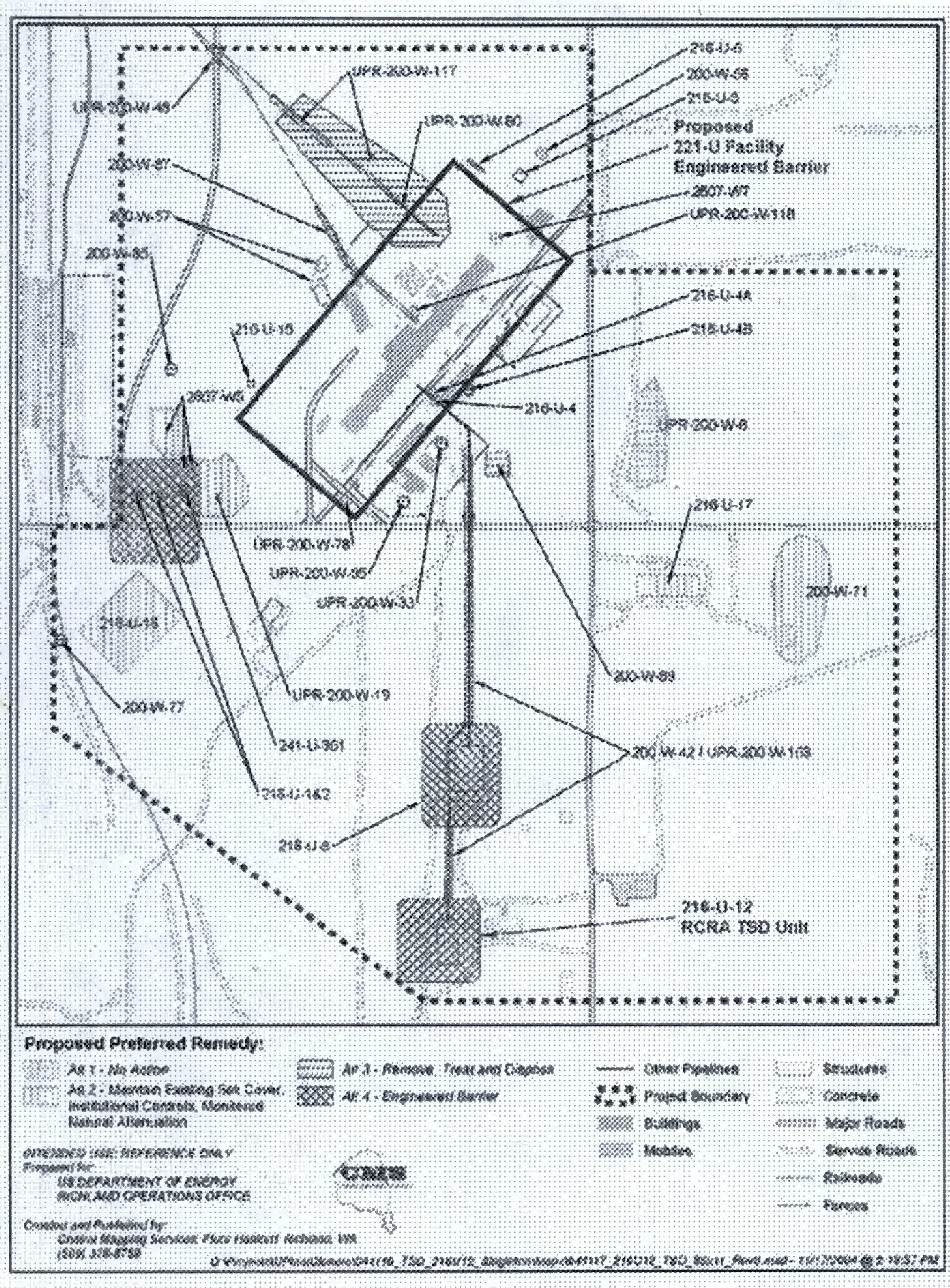
a. Present-worth estimates are a rough order of magnitude and can be 30% under or 50% over due to uncertainties that exist at this time.
b. The cost shown on this table includes the RCRA TSD Closure.

RCRA = *Resource Conservation and Recovery Act of 1976*.
TSD = treatment, storage, and/or disposal (unit).
UPR = unplanned release.
VCP = vitrified clay pipeline.

Characterization
Identification of the characteristics of a site through review of existing site information and/or sampling and analysis of environmental media and materials, to determine the nature and extent of contamination so that informed decisions can be made as to the level of risk presented by the site, and the protective remedial action that is needed.

- Background of the U Plant Area
- Scope and role of the proposed actions, including strategies used to characterize the waste sites, and regulatory requirements and goals for the remedial actions
- Site risks
- Summaries and evaluations of remedial alternatives
- Preferred alternatives for the different waste sites
- Strategies for streamlining future actions at other U Plant Area waste sites (plug-in approach)
- Cleanup strategy for the RCRA TSD unit closure
- Public participation.

FIGURE 2. PROPOSED PREFERRED REMEDIES FOR 200-UW-1 OPERABLE UNIT WASTE SITES.



SITE BACKGROUND

Hanford Site

The Hanford Site (Figure 1) is a 1517 km² (586-mi²) Federal facility located in southeastern Washington State along the Columbia River. From 1943 to 1990, the primary mission of the Hanford Site was the production of nuclear materials for national defense. In July 1989, the 100, 200, 300, and 1100 Areas of the Hanford Site were placed on the National Priorities List (NPL) (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List") pursuant to CERCLA.

Central Plateau

The Central Plateau is located in the central portion of the Hanford Site and is divided into three areas: 200 East Area, 200 West Area, and 200 North Area.

Operations in the 200 East and 200 West Areas were related to chemical separation, plutonium and uranium recovery, processing of fission products, and waste partitioning. Major chemical processes in the Central Plateau resulted in delivery of high-activity waste streams to systems of large underground tanks called "tank farms." The liquid wastes often were neutralized before being sent to the tanks and later evaporated (concentrated). The storage tanks were used to allow the heavier constituents to settle from the liquid effluents, forming sludge. Low-activity liquid wastes were discharged to trenches, cribs, drains, and ponds, most of which were unlined. The 200 North Area formerly was used for the interim storage and staging of irradiated fuel.

U Plant Area and 200-UW-1 Operable Unit

As noted, the 200-UW-1 OU addresses 33 soil waste sites. These sites range from being rather small (approximate surface area of 2.7 m^2 [30 ft^2] and 1 m [3 ft] in depth) to very large (approximate surface area of 4645 m^2 [50,000 ft^2] and 61 m [200 ft] in depth). There are contaminants at depth that exceed soil concentrations that are protective of groundwater in accordance with RAO 3.

The groundwater underlying the U Plant Area is located approximately 255 ft below ground surface. The groundwater currently has elevated levels of nitrates, technetium-99, uranium, and carbon tetrachloride. The 200-UW-1 OU high-risk waste sites are suspected to have contributed to the already contaminated groundwater by supplying additional concentrations of uranium, technetium-99, and nitrates. Monitoring and treatment of the groundwater currently are ongoing within the 200-UP-1 OU. Results of these treatment efforts indicate a general downward trend in contaminant concentrations. However, concentrations still exceed maximum contaminant levels.

SCOPE AND ROLE OF ACTION

This Plan presents remedial actions for contaminated soils, structures (e.g., concrete, tanks), and debris (e.g., timbers) associated with liquid-waste disposal sites and solid waste sites in the 200-UW-1 OU. The preferred remedial actions identify and address existing and potential future threats to human health and the environment from waste site contaminants. This is a source control action that will protect groundwater from future contamination. The scope of this Plan does not include remediation of the groundwater beneath these waste sites, which will be addressed separately.

Integration of CDI with Other U Plant Area Activities

The CDI has been developed to address potential threats to human health and the environment at the 221-U Facility. At this time, the preferred alternative being considered is to partially demolish the structure, place equipment in the process cells, fill void spaces with grout, and dispose in place under an engineered barrier. Because the 221-U Facility engineered barrier will cover several 200-UW-1 OU waste sites, the integration of the U Plant Area activity is vital. Details on each of the alternatives considered are available in DOE/RL-2001-29, *Proposed Plan for Remediation of the 221-U Facility (Canyon Disposition Initiative).*

Characterization Approach

An analogous site approach was used in the characterization of the waste sites discussed in this Plan. As discussed in DOE/RL-98-28, *200 Areas Remedial*

NPL
National Priorities List
A list of releases / priority hazardous waste sites in the United States that are eligible for investigation and cleanup under Superfund (40 CFR 300, Appendix B).

Characterization of Waste Sites
Waste sites within the 200-UW-1 OU have been characterized through a series of three investigations:

(1) A scoping-level investigation using available information including process knowledge (e.g., *U Plant Source Aggregate Area Management Study Report* [DOE/RL-91-52]).

(2) A limited field investigation (e.g., *Limited Field Investigation for the 200-UP-2 Operable Unit* [DOE/RL-95-13]).

(3) The application of the analogous sites approach (DOE/RL-2003-23).

High-Risk Sites
Waste sites suspected of contributing to groundwater contamination. Capping is proposed for these sites. All of the known high-risk sites have been sampled, and the remaining OU waste sites have been characterized through process knowledge and the analogous site approach.

A separate ROD will address the 221-U Facility and a separate engineering evaluation/cost analyses and action memorandums will address ancillary facilities and pipelines. The remediation of contaminated groundwater located under the 200-UW-1 OU is being addressed by the 200-UP-1 OU (EPA/541/R-97/048, *Record of Decision for the 200-UP-1 Interim Remedial Measure*). The public will have future opportunities to review and comment on these documents.

MCL
Maximum Contaminant Level
The maximum concentration of a contaminant allowed in water delivered to public drinking water

Analogous Site Approach
Source sites can be similar geologically, have similar process and waste disposal histories, and have similar contaminant inventories. Based on these similarities, the site conceptual model is expected to be similar or analogous. In these situations, the analogous site concept is used to reduce the amount of site characterization and evaluation required to support remedial action decision making. Within each group of similar sites, a representative site(s) is selected for comprehensive field investigations, including sampling and analyses. Findings from site investigations at representative sites are used to develop a site conceptual model that is applied to other "analogous" sites that were not sampled.

It is assumed that the nature and extent of contamination at analogous sites is similar to the nature and extent of contamination described by the site conceptual model for representative site(s) that were sampled. The site conceptual model, along with other site-specific knowledge, then is used as the basis for evaluating and identifying the preferred remedy (as accomplished in this Plan). Confirmatory investigations are conducted through the remedial design/remedial action to confirm the accuracy of the site conceptual model with respect to the analogous site.

UPR
Unplanned release

HAB
Hanford Advisory Board

Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program (Implementation Plan), the analogous site approach streamlines the investigation process by grouping similar sites together. This approach generally is implemented by selecting representative sites for comprehensive evaluation by site investigation. The representative sites are selected based on process and characterization data such as effluent volume, contaminant inventory, and contaminant distribution. Because of how the representative waste sites have been selected, the data typically suggest greater environmental impact and risk relative to other similar OU waste sites. Thus, representative sites generally are considered worst case relative to similar OU waste sites. Findings from the site investigation are used to assess information and develop site conceptual models at other OU sites with similar disposal histories. Confirmatory site investigations (additional sampling and analysis) are conducted through the remedial design/remedial action, to confirm the accuracy of the site conceptual models/site conditions. The confirmatory sampling approaches applicable to the preferred remedies (Alternatives 1 through 4) are described below.

- For waste sites where the preferred remedy is Alternative 3, data will be collected using an observational approach, samples will be taken from the open excavation during various stages of the removal and verification samples will be collected at the proposed end of excavation.
- For waste sites where the preferred remedy is Alternative 4, data will be collected to support design activities, as well as to confirm the assumptions of the site conceptual model, and the extent of contamination.
- For those waste sites where the preferred remedy is Alternative 1 or Alternative 2, data typically will be collected to confirm the assumptions of the site conceptual model, and verify the nature and/or vertical extent of contamination. Site-specific data needs will be specified in the sampling and analysis plan.

Representative Waste Sites and Site Conceptual Models

The site conceptual models used to describe the waste distribution were developed using sample data from representative waste sites. The representative sites are the 216-U-1 and 216-U-2 Cribs, the 216-U-8 Crib, the 216-U-12 Crib, the 216-U-4 Reverse Well/216-U-4A French Drain, and unplanned release (UPR) 200-W-19.

Table 3 identifies the representative sites, the analogous sites, and the rationale for applying the representative waste site conceptual models to the analogous sites. Appendix B provides additional information on these waste sites.

Land Use

Site risks were evaluated based on a reasonably anticipated future land use for the Central Plateau. These evaluations were based on the criteria presented in, and are consistent with, the Tri-Party's response to Hanford Advisory Board (HAB) Advice #132 (Klein et al. 2002, "Consensus Advice #132: Exposure Scenarios Task Force on the 200 Area" http://www.hanford.gov/boards/hab/advice/habadv-132.pdf).

The HAB acknowledged that some waste will remain in the Core Zone when cleanup of the Central Plateau is completed and advised that the Core Zone be as small as possible and not include contamination outside the 200 Area fences.

The DOE is expected to continue industrial-exclusive land use activities for at least 50 yr, in accordance with DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, and 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement."

TABLE 3. CONCEPTUAL MODELS, ANALOGOUS SITES, AND RATIONALE FOR APPLICATION.

Representative Waste Site	Analogous Sites	Site Conceptual Model Rationale	Further Information
Group 1: 216-U-1 and 216-U-2 Cribs	241-U-361 Settling Tank	♦ The waste sites received the same waste, because waste passed through the 241-U-361 Settling Tank before being disposed of in the 216-U-1 and 216-U-2 Cribs. ♦ The contaminant concentrations are expected to be much higher for the 216-U-1 and 216-U-2 Cribs, because the tank was not 100% efficient for removing solids, and the suspended and soluble contaminants were discharged to the cribs.	See Tables B-1 and B-2
Group 2: 216-U-8 Crib	200-W-42 VCP / UPR-200-W-163	♦ The waste sites received the same waste, because waste was routed to the 216-U-8 Crib via the 200-W-42 VCP. UPR-200-W-163 is the contaminated surface soil above the pipeline. ♦ The contaminant concentrations are expected to be much higher at the crib, because it was designed to discharge wastes. The pipeline was designed to transfer wastes.	See Tables B-1 and B-3
Group 3: 216-U-12 Crib (RCRA TSD unit)	216-U-5 Trench 216-U-6 Trench 216-U-15 Trench 216-U-16 Crib 216-U-17 Crib	♦ The volume and magnitude of effluent discharged to the 216-U-12 Crib is greater than that of the analogous sites. ♦ The primary constituent in the 216-U-12 Crib waste inventory is nitrogen as nitrate and nitrite. ♦ Similarities exist in the contaminant inventories, release depths, and distributions.	See Tables B-1 and B-4
Group 4: 216-U-4 Reverse Well / 216-U-4A French Drain	216-U-4B French Drain	The 216-U-4 Reverse Well and 216-U-4A French Drain have a single site conceptual model because of their proximity to one another and because they received the same waste stream. This conceptual model applies to the 216-U-4B French Drain for the following reasons. ♦ The waste sites were constructed similarly. ♦ Each waste site received waste from the 222-U Laboratory, with the 216-U-4B French Drain receiving less volume. ♦ The contaminant concentrations are expected to be significantly deeper for the representative site than for the 216-U-4B French Drain.	See Tables B-1 and B-5
Group 5: UPR-200-W-19 Unplanned Release	2607-W5 Septic Tank and Tile Field 2607-W7 Septic Tank and Tile Field	♦ Similar depth of discharge. ♦ Limited contaminants discharged and minimal distribution anticipated. ♦ No suspected impacts to groundwater. ♦ 2607-W7 was abandoned under WAC 246-272-18501.	See Tables B-1 and B-6
	200-W-71 Pit UPR-200-W-8 Burning Ground	♦ Similar depth of discharge. ♦ The limited contaminants discharged and minimal distribution anticipated at UPR-200-W-19 are expected to be higher than those for the analogous sites listed, because less contaminants and volume were disposed of at these waste sites. ♦ No suspected impacts to groundwater.	

	UPR-200-W-118
	And shallow/ surface sites:
	UPR-200-W-33
	UPR-200-W-48
	UPR-200-W-55
	UPR-200-W-78
	200-W-77
	200-W-85
	200-W-87
	200-W-89 Foundation
	UPR-200-W-117 / UPR-200-W-60.
		♦ Similar depth of discharge and contaminant distribution.
		♦ Limited contaminants discharged and minimal distribution are anticipated to be higher at UPR-200-W-19—the risk at this site would bound the analogous sites in terms of risk.
		♦ No suspected impacts to groundwater.
		♦ With respect to the shallow / surface waste sites, the site conceptual model characterizes the site risks because of the following:
		  ♦ They are expected to be limited to surface soils within 3 m (10 ft) of the ground surface for the representative site, and within 1 m (3 ft) of the ground surface for the analogous sites of the ground surface, based on the nature of the releases.
		  ♦ Limited contaminants discharged and minimal distribution are anticipated at UPR-200-W-19.
		  ♦ No suspected impacts to groundwater.	

NOTE: The contaminants of concern are included in Table B-1.

Comprehensive descriptions of the waste sites and all of the alternatives considered in this plan are provided in greater detail in the focused feasibility study (DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Operable Unit*).

WAC- 246-272-18501, "Department of Health," "On Site Sewage Systems," "Abandonment."

RCRA = *Resource Conservation and Recovery Act of 1976.*
TSD = treatment, storage, and/or disposal (unit).
UPR = unplanned release.
VCP = vitrified clay pipeline.

Industrial-Exclusive
A land-use designation under DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, that applies to the 200 Areas Core Zone. Under this land-use designation, waste management activities would continue. This land use assumes an industrial worker scenario—an exposure scenario in which the receptor works on site on a full-time basis (i.e., worker spends 2,000 h/yr over the duration of his or her entire career). The evaluation assumes that the Central Plateau exposure pathways include direct exposure to radiation, incidental ingestion of soil, and inhalation of resuspended dust and volatile constituents (exposure to groundwater is not considered).

ARARs
Applicable or relevant and appropriate requirements. Those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, or that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

References
DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*.

OSWER Directive 9200.4-31P (EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q&A*).

WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection."

TBC
To Be Considered criteria

Based on this documentation and current Central Plateau assumptions, the alternative evaluations considered the following anticipated land-use requirements.

- The Core Zone will have an industrial scenario for the foreseeable future. The evaluation considers the following uses:
  - Industrial-exclusive use for the next 50 yr (through 2050)
  - Industrial land use (non-DOE worker) for 100 yr after 2050 (through 2150)
  - Industrial land use post 150 yr.
- Groundwater contamination under the Core Zone will preclude beneficial use for the foreseeable future. This evaluation considers the following:
  - No consumptive use of groundwater for the next 150 yr, based on the expected period of waste management.
  - Any selected remedy will provide for no further degradation of groundwater from the 200-UW-1 OU waste sites
  - No drilling for water or other purposes will be allowed in the Core Zone, except as part of an EPA- and Ecology-approved monitoring or cleanup plan.

In addition, risks were calculated considering the possibility of intruders 150 yr from now (2150).

Applicable or Relevant and Appropriate Requirements

Applicable or relevant and appropriate requirements (ARAR) are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations placed into Federal or state law that:

- Specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, or
- Address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

A more detailed discussion of the potential ARARs associated with the 200-UW-1 OU waste sites is found in the FFS. These potential ARARs are incorporated into the RAOs and preliminary remediation goals that drive the evaluation of alternatives and the selection of preferred remedies.

The key potential ARAR used for the remedy selection of these waste sites was the implementing regulation under Washington Department of Ecology's WAC 173-340-745(5)(b), "Soil Cleanup Standards for Industrial Properties," "Method C, Industrial Soil Cleanup Levels."

Remedial Action Objectives

These RAOs have been developed taking into consideration information currently available for the 200-UW-1 OU and the Central Plateau. The development of the RAOs has not taken into consideration the cumulative impact of remedies for other OUs (which have yet to be determined) and potential implications from the remediation/closure of the whole Central Plateau. The RAOs identified for the waste sites are based on evaluations of reasonably anticipated future land use, site conceptual models, potential ARARs, and To Be Considered criteria. Below are the four RAOs identified for the 200-UW-1 OU.

- RAO 1 – Prevent unacceptable risk to human health and ecological receptors by exposure to nonradiological constituents in soils and debris at concentrations above the industrial use criteria, as defined in WAC 173-340-745(5).
- RAO 2 – Provide cleanup protective for future industrial land use and protective for ecological receptors, respectively, by:
  - preventing exposure to radiological constituents at concentrations that will cause a dose rate limit of 15 mrem/yr above background for industrial workers (OSWER Directive 9200.4-31P, EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q&A*). A dose rate limit of 15 mrem/yr above background generally achieves the EPA excess lifetime cancer risk threshold, which ranges from 1×10^{-6} to 1×10^{-4}.
  - protecting ecological receptors based on a dose rate limit of 0.1 rad/day for terrestrial wildlife populations (DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, which is a To Be Considered criteria).
- RAO 3[2] – Prevent migration of contaminants through the soil column to groundwater or reduce soil concentrations below WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection," groundwater protection criteria so that no further degradation of the groundwater results from contaminant leaching from 200-UW-1 OU waste sites.
- RAO 4 – Prevent adverse impacts to cultural resources and threatened or endangered species and minimize wildlife habitat disruption.

These four RAOs were used to develop the preliminary remediation goals discussed below, and may be finalized as remediation goals in the 200-UW-1 OU ROD.

Preliminary Remediation Goals

As described in the FFS, preliminary remediation goals were developed to establish residual soil concentrations for individual contaminants that are protective of human health and the environment. The FFS screening process compared the observed constituent concentrations at the waste sites to the following concentrations:

- Naturally occurring levels
- Radiological dose exposure limits
- Cleanup levels consistent with the RAOs.

The comprehensive list of contaminants of potential concern (COPC) developed for the waste sites was based on historical U Plant Area operations and characterization information. Although preliminary remediation goals were developed for each of the COPCs, it should be emphasized that they are listed as *potential contaminants;* all did not exceed the preliminary remediation goals or associated RAOs for the evaluated waste sites. Therefore, the COPCs are not anticipated to be of concern but are included for further sampling as will be specified in separate Ecology-approved sampling and analysis plans. Constituents that exceeded one or more of the RAOs will be retained as contaminants of concern (COC).

Table 4 summarizes the preliminary remediation goals for the COPCs evaluated and the COCs included in the evaluation of alternatives in the FFS.

RAO 1
RAO 1 is satisfied if the following conditions are met:

- Total human health carcinogenic risks do not exceed 1×10^{-5}
- Human health noncarcinogenic hazard indexes do not exceed 1
- Soil concentrations of COCs do not exceed applicable thresholds for protection of ecological receptors.

RAO 2
RAO 2 is satisfied if the following conditions are met:

- Industrial worker dose rates do not exceed 15 mrem/yr above background
- Terrestrial animal exposure rates do not exceed 0.1 rad/day
- Waste is 15 ft or more below the ground surface.

RAO 3
RAO 3 is satisfied if the following conditions are met:

- Soil concentrations are below WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection," groundwater protection methods, or
- The flux of contaminants into groundwater does not cause groundwater concentrations to exceed MCLs, or
- The flux of contaminants into groundwater is reduced or eliminated, based on a decreasing trend in the difference between the concentration of contaminants in up-gradient and down-gradient wells.

RAO 4
RAO 4 is satisfied if the following conditions are met:

- RAOs 1, 2, and 3 are met
- Cultural and ecological reviews are performed to evaluate the construction area for potential impacts (e.g., bird nesting grounds) and appropriate mitigative measures are implemented.

COPC
Contaminant of potential concern
The list of all hazardous substances potentially present at a waste site.

[2]Note: Protection of the Columbia River from contaminants in this OU is achieved through RAO 3; there is no surface water in the immediate vicinity of the waste sites that requires a separate RAO.

TABLE 4. SUMMARY OF SOIL PRELIMINARY REMEDIATION GOALS. [a]

Constituent	Overall Preliminary Remediation Goal [b] (mg/kg)	Constituent	Overall Preliminary Remediation Goal [b] (mg/kg)
Nonradioactive Contaminants of Concern			
Nitrogen in nitrite and nitrate	40	Uranium	3.21
Nonradioactive Contaminants of Potential Concern Screened Out Through Risk Assessment [c]			
Chloride	1,000	Vanadium	2,240
Fluoride	5.78	Zinc	360
Nitrate (as nitrogen)	40	Acenaphthene	121
Nitrite	4	Acetone	28.9
Sulfate	1,000	Benzoic acid	257
Antimony	5.4	Bis(2-ethylhexyl) phthalate	13.9
Arsenic	6.47	2-Butanone	19.6
Barium	132	Bromomethane	0.01
Cadmium	0.81	Carbon disulfide	5.65
Chromium	67	Chloromethane	0.0165
Cobalt	290	2-Chlorophenol	0.943
Copper	217	Di-n-butylphthalate	56.5
Lead	118	1,4-Dichlorobenzene	0.03
Manganese	512	Hexane	96.2
Mercury	2.09	Kerosene	2,000
Nickel	130	Methylene chloride	0.0218
Selenium	1	Pentachlorophenol	0.33
Silver	13.6	Pyrene	655
Strontium	2,920	Tetrachloroethene	0.0091
Thallium	1.59	Toluene	7.27
Titanium	unlimited	Tributyl phosphate	6.18
	(pCi/g)		(pCi/g)
Radioactive Contaminants of Concern			
Cesium-137	23.4	Technetium-99	1
Radioactive Contaminants of Potential Concern Screened Out Through Risk Assessment [c]			
Americium-241	335	Radium-226	7.03
Cesium-134	8.43	Radium-228	8.15
Cobalt-60	4.9	Selenium-79	--
Curium-244	744	Sodium-22	5.83
Europium-152	11.4	Strontium-90	22.5
Europium-154	10.3	Thorium-228	7.73
Europium-155	426	Thorium-232	4.8
Neptunium-237	59.2	Uranium-233/234	2,665
Plutonium-238	470	Uranium-234	2,665
Plutonium-239/240	425	Uranium-235	101
Potassium-40	76.4	Uranium-238	504

a. This table does not include constituents that were eliminated through the contaminants of potential concern screening process described in Appendix C of the focused feasibility study (DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Waste Sites*). Screening criteria include the identification of detected constituents, frequency of detection, essential nutrients, comparison to background, and availability of toxicity values.

b. Listed values represent the most restrictive soil preliminary remediation goal derived from evaluation of direct contact, groundwater protection, and terrestrial wildlife protection according to the focused feasibility study (DOE/RL-2003-23). Values presented are for screening purposes. Site-specific evaluation and modeling will be performed to determine that remedial actions are protective of human health and the environment.

c. The contaminants of potential concern are provided for informational purposes only.

-- = no value established.
pCi/g = picocurie / gram.

Direct Contact
Risk-based concern due to contact with or ingestion of contaminated soil.

A detailed evaluation of the COPCs and COCs is contained in the FFS Appendices C and D, and Chapter 3.0. Numeric soil preliminary remediation goals were developed to address protection of human health, ecological receptors, and groundwater. The most restrictive (lowest) preliminary remediation goal was selected to determine if site remediation was needed, because it would be protective of all exposure pathways. Following the consideration of comments received during the public comment period, the final remedial action goals or cleanup levels for the 200-UW-1 OU waste sites will be issued in the ROD.

PRGs are developed during the CERCLA process, and may be refined in the ROD to become final cleanup levels (i.e., the remedial action goals). A complete discussion of the PRGs is presented in the FFS (DOE/RL-2003-23).

The COPCs are evaluated to screen out chemicals that are unlikely to be a threat (because of persistence or abundance) to develop a list of COCs (see below).

Summary of Remediation Objectives

The human health and ecological risk assessments, which are fundamental to the scope and role of the actions in this Plan, were performed in accordance with CERCLA. A site conceptual model was developed for the waste sites, and potential risks to human health and ecological receptors were evaluated in a risk assessment for the representative sites, as discussed in the FFS. The Tri-Parties believe that remedial action is necessary at the waste sites addressed by this Plan to protect public health and welfare and/or the environment from actual or potential releases of hazardous substances. Such releases, or potential releases, could present an imminent and substantial danger to public health, welfare, or the environment.

COC
Contaminants of concern
A list of radioactive and/or chemical constituents that are a risk to human health or the environment. The COC list is developed from the COPC list (see above). COCs for the 200-UW-1 OU are cesium-137, technetium-99, uranium, and nitrogen.

SUMMARY OF SITE RISKS

Estimated risks were based on the RAOs and current site information and reflect the Tri-Parties' response to HAB Advice #132 (Klein et al. 2002). The Tri-Parties will use an industrial-exposure scenario to assess risks in the Core Zone of the Central Plateau. This exposure scenario includes the assumption that groundwater under the Central Plateau will not be used for 150 yr. This exposure scenario does not preclude remedial decisions for groundwater OUs that may establish a different restoration timeframe. The findings of the risk evaluation for the 200-UW-1 OU are summarized below. Table 5 provides a summary of the risk assessment found in Appendices C and D of the FFS, and provides a basis for action under CERCLA.

- Nonradionuclide contaminants associated with the representative waste sites meet RAO 1 for human and ecological receptors.
- Cesium-137 levels associated with the waste sites exceed the RAO 2 target dose of 15 mrem/yr for industrial workers.
- Ecological evaluations indicate that the radionuclide constituents meet RAO 2 criteria for terrestrial wildlife populations, with the exception of the 200-W-42 Vitrified Clay Pipeline (VCP) and the associated UPR-200-W-163. These waste sites exceed the ecological criteria for cesium-137.
- RAO 3, groundwater protection, is not met for the 216-U-1 and 216-U-2, 216-U-8, and 216-U-12 Cribs. Constituents in exceedance include uranium (metal), technetium-99, and nitrogen (measured as nitrate and nitrite).

VCP
Vitrified Clay Pipeline

Note to RAO 3:
Groundwater underlying the sites already exceeds drinking water maximum contaminant levels, due to the multiple sources of contamination in the 200 West Area. The existing groundwater contamination is being addressed by current and possible future responses for the 200-UP-1 Groundwater Operable Unit.

Potential risks to an inadvertent intruder from exposure to radioactive COCs were evaluated for informational purposes only, as identified in the Tri-Parties' response to HAB Advice #132. This inadvertent intruder scenario assumes that institutional controls could be lost 100 yr after closure of disposal facilities containing radioactive waste (50 yr of industrial–exclusive use is presumed to end in 2050, and 100 yr of institutional controls will end in 2150). The acceptable regulatory exposure guideline is 15 mrem/yr. Three scenarios were evaluated: a construction trench worker, a well driller, and a rural resident. These scenarios are evaluated in detail in Appendix E of the FFS. The construction trench

Inadvertent Intruder Scenario
An exposure scenario in which the receptor (e.g., construction trench worker or driller) has drilled or trenched into the contaminated soil and is therefore exposed. The scenario assumes that, after 150 yr of institutional controls, the intruder unknowingly could be exposed to contamination in the waste site area.

TABLE 5. SUMMARY OF WASTE SITE RISKS AND BASIS FOR ACTION.

Waste Site	Risk-Based Concern	Summary of Waste Site Risks	Basis for Action?
216-U-1 and 216-U-2 Cribs	Direct Contact	All nonradionuclide constituents are less than RAO.	No
		157 mrem/yr total dose, primarily from cesium-137, exceeds the 15 mrem/yr total dose.	Yes
	Ecological Contact	All nonradionuclide and radionuclide constituents are less than RAO.	No
	Groundwater Protection	Model results indicate that technetium-99 may reach groundwater with a resulting peak groundwater concentration (3,530 pCi/L) greater than the MCL of 900 pCi/L. Other modeled constituents would have a groundwater concentration less than the MCL.	Yes
		Antimony and uranium remain as potential groundwater protection concerns.*	No
216-U-8 Crib	Direct Contact	All nonradionuclide constituents are less than RAO.	No
		262 mrem/yr total dose, primarily from cesium-137, exceeds the 15 rem/yr total dose.	Yes
	Ecological Contact	All nonradionuclide and radionuclide constituents are less than RAO.	No
	Groundwater Protection	Model results indicate that uranium and nitrogen as nitrate and nitrite are predicted to reach groundwater within 1,000 yr and the resulting peak groundwater concentrations (6.3 mg/L and 14 mg/L, respectively) are predicted to be greater than the MCL of 0.02 mg/L and 10 mg/L, respectively. Other modeled constituents would have a groundwater concentration less than the MCL.	Yes
		Antimony remains as potential groundwater protection concerns.*	No
216-U-12 Crib	Direct Contact	All nonradionuclide and radionuclide constituents are less than RAO.	No
	Ecological Contact	Arsenic and barium concentrations slightly exceed screening levels but are within or near naturally occurring background levels and are not expected to be biologically significant. Radionuclide constituents are less than RAO.	No
	Groundwater Protection	Model results indicate that nitrogen as nitrate and nitrite is predicted to reach groundwater within 1,000 yr with a resulting peak groundwater concentration (17 mg/L) greater than the MCL of 10 mg/L. Other modeled constituents would have a groundwater concentration less than the MCL.	Yes
		Arsenic and uranium remain as potential groundwater protection concerns.*	No
216-U-4 Reverse Well/ 216-U-4A French Drain	Direct Contact	All nonradionuclide constituents are less than RAO.	No
		108 mrem/yr total dose, primarily from cesium-137, exceeds the 15 mrem/yr total dose.	Yes
	Ecological Contact	No ecological exposure pathway is complete because the area is devoid of ecological habitat.	No
	Groundwater Protection	Model results indicate that constituents would have a groundwater concentration less than the MCL.	No
		Mercury and uranium remain as potential groundwater protection concerns.*	No
Unplanned Release UPR-200-W-19	Direct Contact	All nonradionuclide constituents are less than RAO.	No
		163 mrem/yr total dose, primarily from cesium-137, exceeds the 15 mrem/yr total dose.	Yes
	Ecological Contact	Arsenic concentrations slightly exceed screening levels, but are within or near naturally occurring background levels and are not expected to be biologically significant. Radionuclide constituents are less than RAO.	No
	Groundwater Protection	Model results indicate that constituents would have a groundwater concentration less than the MCL.	No
		Mercury and antimony remain as a potential groundwater protection concern.*	No
200-W-42 VCP / UPR-200-W-163	Direct Contact	All nonradionuclide constituents are less than RAO.	No
		24,800 mrem/yr total dose, primarily from cesium-137, exceeds the 15 mrem/yr total dose.	Yes
	Ecological Contact	All nonradionuclide constituents are less than RAO.	No
		Radionuclide levels exceed terrestrial wildlife screening values, primarily from cesium-137, which exceeds cleanup levels by a factor of 45.	Yes
	Groundwater Protection	Model results indicate that constituents would have a groundwater concentration less than the MCL.	No
		Arsenic, uranium, and nitrogen as nitrate remain as potential groundwater protection concerns.*	No

*The fate and transport vadose zone modeling conclude that these constituents meet the ground water protection RAO, in accordance with WAC 173-340-747(8), "Deriving Soil Concentrations for Ground Water Protection," "Alternative Fate and Transport Models."

MCL = maximum contaminant level. RAO = remedial action objective.

worker scenario is most consistent with the Central Plateau land-use assumptions and shows that the waste sites are below regulatory guidelines in 150 yr, when the intruder scenario is assumed to begin. It is the Tri-Parties current judgement that action is necessary to protect human health and the environment from releases and potential releases of hazardous substances into the environment.

SUMMARY OF REMEDIAL ALTERNATIVES

Significant analyses and evaluations have contributed to defining applicable technologies and process options to address the waste sites associated with the 200-UW-1 OU. The contaminants, waste form, and waste location were all considered as part of this process. As discussed in the FFS, technologies and process options were identified and evaluated based on their ability to reduce potential risks to human health and the environment at the waste sites.

Collective experience gained from previous studies and evaluations of cleanup methods at the Hanford Site was used to identify technologies that could be carried forward as remedial alternatives to address the RAOs. The FFS identified four remedial alternatives for detailed and comparative analyses:

- **Alternative 1 – No Action.** The no action alternative represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the site. No action implies "walking away" from the waste site and allowing the wastes to remain in place. Verification sampling is performed to confirm that the no action decision is protective.
- **Alternative 2 – Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.** Existing soil covers (e.g., the clean soils placed over the waste site to stabilize it, as well as the clean fill placed during construction of the waste site) are maintained as needed to provide continuous protection from intrusion by plants and burrowing animals (e.g., badgers). In addition, institutional controls (e.g., deed restrictions, land-use zoning, and excavation permits) are put in place to prevent human access to the site. Monitored natural attenuation also is an important element of this alternative. The process reduces contaminant level in place by physical, biological, and/or chemical processes such as radioactive decay. Monitoring would be conducted to demonstrate that natural attenuation is occurring and that contamination is remaining in place as concentrations decrease. It will be necessary to maintain the institutional controls for up to 150 yr, or the time at which radioactivity decays to levels that comply with the RAOs.
- **Alternative 3 – Removal, Treatment, and Disposal.** Structures and soil with contaminant concentrations exceeding the RAOs are excavated, using available data and the observational approach and conventional excavation techniques, followed by verification sampling. As noted in Appendix B, the 200-UW-1 OU waste sites range in depth from 1 m (3 ft) to approximately 60 m (200 ft) below ground surface. For some waste sites, contamination exists at significant depths (approximately 60 m [200 ft] below ground surface) and would require an engineered excavation such as benching (similar to open pit-mining operations). These benches are assumed to be 3 m (10 ft) in width and are planned at depth intervals of 8 m (25 ft) to ensure safe operations and excavation access. At the remaining waste sites, the excavation will use standard approaches similar to other excavations occurring on the Hanford Site. Excavated material above the RAOs will be disposed of on the Hanford Site (e.g., Environmental Restoration Disposal Facility [ERDF]) in accordance with that facility's established waste acceptance criteria. Other materials (e.g., non-hazardous debris) may be disposed of off the Hanford Site, as appropriate. ERDF is very close (0.4 km

Institutional Controls
Nonengineered controls (e.g., administrative and/or legal controls) that minimize the potential for exposure to contamination by limiting land or other resource uses. The State of Washington also considers physical controls, such as fencing and signs, to be institutional controls.

Monitored Natural Attenuation
A decrease in the concentration of a contaminant because of natural processes such as radioactive decay, oxidation/reduction, biodegradation, and/or sorption. Monitoring of natural attenuation will occur to determine if additional cleanup activities are warranted.

Removal, Treatment, and Disposal
A cleanup method where soil and debris are excavated in such a way that no contaminants above the approved remedial action goals for direct exposure and groundwater protection remain at the Site. Excavated material is treated (as necessary) and sent to an on Hanford Site or off Hanford Site engineered facility for disposal, as necessary.

Observational Approach
The selective sampling of areas where potential or suspected soil contamination can be expected to be found if a release of hazardous substance has occurred. Information that is gathered during the remedial action phase is used to make real-time decisions to guide the remedial action. For many sites, this method is more cost- and time-effective than traditional methods that require large amounts of initial data to make detailed plans and designs for remedial actions.

ERDF
Environmental Restoration Disposal Facility

ERDF is the Hanford Site's disposal facility for most waste and contaminated environmental media (dependent on the waste meeting the ERDF waste acceptance criteria) generated under a CERCLA response action. The ERDF currently receives wastes from ongoing cleanup activities at the Hanford Site 100, 200, and 300 Areas. For the purposes of this proposed remedial action, ERDF is considered to be on-site.

Waste Acceptance Criteria
The criteria defined for the acceptance of waste for disposal at the ERDF or a permitted RCRA TSD. These criteria are based primarily upon protection of human health and the environment.

Evapotranspiration
The portion of precipitation returned to the air through direct evaporation and by transpiration of vegetation.

Potential Evapotranspiration
Potential evapotranspiration is the evapotranspiration that would occur under given climatic conditions if the soil moisture supply were unlimited in the soil for the collective loss of water by transpiration and evaporation. Factors that influence the potential evapotranspiration include local climate characteristics (e.g., net solar radiation, heat flux in the ground, wind speed, vapor pressure, psychometric constant) and local plant and soil characteristics.

[0.7 mi]) to the waste sites and is being used for disposal of remediation wastes on the Hanford Site. Any material that exceeds the disposal facility waste acceptance criteria would be stored on the Hanford Site (consistent with storage requirements) until the material was treated to meet ERDF's waste acceptance criteria. As the contaminated material is excavated, it is characterized and segregated before being transported to ERDF. Excavation would continue until all contaminated material exceeding the RAOs is removed and the site is backfilled with clean material.

- **Alternative 4 – Engineered Barrier.** An engineered barrier (e.g., evapotranspiration barrier) is built over the contaminated waste sites, thus "capping" the site to prevent or limit water from infiltrating into the waste and to prevent intrusion by human or ecological receptors. Deploying an evapotranspiration barrier in this arid climate takes advantage of several natural systems. Specifically, an annual precipitation rate of approximately 6 in./yr, a near-zero water recharge for fine-grained soils associated with the barrier (e.g., silts and silt loam soils), deep-rooted vegetation, and a potential evapotranspiration rate of approximately 50 in./yr result in severely limiting vadose zone contaminant migration. Natural soil analogs (natural soil deposits that have long-term exposure to meteorological, geological, pedological, and biological processes) present on the Hanford Site provide an indication of the long-term stability and effectiveness of evapotranspiration barriers that would exploit such locally available soil. These barriers would be monitored to evaluate their performance. This performance monitoring (e.g., moisture monitoring within the engineered barrier) will allow for corrective measures (e.g., cap thickening) to be planned and implemented before any increased impact to the environment. The engineered barrier alternative uses the barrier for groundwater and human health protection, as well as ecological protection by preventing intrusion by plants and burrowing animals. Institutional controls (e.g., deed restrictions, land-use zoning, and excavation permits) would be required to minimize the potential for exposure to contamination or compromising the effectiveness of the barrier. It will be necessary to maintain institutional controls for 150 yr, or longer, to ensure that human and biological intruders do not breach the barriers to create pathways for contamination.

While the above four alternatives were evaluated for their applicability to all the waste sites, it should be noted that the 241-U-361 Settling Tank, the analogous site to the 216-U-1 and 216-U-2 Cribs, poses an additional remediation challenge. It is estimated that 106,000 L (28,000 gal) of sludge and 378 L (100 gal) of liquid remain in the tank. Removal of the sludge and liquid from the tank is included as an element of each remedial action alternative. The tank contents will be removed, treated as appropriate, and disposed. Based on existing information, the stabilized waste can be disposed at ERDF. Under Alternatives 2 and 4, the tank void will be filled, with the void material picked as part of the remedial design. The schedule for removal of tank contents will be included in the remedial design report/remedial action work plan.

CERCLA EVALUATION CRITERIA AND PROCESS

The Tri-Parties expect the preferred alternative to satisfy the following statutory requirements of CERCLA §121(b):

- Be protective of human health and the environment
- Comply with potential ARARs

- Be cost-effective
- Use permanent solution and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment as a principle element.

As a critical part of the evaluation process, the alternatives are evaluated against the following nine CERCLA criteria:

- 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
- Community acceptance.

The first two criteria (overall protection of human health and the environment and compliance with ARARs) are **threshold criteria**. Alternatives that do not protect human health and the environment or do not comply with ARARs (or justify a waiver) do not meet statutory requirements and are eliminated from further consideration in the FFS.

The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost) are **balancing criteria** on which the remedy selection is based.

The final two criteria (state and community acceptance) are **modifying criteria**. The State of Washington concurs with the proposed alternatives outlined, and the preferred remedies identified are acceptable to the Tri-Parties. Community acceptance of a preferred alternative, however, only can be determined following the public comment period. A summary of the evaluation of these criteria is provided in Appendix C.

- For the 200-UW-1 OU, the implementability and long-term effectiveness criteria help to distinguish between preferences for Alternative 4 and Alternative 3.
- For waste sites that have the potential to adversely impact groundwater because of contaminants at significant depth, Alternative 4 is preferred. Several of the representative waste sites have COC concentrations in excess of the groundwater protection criteria at depths ranging from near the surface to near the water table. An engineered barrier would minimize potential exposure for human and ecological receptors and would limit water infiltration that contributes to contaminant migration to groundwater. Thus, Alternative 4 would meet the objective of no further groundwater degradation.
- For shallow, low-volume waste sites, Alternative 3 is preferred. Removing the contaminants and placing them in a disposal facility eliminates the potential exposure pathways to human and ecological receptors at this waste site.

NEPA VALUES

The *Secretarial Policy on the National Environmental Policy Act* (DOE 1994), and DOE O 451.1B, *National Environmental Policy Act Compliance Program*, require

THE NINE CERCLA CRITERIA

Threshold Criteria:

- Overall protection of human health and the environment
- Compliance with ARARs

Balancing Criteria:

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

Modifying Criteria:

- State acceptance
- Community acceptance.

NEPA
National Environmental Policy Act of 1969
A Federal law that establishes a program to help prevent or eliminate damage to the environment.

NEPA values encompass a range of environmental concerns:

- Transportation impacts
- Air quality
- Natural, cultural, and historical resources
- Noise, visual, and aesthetic effects
- Socioeconomic impacts
- Environmental justice
- Cumulative impacts (direct and indirect)
- Mitigation
- Irreversible and irretrievable commitment of resources.

Borrow Source Material
Natural soil deposits (e.g., silt loam and sand) used in the construction of Alternative 4 engineered barriers, and to backfill excavated Alternative 3 waste sites.

Representative Waste Sites 216-U-1 and 216-U-2 Cribs
The 216-U-1 and 216-U-2 Cribs are the representative sites for the 241-U-361 Settling Tank. The site conceptual model rationale for these sites is presented in Table 3, with further information specific to each waste site provided in Appendix B, Table B-2. A summary of the risks associated with the 216-U-1 and 216-U-2 Cribs is provided in Table 1. Expected dimensions and contaminated volumes can be found in Appendix B.

that CERCLA documents incorporate NEPA values (e.g., analysis of cumulative, off site, ecological, and socioeconomic impacts) to the extent practicable, in lieu of preparing separate NEPA documentation for CERCLA activities.

The NEPA process is intended to help Federal agencies:

- Make decisions that are based on understanding environmental consequences
- Take actions that protect, restore, and enhance the environment.

The NEPA-related resources and values considered for the 200-UW-1 OU waste sites support the CERCLA decision-making processes. For the remedies evaluated, NEPA impacts include temporary short-term disturbance (e.g., increased traffic, noise levels, and fugitive dust) of approximately 1.3 km^2 (0.5 mi^2) for a disturbed industrial area that has low- to marginal-habitat quality. Appropriate borrow source material source areas were analyzed in DOE/EA-1403, *Environmental Assessment, Use of Existing Borrow Areas, Hanford Site, Richland, Washington.*

Long-term impacts identified for the remedies evaluated include potential aesthetic and visual impacts should the caps not be adequately contoured and vegetated to blend with the surrounding area. Minimal or no impacts are expected for air quality; natural, cultural, and historical resources; transportation; socioeconomics; environmental justice; irreversible and irretrievable commitment of resources; or cumulative impacts.

SUMMARY OF ALTERNATIVE EVALUATIONS AND PREFERRED ALTERNATIVES

Four remedial alternatives were developed for evaluation:

- Alternative 1 – No Action
- Alternative 2 – Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation
- Alternative 3 – Removal, Treatment, and Disposal
- Alternative 4 – Engineered Barrier.

Because CERCLA requires the evaluation of a "no action" alternative as a baseline for comparison to other alternatives, this alternative is evaluated for all waste sites. Given that the Central Plateau is expected to support waste management for the foreseeable future, the evaluations use an industrial exposure scenario.

The alternatives are evaluated on the basis of the representative waste site groups 1 through 5 and associated analogous waste sites in Table 3. A detailed discussion of the CERCLA criteria for each group is provided in Appendix C.

Group 1 – Representative Waste Sites 216-U-1 and 216-U-2 Cribs and Analogous Sites

Based on current information, the near-surface soils surrounding the 216-U-1 and 216-U-2 Cribs exceed the human health exposure for cesium-137. These waste sites are predicted to reach acceptable levels for cesium-137 in 128 yr due to natural decay. Contaminants at these waste sites meet the ecological criteria. The groundwater protection value for technetium-99 is exceeded because of elevated concentrations found throughout the soil column to approximately 61 m (200 ft) below ground surface. Fate and transport modeling, based on current conditions with no actions being taken, predicts that the waste site contaminants will not reach acceptable levels for technetium-99 for at least 1,000 yr.

The 216-U-1 and 216-U-2 cribs are close to the 241-U-361 Settling Tank, as shown in Figure 2. Contaminant distribution around the settling tank is expected to be much less than the contaminant distribution around the 216-U-1 and 216-U-2 Cribs. The settling tank was designed to hold and transfer wastes to the cribs rather than to discharge liquid wastes directly into the soils. Although the tank is not known to have leaked, leakage did occur from an overflow condition through the vent pipes of the tank and cribs. It is not known whether this resulted in contaminants being distributed at depths in excess of the groundwater protection criterion. Confirmatory sampling activities are planned to validate the site conceptual model.

Group 1 – Alternative Evaluations

Appendix C provides a detailed evaluation of the alternative for the CERCLA threshold and balancing criteria. Table 6 provides a summary of these findings.

Group 1 – Preferred Alternatives Selection Rationale

- The preferred alternative for the 216-U-1 Crib, 216-U-2 Crib, and the 241-U-361 Settling Tank is Alternative 4. This alternative is more protective of human health and the environment than Alternative 3, it is easy to construct and maintain, and is cost effective, given the groundwater protection requirements.
- Placing an engineered barrier (Alternative 4) over the 216-U-1 Crib, 216-U-2 Crib, and the 241-U-361 Settling Tank is protective of human health and the environment, complies with ARARs, uses permanent solutions, and is cost effective. Alternative 4 addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation and the contents of the 241-U-361 Settling Tank through ex-situ treatment (as appropriate); and does not address long-lived radionuclides.

Group 2 – Representative Waste Site 216-U-8 Crib and Analogous Sites

Based on current information, the near-surface soils surrounding the 216-U-8 Crib exceed the human health exposure for cesium-137. This waste site is predicted to reach acceptable levels for cesium-137 in 141 yr due to natural decay. Contaminants in soils are below levels protective of ecological receptors evaluated. The groundwater protection values for uranium and nitrogen as nitrate and nitrite are exceeded because of elevated concentrations to a depth of approximately (61 m) 200 ft. The modeling, based on current conditions with no action being taken, predicts that the waste site contaminants will not reach acceptable levels for groundwater protection for at least 1,000 yr.

The 200-W-42 VCP consists of a vitrified clay portion leading to the 216-U-8 and 216-U-12 Cribs and a steel portion leading to the 221-U Facility. The VCP portion of this pipeline is addressed in this Plan because of its known degradation and closeness to the cribs. The remaining steel portion of this pipeline will be addressed by a separate action for the other underground pipelines in the U Plant Area.

The contaminant distribution around the 200-W-42 VCP and the associated UPR-200-W-163 is expected to be much less in comparison to that of the 216-U-8 Crib. The pipeline was designed to transfer wastes to the crib. An unplanned

COCs

The COCs for the 216-U-1 and 216-U-2 Cribs include cesium-137 and technetium-99. These COCs are at measurable quantities from the surface to 168 ft below ground surface.

- Maximum concentration of cesium-137 is 259 pCi/g located at 6 ft below ground surface with a contaminant distribution ranging from 0 to 13 ft in depth.
- Maximum concentration of technetium-99 is 350 pCi/g located at 43 ft below ground surface with a contaminant distribution ranging from 0 to 168 ft in depth.

The COCs for the 241-U-361 Settling Tank are assumed to be similar to the representative waste sites 216-U-1 and 216-U-2 Cribs.

Preferred Remedy

Alternative 4 is the preferred alternative for representative waste sites 216-U-1 and 216-U-2 Cribs.

Alternative 4 – Engineered Barrier – is the preferred alternative for analogous waste site 241-U-361 Settling Tank.

Representative Waste Site 216-U-8 Crib

The 216-U-8 Crib is the representative site for the 200-W-42 VCP and the associated unplanned release UPR-200-W-163. The site conceptual model rationale for these sites is presented in Table 3, with additional information specific to each waste site provided in Appendix B, Table B-3. A summary of the risks associated with the 216-U-8 Crib and the 200-W-42 VCP is provided in Table 1. Expected dimensions and contaminated volumes are found in Appendix B.

COCs

The COCs for the 216-U-8 Crib include cesium-137, uranium, and nitrogen as nitrate and nitrite. These COCs are at measurable quantities from the surface to 60 m (199 ft) below ground surface.

TABLE 6. COMPARISON OF ALTERNATIVES FOR GROUP 1: REPRESENTATIVE SITE 216-U-1 AND 216-U-2 CRIBS AND ANALOGOUS SITE.

	ALTERNATIVES			
	❶ NO ACTION	❷ MESC, IC, MNA[a]	❸ RTD[b]	❹ ENGINEERED BARRIER
Representative Sites 216-U-1 and 216-U-2 Cribs				☑
Threshold Criteria				
Overall Protection	☐	☐	☑	☑
Compliance with Laws	☐	☐	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Best
Short-term effectiveness	Best	Moderate	Least	Moderate
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Least	Best
Cost (in thousands)				
Capital costs	$0	$0	$52,973	$696
Operating and maintenance costs[e]	$0	$16,325	$0	$13,805
Present worth[f]	$0	$393	$52,973	$1,347
Analogous Site 241-U-361 Settling Tank[g]				☑[h]
Threshold Criteria				
Overall Protection	☐	☑	☑	☑
Compliance with Laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Best
Short-term effectiveness	Best	Moderate	Least	Moderate
Reduction in TMV[d]	Least	Moderate	Best	Moderate
Implementability	Best	Best	Least	Best
Cost (in thousands)				
Capital costs	$0	$4,762	$5,078	$5,037
Operating and maintenance costs[e]	$0	$2,090	$0	$2,042
Present worth[f]	$0	$5,148	$5,078	$5,674

a. Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.
b. Removal, Treatment, and Disposal.
c. The comparison is qualitative (using best, moderate, least) based on best professional judgment. Quantitative values cannot directly be assigned.
d. Toxicity, mobility, or volume through treatment (TMV).
e. Operating and maintenance costs are discussed in Appendix F of the FFS.
f. Present worth is the total cost over time (see Appendix A) discounted (3.2% rate) to today's dollars.
g. Sludge and liquid removal are included in the evaluation and cost, except under no action.
h. The preferred remedy includes the removal and treatment of the tank contents.

☑	Indicates the preferred alternative
☑	Yes, meets criterion
☐	No, does not meet criterion
Best	Best satisfies criterion
Moderate	Partially meets criterion
Least	Least satisfies criterion

◆ Maximum concentration of cesium-137 at the 216-U-8 Crib is 429 pCi/g located at 0.6 m (2 ft) below ground surface with a contaminant distribution ranging from 0 to 2 m (0 to 6 ft) in depth.

release associated with the pipeline (identified as UPR-200-W-163) was known to have spread contamination laterally at the surface (estimated to be from 1 to 3 m [3 to 5 ft]) to approximately 4 m [12 ft] in depth). Results from investigations in this area indicate that, based on current conditions, the sites exceed the human health and ecological exposure for cesium-137 in the near-surface soils. Because of natural decay, the waste sites will reach acceptable levels for cesium-137 in 831 yr if no actions are taken. Because of the low mobility of cesium-137, the groundwater protection criteria are met. Because of the limited depth of the investigation, there is uncertainty regarding the concentration and distribution of contaminants deeper in the vadose zone. Confirmatory sampling activities are planned to validate the site conceptual model.

Group 2 – Alternative Evaluations

Appendix C provides a detailed evaluation of the alternative for the CERCLA threshold and balancing criteria. Table 7 provides a summary of these findings.

Group 2 – Preferred Alternative Selection Rationale

- The preferred alternative for the 216-U-8 Crib is Alternative 4. This alternative is protective of human health and the environment, it is easy to construct and maintain, provides more short-term effectiveness due to limited contaminated exposure, and is cost effective given the groundwater protection requirements. Alternative 4 addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation and does not address long-lived radionuclides.
- The preferred alternative for the 200-W-42 VCP and UPR-200-W-163 is Alternative 3, in conjunction with the preferred Alternative 4 for the 216-U-8 and 216-U-12 Cribs. This combined alternative (i.e., leaving a section of the pipeline under the effective portion of the barrier while excavating the remaining sections) provides overall protection of human health and the environment, complies with ARARs, and is most cost effective. The statutory preference for treatment is achieved by removal, treatment, and disposal for the portion of the pipeline being removed. For the remaining portion of the pipeline, the engineered barrier addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation and does not address long-lived radionuclides.

Group 3 – Representative Waste Site 216-U-12 Crib and Analogous Sites

Based on current information, the groundwater protection value in the soils associated with the 216-U-12 Crib for nitrogen as nitrate and nitrite are exceeded because of elevated concentrations found throughout the soil column to approximately 61 m (200 ft) below ground surface. The modeling, based on current conditions with no action being taken, predicts that the waste site will not reach acceptable levels for groundwater protection for at least 1,000 yr.

Contaminant distribution beneath the 216-U-5, 216-U-6, and 216-U-15 Trenches is expected to be less than that of the 216-U-12 Crib. These trenches were designed to be used one time for disposing of nonradioactive liquid waste; i.e., for one-time use to dispose of liquid wastes that were not exposed to radiation or small amounts of radioactive wastes. Because of the low volume of liquid waste that these trenches received, near-surface contamination is expected, with little deep contamination anticipated.

The remaining waste sites in this group include the 216-U-16 and 216-U-17 Cribs. These cribs are much larger than the trenches and received a greater volume of liquids. However, the contaminant mass in the effluent were orders of magnitude less than those in the 216-U-12 Crib. Contaminants at these cribs are still anticipated to exceed the direct exposure preliminary remediation goals. The site conceptual model is that historical discharge volumes, coupled with limited inventory, left few residual contaminants in the vadose zone.

- Maximum concentration of uranium at the 216-U-8 Crib is 280 pCi/g located at 189 ft below ground surface with a contaminant distribution ranging from 0 to 60 m (0 to 199 ft) in depth.
- Maximum concentration of nitrogen as nitrate and nitrite at the 216-U-8 Crib is 304 mg/kg located at 60 m (199 ft) below ground surface with a contaminant distribution ranging from 0 to 60 m (0 to 199 ft) in depth.

The COCs for the 200-W-42 VCP/ UPR-200-W-163 include cesium-137.

- Maximum concentration of cesium-137 is 40,081 pCi/g located at 3.4 m (11 ft) below ground surface with a contaminant distribution ranging from 1.5 to 4 m (5 to 13 ft) in depth.

Preferred Remedy

Alternative 4 is the preferred alternative for representative waste site 216-U-8 Crib.

Alternative 3 is the preferred alternative for analogous sites 200-W-42 VCP and unplanned release UPR-200-W-163.

Representative Waste Site 216-U-12 Crib

The 216-U-12 Crib is the representative site for several other liquid waste sites, including the 216-U-5, 216-U-6, and 216-U-15 Trenches and the 216-U-16 and 216-U-17 Cribs. The site conceptual model rationale for these sites is presented in Table 3, with further information specific to each waste site provided in Appendix B, Table B-4. A summary of the risks associated with the 216-U-12 Crib is provided in Table 1. Expected dimensions and contaminated volumes can be found in Appendix B.

COCs

The COC for the 216-U-12 Crib includes nitrogen as nitrate and nitrite. This COC is at measurable quantities from the surface to 233 ft below ground surface.

TABLE 7. COMPARISON OF ALTERNATIVES FOR GROUP 2: REPRESENTATIVE SITE 216-U-8 CRIB AND ANALOGOUS SITES.

CRITERIA	ALTERNATIVES ❶ NO ACTION	❷ MESC, IC, MNA[a]	❸ RTD[b]	❹ ENGINEERED BARRIER
Representative Site 216-U-8 Crib				☑ (preferred)
Threshold Criteria				
Overall protection	☐	☐	☑	☑
Compliance with laws	☐	☐	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Best
Short-term effectiveness	Best	Moderate	Least	Moderate
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Least	Best
Cost (in thousands)				
Capital costs	$0	$0	$62,266	$944
Operating and maintenance costs[e]	$0	$16,325	$0	$13,960
Present worth[f]	$0	$393	$62,266	$1,598
Analogous Sites 200-W-42 Vitrified Clay Pipeline and Unplanned Release UPR-200-W-163			☑ (preferred)	
Threshold Criteria				
Overall protection	☐	☐	☑	☑
Compliance with laws	☐	☐	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Moderate
Short-term effectiveness	Best	Best	Moderate	Best
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$4,039	$2,244
Operating and maintenance costs[e]	$0	$13,566	$0	$11,921
Present worth[f]	$0	$393	$4,039	$2,906

a. Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.
b. Removal, Treatment, and Disposal.
c. The comparison is qualitative (using best, moderate, least) based on best professional judgment. Quantitative values cannot directly be assigned.
d. Toxicity, mobility, or volume through treatment (TMV).
e. Operating and maintenance costs are discussed in Appendix F of the FFS.
f. Present worth is the total cost over time (see Appendix A) discounted (3.2% rate) to today's dollars.

☑ (bold) Indicates the preferred alternative
☑ Yes, meets criterion
☐ No, does not meet criterion
Best — Best satisfies criterion
Moderate — Partially meets criterion
Least — Least satisfies criterion

- Maximum concentration of nitrogen as nitrate and nitrite at the 216-U-12 Crib is 197 mg/kg located at 212 ft below ground surface with a contaminant distribution ranging from 4 to 233 ft in depth.

The COCs associated with the analogous waste sites are assumed to be limited to human health exposure to contaminants that pose risk (such as cesium-137).

Confirmatory sampling activities are planned to validate the site conceptual model.

GROUP 3 – ALTERNATIVE EVALUATIONS

Appendix C provides a detailed evaluation of the alternative for the CERCLA threshold and balancing criteria. Table 8 provides a summary of those findings.

TABLE 8. COMPARISON OF ALTERNATIVES FOR GROUP 3: REPRESENTATIVE SITE 216-U-12 CRIB AND ANALOGOUS SITES.

CRITERIA	ALTERNATIVES ❶ NO ACTION	❷ MESC, IC, MNA[a]	❸ RTD[b]	❹ ENGINEERED BARRIER
Representative Site 216-U-12 Crib				☑
Threshold Criteria				
Overall protection	☐	☐	☑	☑
Compliance with laws	☐	☐	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Best
Short-term effectiveness	Best	Moderate	Least	Moderate
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Least	Best
Cost (in thousands)				
Capital costs	$0	$0	$42,950	$460
Operating and maintenance costs[e]	$0	$16,325	$0	$13,610
Present worth[f]	$0	$393	$42,950	$1,106
Analogous Sites 216-U-5, 216-U-6, and 216-U-15 Trenches			☑	
Threshold Criteria				
Overall protection	☐	☑	☑	☑
Compliance with laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Moderate	Best	Best
Short-term effectiveness	Best	Best	Moderate	Best
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$1,201	$979
Operating and maintenance costs[e]	$0	$6,906	$0	$6,654
Present worth[f]	$0	$1,167	$1,201	$2,900
Analogous Sites 216-U-16 and 216-U-17 Cribs		☑		
Threshold Criteria				
Overall protection	☐	☑	☑	☑
Compliance with laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Moderate	Best	Best
Short-term effectiveness	Best	Best	Moderate	Best
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$6,412	$1,884
Operating and maintenance costs[e]	$0	$5,238	$0	$4,613
Present worth[f]	$0	$917	$6,412	$3,193

a. Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.
b. Removal, Treatment, and Disposal.
c. The comparison is qualitative (using best, moderate, least) based on best professional judgment. Quantitative values cannot directly be assigned.
d. Toxicity, mobility, or volume through treatment (TMV).
e. Operating and maintenance costs are discussed in Appendix F of the FFS.
f. Present work is the total cost over time (see Appendix A) discounted (3.2% rate to today's dollars.

☑	Indicates the preferred alternative
☑	Yes, meets criterion
☐	No, does not meet criterion
Best	Best satisfies criterion
Moderate	Partially meets criterion
Least	Least satisfies criterion

Preferred Remedy
Alternative 4 is the preferred alternative for representative site 216-U-12 Crib.

Alternative 3 is the preferred alternative for analogous sites 216-U-5, 216-U-6, and 216-U-15 Trenches.

Alternative 2 is the preferred alternative for analogous sites 216-U-16 and 216-U-17 Cribs.

Representative Waste Site 216-U-4 Reverse Well and 216-U-4A French Drain
The 216-U-4 Reverse Well and the 216-U-4A French Drain are the representative sites for the 216-U-4B French Drain. The site conceptual model rationale for these sites is presented in Table 3, with further information specific to each waste site provided in Appendix B, Table B-5. A summary of the risks associated with the 216-U-4 Reverse Well and the 216-U-4A French Drain is provided in Table 1. Expected dimensions and contaminated volumes can be found in Appendix B.

COCs
The COC for the 216-U-4 Reverse Well and the 216-U-4A French Drain includes cesium-137. This COC is at measurable quantities from near surface to 14 ft below ground surface.

- Maximum concentration of cesium-137 is 342 pCi/g located at 5 ft below ground surface with a contaminant distribution ranging from 4 to 14 ft in depth.

The COCs for the 216-U-4B French Drain are assumed to be similar to those of the representative waste site 216-U-4 Reverse Well / 216-U-4A French Drain.

Preferred Remedy
Alternative 2 is the preferred Alternative for representative sites 216-U-4 Reverse Well and 216-U-4A French Drain. These sites will be located under the proposed engineered barrier for the 221-U Facility.

GROUP 3 – PREFERRED ALTERNATIVE SELECTION RATIONALE

- The preferred alternative for the 216-U-12 Crib is Alternative 4. This alternative is more protective of human health and the environment than Alternative 3, is easy to construct and maintain, provides greater short-term effectiveness, and is cost effective given the groundwater protection requirements. Alternative 4 addresses the statutory preference for treatment for short-lived radionclides through monitored natural attenuation and the contents of the 241-U-361 Settling Tank through ex-situ treatment (as appropriate); and does not address long-lived radionuclides.
- The preferred alternative for the 216-U-5, 216-U-6, and 216-U-15 Trenches is Alternative 3. This alternative is protective of human health and the environment, can be implemented easily, provides long-term effectiveness, and is cost effective given the expected shallow extent of contamination. The statutory preference for treatment is achieved by Alternative 3.
- The preferred alternative for the 216-U-16 and 216-U-17 Cribs is Alternative 2. This alternative is protective of human health and the environment, can be implemented easily, and is the most cost-effective alternative. Alternative 2 addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation. Confirmatory sampling will be required to validate the conceptual model assumptions for these two sites.

Group 4 – Representative Waste Sites 216-U-4 Reverse Well and the 216-U-4A French Drain and Analogous Sites

The 216-U-4 Reverse Well and the 216-U-4A French Drain are located near each other (see Figure 2). Based on current information, these waste sites exceed the human health exposure for cesium-137; it is estimated that it will take 125 yr, due to natural decay, to reach acceptable (contamination) levels at these sites. Currently, they meet the ecological and groundwater protection criteria.

The 216-U-4 Reverse Well, 216-U-4A French Drain, and 216-U-4B French Drain received liquid wastes from the same facility. The main difference between these waste sites is the depth to which the liquid waste was discharged. The bottom of the 216-U-4 Reverse Well is 22.9 m (75 ft); whereas, the bottom of the 216-U-4A and 216-U-4B French Drains is approximately 3.1 m (10 ft).

GROUP 4 – ALTERNATIVE EVALUATIONS

Appendix C provides a detailed evaluation of the alternative for the CERCLA threshold and balancing criteria. Table 9 provides a summary of those findings.

GROUP 4 – PREFERRED ALTERNATIVE SELECTION RATIONALE

- The preferred alternative for the 216-U-4 Reverse Well and the 216-U-4A French Drain is Alternative 2 until the proposed 221-U Facility engineered barrier is constructed (Figure 2). The combination of Alternative 2 with the proposed 221-U barrier alternative is protective of human health and the environment, can be implemented easily, and is the most cost-effective alternative. This combined alternative addresses the statutory preference for treatment for short-lived radionclides through monitored natural attenuation.

TABLE 9. COMPARISON OF ALTERNATIVES FOR GROUP 4: REPRESENTATIVE SITE 216-U-4 RESERVE WELL AND 216-U-4A FRENCH DRAIN AND ANALOGOUS SITE.

CRITERIA	ALTERNATIVES ❶ NO ACTION	❷ MESC, IC, MNA[a]		❸ RTD[b]	❹ ENGINEERED BARRIER
Representative Sites 216-U-4 Reverse Well and 216-U-4A French Drain[c]		☑			
Threshold Criteria					
Overall protection	☐	☑		☑	☑
Compliance with laws	☐	☑		☑	☑
Balancing Criteria[d]					
Long-term effectiveness	Least	Moderate		Best	Moderate
Short-term effectiveness	Best	Moderate		Least	Moderate
Reduction in TMV[e]	Least	Least		Moderate	Least
Implementability	Best	Best		Moderate	Best
Cost (in thousands)					
Capital costs	$0	$0	$0[f]	$124	$251
Operating and maintenance costs[g]	$0	$916	$107[f]	$0	$874
Present worth[h]	$0	$193	$74[f]	$124	$695
Analogous Site 216-U-4B French Drain				☑	
Threshold Criteria					
Overall protection	☐	☑		☑	☑
Compliance with laws	☐	☑		☑	☑
Balancing Criteria[d]					
Long-term effectiveness	Least	Moderate		Best	Moderate
Short-term effectiveness	Best	Best		Moderate	Best
Reduction in TMV[e]	Least	Least		Moderate	Least
Implementability	Best	Best		Moderate	Best
Cost (in thousands)					
Capital costs	$0	$0		$115	$248
Operating and maintenance costs[g]	$0	$916		$0	$874
Present worth[h]	$0	$193		$115	$692

a. Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.
b. Removal, Treatment, and Disposal.
c. The 216-U-4 Reverse Well and 216-U-4A French Drain will be located under the proposed barrier for the 221-U Facility.
d. The comparison is qualitative (using best, moderate, least) based on best professional judgment. Quantitative values cannot directly be assigned.
e. Toxicity, mobility, or volume through treatment (TMV).
f. The costs shown in the left column are based on maintaining the required institutional controls at the given site for the full implementation period of Alternative 2 (i.e., 129 yr for 2607-W7 Tank and Tile Field). Potentially, however, Alternative 2 for these sites may be combined with the implementation of the proposed barrier over the 221-U Facility. If, as anticipated, the barrier were to be placed within the next 20 yr, maintaining institutional controls at the site correspondingly would be reduced to 20 yr. The costs shown in the right column are based on the reduced institutional controls costs resulting from this potential combination of Alternative 2 and the proposed barrier.
g. Operating and maintenance costs are discussed in Appendix F of the FFS.
h. Present worth is the total cost over time (see Appendix A) discounted (3.2% rate) to today's dollars.

☑	Indicates the preferred alternative
☑	Yes, meets criterion
☐	No, does not meet criterion
Best	Best satisfies criterion
Moderate	Partially meets criterion
Least	Least satisfies criterion

Preferred Remedy
Alternative 3 is the preferred alternative for analogous site 216-U-4B French Drain.

Representative Waste Site UPR-200-W-19
The unplanned release UPR-200-W-19 is the representative site for the following:

- Solid waste sites (200-W-71 Pit and UPR-200-W-8 Burning Ground)
- Unplanned release UPR-200-W-118
- The shallow/surface waste sites (UPRs 200-W-77, 200-W-85, 200-W-87, the 200-W-89 Foundation, UPR-200-W-33, UPR-200-W-48, UPR-200-W-55, UPR-200-W-78, and the collocated waste sites UPR-200-W-117 and UPR-200-W-60).

Also included are the septic systems either planned to be or already abandoned under WAC 246-272-18501. Completion of this abandonment, with sampling conducted as appropriate, will verify the appropriate action under CERCLA.

- 2607-W5 and 2607-W7 Septic Tanks and Tile Fields.

Expected dimensions and contaminated volumes for these sites can be found in Appendix B. The site conceptual model rationale for these waste sites is presented in Table 3, with further information specific to each waste site provided in Appendix B, Table B-6. A summary of the risks associated with the UPR-200-W-19 is provided in Table 1.

- The preferred alternative for the 216-U-4B French Drain is Alternative 3. Given the expected shallowness of contamination, this alternative is protective of human health and the environment, can be implemented easily, provides long-term effectiveness, and is cost effective. The statutory preference for treatment is achieved by removal, treatment, and disposal.

Group 5 – Representative Waste Site Unplanned Release UPR-200-W-19 and Analogous Sites

The UPR-200-W-19 is a surface spill that covers an area above and around the 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank (shown in Figure 2). Contaminant extends to a depth of approximately 2 m (6 ft). Based on current information, UPR-200-W-19 exceeds the human health exposure for cesium-137; it is estimated that it will take 129 yr to reach acceptable (contamination) levels, due to natural decay, at this site. Concentrations of contaminants in soils are protective of ecological receptors and are protective of groundwater.

The proposed 221-U Facility engineered barrier (Figure 2) is expected to cover several waste sites that include the 2607-W7 Septic Tank and Tile Field, UPR-200-W-118, and UPR-200-W-78. Once in place, this proposed engineered barrier is expected to eliminate direct exposure to contaminants.

The 2607-W5 and 2607-W7 Septic Tank and Tile Fields include the typical septic tank (approximately 11 ft deep) and a tile field (approximate depth of 5 ft). The 2607-W7 Septic Tank and Tile Field were remediated in 1999 in accordance with WAC 246-272-18501, "Department of Health," "On-Site Sewage Systems," "Abandonment." The 2607-W5 Septic Tank and Tile Field are planned for abandonment as well. The proposed 221-U Facility engineered barrier will cover the 2607-W7 waste site; therefore, confirmatory sampling is not considered necessary.

The two solid waste sites (200-W-71 Pit and UPR-200-W-8 Burning Ground) range in depth from 1 m to 3 m (3 ft to 10 ft). The 200-W-71 Pit did not accept hazardous wastes. The UPR-200-W-8 Burning Ground had surface contamination in the trench. This contamination was removed. Confirmatory or verification sampling are planned at these waste sites to validate the site conceptual model.

The other unplanned release and shallow/surface waste sites are contaminated to a depth of 1 m (3 ft) or less, with the exception of UPR-200-W-118, which is assumed to be 4.6 m (15 ft). The shallow/surface waste sites are unplanned releases 200-W-77, 200-W-85, 200-W-87, the 200-W-89 Foundation, UPR-200-W-33, UPR-200-W-48, UPR-200-W-55, and UPR-200-W-78, as well as the collocated waste sites UPR-200-W-117 and UPR-200-W-60.

Group 5 – Alternative Evaluations

Appendix C provides a detailed evaluation of the alternative for the CERCLA threshold and balancing criteria. Table 10 provides a summary of those findings.

Group 5 – Preferred Alternative Selection Rationale

- The preferred alternative for the unplanned release UPR-200-W-19 is Alternative 2 in combination with Alternative 4, the preferred alternative for the 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank. This alternative provides the necessary protection until the barrier is constructed

TABLE 10. COMPARISON OF ALTERNATIVES FOR GROUP 5: REPRESENTATIVE SITE UPR-200-W-19 AND ANALOGOUS SITES. PAGE 1 OF 2

CRITERIA	ALTERNATIVES ❶ NO ACTION	❷ MESC, IC, MNA[a]	❸ RTD[b]	❹ ENGINEERED BARRIER
Representative Site Unplanned Release UPR-200-W-19		☑		
Threshold Criteria				
Overall protection	☐	☑	☑	☑
Compliance with laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Moderate	Best	Moderate
Short-term effectiveness	Best	Moderate	Least	Moderate
Reduction in TMV[d]	Least	Least	Moderate	Least
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$5,184	$2,056
Operating and maintenance costs[e]	$0	$774	$0	$1,130
Present worth[f]	$0	$184	$5,184	$2,541
Analogous Sites Shallow Surface Unplanned Release Waste Sites 200-W-77, 200-W-85, 200-W-87, 200-W-89 Foundation, UPR-200-W-33, UPR-200-W-48, UPR-200-W-55, UPR-200-W-60, and UPR-200-W-117			☑	
Threshold Criteria				
Overall protection	☐	☑	☑	☑
Compliance with laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Moderate
Short-term effectiveness	Best	Best	Moderate	Best
Reduction in TMV[d]	Least	Moderate	Best	Moderate
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$1,198	$2,517
Operating and maintenance costs[e]	$0	$1,552	$0	$7,186
Present worth[f]	$0	$368	$1,198	$6,078
Analogous Sites 2607-W5 Septic Tank and Tile Field and 200-W-71 Pit Solid Waste Dump		☑		
Threshold Criteria				
Overall protection	☐	☑	☑	☑
Compliance with laws	☐	☑	☑	☑
Balancing Criteria[c]				
Long-term effectiveness	Least	Least	Best	Moderate
Short-term effectiveness	Best	Best	Moderate	Best
Reduction in TMV[d]	Least	Moderate	Best	Moderate
Implementability	Best	Best	Moderate	Best
Cost (in thousands)				
Capital costs	$0	$0	$2,252	$2,019
Operating and maintenance costs[e]	$0	$388	$0	$1,918
Present worth[f]	$0	$92	$2,252	$2,930

(continued next page)

TABLE 10. COMPARISON OF ALTERNATIVES FOR GROUP 5: REPRESENTATIVE SITE UPR-W-19 AND ANALOGOUS SITES. PAGE 2 OF 2

CRITERIA	ALTERNATIVES ❶ NO ACTION	❷ MESC, IC, MNA[a]		❸ RTD[b]	❹ ENGINEERED BARRIER
Analogous Sites Unplanned Release UPR-200-W-118[g] and UPR-200-W-78[g]		☑			
Threshold Criteria					
Overall protection	☐	☑		☑	☑
Compliance with laws	☐	☑		☑	☑
Balancing Criteria[c]					
Long-term effectiveness	Least	Least		Best	Moderate
Short-term effectiveness	Best	Best		Moderate	Best
Reduction in TMV[d]	Least	Moderate		Best	Moderate
Implementability	Best	Best		Moderate	Best
Cost (in thousands)					
Capital costs	$0	$0	$0[h]	$4,144	$1,383
Operating and maintenance costs[e]	$0	$968	$150[h]	$0	$1,906
Present worth[f]	$0	$230	$110[h]	$4,144	$2,292
Analogous Sites 2607-W7 Septic Tank and Tile Field[e] and Solid Waste Site Unplanned Release UPR-200-W-8 Burning Ground	☑				
Threshold Criteria					
Overall protection	☑	☑		☑	☑
Compliance with laws	☑	☑		☑	☑
Balancing Criteria[c]					
Long-term effectiveness	Best	Best		Best	Moderate
Short-term effectiveness	Best	Best		Moderate	Best
Reduction in TMV[d]	Least	Moderate		Best	Moderate
Implementability	Best	Best		Moderate	Best
Cost (in thousands)					
Capital costs	$0	$0	$0[h]	$3,149	$1,997
Operating and maintenance costs[e]	$0	$388	$224[h]	$0	$1,945
Present worth[f]	$0	$92	$68[h]	$3,149	$2,914

a. Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation.
b. Removal, Treatment, and Disposal.
c. The comparison is qualitative (using best, moderate, least) based on best professional judgment. Quantitative valves cannot directly be assigned.
d. Toxicity, mobility, or volume through treatment (TMV).
e. Operating and maintenance costs are discussed in Appendix F of the FFS
f. Present worth is the total cost over time (see Appendix A) discounted (3.2% rate) to today's dollars.
g. The 2607-W7, UPR-200-W-118, and UPR-200-W-78 waste sites will be located under the proposed barrier for the 221-U Facility.
h. The costs shown in the left column are based on maintaining the required institutional controls at the given site for the full implementation period of Alternative 2 (i.e., 129 yr for 2607-W7 Tank and Tile Field). Potentially, however, Alternative 2 for these sites may be combined with the implementation of the proposed barrier over the 221-U Facility. If, as anticipated, the barrier were to be placed within the next 20 yr, maintaining institutional controls at the site would correspondingly be reduced to 20 yr. The costs shown in the right column are based on the reduced institutional controls costs resulting from this potential combination of Alternative 2 and the proposed barrier.

☑ (large)	Indicates the preferred alternative
☑	Yes, meets criterion
☐	No, does not meet criterion
Best	Best satisfies criterion
Moderate	Partially meets criterion
Least	Least satisfies criterion

and it is also the most cost-effective alternative. This combined alternative addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation.

- Alternative 3 is the preferred remedy for nine of the waste sites – the 200-W-77, 200-W-85, 200-W-87, 200-W-89 Foundation, UPR-200-W-33, UPR-200-W-48, UPR-200-W-55, UPR-200-W-60, and UPR-200-W-117. Given the expected shallow extent of contamination, this alternative protects human health and the environment, can be implemented easily, provides long-term effectiveness, and is cost effective. The statutory preference for treatment is achieved by removal, treatment, and disposal.
- Alternative 2 is the preferred remedy for the 2607-W5 Septic Tank and Tile Field and the 200-W-71 Pit. This alternative is protective of human health and the environment, can be implemented easily, and is the most cost-effective alternative. Alternative 2 addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation. Confirmatory sampling will be conducted at these sites to validate their site conceptual models.
- Alternative 2 is the preferred remedy for unplanned releases UPR-200-W-118 and UPR-200-W-78 provided the proposed 221-U Facility engineered barrier is selected and constructed. This alternative is protective of human health and the environment, can be implemented easily, and is the most cost-effective alternative. This combined alternative addresses the statutory preference for treatment for short-lived radionuclides through monitored natural attenuation.
- Alternative 1 is the preferred remedy for the 2607-W7 Septic Tank and Tile Field. This waste site has been abandoned in accordance with WAC 246-272-18501.
- Alternative 1 also is the preferred remedy for the UPR-200-W-8 Burning Ground, because the site conceptual model is that hazardous materials were either not disposed at or have already been removed from this waste site. Verification sampling will be done to validate the site conceptual model.

Groups 1 Through 5 and Analogous Sites

Based on information currently available, the Tri-Parties believe the Preferred Alternatives described above meet the threshold criteria and provide the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Tri-Parties expect the Preferred Alternatives to satisfy the following statutory requirements of CERCLA §121(b):

1) Be protective of human health and the environment
2) Comply with ARARs
3) Be cost-effective
4) Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
5) Satisfy the preference for treatment as a principal element.

PLUG-IN OF U PLANT AREA SOIL WASTE SITES

The plug-in approach is a process that will help the Tri-Parties make remedial action decisions for waste sites that have not been addressed in this Plan, using these existing CERCLA evaluations. The agencies propose that the

COCs

The COC for UPR-200-W-19 includes cesium-137. This COC is at measurable quantities from the surface to 6 ft below ground surface.

- Maximum concentration of cesium-137 is 259 pCi/g located at 6 ft below ground surface with a contaminant distribution ranging from 0 to 13 ft in depth.

The COCs for the analogous waste sites are assumed to be similar to those of the representative waste site UPR-200-W-19.

Preferred Remedy

Alternative 2 is the preferred alternative for:

- Representative site unplanned release UPR-200-W-19
- Analogous sites 2607-W5 Septic Tank and Tile Field and the 200-W-71 Pit (solid waste dump)
- Analogous sites unplanned releases UPR-200-W-118 and UPR-200-W-78 until the proposed 221-U Facility engineered barrier is in place.

Alternative 3 is the preferred alternative for:

- Analogous shallow surface unplanned release waste sites 200-W-77, 200-W-85, 200-W-87, 200-W-89 Foundation, UPR-200-W-33, UPR-200-W-48, UPR-200-W-55, UPR-200-W-60, and UPR-200-W-117.

Alternative 1 is the preferred alternative for:

- Analogous sites 2607-W7 Septic Tank and Tile Field until the proposed 221-U Facility engineered barrier is in place.
- Solid waste site UPR-200-W-8. No COCs are identified for this waste site. Verification sampling will be conducted to verify the no action decisions for the UPR-200-W-8 Burning Ground.

plug-in approach be used in future remedy decisions for three types of waste sites:

- Unknown waste sites that are discovered in the future
- Known waste sites that could be reassigned from another OU
- Confirmatory sampling that indicates variations from the defined site conceptual model such that the selected alternative is no longer protective and a different alternative must be selected.

The benefit of a plug-in approach focus is to expeditiously clean up waste sites within the U Plant Area. The traditional CERCLA approach for remedy selection requires the development of many proposed plans and RODs. The proposed plug-in approach would allow analyses, evaluations, and selection of preferred alternatives identified in the 200-UW-1 OU FFS and Plan to be applied to similar waste sites. Building off of existing work allows remedial actions to begin earlier and streamlines a costly and often redundant remedy selection process.

Three elements/criteria are required to successfully use a plug-in approach.

- Establishing the Conceptual Model. Multiple analogous waste sites must be identified that share common physical and contaminant characteristics. These characteristics are known as the site conceptual model.
- Establishing the Standard Remedy. A remedial (cleanup) alternative, or standard remedy, must be established that has been shown to be protective and cost effective for sites that share the common site conceptual model.
- Establishing Need for Remedial Action. Sites sharing a common site conceptual model must be shown to require remedial action because of contaminant concentrations that pose a risk to human health and the environment.

To use the plug-in approach for a waste site not evaluated in the FFS, the site must fit the defined conceptual model and must be shown to require remedial action. The site then can be "plugged in" to the standard remedy. The following section describes how the plug-in approach would be used for remedy selection.

Establishing the Site Conceptual Model and Associated Standard Remedies

Four site conceptual models were defined, based on the following site characteristics:

- Type of contaminant at the waste site (e.g., radionuclides, nonradionuclides)
- Concentration of contaminant at the waste site
- Types of contaminated environmental media (e.g., soil) or material (e.g., concrete, metal, wood)
- Extent of contamination within the environment (i.e., the depth of discharge, the expected contaminant distributions (both lateral and vertical), and the potential for contaminant to impact groundwater).

Based on the representative sites evaluated in the FFS, the following four site conceptual models were developed and the associated standard remedies were identified:

- Waste sites where no hazardous material was disposed of or where contaminants disposed of currently meet the RAOs. The standard remedy is defined as Alternative 1 – No Action.
- Waste sites where limited contamination exists, there is no potential for groundwater contamination, and contaminants are expected to meet the RAOs. Contaminated environmental media include soil and solid waste,

including debris and materials (e.g., timbers and vent pipes), associated with the waste sites. The standard remedy is defined as Alternative 2 – Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.

- Waste sites where contaminants exceed the RAOs and contamination is shallow, low volume, and can be cost effectively remedied through removal, treatment, and disposal. Typically, these contaminants exceed the human health and ecological preliminary remediation goals. Contaminated environmental media include soil and solid waste, including debris and materials (e.g., timbers and vent pipes), associated with the waste sites. The standard remedy is defined as Alternative 3 – Removal, Treatment, and Disposal.
- Waste sites where contaminants exceed the RAOs and the contaminants have a potential to adversely impact groundwater because of contaminants at significant depth. Contaminated environmental media include soil and solid waste, including debris and materials (e.g., timbers and vent pipes), associated with the waste sites. The standard remedy is defined as Alternative 4 – Engineered Barrier.

Establishing the Need for Remedial Action

Waste sites that share a common site conceptual model will "plug in" to the standard remedy if it is determined that remedial action is required because of the risk to human health and the environment. The risks for newly discovered waste sites will be evaluated following data evaluation. Remedial action will be required for sites that contain radioactive contaminants that exceed the RAOs. For sites that do not exceed these criteria, no further action is proposed.

Public Involvement in the Plug-in Approach

To ensure that the public is involved meaningfully when the plug-in approach is used, the Tri-Parties propose to publish these post-ROD changes as explanations of significant differences (ESD), consistent with EPA guidance. The ESD includes a 30-day public comment period. The ESD must describe the nature of the significant changes, summarize the information that leads to making the changes, and affirm that the revised remedy complies with CERCLA and 40 CFR 300 (including ARARs).

These post-ROD changes will be evaluated at the following points in the plug-in process:

- When newly discovered waste sites are proven through sampling and analysis to be above remediation goals and can plug in to a standard remedy
- When confirmatory sampling indicates variations from the defined site conceptual model such that the selected alternative is no longer protective and a different standard remedy must be selected.

RCRA TSD UNIT CLOSURE PERFORMANCE STANDARDS AND CLOSURE STRATEGY

Concurrently with this Proposed Plan, a modification to WA7890008967, *Hanford Facility RCRA Permit*, is being submitted for public comment. The modification includes closure requirements for the 216-U-12 Crib.

Significant Changes
Significant Changes generally involve a change to a component of a remedy that does not fundamentally alter the overall cleanup approach.

ESD
Explanation of significant differences must describe to the public the nature of the significant changes, summarize the information that led to making the changes, and affirm that the revised remedy complies with CERCLA.

Reference
OSWER 9200.1-23P (EPA/540/R-98-031, *A Guide To Preparing Superfund Proposed Plans, Records of Decision, And Other Remedy Selection Decision Documents*)

The Tri-Party Agreement (Sections 5.5 and 6.3) prescribes the integration of the RCRA closure process with the CERCLA process. This integration provides a standard approach to direct cleanup activities in a consistent manner. These elements are summarized in Section 1.4 of DOE/RL-2003-23.

WA7890008967, *Hanford Facility RCRA Permit*

Because the 216-U-12 Crib cannot be clean closed in accordance with WAC 173-303-610(2)(b), the TSD will be closed as a landfill in accordance with WAC 173-303-665(6), "Landfills," "Closure and Post-Closure Care. " This closure strategy is consistent with the requirements specified in WAC 173-303-665(6); the land-disposal unit closure requirements of the Tri-Party Agreement, Section 6.3.2; and the landfill closure requirements of Condition II.K.4 of WA7890008967, *Hanford Facility RCRA Permit.* The current RCRA permit modification specifies the closure requirements for the TSD as well as a compliance schedule specifying the submittal of a postclosure plan and groundwater-monitoring plan at a later date.

Postclosure requirements will ensure that the engineered barrier is maintained (i.e., repaired), monitored to ensure it is performing as expected, and that water run-on/runoff is managed. Postclosure activities will be coordinated with the operations and maintenance for the 200-UW-1 OU.

Ecology has used information identified in Table 11 and information from other CERCLA documents to prepare a draft closure permit modification in accordance with Sections 5.5 and 6.3 of the Tri-Party Agreement. After public review and comment, Ecology will incorporate the draft closure permit into WA7890008967, *Hanford Facility RCRA Permit.*

TABLE 11. CROSSWALK BETWEEN RCRA TREATMENT, STORAGE, AND DISPOSAL CLOSURE PLAN REQUIREMENTS AND SUPPORTING DOCUMENTATION.

RCRA Treatment, Storage, and Disposal Closure Plan Section	Information Contained	Location in Supporting Documents
1.0 Introduction	Permitting history	DOE/RL-2003-23, Section 2.5.1.3
	Closure strategy	DOE/RL-2003-23, Section 7.2
	Part A Permit Application	DOE/RL-88-21, Section 4.2.3.8
2.0 Facility Description and Location	Location maps and discussion	DOE/RL-88-21, Section 4.2.3.8 DOE/RL-2003-23, Section 2.5.1.3
	Operational history	DOE/RL-88-21, Section 4.2.3.8 DOE/RL-2003-23, Section 2.5.1.3
3.0 Process Information	Process history for waste streams discharged to the TSD	DOE/RL-88-21, Section 4.2.3.8 DOE/RL-2003-23, Section 2.5.1.3
4.0 Waste Characteristics	Waste types and characteristics discharged to the TSD	DOE/RL-88-21, Section 4.2.3.8 DOE/RL-2003-23, Section 2.5.1.3
5.0 Groundwater Monitoring	Groundwater impacts and monitoring activities	Groundwater monitoring requirements will be contained in the groundwater-monitoring plan.
6.0 Closure Performance Standards	Closure strategy and performance standards	DOE/RL-2003-23, Sections 5.2 and 7.2
7.0 Closure Activities	Sampling and analysis; closure alternatives and closure requirements; includes schedule and certification of closure	DOE/RL-2003-23, Section 2.5.2.2 DOE/RL-2003-23 Appendix C, Tables C-3 and C-9 Closure alternatives and requirements evaluated through DOE/RL-2003-23, Sections 5.0 through 7.0 Closure schedule will be included in the remedial design report/remedial action work plan and closure certification through the actual remediation and closeout verification process.
8.0 Post-Closure Plan	Groundwater monitoring, cover design, surveillance and maintenance, inspection plan, if needed when clean closure is not achieved	Will be incorporated through the U Plant Area operations and maintenance plan, as necessary Groundwater monitoring requirements will be contained in the groundwater-monitoring plan.

DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application.*
DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Operable Unit.*
RCRA = *Resource Conservation and Recovery Act of 1976.*
TSD = treatment, storage, and/or disposal (unit).

PUBLIC PARTICIPATION

Public Involvement

Tribal nations, stakeholders, and the general public are encouraged to review and provide comments on the 200-UW-1 OU Proposed Plan during the 45-day public comment period that runs from May 16 through June 30, 2005.

Public Meeting

A public meeting will be held jointly with the public hearing on the permit modification (for the 216-U-12 Crib, a TSD unit). The public meeting will be held during the public comment period and will be announced in the *Tri-City Herald.*

Submitting Comments

The Tri-Parties will accept written comments on this Plan from May 16 through June 30, 2005. Comments should be sent to John Price at the Washington State Department of Ecology via:

- mail: ATTN: Mr. John Price, 3100 Port of Benton Blvd., Richland, WA 99354-1670
- fax: (509) 372-7971
- email: jpri461@ecy.wa.gov

Hanford Public Information Repository Locations

Copies of this Plan are available at the Hanford Public Information Repositories located at the University of Washington in Seattle, Washington; Gonzaga University in Spokane, Washington; Portland State University in Portland, Oregon; and Washington State University in Richland, Washington.

The Proposed Plan also is available electronically at http://www.hanford.gov/public/calendar/ under the Public Comment Period section.

The Administrative Record also contains copies of the Proposed Plan and supporting documents. The Administrative Record is located at 2440 Stevens Center Place, Room 1101; Richland, Washington 99352. This information can be accessed electronically at http://www2.hanford.gov/arpir

Points of Contact

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Public Comment Period:
May 16 through June 30, 2005.

Public Meetings:
To be scheduled during the public comment period.

Information Repositories:
This Proposed Plan is available for viewing at the following public information repositories:

- **University of Washington**
  Government Publications
  Suzzallo Library
  Seattle, Washington 98195
  206/543-1937
  ATTN: Eleanor Chase
  email: echase@u.washington.edu
- **Gonzaga University**
  Foley Center
  East 502 Boone
  Spokane, Washington 99258
  509/323-3834
  ATTN: Linda Pierce
  email: pierce@gonzaga.edu
- **Portland State University**
  Branford Price Millar Library
  934 SW Harrison
  Portland, Oregon 97207-1151
  503/725-4126
  ATTN: Judy Andrews
  email: andrewsj@pdx.edu
- **Washington State University**
  Public Reading Room
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  ATTN: Janice Parthtree
  email: reading_room@pnl.gov

APPENDIX A

SUMMARY OF SITE COST ESTIMATES

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TABLE A-1. COST ESTIMATES (IN $1,000). (4 PAGES)

Waste Site/Group and Associated Cost Summary[a]	Alternative 1 No Action	Alternative 2 MESC/IC/MNA[b]	Alternative 3 RTD[c]	Alternative 4 Engineered Barrier
Group 1: Representative Waste Sites 216-U-1/216-U-2 Cribs				
216-U-1/216-U-2 Cribs				
Total Capital Cost	-	-	$52,973[d]	$696
Implementation Time (Yr)	-	1,000	<4	1,000
Total Operations and Maintenance Cost	-	$16,325	-	$13,805
Present Worth Cost	-	$393	$52,973	$1,347
241-U-361 Settling Tank				
Total Capital Cost	-	$4,762	$5,078	$5,037
Implementation Time (Yr)	-	128	<1	128
Total Operations and Maintenance Cost	-	$2,090	-	$2,042
Present Worth Cost	-	$5,148	$5,078	$5,674
Group 2: Representative Waste Site 216-U-8 Crib				
216-U-8 Crib				
Total Capital Cost	-	-	$62,266[d]	$944
Implementation Time (Yr)	-	1000	<4	1,000
Total Operations and Maintenance Cost	-	$16,325	-	$13,960
Present Worth Cost	-	$393	$62,266	$1,598
200-W-42 Vitrified Clay Pipeline/UPR-200-W-163				
Total Capital Cost	-	-	$4,039	$2,244
Implementation Time (Yr)	-	831	<1	831
Total Operations and Maintenance Cost	-	$13,566	-	$11,920
Present Worth Cost	-	$393	$4,039	$2,906
Group 3: Representative Waste Site 216-U-12 Crib				
216-U-12 Crib				
Total Capital Cost	-	-	$42,950[d]	$460
Implementation Time (Yr)	-	1,000	<4	1,000
Total Operations and Maintenance Cost	-	$16,325	-	$13,610
Present Worth Cost	-	$393	$42,950	$1,106
216-U-5 Trench				
Total Capital Cost	-	-	$552	$366
Implementation Time (Yr)	-	141	<1	141
Total Operations and Maintenance Cost	-	$2,302	-	$2,223
Present Worth Cost	-	$389	$552	$1,007
216-U-6 Trench				
Total Capital Cost	-	-	$494	$353
Implementation Time (Yr)	-	141	<1	141
Total Operations and Maintenance Cost	-	$2,302	-	$2,222
Present Worth Cost	-	$389	$494	$994

TABLE A-1. COST ESTIMATES (IN $1,000). (4 PAGES)

Waste Site/Group and Associated Cost Summary[a]	Alternative 1 No Action	Alternative 2 MESC/IC/MNA [b]		Alternative 3 RTD[c]	Alternative 4 Engineered Barrier
216-U-15 Trench					
Total Capital Cost	-	-		$155	$260
Implementation Time (Yr)	-	141		<1	141
Total Operations and Maintenance Cost	-	$2,302		-	$2,209
Present Worth Cost	-	$389		$155	$899
216-U-16 Crib					
Total Capital Cost	-	-		$4,928	$1,334
Implementation Time (Yr)	-	141		<1	141
Total Operations and Maintenance Cost	-	$2,936		-	$2,364
Present Worth Cost	-	$528		$4,928	$1,998
216-U-17 Crib					
Total Capital Cost	-	-		$1,484	$550
Implementation Time (Yr)	-	141		<1	141
Total Operations and Maintenance Cost	-	$2,302		-	$2,249
Present Worth Cost	-	$389		$1,484	$1,195
Group 4: Representative Waste Sites 216-U-4 Reverse Well/216-U-4A French Drain					
216-U-4 Reverse Well/216-U-4A French Drain[e]					
Total Capital Cost	-	-	-	$124	$251
Implementation Time (Yr)	-	125	20	<1	125
Total Operations and Maintenance Cost	-	$916	$107	-	$874
Present Worth Cost	-	$193	$74	$124	$695
216-U-4B French Drain					
Total Capital Cost	-	-		$115	$248
Implementation Time (Yr)	-	125		<1	125
Total Operations and Maintenance Cost	-	$916		-	$874
Present Worth Cost	-	$193		$115	$692
Group 5: Representative Waste Site Unplanned Release UPR-200-W-19					
UPR-200-W-19					
Total Capital Cost	-	-		$5,184	$2,056
Implementation Time (Yr)	-	129		<1	129
Total Operations and Maintenance Cost	-	$774		-	$1,130
Present Worth Cost	-	$184		$5,184	$2,541
2607-W5 Septic Tank and Tile Field					
Total Capital Cost	-	-		$1,407	$1,466
Implementation Time (Yr)	-	129		<1	129
Total Operations and Maintenance Cost	-	$194		-	$990
Present Worth Cost	-	$46		$1,407	$1,927
2607-W7 Septic Tank and Tile Field[e]					
Total Capital Cost	-	-	-	$648	$805
Implementation Time (Yr)	-	129	20	<1	129
Total Operations and Maintenance Cost	-	$194	$30	-	$934
Present Worth Cost	-	$46	$22	$648	$1,257

TABLE A-1. COST ESTIMATES (IN $1,000). (4 PAGES)

Waste Site/Group and Associated Cost Summary[a]	Alternative 1 No Action	Alternative 2 MESC/IC/MNA [b]	Alternative 3 RTD[c]	Alternative 4 Engineered Barrier
200-W-71 Pit				
Total Capital Cost	-	-	$845	$553
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$928
Present Worth Cost	-	$46	$845	$1,003
UPR-200-W-8 Burning Ground				
Total Capital Cost	-	-	$2,501	$1,192
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$1,011
Present Worth Cost	-	$46	$2,501	$1,657
UPR-200-W-118[e]				
Total Capital Cost	-	- -	$4,040	$1,131
Implementation Time (Yr)	-	129 20	<1	129
Total Operations and Maintenance Cost	-	$774 $120	-	$1,015
Present Worth Cost	-	$184 $88	$4,040	$1,596
200-W-77 Unplanned Release				
Total Capital Cost	-	-	$106	$252
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$891
Present Worth Cost	-	$46	$106	$696
200-W-85 Unplanned Release				
Total Capital Cost	-	-	$111	$261
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$891
Present Worth Cost	-	$46	$111	$705
200-W-87 Unplanned Release				
Total Capital Cost	-	-	$167	$340
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$900
Present Worth Cost	-	$46	$167	$785
200-W-89 Foundation				
Total Capital Cost	-	-	$274	$479
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$919
Present Worth Cost	-	$46	$274	$928
UPR-200-W-33				
Total Capital Cost	-	-	$106	$258
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$891
Present Worth Cost	-	$46	$106	$702

TABLE A-1. COST ESTIMATES (IN $1,000). (4 PAGES)

Waste Site/Group and Associated Cost Summary[a]	Alternative 1 No Action	Alternative 2 MESC/IC/MNA[b]	Alternative 3 RTD[c]	Alternative 4 Engineered Barrier
UPR-200-W-48				
Total Capital Cost	-	-	$121	$277
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$894
Present Worth Cost	-	$46	$121	$721
UPR-200-W-55				
Total Capital Cost	-	-	$105	$251
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$891
Present Worth Cost	-	$46	$105	$695
UPR-200-W-78[e]				
Total Capital Cost	-	- / -	$104	$252
Implementation Time (Yr)	-	129 / 20	<1	129
Total Operations and Maintenance Cost	-	$194 / $30	-	$891
Present Worth Cost	-	$46 / $22	$104	$696
UPR-200-W-117/UPR-200-W-60				
Total Capital Cost	-	-	$208	$399
Implementation Time (Yr)	-	129	<1	129
Total Operations and Maintenance Cost	-	$194	-	$909
Present Worth Cost	-	$46	$208	$846

NOTE: The bolded boxes indicate the preferred alternatives.

a. The cost summary includes the total undiscounted capital as well as operations and maintenance costs. The present worth is based on an interest rate of 3.2% (Office of Management and Budget Circular No. A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*).

b. Alternative 2 is Maintain Existing Soil Cover (MESC), Institutional Controls (IC), and Monitored Natural Attenuation (MNA).

c. Alternative 3 is Removal, Treatment, and Disposal (RTD).

d. Estimated costs are due to full excavation from surface to 200 ft below ground surface.

e. For the split boxes, the costs shown in the left column are based on maintaining the required institutional controls at the given site for the full implementation period of Alternative 2 (for example, 129 yr for UPR-200-W-78). Potentially, however, Alternative 2 for these sites may be combined with implementation of the proposed barrier over the U Plant Canyon Building. If, as anticipated, the barrier were to be placed within the next 20 yr, maintaining institutional controls at the site correspondingly would be reduced to 20 yr. The costs shown in the right column are based on the reduced institutional controls costs resulting from this potential combination of Alternative 2 and the proposed barrier.

APPENDIX B

200-UW-1 OPERABLE UNIT DETAILED WASTE SITE INFORMATION

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TABLE B-1. WASTE SITE AREAS AND VOLUMES. (2 PAGES)

Waste Site	Dimensions[a] (length x width) (ft)	Surface Area (ft^2)[a]	Estimated Contaminated Volume (ft^3)[a]	COCs for Representative Waste Sites	Liquid Volume Discharged to Waste Site[b] gal (m^3) (unless noted otherwise)
Group 1					
216-U-1 Crib/216-U-2 Crib (Representative Waste Sites)	174 x 102	17,750	3,549,600	Cs-137, Tc-99	12,204,749 (46,200)
241-U-361 Settling Tank	30 x 30	900	22,500	--	27,474 (104)[c]
Group 2					
216-U-8 Crib (Representative Waste Site)	222 x 112	24,870	4,972,800	Cs-137, uranium, nitrogen as nitrate/nitrite	100,121,207 (379,000)
200-W-42 VCP/UPR-200-W-163[d]	1,965 x 20	39,300	589,600	Cs-137	N/A
Group 3					
216-U-12 Crib (RCRA TSD unit) (Representative Waste Site)	150 x 60	9,000	1,962,090	Nitrogen as nitrate/nitrite	39,625,808 (150,000)
216-U-5 Trench	70 x 70	4,900	73,500	--	1,188,774 (4500)
216-U-6 Trench	105 x 40	4,200	63,000	--	1,188,774 (4500)
216-U-15 Trench	20 x 20	400	6,000	--	17,963 (68)
216-U-16 Crib	262 x 191	50,050	850,720	--	108,046,369 (409,000)
216-U-17 Crib	204 x 64	13,060	235,010	--	557,403 (2110)
Group 4					
216-U-4 Reverse Well 216-U-4A French Drain (Representative Waste Sites)	10 x 10	100	1,500	Cs-137	79,252 (300) 143,974 (545)
216-U-4B French Drain	5 x 5	30	140	--	8718 (33)
Group 5					
UPR-200-W-19 (Representative Waste Site)	425 x 197	83,730	837,250	Cs-137 --	N/A
2607-W5 Septic Tank and Tile Field	30 x 13 136 x 100 (Active Tile Field) 174 x 100 (Inactive Tile Field)	32,400	166,170	--	3196 gal/day (12.1 m^3/day)
2607-W7 Septic Tank and Tile Field	4 x 2 (Tank) 136 x 100 (Tile Field)	13,600	68,000	--	264 gal/day (1 m^3/day)
200-W-71 Pit	262.5 x 49.2	12,920	129,150	--	N/A
UPR-200-W-8 Burning Ground	425 x 100	42,500	425,000	--	N/A
UPR-200-W-118	209 x 209	43,690	655,220	--	N/A
UPR-200-W-33	10 x 15	150	450	--	N/A
UPR-200-W-48	32 x 32	1,000	3,000	--	N/A
UPR-200-W-55	10 x 10	100	300	--	N/A
UPR-200-W-78	5 x 8	40	120	--	N/A

TABLE B-1. WASTE SITE AREAS AND VOLUMES. (2 PAGES)

Waste Site	Dimensions[a] (length x width) (ft)	Surface Area (ft^2)[a]	Estimated Contaminated Volume (ft^3)[a]	COCs for Representative Waste Sites	Liquid Volume Discharged to Waste Site[b] gal (m^3) (unless noted otherwise)
200-W-77 Unplanned Release	8 x 15	120	360	--	N/A
200-W-85 Unplanned Release	20 x 20	400	1,200	--	N/A
200-W-87 Unplanned Release	120 x 30	3,600	10,800	--	N/A
200-W-89 Foundation (Unplanned Release)	100 x 100	10,000	30,000	N/A	N/A
UPR-200-W-117/UPR-200-W-60	200 x 30	6,000	18,000	N/A	N/A

a. DOE/RL-2003-23, Appendix F.

b. DOE/RL-2003-23, Chapter 2.0.

c. 241-U-361 Tank residual waste volume.

d. Although this site is not a representative site (described on page 8 of the Proposed Plan), enough data have been collected to determine site-specific risk and contaminant distribution.

COC = contaminant of concern.
N/A = not applicable.
RCRA = *Resource Conservation and Recovery Act of 1976.*

DOE/RL-2003-23, 2003, *Focused Feasibility Study for the 200-UW-1 Operable Unit*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

TABLE B-2. 216-U-1 AND 216-U-2 CRIBS AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
	Representative Site	
216-U-1 and 216-U-2 Cribs	*Waste sites configuration/construction:* • Located west of the 221-U Building and north of 16th Street, the 174- by 102-ft site consists of two wooden structures open at the bottom, each measuring 12 by 12 by 4 ft and constructed of wooden timbers, located at the bottom of a 20-ft-deep excavation. The wooden structures are spaced 60 ft apart and are connected by stainless steel pipeline. U Plant wastes flowed from the 241-U-361 Settling Tank to the cribs through a stainless steel pipeline. • In 1992, contaminated soil in the vicinity of the 216-U-1 and 216-U-2 Cribs was scraped and consolidated near the 241-U-361 Settling Tank. The surface surrounding the 241-U-361 Settling Tank was surface stabilized with shotcrete. The area then was covered with 18 to 24 in. of clean backfill and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1952 to 1957 until the uranium recovery process operations were shut down, the cribs received cell drainage from the 5-6 tank in the 221-U Building and waste from the 224-U Building. • From 1957 through 1967, the cribs received 224-U Building and equipment decontamination waste, and reclamation waste from the 221-U Building Canyon. • In January 1985, wastewater from the 216-U-16 Crib had migrated north along a subsurface caliche layer and flushed vadose zone contamination from beneath the cribs through unsealed well casings to groundwater. During a remedial action from June until November 26, 1985, an estimated 687 kg of uranium were removed.	The 216-U-1 and 216-U-2 Cribs have been selected as a representative site because of the amount of available characterization data, their significant impact to groundwater, and their direct association with the 241-U-361 Settling Tank. The criteria considered to evaluate the suitability of this site as representative are as follows. (1) *Waste site configuration and construction*: The 216-U-1 and 216-U-2 Cribs are below-grade timber crib structures constructed in an open excavation, which was backfilled with soil. The 241-U-361 Settling Tank is a circular reinforced concrete underground tank structure. This criterion is only partially applicable, because only the depth of the engineered structure for these sites is similar. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the 241-U-361 Settling Tank was not designed to discharge waste to the vadose zone. (3) *Contaminant* inventory:* The contaminant type for the representative and the analogous waste sites should be identical, because the 241-U-361 Settling Tank was not 100% efficient for removing solids, and the suspended and soluble contaminants were discharged to the cribs. The contaminant inventory in the 241-U-361 Settling Tank should be bounded by the 216-U-1 and 216-U-2 Cribs, because the tank only held a portion of the total waste stream. (4) *Depth of waste discharge:* The structure depths are similar for the representative and analogous sites; however, this criterion is not applicable, because the tank was not designed to discharge waste to the vadose zone. (5) *Expected distribution of contaminants:* The distribution of contaminants in the vadose zone is expected to be much higher for the 216-U-1 and 216-U-2 Cribs as compared to the 241-U-361 Settling Tank, because the cribs were designed to discharge liquid wastes and the tank was not. (6) *Potential for hydrologic and contaminant impacts to groundwater:* The 216-U-1 and 216-U-2 Cribs are known to have impacted groundwater. The zone of highest contamination is at the base of the crib, from 6 to 12 m (20 to 40 ft) bgs. Maximum concentrations in this interval include Sr-90 at 2,400,000 pCi/g, and Cs-137 at 1,700,000 pCi/g. Uranium was detected throughout the vadose zone with peak values around 12 m (40 ft) (maximum concentration for U-233/234 of 1400 pCi/g, for U-235 of 148 pCi/g, and for U-238 of 10,080 pCi/g) and within the Cold Creek unit (32 pCi/g for U-233/234, 2.2 pCi/g for U-235, and 10, 080 pCi/g for U-238). Spectral gamma borehole logging indicated a maximum U-238 activity of 5000 pCi/g at 12 m (39.5 ft). The 241-U-361 Settling Tank was not designed to discharge liquid waste to the vadose zone; however, the unplanned tank overflow would have had the potential to follow the outside surface of the tank and reach the crib discharge depth, so it has a small potential to have impacted groundwater. Therefore, the 216-U-1 and 216-U-2 Cribs would bound the 241-U-361 Settling Tank in terms of impacts to groundwater.

TABLE B-2. 216-U-1 AND 216-U-2 CRIBS AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Process Waste Group Analogous Sites to be Evaluated using the 216-U-1 and 216-U-2 Cribs Representative Site Conceptual Model		
241-U-361 Settling Tank	*Waste sites configuration/construction:* • Located west of the 221-U Building and north of 16th Street, the 30- by 30-ft site consists of a circular underground settling tank 20 ft in diameter by 19 ft in height constructed of 6 in. steel-reinforced concrete. The top of the tank is approximately 6 ft below grade, and several vents and risers penetrated the ground surface. The bottom of the tank is located approximately 25 ft below grade. U Plant wastes flowed to the 241-U-361 Settling Tank to the 216-U-1 and 216-U-2 Cribs through a stainless steel pipeline. • In 1992, contaminated soil in the vicinity of the 216-U-1 and 216-U-2 Cribs was scraped and consolidated near the 241-U-361 Settling Tank. The surface surrounding the 241-U-361 Settling Tank was surface stabilized with shotcrete. The area then was covered with 18 to 24 in. of clean backfill and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1952 to 1957 until the uranium recovery process operations were shut down, the tank received cell drainage from the 5-6 tank in the 221-U Building and waste from the 224-U Building. • From 1957 through 1967, the tank received 224-U Building and equipment decontamination waste, and reclamation waste from the 221-U Building Canyon. • In 1953, an unknown volume of liquid wastes from the uranium recovery process in the 221-U Building and the 224-U Building overflowed from the vents on the 241-U-361 Settling Tank and the 216-U-1 and 216-U-2 Cribs and on to the ground. Contamination was reported over an area of approximately 50 ft^2. Soil removal and backfill were performed. The area originally was marked by a wooden fence, and posted with Radiation Zone signs. Over the years, contamination from windblown soil and vegetation extended the area of surface contamination until it was stabilized in 1992 (see UPR-200-W-19). • Approximately 106,000 L (28,000 gal) of waste sludge are believed to remain in the tank.	This settling tank is analogous to the 216-U-1 and 216-U-2 Cribs because of the following. (1) *Waste site configuration and construction*: The 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank are associated structures. This criterion is only partially applicable, because only the depth of the engineered structure for these sites is similar. (2) *Volume of effluent received in relation to the available pore volume:* The volume of effluent discharged from the 216-U-1 and 216-U-2 Cribs is significantly higher than the available soil pore volume (46,200 m^3 compared to 400 m^3). Because the volume and precise location of leakage from the 241-U-361 Settling Tank overflow (UPR-200-W-19) are unknown, a direct comparison cannot be made to the 216-U-1 and 216-U-2 Cribs. However, because the overflow was unplanned and not part of normal operation, it is reasonable to assume that the volume of waste discharged to the crib would be much higher than the amount of waste that overflowed from the tank. (3) *Contaminant* inventory:* The contaminant type for the representative and the analogous waste sites should be identical, because the 241-U-361 Settling Tank was not 100% efficient for removing solids, and the suspended and soluble contaminants were discharged to the cribs. The contaminant inventory in the 241-U-361 Settling Tank should be bounded by the 216-U-1 and 216-U-2 Cribs, because the tank only held a portion of the total waste stream. (4) *Depth of waste discharge:* The structure depths are similar for the representative and analogous sites; however, this criterion is only partially applicable, because the tank was not designed to discharge waste to the vadose zone and only the unplanned tank overflow would have had the potential to follow the outside surface of the tank and reach the crib discharge depth. (5) *Expected distribution of contaminants:* The distribution of contaminants in the vadose zone is expected to be much higher for the 216-U-1 and 216-U-2 Cribs compared to the 241-U-361 Settling Tank, because the cribs were designed to discharge liquid wastes and the tank (regardless of the unplanned tank overflow) was designed as a containment structure. (6) *Potential for hydrologic and contaminant impacts to groundwater:* The 216-U-1 and 216-U-2 Cribs are known to have impacted groundwater. The 241-U-361 Settling Tank was not designed to discharge liquid waste to the vadose zone; however, the unplanned tank overflow would have had the potential to follow the outside surface of the tank and reach the crib discharge depth, so it has a small potential to have impacted groundwater. Therefore, the 216-U-1 and 216-U-2 Cribs would bound the 241-U-361 Settling Tank in terms of impacts to groundwater.

*Note that the contaminant inventory (e.g., total mass of a constituent) is based on historic disposal records. Actual vadose zone concentrations were determined based on the field investigation phase of the project. The vadose zone concentrations were used in the risk assessment calculations.

bgs = below ground surface.

TABLE B-3. 216-U-8 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Representative Site		
216-U-8 Crib	*Waste sites configuration/construction:* • Located south of the 221-U Building and west of Beloit Avenue, the 222- by 112-ft site consists of three wooden structures open at the bottom and set in series at the bottom of a trench that measures 160 by 50 by 31 ft. Each wooden structure is 16 by 16 by 10 ft deep. The trench was filled with crushed stone to the tops of the wooden structures and backfilled to the existing grade. • In 1995, the site-contaminated soil from the area above the 200-W-42 VCP/UPR-200-W-163 was removed and placed over the top of the 216-U-8 Crib. The area over the crib and consolidated soils was covered with clean soil and the site posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1952 to 1960, the site received process condensate from the 221-U uranium recovery process, 291-U-1 Stack drainage, and 224-U Plant uranium oxide production (calcining) process condensate. In 1960, because of internal collapse of the crib, the 216-U-12 Crib was replaced by the 216-U-8 Crib.	The criteria considered to evaluate the suitability of the 216-U-8 Crib as representative of the analogous sites assigned to it are as follows. (1) *Waste site configuration and construction:* The 216-U-8 Crib consists of three wooden structures constructed in a 9 m (31 ft) deep open excavation, which was filled with 1.3 cm (0.5-in.) crushed stone to the tops of the wooden structures and backfilled to the existing grade with soil. The analogous site, 200-W-42 VCP, consists of a 15 cm (6-in.) diameter underground VCP buried approximately 3 to 4 m (10 to 12 ft) deep, and its associated surface unplanned release UPR-200-W-163. Although the structures are different, the representative site is deeper within the vadose zone and therefore bounds its analogous site in terms of depth. (2) *Volume of effluent received in relation to the available pore volume:* The volume of effluent discharged from the 216-U-8 Crib is significantly higher than the available soil pore volume (379,000 m^3 compared to 11,100 m^3). Because the volume and precise location of leakage from the 200-W-42 VCP are unknown, a direct comparison cannot be made to the 216-U-8 Crib. Because the pipeline discharged to the 216-U-8 Crib, it is reasonable to assume that the volume of waste discharged to the crib would be much higher than the amount of waste that leaked from the pipeline. Therefore, the volume of effluent discharged to the 216-U-8 Crib is believed to bound the volume released from the 200-W-42 VCP. (3) *Contaminant inventory:** The contaminant inventory for the 216-U-8 Crib bounds the contaminant inventory for the 200-W-42 VCP, because only a portion of the waste was released from the pipeline. The pipeline did, however, carry the same uranium-rich waste stream that was discharged to the crib, so it is expected that the contaminants would be the same. (4) *Depth of waste discharge:* The 216-U-8 Crib discharged wastes at a depth of between 6 and 9 m (21 and 31 ft) bgs (crib structure was 3 m [10 ft] tall) compared to the depth of the pipeline, which was 3 to 4 m (10 to 12 ft) bgs. The representative site bounds the analogous site in terms of discharge depth. (5) *Expected distribution of contaminants:* The expected distribution of contaminants in the vadose zone from the 216-U-8 Crib is expected to be similar to that of the 200-W-42 VCP, because the waste streams are the same, and the sites are located adjacent to each other. Less mobile contaminants, such as Cs-137, are found near the depth of release at both sites. The distribution of these contaminants is shallower at 200-W-42 VCP because of the shallower discharge depth. Insufficient data exist to evaluate the distribution of contaminants deeper in the vadose zone beneath the 200-W-42 VCP. (6) *Potential for hydrologic and contaminant impacts to groundwater:* The 216-U-8 Crib is known to have impacted groundwater. The potential for contaminants to impact groundwater at the 216-U-8 Crib is expected to be greater than that of the 200-W-42 VCP, because the volume of waste discharged is believed to be much greater than that of the 200-W-42 VCP and the discharge depth of the crib was greater. Significant zones of contamination are at the base of the crib (9 m [31 ft] bgs to 13 m [42 ft] bgs) and in the deep vadose zone (50 m [165 ft] to 61 m [199 ft]). Cesium-137 concentrations are highest from 9 to 13 m (30 to 42 ft) bgs (maximum value of 91,190 pCi/g at 9 m [30 ft] bgs) with no detectable concentrations below 30 m (100 ft). Strontium-90 was detected from 9 to 61 m (31 to 199 ft) with the value near the base of the crib (130 pCi/g) and between 35 and 50 m (115 and 165 ft) (maximum value of 520 pCi/g at 35 and 50 m [115 and 165 ft] bgs) with concentrations <20 pCi/g between 12 to 50 m [40 to 165 ft]). Uranium near the base of the crib is 28 pCi/g for U-233/234 and 94 pCi/g for U-238, and within the Cold Creek unit, maximum values of uranium are 140 pCi/g U-233/234 and 150 pCi/g U-238 at 56 m [185 ft] bgs). Spectral gamma borehole logging indicated a maximum U-238 activity of 831 pCi/g at 12 m (38 ft). Levels of Tc-99, Am-241, plutonium, and Np-237 are less than 1 pCi/g in the deep vadose zone.

TABLE B-3. 216-U-8 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Process Waste Group Analogous Sites to be Evaluated using the 216-U-8 Crib Representative Site Conceptual Model		
200-W-42 VCP/ UPR-200-W-163	*Waste sites configuration/construction:* • Located south of the 221-U Building and west of Beloit Avenue, the 1,965- by 20-ft site consists of VCP buried approximately 10 ft below grade extending from the 270-W Neutralization Tank beneath the 2715-UA Building south to the 216-U-8 Crib and then to the 216-U-12 Crib. • In 1995, the site-contaminated soil from the area above the 200-W-42 VCP/UPR-200-W-163 south of Beloit Avenue to the 216-U-8 was removed and placed over the top of the 216-U-8 Crib. The area over the crib and consolidated soils was covered with soil and the site posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1952 to 1960, the pipeline carried process condensate from the 221-U uranium recovery process, 291-U-1 Stack drainage, and 224-U Plant uranium oxide production (calcining) process condensate. • From 1960 to 1988, the pipeline carried 291-U-1 Stack drainage and 224-U Plant uranium oxide production (calcining) process condensate. Contaminated water that was discharged to the crib from the 241-WR Vault in October 1965 included 3.14 kg (6.9 lb) thorium.	This VCP/unplanned release is considered to be analogous to the 216-U-8 Crib, because of the following criteria. (1) *Waste site configuration and construction*: This criterion is partially applicable. Although the crib and pipeline structures are different, the representative site is deeper within the vadose zone and therefore bounds its analogous site in terms of depth. (2) *Volume of effluent received in relation to the available pore volume*: Because the section of pipeline associated with the unplanned release discharged to the 216-U-8 Crib and only a portion of the effluent volume leaked from the pipeline, the volume of effluent discharged to the 216-U-8 Crib is believed to bound the volume released from the 200-W-42 VCP. (3) *Contaminant inventory*:* The contaminant inventory for the 216-U-8 Crib bounds the contaminant inventory for the 200-W-42 VCP, because only a portion of the waste was released from the pipeline. (4) *Depth of waste discharge*: The representative site bounds the analogous site in terms of discharge depth. (5) *Expected distribution of contaminants*: The distribution of less mobile contaminants is expected to be shallower at the 200-W-42 VCP than at the 216-U-8 Crib, because of the shallower discharge depth. Insufficient data exist to evaluate the distribution of contaminants deeper in the vadose zone beneath the 200-W-42 VCP. (6) *Potential for hydrologic and contaminant impacts to groundwater*: The potential for contaminants to impact groundwater at the 216-U-8 Crib is expected to be greater than that of the 200-W-42 VCP, because the volume of waste discharged to the crib is believed to be much greater than the volume that leaked from the 200-W-42 VCP and the discharge depth of the crib was greater than the leak depth of the VCP. Surface soil samples collected during the VCP limited field investigation in 1994 typically showed low levels of activity for analyzed constituents. However, the highest Sr-90 and Tc-99 activities were detected in adjacent vegetation samples at 1,380 pCi/g for Sr-90 and 117 pCi/g for Tc-99. Significantly higher levels of contamination (maximums of 420 pCi/g Am-241, 40,081 pCi/g Cs-137, 146 pCi/g Sr-90, 50 pCi/g Tc-99, 43 pCi/g U-238, 3.3 pCi/g U-235, and 38 pCi/g U-233/234) were detected throughout the 4 m (12-ft) depth of the investigation above the pipeline. The data also suggested that minor lateral spreading (no more than 1 to 2 m [3 to 5 ft]) was apparent.

*Note that the contaminant inventory (e.g., total mass of a constituent) is based on historic disposal records. Actual vadose zone concentrations were determined based on the field investigation phase of the project. The vadose zone concentrations were used in the risk assessment calculations.

bgs = below ground surface.
VCP = vitrified clay pipeline.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Representative Site		
216-U-12 Crib	*Waste sites configuration/construction:* • Located south of the 221-U Building and west of Beloit Avenue, the 150- by 60-ft site consists of a backfilled trench with gravel overlain by a polyethylene barrier and soil backfill. A perforated VCP is placed along the bottom of the trench. The bottom of the trench is approximately 15 ft deep and measures 10 by 100 ft. The crib was constructed by first filling the bottom few feet with gravel. Then the VCP was placed along the centerline and covered with gravel for a total depth of 5 ft. A plastic barrier was placed over the gravel layer, and the trench was backfilled to grade with the original excavated sediment. • In 1992, the site surface was radiologically surveyed and down posted from a Surface Contamination Area to an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1960 to 1988, the site received 291-U-1 Stack drainage and 224-U Plant uranium oxide production (calcining) process condensate. Contaminated water that was discharged from the 241-WR Vault to the crib in October 1965 included 3.14 kg (6.9 lb) thorium. In 1988, the 216-U-12 Crib was replaced by the 216-U-17 Crib.	The criteria considered to evaluate the suitability of the 216-U-12 Crib as representative of the analogous sites assigned to it are as follows. (1) *Waste site configuration and construction:* The 216-U-12 Crib was constructed in a 5 m (15 ft) deep open excavation, which was backfilled with drainage layers of gravel, overlain by a polyethylene barrier and soil backfill. The 216-U-16 Crib and 216-U-17 Crib are constructed similarly, while the 216-U-5, 216-U-6, and 216-U-15 Trenches were open excavations that were intended for short-term use, contained no structure, and were backfilled with soil after use. The depths of the analogous sites range between 3 and 6 m (10 and 18 ft). (2) *Volume of effluent received in relation to the available pore volume:* The volume of effluent discharged to the 216-U-12 Crib is significantly greater than the soil pore volume beneath the site (150,000 m^3 compared to 1400 m^3). The 216-U-12 Crib bounds the analogous sites, because it had a significantly higher ratio of effluent volume to soil pore volume compared to analogous sites. (3) *Contaminant inventory:** The primary constituents in the 216-U-12 Crib waste inventory are uranium, Tc-99, and nitrate. Of these constituents, actual inventories for the 216-U-12 Crib were calculated only for uranium (2010 kg). Total uranium, Tc-99, and nitrate inventories for the 216-U-16 Crib and 216-U-17 Crib are expected to be lower than for the 216-U-12 Crib, because they received similar process condensate wastes from the 224-U Plant but received a smaller volume of waste. Because the 216-U-5 and 216-U-6 Trenches received unirradated fuel waste streams, no Tc-99 is expected to be present. The 216-U-15, 216-U-5, and 216-U-6 Trenches uranium inventories were estimated at 2.25 kg, 363 kg, and 363 kg, respectively. Nitrate inventories at the 216-U-5 and 216-U-6 Trenches were estimated at 200 kg for each trench. The 216-U-15 Trench received approximately 1 Ci of fission products (compared to about 6 Ci of fission products at 216-U-12) and significant amounts of organic solution, whereas none of the other sites, including the 216-U-12 Crib, did. (4) *Depth of waste discharge:* The discharge depth for the 216-U-12 Crib is 5 m (15 ft) compared to a range of 3 to 6 m (10 to 18 ft). The discharge depth for the representative site is consistent with the analogous sites. (5) *Expected distribution of contaminants:* The distribution of contaminants at the 216-U-12 Crib in the vadose zone is expected to bound the distribution of mobile contaminants at the 216-U-15, 216-U-5, and 216-U-6 Trenches. Because of the relatively small volume of waste discharged (approximately equal to or less than 1 pore volume), the contaminants would not be carried very deep into the vadose zone and would be found primarily near the point of release. Contaminant distributions for the 216-U-16 Crib and 216-U-17 Crib primarily were mobile contaminants that would have a distribution similar to those of the 216-U-12 Crib. (6) *Potential for hydrologic and contaminant impacts to groundwater:* The 216-U-12 Crib is bounding, because it is known to have impacted groundwater as evidenced by the presence of Tc-99 and nitrate in the groundwater.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-12 Crib (cont)		The 216-U-16 Crib also may have impacted groundwater, primarily because of the large volume of water discharged to this site. No other analogous sites in this group impacted groundwater because of the limited volumes of waste discharged to these sites. Limited characterization data are available for the crib from a 1994 borehole placed adjacent to the crib footprint, which showed no contaminants above background. A spectral gamma borehole logging of a borehole through the crib to 53 m (175 ft) bgs indicates Cs-137 from 5 to 18 m (16 to 59 ft) (maximum activity of 16,100 pCi/g at 7 m [23 ft]) and U-238 from 5 to 24 m (17 to 80 ft) (maximum activity of 500 pCi/g at 23 m [76 ft] bgs). Uranium-235 was detected by the radionuclide logging system at 20 pCi/g between 22 and 24 m (73 and 80 ft). Levels of Am-241, plutonium, and Np-237 are less than 1 pCi/g in the vadose zone.
Process Waste Group Analogous Sites to be Evaluated using the 216-U-12 Crib Representative Site Conceptual Model		
216-U-5 Trench	*Waste sites configuration/construction:* • Located northwest of the 221-U Building and contains an unlined trench 70 by 70 by 10 ft deep covered by backfill. • In 1994, the crib surface was interim-stabilized with 18 to 24 in. of uncontaminated backfill. This site is posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • A single discharge of liquid waste in 1952 consisting of unirradiated uranium waste from the cold startup run at the 221-U Building.	This trench is considered to be analogous to the 216-U-12 Crib, based on the following criteria. (1) *Waste site configuration and construction.* The site is an inactive unlined trench; however, it lacks drainage layers and an impermeable barrier. (2) *Volume of effluent received in relation to the available pore volume.* The trench received a volume of effluent comparable to the soil pore volume (4500 m^3 compared to 3300 m^3), which is significantly less than the volume received by the 216-U-12 Crib. (3) *Contaminant inventory.** The trench received an uranium-rich waste stream estimated to contain 363 kg of uranium and 200 kg of nitrate. (4) *Depth of waste discharge.* The trench was constructed to a depth that is similar to the 216-U-12 Crib. (5) *Expected distribution of contaminant.* The trench has primary contaminants of uranium and nitrate, and is expected to have similar contaminant distributions with maximum concentrations expected at the base of the trench (3 to 6 m [10 to 12 ft] bgs) and little lateral spreading. (6) *Potential for hydrologic and contaminant impacts to groundwater.* The site is not believed to have impacted groundwater, because of the limited discharge volumes from the site. This site is bounded by the 216-U-12 Crib; however, contaminant concentrations, vertical distribution, and risks likely are lower than those of the crib, based on (1) the site receiving orders of magnitude less wastewater than the 216-U-12 Crib (4500 m^3 compared to 150,000 m^3); (2) the site receiving a smaller inventory of contaminants (an order of magnitude less uranium, which was unirradiated); and (3) the site receiving a single short-duration discharge (lacks a persistent driving source of wastewater), which likely would further limit the vertical movement of contaminants from the point of discharge.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-6 Trench	*Waste sites configuration/construction:* • Located northwest of the 221-U Building and contains an unlined trench 105 by 40 by 10 ft deep covered by backfill. • In 1994, the crib surface was interim-stabilized with 18 to 24 in. of uncontaminated backfill. This site is posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • A single discharge of liquid waste in 1952 consisting of unirradiated uranium waste from the cold startup run at the 221-U Building.	This trench is considered to be analogous to the 216-U-12 Crib based on the following criteria. (1) *Waste site configuration and construction.* The site is an inactive unlined trench; however, it lacks drainage layers and an impermeable barrier. (2) *Volume of effluent received in relation to the available pore volume.* The trench received a volume of effluent comparable to the soil pore volume (4500 m^3 compared to 3300 m^3) and significantly less than the volume received by the 216-U-12 Crib. (3) *Contaminant inventory.** The trench received a uranium-rich waste stream estimated to contain 363 kg of uranium and 200 kg of nitrate. (4) *Depth of waste discharge.* The trench was constructed to a depth similar to that of the 216-U-12 Crib. (5) *Expected distribution of contaminant.* The trench has primary contaminants of uranium and nitrate, and is expected to have similar contaminant distributions with maximum concentrations expected at the base of the trench (3 to 6 m [10 to 12 ft] bgs) and little lateral spreading. (6) *Potential for hydrologic and contaminant impacts to groundwater.* The site is not believed to have impacted groundwater because of the limited discharge volumes from the site. This site is bounded by the 216-U-12 Crib; however, contaminant concentrations, vertical distribution, and risks likely are lower than those of the crib, based on (1) the site receiving orders of magnitude less wastewater than the 216-U-12 Crib (4500 m^3 compared to 150,000 m^3); (2) the site receiving a smaller inventory of contaminants (an order of magnitude less uranium, which was unirradiated); and (3) the site receiving a single short-duration discharge (lacks a persistent driving source of wastewater), which likely would further limit the vertical movement of contaminants from the point of discharge.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-15 Trench	*Waste sites configuration/construction:* • Located north of 16th Street and west of the 271-U Building, the site contains an unlined trench 20 by 20 by 15 ft deep covered by backfill. • No surface markers exist to identify the exact location of this waste unit. *Release history/volume/depth:* • A single discharge of liquid waste consisting of 7,000 gal of interface crud, activated charcoal, and diatomaceous earth containing approximately 1 Ci of fission products. The site is associated with the 388-U Tank and the 276-U Solvent Storage Tank.	This trench is considered to be analogous to the 216-U-12 Crib because of the following criteria. (1) *Waste site configuration and construction.* The site is an inactive unlined trench; however, it lacks drainage layers and an impermeable barrier. (2) *Volume of effluent received in relation to the available pore volume.* The trench received a volume of effluent less than the soil pore volume (68 m^3 compared to 560 m^3). (3) *Contaminant inventory.** The trench received an inventory of fission products (approximately 1 Ci) less than that of the 216-U-12 Crib (approximately 6 Ci); however, it is reported that this trench received organic solutions containing tributyl phosphate. (4) *Depth of waste discharge.* The trench was constructed to a depth similar to that of the 216-U-12 Crib. (5) *Expected distribution of contaminant.* The trench is expected to have similar contaminant distributions, with maximum concentrations expected at the base of the trench (3 to 6 m [10 to 12 ft] bgs) and little lateral spreading. (6) *Potential for hydrologic and contaminant impacts to groundwater.* The site is not believed to have impacted groundwater because of the limited discharge volumes from the site. This site is bounded by the 216-U-12 Crib; however, radionuclide contaminant concentrations, vertical distribution, and risks likely are lower than those of the crib based on (1) the site receiving several orders of magnitude less wastewater (68 m^3 compared to 150,000 m^3); (2) the site receiving a smaller inventory of radionuclides (3 orders of magnitude less uranium); and (3) the site receiving a single short-duration discharge (lacks a persistent driving source of wastewater), which likely would further limit the vertical movement of contaminants from the point of discharge. The 216-U-12 Crib, however, does not bound the chemical inventory of the 216-U-15 Trench, which received organics including tributyl phosphate and normal paraffin hydrocarbon. No analytical data are available for this site other than a report of core samples taken in 1970, which was not radioactive. There is some uncertainty as to the exact location of this site.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-16 Crib	*Waste sites configuration/construction:* • Located south of 16th Street, between Beloit and Cooper Avenues, and southwest of the 224-U Building, the crib covers a 262- by 191-ft area. Its distribution system consists of two 8-in.-diameter polyvinylchloride header pipes (reducing to 6 in.) set 3 ft above the crib bottom and running on opposite sides of the crib. The header pipes are connected by a series of 4 in. perforated polyvinylchloride pipes on 10-ft centers that run across the crib. Each header pipe and cross line has a vent pipe. The bottom around the distribution system is filled with 5 ft of gravel covered by a 36 mil reinforced polyethylene liner. The volume above the liner is backfilled to grade. The crib bottom is approximately 17 ft below ground surface. • The crib is identified with concrete markers and is posted with Underground Radioactive Material Area signs. *Release history/volume/depth:* • Between 1984 and February 1985, liquid waste from the 224-U Uranium Oxide Processing Facility steam condensate, chemical sewer waste, 271-U compressor cooling water, and 221-U chemical sewer waste were released to the crib.	This crib is considered to be analogous to the 216-U-12 Crib. The following criteria were used to evaluate this relationship. (1) *Waste site configuration and construction.* The site is an inactive gravel-filled crib similar in construction to the 216-U-12 Crib. (2) *Volume of effluent received in relation to the available pore volume.* Although the site received large volumes of effluent (409,000 m^3 compared to 150,000 m^3 for the 216-U-12 Crib), its pore volume was significantly larger (16,500 m^3 compared to 1400 m^3) and therefore is bounded by 216-U-12 in terms of effluent volume in relation to available pore volume. (3) *Contaminant inventory.** The site received a dilute uranium-bearing process waste stream. (4) *Depth of waste discharge.* The crib was constructed to a depth similar to the 216-U-12 Crib. (5) *Expected distribution of contaminants.* The primary radionuclide contaminants (uranium, Tc-99, and nitrate) are similar, and the site is expected to have a similar contaminant distribution with maximum concentrations at the base of the crib (5 m [17 ft] bgs). (6) *Potential for hydrologic and contaminant impacts to groundwater.* The 216-U-16 Crib also may have impacted groundwater, primarily due to the large volume of water discharged to this site. The water discharged from the 216-U-16 Crib formed a perched groundwater table that spread laterally along the caliche to the 216-U-1 and 216-U-2 Cribs, where uranium and Tc-99 were mobilized from beneath the 216-U-1 and 216-U-2 Cribs and moved to groundwater through an improperly sealed well near the 216-U-1 Crib. Characterization is limited to geophysical well logs. The site operated for less than 1 yr, but received a high enough rate of effluent to create a perched groundwater table. This site is bounded by the 216-U-12 Crib; however, contaminant concentrations and risks likely are lower based on (1) the site receiving a smaller inventory of contaminants (2 orders of magnitude less uranium) and (2) wastewater was distributed over a much larger crib-base area.

TABLE B-4. 216-U-12 CRIB AND ASSOCIATED ANALOGOUS WASTE SITES. (6 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-17 Crib	*Waste sites configuration/construction:* • Located southeast of the intersection of Beloit Avenue and 16th Street, the crib covers a 204 by 64 ft area. It consists of a single below-surface perforated distribution pipe running down the centerline of the crib in a coarse gravel layer 150 by 10 by 6.5 ft deep. The gravel is covered with a 10 mil polyvinylchloride membrane and 10 ft of backfill. The crib bottom is approximately 18 ft below ground surface. • A surface radiological survey in 1997 found no contamination. The crib is posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • Between 1989 and 1992, 224-U Plant uranium oxide production (calcining) process condensate from the off-gas condensers was neutralized and pumped to the crib for disposal.	This crib is considered to be analogous to the 216-U-12 Crib. The following criteria were used to evaluate this relationship. (1) *Waste site configuration and construction.* The 216-U-17 Crib is an inactive crib of similar construction (drainage layers and overlain by an impermeable barrier) that was built to replace the 216-U-12 Crib. (2) *Volume of effluent received in relation to the available pore volume.* The 216-U-17 Crib received a liquid effluent equal to its pore volume (2110 m^3). (3) *Contaminant inventory.** The crib received a uranium-rich waste steam, although significantly less inventory than the 216-U-12 Crib. (4) *Depth of waste discharge.* The 216-U-17 Crib was constructed to a depth similar to that of the 216-U-12 Crib. (5) *Expected distribution of contaminant.* The 216-U-17 Crib and 216-U-12 Cribs are expected to have similar contaminant distributions with maximum concentrations expected at the base of the crib and little lateral spreading. (6) *Potential for hydrologic and contaminant impacts to groundwater.* The 216-U-17 Crib and 216-U-12 Cribs have similar hydrogeology and a thick vadose zone; however, the volume of effluent discharged is equal to the soil pore volume. Therefore, it is not believed that the contaminants from the crib significantly impacted groundwater. Logging of six boreholes with the Radionuclide Logging System in the 216-U-17 Crib was completed in May 1993, after the crib received approximately 1.12 x 10^6 L of waste, and no man-made radionuclides were detected in the vadose zone beneath the crib. In addition, sampling of the UO_3 Facility process condensate discharged to the crib detected only low concentrations of tritium, uranium, Tc-99, nitrate, and fluoride (WHC-EP-0664). Risks associated with this site are expected to be bounded by those of the 216-U-12 Crib, because the waste inventory and volume are significantly less than at the 216-U-12 Crib logging results.

*Note that the contaminant inventory (e.g., total mass of a constituent) is based on historic disposal records. Actual vadose zone concentrations were determined based on the field investigation phase of the project. The vadose zone concentrations were used in the risk assessment calculations.

bgs = below ground surface.

VCP = vitrified clay pipeline.

WHC-EP-0664, 1993, *Groundwater Impact Assessment for the 216-U-17 Crib*, Westinghouse Hanford Operations, Richland, Washington.

TABLE B-5. 216-U-4 REVERSE WELL/216-U-4A FRENCH DRAIN AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
216-U-4 Reverse Well/216-U-4A French Drain Representative Site		
216-U-4 Reverse Well/216-U-4A French Drain	*Waste sites configuration/construction:* • A 10- by 10-ft area containing a reverse well (a 3-in. diameter pipe extending 75 ft into the ground with the bottom 25 ft of pipe perforated) connected to a French drain (a 51-in.-diameter concrete pipe extending 4 ft into the ground) located near the northwest corner of the 222-U Building. • Area stabilized with clean backfill and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • The reverse well received acidic decontamination liquid waste containing fission products from the 222-U Laboratory hood sinks from 1947 until it plugged in 1955. An overflow line was installed to the 216-U-4A French Drain, which continued to receive similar wastes until 1970 when laboratory operations were shut down.	Because of the proximity of the 216-U-4 Reverse Well and 216-U-4A French Drain sites, they have been combined into one conceptual contaminant distribution model. The 216-U-4 Reverse Well and 216-U-4A French Drain were selected as a representative site based on the following criteria. (1) *Waste site configuration and construction.* The 216-U-4 Reverse Well is the only reverse well among the U Plant Area waste sites, and the 216-U-4A French Drain and the 216-U-4B French Drain were constructed similarly (having similar materials and depth). (2) *Volume of effluent received in relation to the available pore volume.* The volume of effluent discharged through the 216-U-4 Reverse Well and the 216-U-4A French Drain is 845 m^3 compared to 33 m^3 for the 216-U-4B French Drain. (3) *Contaminant inventory.** The 216-U-4 Reverse Well, the 216-U-4A Drain, and the 216-U-4B French Drain received waste from the 222-U Laboratory. The primary contaminants discharged to the 216-U-4 Reverse Well and the 216-U-4A French Drain are uranium (8.83 kg), plutonium (9.00 E-03 g), Cs-137 (1.85 E-01 Ci), Sr-90 (1.59 E-02 Ci), and nitrate (1,300 kg). The contaminant inventory for the 216-U-4B French Drain is higher in terms of plutonium (5.40 E-02 g), similar in terms of Cs-137 (1.97 E-01 Ci), lower in Sr-90 (1.65 E-03 Ci) and nitrate (10 kg), and lacks uranium altogether. (4) *Depth of waste discharge.* The depth of discharge is similar for the 216-U-4A French Drain and 216-U-4B French Drain; however, the 216-U-4 Reverse Well is approximately 20 m (66 ft) deeper. (5) *Expected distribution of contaminant.* Because of the greater depth of the reverse well and much greater combined volume of discharge from the 216-U-4 Reverse Well and 216-U-4A French Drain, the contaminant distribution is expected to be significantly deeper for the representative site than for the analogous site (the 216-U-4B French Drain). Similar to other waste sites in the U Plant Area, immobile contaminants such as Cs-137 are found near the point of release, and more mobile contaminants such as nitrate are migrating lower in the vadose zone. The representative site bounds the analogous site in terms of the depth of the contaminant distribution. (6) *Potential for hydrologic and contaminant impacts to groundwater.* Because of the depth of the 216-U-4 Reverse Well, the volume of effluent discharged in comparison to the soil pore volume, and the detection of uranium at the caliche layer in excess of the background concentration, it is believed that the representative site may have impacted groundwater.

TABLE B-5. 216-U-4 REVERSE WELL/216-U-4A FRENCH DRAIN AND ASSOCIATED ANALOGOUS WASTE SITES. (2 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Reverse Well/French Drain Group Analogous Sites to be Evaluated using the 216-U-4 Reverse Well/216-U-4A French Drain Representative Site Conceptual Model		
216-U-4B French Drain	*Waste sites configuration/construction:* • A 5- by 5-ft area containing a French drain (a 36-in. concrete pipe extending 10 ft into the soil) located south of the 222-U Building. The French drain is a Washington State-registered underground injection well. • This site is posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • From 1960 to 1970, the site received contaminated liquid laboratory waste from hot cells and hoods in the 222-U Laboratory.	This site is analogous to the 216-U-4 Reverse Well/216-U-4A French Drain, based on the following criteria. (1) *Waste site configuration and construction.* This site is an inactive French drain of construction similar to that of the 216-U-4A French Drain. (2) *Volume of effluent received in relation to the available pore volume.* This site received a smaller effluent volume than the 216-U-4A French Drain and therefore is bounded by it. (3) *Contaminant inventory.** This site received a similar contaminant inventory (see discussion under 216-U-4 Reverse Well). (4) *Depth of waste discharge.* The 216-U-4A and 216-U-4B French Drains have similar structure depths. (5) *Expected distribution of contaminant.* The contaminant distribution is expected to be similar to the 216-U-4A French Drain, although bounded by it because of smaller release volume and inventory. (6) *Potential for hydrologic and contaminant impacts to groundwater.* The site has a thick vadose zone and depth similar to the caliche layer of the representative site because of the proximity of the two sites. Because the waste inventory for nitrate, the release depth, and effluent volume are all significantly less for the 216-U-4B French Drain, the representative site is believed to bound it in terms of impacts to groundwater.

*Note that the contaminant inventory (e.g., total mass of a constituent) is based on historic disposal records. Actual vadose zone concentrations were determined based on the field investigation phase of the project. The vadose zone concentrations were used in the risk assessment calculations.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
UPR-200-W-19 Representative Site		
UPR-200-W-19	*Waste sites configuration/construction:* • The 425- by 197-ft soil area is located north of 16th Street, west of the 221-U Building, and east of the 207-U Retention Basin. This site contains the 216-U-1 and 216-U-2 Cribs, the 241-U-361 Settling Tank, and the 2607-W5 Septic Tank and diversion boxes. • In 1992, contaminated soil in the vicinity of the 216-U-1 and 216-U-2 Cribs was scraped and consolidated near the 241-U-361 Settling Tank. The surface surrounding the 241-U-361 Settling Tank was surface stabilized with shotcrete. The area then was covered with 18 to 24 in. of clean backfill and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • In 1953, an unknown volume of liquid wastes from the uranium recovery process in the 221-U Building and the 224-U Building overflowed from the vents on the 241-U-361 Settling Tank and the 216-U-1 and 216-U-2 Cribs and on to the ground. Contamination was reported over an area of approximately 50 ft^2. Soil removal and backfill were performed. The area originally was marked by a wooden fence, and posted with Radiation Zone signs. Over the years, contamination from windblown soil and vegetation extended the area of surface contamination until it was stabilized in 1992.	The criteria considered to evaluate the suitability of UPR-200-W-19 as a representative of the sites assigned to it are as follows. (1) *Waste site configuration and construction.* UPR-200-W-19 is an unplanned release site where contaminated liquid from a high-risk waste site was known to have been released to the ground. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is only applicable when a known volume of waste is released to a site of defined size. Because the volume of the release for UPR-200-W-19 is not known, the relationship to pore volume cannot be determined. (3) *Contaminant inventory:** Because UPR-200-W-19 was an unplanned release, contaminant inventory is not known. (4) *Depth of waste discharge*: The UPR-200-W-19 was a surface release of liquid that was later spread to a wider area by plant and animal/insect intrusion. The depth of the release is expected to be 1 to 2 m below the clean backfill. (5) *Expected distribution of contaminants:* Immobile contaminants from UPR-200-W-19 have remained near the surface and have been spread laterally by windblown soil and vegetation. More mobile contaminants are anticipated to be relatively shallow, because the effluent volume released was small relative to the volume discharged to the cribs. (6) *Potential for hydrologic and contaminant impacts to groundwater:* No impacts to groundwater are anticipated because of the small effluent volume believed to have been released to the site compared to the volumes released at high-risk waste sites.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Septic System Group Analogous Sites to be Evaluated using the UPR-200-W-19 Representative Site Conceptual Model		
2607-W5 Septic Tank and Tile Field	*Waste sites configuration/construction:* • The septic tank (a buried concrete box 30 ft long, 13 ft wide, and 11 ft deep) and two concrete diversion boxes are located north of the 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank in an Underground Radioactive Material Area. The two tile fields are located outside the Underground Radioactive Material Area boundary also to the north. One tile field (174 by 100 ft) has been inactive since 1954. The second tile field (136 by 100 ft) is active and receives waste from U Plant facilities. • The septic tank and the two concrete diversion boxes were decontaminated and surface stabilized with clean backfill in 1992 and posted as an Underground Radioactive Material Area. Radiological contamination on the surface within the active tile field was decontaminated by scraping off surface soils and the posting removed. *Release history/volume/depth:* • Contamination from windblown soil and vegetation from the 241-U-361 unplanned release probably was the source of the contamination. However, no radionuclides or hazardous chemicals are known to have been associated with discharges to this septic system. The system was designed to receive up to 3,200 gal/day of sanitary waste from U Plant facilities.	This site is considered to be similar to and bounded by UPR-200-W-19 based on the following criteria. (1) *Waste site configuration and construction:* This criterion is not applicable, because the unplanned release is not an engineered structure compared to the 2607-W5 Septic Tank and Tile Field, which was designed to accept sanitary effluent. (2) *Volume of effluent received in relation to the available pore volume:* The volume of effluent received at the 2607-W5 Septic Tank and Tile Field is expected to exceed the soil pore volume. This is not the case for UPR-200-W-19; however, this may not be of significance, because the septic tank and tile field system was intended to accept sanitary effluent, not contaminated effluents. Therefore, the waste inventory transported with that liquid effluent is expected to be minimal. (3) *Contaminant inventory:** The waste inventory of the septic system is unknown, but is believed to be bounded by the contaminant inventory released to UPR-200-W-19, where a known release of contaminants from a high-risk waste site was documented and confirmed through characterization. No releases of radiological contaminants have been documented for the 2607-W5 Septic Tank and Tile Field, because it was not intended for disposal of sanitary effluent. (4) *Depth of waste discharge*: The depth of discharge for the septic system is considered similar to UPR-200-W-19, because the septic tank and tile fields are near the surface. (5) *Expected distribution of contaminants:* The contaminant distribution is expected to be near the surface for immobile contaminants such as Cs-137 that may have been inadvertently released into the septic system. More mobile contaminants inadvertently discharged into the septic system could migrate deeper into the vadose zone; however, the amounts of these contaminants are expected to be small, because these contaminants were not purposely discharged into the septic system, and no unplanned releases have been documented. Because surface contamination has been documented and characterized at UPR-200-W-19, it is believed that the representative site would bound the analogous sites in terms of risk. (6) *Potential for hydrologic and contaminant impacts to groundwater:* Because of the limited contaminant inventory released to the sites compared with the inventory release to other U Plant waste sites designed to accept liquid effluent, the site is not believed to have impacted groundwater. Characterization data from borehole 299-W19-97 placed adjacent to the south west corner of the tile fields as part of a 1994 investigation showed no evidence of impact to the vadose zone from the tile field. Low levels of Cs-137 associated with UPR-200-W-19 were detected near the surface.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
2607-W7 Septic Tank and Tile Field	*Waste sites configuration/construction:* • The 350-gal septic tank and 136- by 100-ft drain field. This unit lies 45.9 ft north of the northernmost corner of the 221-U Canyon Building. • This system was abandoned in 1999 in accordance with the requirements of WAC 246-272-18501. All sewage inside the tank was removed, and the empty tank was filled to eliminate void spaces. *Release history/volume/depth:* • No radionuclides or hazardous chemicals are known to have been associated with this septic system. The system was designed to receive up to 264 gal/day of sanitary waste from the restroom located in the 221-U Canyon Building.	This site is considered to be similar to and bounded by UPR-200-W-19 based on the following criteria. (1) *Waste site configuration and construction:* This criterion is not applicable, because the unplanned release is not an engineered structure like the 2607-W7 Septic Tank and Tile Field, which was designed to accept sanitary effluent. (2) *Volume of effluent received in relation to the available pore volume:* The volume of effluent received at the 2607-W7 Septic Tank and Tile Field is expected to exceed the soil pore volume. This is not the case for UPR-200-W-19; however, this may not be of significance, because the septic tank and tile field system was intended to accept sanitary effluent, not contaminated effluents. Therefore, the waste inventory transported with that liquid effluent is expected to be minimal. (3) *Contaminant inventory:* * The waste inventory of the septic tank and tile field system is unknown, but is believed to be bounded by the contaminant inventory released to UPR-200-W-19, where a known release of contaminants from a high-risk waste site was documented and confirmed through characterization. No releases of radiological contaminants have been documented for the 2607-W7 Septic Tank and Tile Field, because it was not intended for disposal of sanitary effluent. (4) *Depth of waste discharge*: The depth of discharge for the septic tank and tile field system is considered similar to UPR-200-W-19, because the septic tank and tile fields are near the surface. (5) *Expected distribution of contaminants:* The contaminant distribution is expected to be near the surface for immobile contaminants such as Cs-137 that may have been inadvertently released into the septic tank and tile field system. More mobile contaminants inadvertently discharged into the septic tank and tile field system could migrate deeper into the vadose zone; however, the amounts of these contaminants are expected to be small, because these contaminants were not purposely discharged into the septic system, and no unplanned releases have been documented. Because surface contamination has been documented and characterized at UPR-200-W-19, it is believed that the representative site would bound the analogous sites in terms of risk. (6) *Potential for hydrologic and contaminant impacts to groundwater:* Because of the shallow nature of the site, and the limited contaminant inventory released to the sites in comparison to other U Plant Area waste sites designed to accept liquid effluent, the site is not believed to have impacted groundwater.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Solid Waste Group Analogous Sites to be Evaluated using the UPR-200-W-19 Representative Site Conceptual Model		
200-W-71 Pit	*Waste sites configuration/construction:* • A 262.5- by 49.2-ft soil area originally containing a burning pit located southeast of the 221-U Building, south of 16th Street, and east of Beloit Avenue. • The site was identified from aerial photos taken in the late 1940s. The site is not marked. *Release history/volume/depth:* • Suspected uranium-contaminated debris was burned at this site in the late 1940s and apparently covered with soil. No radioactive contamination has been discovered in or around this site.	Significant uncertainties exist concerning the nature of any releases at this 200-W-71 Pit site as well as the location of the site. Based on the historical photographs and the general lack of information on this site and on the UPR-200-W-8 Burning Ground, this site may be the burn pit that is described in the UPR-200-W-8 Burning Ground waste site. See the UPR-200-W-8 Burning Ground rationale in the following description.
UPR-200-W-8 Burning Ground	*Waste sites configuration/construction:* • A 425- by 100-ft soil area located east of the 221-U Building, adjacent to the northwest corner of Beloit Avenue and 16th Street. • The site was cleaned up and removed from radiation zone status in 1970. The site is no longer marked or posted. *Release history/volume/depth:* • Suspected fission-product-contaminated debris was burned here in the 1950s and covered with about 10 ft of clean fill. NOTE: Based on historical photographs and the general lack of information on this site, the 200-W-71 Pit may be the burn pit that is described as the 200-W-8 Burning Ground waste site.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This criterion is not applicable, because the 200-W-8 Burning Ground site consisted of a trench that may have been used as a burning ground, compared to UPR-200-W-19, which was an unplanned release with no structure. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable to the 200-W-8 Burning Ground, because no effluent is known to have been discharged to the site. (3) *Contaminant inventory:** The contaminant inventory discharged to this site was not documented, but the maximum dose rate of 45 rem/h at 5 cm (2 in.) is comparable to the 11.5 rem/h at a distance of 7.6 cm (3 in.) measured at UPR-200-W-19. However, because surface contamination has been documented by soil sampling at UPR-200-W-19, and the release occurred from a high-risk site, it is believed that the representative site would bound the analogous site in terms of risk. (4) *Depth of waste discharge:* The 200-W-8 Burning Ground site consisted of a shallow trench that is believed to have been backfilled, and therefore the release depth of the contamination is similar to that of UPR-200-W-19. (5) *Expected distribution of contaminants:* The contaminant distribution at the 200-W-8 Burning Ground is expected to be near the surface, because only solid waste was released at this site. Because contamination at the 200-W-8 Burning Ground is believed to have been cleaned up, UPR-200-W-19 would bound the 200-W-8 Burning Ground in terms of contaminant distribution. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable to the 200-W-8 Burning Ground, because no liquid was discharged at this site.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
Unplanned Release Group Analogous Sites to be Evaluated using the UPR-200-W-19 Representative Site		
UPR-200-W-118	*Waste sites configuration/construction:* • A 209- by 209-ft soil area located around the railroad spur and 211-U Chemical Tank Farm northwest of the 221-U Building. • Area stabilized with gravel and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • Drips and spills from the reclaimed nitric acid unloading station at the 211-U Chemical Tank Farm in the 1960s and 1970s was spread by the wind to the ground surface outside the concrete unloading station and onto surrounding soils.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* The representative site and the analogous site in this grouping are unplanned releases expected to be limited to surface soils within 3 m (10 ft) of the ground surface, based on the nature of the releases. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the volume of liquid discharged is not known. (3) *Contaminant inventory:** The contaminant inventory discharged to this site was not documented. However, because surface contamination has been documented at UPR-200-W-19, and the release occurred from a high-risk site, it is believed that the representative site would bound the analogous site in terms of risk. (4) *Depth of waste discharge:* Both the representative site UPR-200-W-19 and the analogous site UPR-200-W-118 were released to surface soil and therefore have similar release depths. (5) *Expected distribution of contaminants:* Because the release depths are similar, it is anticipated that contaminant distributions at the representative site and the analogous site would be similar. Because surface contamination has been documented and characterized at UPR-200-W-19, and the release occurred from a high-risk waste site, it is believed that the representative site would bound the analogous site in terms of risk. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.
Shallow/Surface Waste Site Group Analogous Sites to be Evaluated using the UPR-200-W-19 Representative Site Conceptual Model		
UPR-200-W-33	*Waste sites configuration/construction:* • A 10- by 15-ft soil area located approximately 90 ft east of the 224-U Building. • In 1955, the top 4 in. of contaminated soil were removed and new soil was used to fill the excavation. The site was removed from radiation zone status in 1970. The site is no longer marked or posted. *Release history/volume/depth:* • A leaking flange of the C-5 Condensate Line from the 224-U Building caused a small area of the ground to become contaminated in March 1955.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release of liquid waste to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the volume of effluent discharged to UPR-200-W-33 is not known. (3) *Contaminant inventory:** The contaminant inventory at UPR-200-W-33 was not documented. However, because UPR-200-W-33 was a small release compared to UPR-200-W-19, it is believed that the representative site would bound the analogous sites in terms of risk. (4) *Depth of waste discharge:* UPR-200-W-33 was an unplanned release to surface soil and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from UPR-200-W-33 is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was small and was cleaned up. Because the release depths are similar, and the effluent volume and contaminant inventory of UPR-200-W-19 is significantly higher, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
UPR-200-W-48	*Waste sites configuration/construction:* • A 32- by 32-ft soil area located at the west end of the 221-U Building railroad cut at Bridgeport Avenue. • Contaminated soil was removed and a patch of gravel at the site may be part of the 1958 stabilization effort. The site is no longer marked or posted. *Release history/volume/depth:* • Suspected fission-product-contaminated particulates that spread from a jumper, wrapped in plastic, as it was transferred from a flatbed truck to a railroad flatcar at the railroad crossing in 1958.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release of liquid waste to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the UPR-200-W-48 effluent volume discharged is unknown. (3) *Contaminant inventory:** The contaminant inventory at UPR-200-W-48 was not documented but the maximum dose rate of 9 rem/h is comparable to the 11.5 rem/h at a distance of 7.6 cm (3 in.) measured at UPR-200-W-19. However, because UPR-200-W-48 was a small release compared to the release at UPR-200-W-19, it is believed that the representative site would bound the analogous sites in terms of contaminant inventory. (4) *Depth of waste discharge:* UPR-200-W-48 was an unplanned release to surface soil, and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from UPR-200-W-48 is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was small. Because the release depths are similar, and the effluent volume and contaminant inventory of UPR-200-W-19 are significantly higher, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable, because of the shallow nature of the representative and analogous sites.
UPR-200-W-55	*Waste sites configuration/construction:* • A 10- by 10-ft soil area located adjacent to the 224-UA Building loading ramp at the southwest end of the building • The site is no longer marked or posted. *Release history/volume/depth:* • An unknown amount of uranium powder remaining from cleanup of a 1960, 1.5-ton spill was washed off the asphalt, and it soaked into the adjacent soil surface.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release to the surface, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the volume of water used to wash off the asphalt is unknown. (3) *Contaminant inventory:** The contaminant inventory at UPR-200-W-55 was not documented. However, because most of the uranium oxide powder was swept up and recovered from UPR-200-W-55, and only a small release would remain, it is believed that UPR-200-W-19 would bound this site in terms of contaminant inventory. (4) *Depth of waste discharge:* UPR-200-W-55 was an unplanned release at the surface, and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from UPR-200-W-55 is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was small. Because the release depths are similar, and the effluent volume and contaminant inventory of UPR-200-W-19 are significantly higher, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
UPR-200-W-78	*Waste sites configuration/construction:* • A 5- by 8-ft soil area located approximately 120 ft south of the 224-U building at the former uranium trioxide barrel storage area. • Contaminated soil removed after discovery in 1970. The site is no longer marked or posted. *Release history/volume/depth:* • Suspected uranium-oxide-contaminated particulates from pallets of stored barrels.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because UPR-200-W-78 was believed to have been caused by a spill of uranium oxide powder, and therefore had no liquid effluent. (3) *Contaminant inventory:** The contaminant inventory at UPR-200-W-78 was not documented. However, because contaminated soil was removed from UPR-200-W-78, it is believed that the UPR-200-W-19 would bound this site in terms of contaminant inventory. (4) *Depth of waste discharge:* UPR-200-W-78 was an unplanned release to surface soil, and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Because contaminant distribution from UPR-200-W-78 is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, and contaminated soil was removed from the site, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.
200-W-77 Unplanned Release	*Waste sites configuration/construction:* • An 8- by 15-ft soil area located adjacent to the railroad track, west of the 216-U-16 Crib and east of the stabilized 216-U-14 Ditch. • Area stabilized with clean backfill in 2000 and posted as a Contamination Area. *Release history/volume/depth:* • Suspected fission-product-contaminated vegetation from the 216-U-14 Ditch (before stabilization of the ditch) blown in by the wind that contaminated the surface soils.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because the 200-W-77 Unplanned Release was believed to have been caused by windblown vegetation that was contaminated, and therefore had no liquid effluent. (3) *Contaminant inventory:** The contaminant inventory at the 200-W-77 Unplanned Release was not documented. However, because the 200-W-77 Unplanned Release was a small release, it is believed that UPR-200-W-19 would bound this site in terms of contaminant inventory. (4) *Depth of waste discharge*: The 200-W-77 Unplanned Release was an unplanned release at the surface, and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from the 200-W-77 Unplanned Release is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was small. Because the release depths are similar, and the effluent volume and contaminant inventory of UPR-200-W-19 is significantly higher, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
200-W-85 Unplanned Release	*Waste sites configuration/construction:* • A 20- by 20-ft soil area located approximately 100 ft east of the 2727-WA Sodium Storage Building equipment storage yard. • Area stabilized with clean backfill in 2001 and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • Suspected fission-product-contaminated particulates from unknown source contaminated surface soils.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion cannot be evaluated, because the exact source of the 200-W-85 Unplanned Release is not known. (3) *Contaminant inventory:** The contaminant inventory at the 200-W-85 Unplanned Release was not documented; however, because this site is a small release, it is believed that UPR-200-W-19 would bound this site in terms of contaminant inventory. (4) *Depth of waste discharge:* The 200-W-85 Unplanned Release was an unplanned release to surface soil, and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from the 200-W-85 Unplanned Release is believed to be limited to surface soils within 1 m (3 ft) of the ground surface and, because the release is small, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.
200-W-87 Unplanned Release	*Waste sites configuration/construction:* • A 120- by 30-ft soil area located adjacent to the railroad track northwest of the 2714-U Building and T-Hopper yard on the U Plant chemical spur railroad track. • Area stabilized with clean backfill in 2001 and posted as an Underground Radioactive Material Area. *Release history/volume/depth:* • Suspected fission product from contamination along a railroad spur. The site was discovered in 2000.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is a potential unplanned release to surface soil associated with a potentially contaminated train; therefore, this site has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion cannot be evaluated, because it is unknown if any waste was released. (3) *Contaminant inventory:** This criterion cannot be evaluated, because it is unknown if any waste was released. (4) *Depth of waste discharge*: If any releases had occurred from the 200-W-87 Unplanned Release, they would have been to surface soil and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants*: This criterion cannot be evaluated, because it is unknown if any waste was released. (6) *Potential for hydrologic and contaminant impacts to groundwater*: This criterion cannot be evaluated, because it is unknown if any waste was released.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale
200-W-89 Foundation (Unplanned Release)	*Waste sites configuration/construction:* • Decommissioned 252-U Electrical Substation east of the 224-U Building near the intersection of Beloit Avenue and 16th Street with transformer left in place. Concrete pad and surrounding soil area dimensions are 100 ft long by 100 ft wide. • Area stabilized with gravel and posted as an Underground Radioactive Material Area in 1999. *Release history/volume/depth:* • Fission product containing particulates contaminated pad and soils. No polychlorinated biphenyls have been identified at the site.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release to surface soil, similar to UPR-200-W-19. A concrete foundation is associated with this site. (2) *Volume of effluent received in relation to the available pore volume:* This criterion would not be applicable, because the release is associated with the release of contaminated particles. (3) *Contaminant inventory:** This criterion cannot be evaluated, because the exact source of the 200-W-89 Foundation (Unplanned Release) is not known. (4) *Depth of waste discharge:* The 200-W-89 Foundation (Unplanned Release) was an unplanned release at the surface and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from the 200-W-89 Foundation (Unplanned Release) is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was small and may have been caused by emissions from the 291-U-1 Stack. Because the release depths are similar, the representative site bounds this site. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.
UPR-200-W-117/ UPR-200-W-60	*Waste sites configuration/construction:* • UPR-200-W-117/UPR-200-W-60 surface sites dimensions are 200 ft long by 30 ft wide co-located in the railroad cut northwest of the 221-U Building. • Area stabilized with gravel to a depth of 0.3 m (1 ft) and posted as an Underground Radioactive Material Area in 2001. *Release history/volume/depth:* • Fission product containing liquids and particulates of very low volume dropped onto soils from railroad cars moving equipment in and out of the 221-U Building.	This site is considered to be similar to and bounded by the representative site based on the following criteria. (1) *Waste site configuration and construction:* This site is an unplanned release of liquid and particulate waste to surface soil, similar to UPR-200-W-19, and therefore has no structure associated with it. (2) *Volume of effluent received in relation to the available pore volume:* This criterion is not applicable, because UPR-200-W-117 and the representative site UPR-200-W-19 had relatively low volumes of effluent discharged to them. (3) *Contaminant inventory:** This criterion cannot be compared directly, because the contaminant inventory at UPR-200-W-117 was not documented. However, because UPR-200-W-117 was a widely spread release compared to UPR-200-W-19, it is believed that the representative site would bound the analogous sites in terms of risk. (4) *Depth of waste discharge:* UPR-200-W-117 was an unplanned release to surface soil and therefore similar to UPR-200-W-19 in terms of discharge depth. (5) *Expected distribution of contaminants:* Contaminant distribution from UPR-200-W-117 is believed to be limited to surface soils within 1 m (3 ft) of the ground surface, because the release was spread over a large area. Because the release depths are similar, and the effluent volume and contaminant inventory per unit area of UPR-200-W-19 is believed to be significantly higher, the representative site bounds this site. Both UPR-200-W-117 and UPR-200-W-19 are believed to have had contamination spread laterally through windblown vegetation and soil. (6) *Potential for hydrologic and contaminant impacts to groundwater:* This criterion is not applicable because of the shallow nature of the representative and analogous sites.

TABLE B-6. UNPLANNED RELEASE UPR-200-W-19 AND ASSOCIATED ANALOGOUS WASTE SITES. (10 Pages)

Waste Site	Site Construction and Discharge History	Rationale

*Note that the contaminant inventory (e.g., total mass of a constituent) is based on historic disposal records. Actual vadose zone concentrations were determined based on the field investigation phase of the project. The vadose zone concentrations were used in the risk assessment calculations.

WAC = *Washington Administrative Code*.

WAC 246-272-18501, "Department of Health," "On-Site Sewage Systems," "Abandonment," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

APPENDIX C

DETAILED EVALUATION DISCUSSIONS

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APPENDIX C
DETAILED EVALUATION DISCUSSIONS

Alternatives Evaluated for Representative Waste Sites

The following four alternatives were evaluated for each of the representative waste sites:
Alternative 1 – No Action
Alternative 2 – Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation
Alternative 3 – Removal, Treatment, and Disposal
Alternative 4 – Engineered Barrier.

Group 1 – Representative Waste Sites 216-U-1 and 216-U-2 Cribs

Overall Protection of Human Health and the Environment

Alternative 1 provides no protection for human health and groundwater, because constituents remain above the acceptable values.

Alternative 2 is protective of human health exposure during the 150-yr timeframe, but exceeds the groundwater protection values for the 216-U-1 and 216-U-2 Cribs.

Alternative 3 limits human health and environmental impacts by removing the contaminants and disposing of them in an on-site engineered facility. Alternative 3 requires a significantly large excavation at the 216-U-1 and 216-U-2 Cribs (approximately 934 by 862 ft at the surface of the open pit) and exposes workers to contaminants during the action. This alternative meets remedial action objectives (RAO) 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disrupted and that worker risk will be increased due to the extended direct exposure to the contaminated material. For the 241-U-361 Settling Tank, Alternative 3 provides the greatest overall protection to human health and the environment, because contaminants (sludge, tank, and surrounding soils) are removed, treated (as appropriate), and disposed of at the on-site engineered facility. However, there are difficulties with implementing this remedy because of the proximity of the 241-U-361 Settling Tank to the 216-U-1 and 216-U-2 Cribs.

Alternative 4 provides the greatest overall protection to human health and the environment for the 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank. Alternative 4 removes the exposure pathway by creating a barrier and significantly reduces infiltration, thereby supporting all four RAOs. Institutional controls will provide use limitations around the barrier. The engineered barrier also will limit short-term exposure risks to workers.

Compliance with ARARs

Alternative 1 does not comply with applicable or relevant and appropriate requirements (ARAR), because the waste sites currently exceed the RAOs.

Alternative 2 does not comply with ARARs for the 216-U-1 and 216-U-2 Cribs, because the contaminants exceed human health and groundwater protection preliminary remediation goals (PRG). Alternative 2 meets the ARARs for the 241-U-361 Settling Tank, given the institutional control period of 150 yr and the anticipation that contaminants will reach acceptable levels within this timeframe.

Alternative 3 meets the ARARs through the removal of the contaminated material and disposal at the Environmental Restoration Disposal Facility (ERDF).

Alternative 4 meets the ARARs for the 216-U-1 and 216-U-2 Cribs and 241-U-361 Settling Tank. The technetium-99 contaminant at the 216-U-1 and 216-U-2 Cribs is present at elevated levels to approximately 200 ft below ground surface (bgs) and currently is present in the groundwater (located at approximately 255 ft bgs). Preliminary fate and transport modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that the engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other existing contaminant sources in groundwater, results in groundwater concentrations below the maximum contaminant level (MCL). Appendix D of DOE/RL-2003-23, *Focused Feasibility Study for the 200-UW-1 Operable Unit* (FFS), contains a detailed discussion of this modeling.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives 1 and 2 do not provide long-term effectiveness or permanence, because contaminants are not remedied and remain after the industrial land-use timeframe (2150). The exception is the 241-U-361 Setting Tank. For the 241-U-361 Settling Tank, Alternative 2 provides some long-term effectiveness and permanence, because it is assumed that the sludge within the tank is removed and minimal contamination is expected beyond the tank itself.

Alternative 3 provides long-term effectiveness and permanence for the 216-U-1 and 216-U-2 Cribs, because contaminants are removed and disposed of at the ERDF. The technetium-99 contaminant is present at elevated levels to approximately 200 ft bgs and currently is found in groundwater (located at approximately 255 ft bgs). Alternative 3 requires a significantly large excavation at the 216-U-1 and 216-U-2 Cribs (approximately 934 by 862 ft at the surface of the open pit) and exposes workers to contaminants during the action. Alternative 3 meets RAOs 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disrupted. Alternative 3 is the most reliable and permanent for the 241-U-361 Settling Tank, based on the conceptual site model, because contaminant concentrations above the PRGs will be removed.

Alternative 4 is reliable for the 216-U-1 and 216-U-2 Cribs. Alternative 4 meets RAOs 1, 2, and 3, because it reduces the exposure to contaminants beyond 2150 by limiting both human and ecological intrusion and reducing infiltration through the contaminated zone. Additional modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that an engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other groundwater contaminant sources already present from up-gradient sources, results in groundwater concentrations below the MCL. Analyses of cumulative risk and impact at the Hanford Site are conducted and reported on a site-wide scale via a composite analysis and other evaluations.

The proposed engineered barrier is designed to provide long-term isolation of contaminants contained within these sites. This is supported through the natural soil analogs present on the Hanford Site, which provide an indication of the long-term stability and effectiveness of evapotranspiration barriers that would exploit such locally available soil.

The residual risks to groundwater significantly decrease because of the reduced infiltration rate, coupled with natural radioactive decay. It is anticipated that groundwater monitoring will be required to corroborate the model results with the actual flux and resulting groundwater concentration of technetium-99, thereby supporting RAO 3. For the 241-U-361 Settling Tank, Alternative 4 provides reliability by reducing exposure through the use of an engineered barrier. During the design life of the barrier, the residual risk of contaminants is expected to decrease to acceptable levels through natural radioactive decay.

SHORT-TERM EFFECTIVENESS

Alternative 1 would be effective in the short term, because it does not involve any remedial actions.

Alternatives 2 and 4 would be more effective in the short term when compared to Alternative 3, primarily because of the lower risk to remediation workers and limited impacts to the environment.

Alternative 3 will involve excavating contaminated soil and debris to a depth of 200 ft bgs, creating greater potential for short-term worker impacts (i.e., an increased exposure rate) during the excavation, transportation, and disposal of materials. Risks to workers from potential exposure to contaminated soil and fugitive dust would be greater. Because the U Plant Area is a highly disturbed area with limited habitat in proximity to the waste sites, short-term impacts to vegetation and wildlife in the area are believed to be minimal. However, because of the deep excavations that would occur, Alternative 3 would result in a greater impact to habitat in those areas used for backfill materials. Alternative 3 requires a significantly large excavation (approximately 934 by 862 ft at the surface of the open pit) and exposes workers to contaminants and associated industrial hazards (e.g., heavy equipment, heat stroke) during the action.

Reduction of Toxicity, Mobility, or Volume through Treatment

All of the alternatives identified rely on natural attenuation in the form of radiological decay that is expected to result in reduced toxicity and volume over time.

Alternative 3 includes treatment. However, treatment is not anticipated, because constituents are expected to meet the disposal facility waste acceptance criteria. Therefore, reduction in toxicity, mobility, or volume of the contaminants is not expected. The sludge removed from the 241-U-361 Settling Tank may require some form of stabilization before disposal.

Implementability

Alternative 1 will be easy to implement, because it requires no remedial action.

Alternative 2 currently is used for all of the waste sites. The waste sites are under a surveillance and monitoring program where the area is posted with signs and/or restricted by fencing. In addition, access to the waste sites is controlled through Hanford Site access requirements, an excavation permit program, and a radiation work area permit program. The addition of monitoring wells or boreholes is easy to implement, although there currently is some coverage from the site-wide monitoring network.

Alternative 3 will be difficult to implement in the near term because of increased worker exposure from contaminated soil and debris; safety requirements associated with deep excavation; and the availability of backfill material, transportation, and disposal capacity for the contaminated material. Alternative 3 is not easy to implement for the 216-U-1 and 216-U-2 Cribs because of the extreme depth of excavation. Excavation is not practical at this depth because of the following:

- Potential impacts to existing facilities and the infrastructure (e.g., roads and utilities)
- Required ERDF capacity for disposal, laydown areas, and backfill material needs
- Increased worker risks, given that the contaminants impacting groundwater are at an estimated depth of 200 ft bgs
- Diminishing return of risk reduction versus cost expended.

Because of the proximity of the 216-U-1 and 216-U 2 Cribs to the 241-U-361 Settling Tank, excavation activities would be more complicated, because the excavation itself likely would encroach on the cribs. Chapter 5.0 of the FFS provides a more detailed discussion of Alternative 3.

Alternative 4 is easy to implement. An evapotranspiration barrier was constructed at the Hanford Site, and similar barrier types were regulatory approved and constructed at other western arid sites. These barriers are easy to construct and maintain.

Cost

Capital costs along with operation and maintenance costs are shown in Table 6 of this Proposed Plan. These costs are based on an individual waste site and do not reflect economies of scale that might be obtained by implementing a common alternative or aggregated remedies across multiple waste sites. The present worth is calculated with a discount rate of 3.2 percent, and the costs are estimated based on the +50/-30 percent accuracy in accordance with U.S. Environmental Protection Agency (EPA) guidance (EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*).

Group 2 – Representative Waste Site 216-U-8 Crib

Overall Protection of Human Health and the Environment

Alternative 1 provides no protection for human health and groundwater, because constituents remain above the acceptable levels.

Alternative 2 is protective of human health exposure during the 150-yr timeframe, but exceeds the groundwater protection values for the 216-U-8 Crib.

Alternative 3 limits human health and environmental impacts by removing the contaminants and disposing of them in an on-site engineered facility. Alternative 3 requires a significantly large excavation for the 216-U-8 Crib (approximately 982 by 872 ft at the surface of the open pit) and exposes workers to contaminants during the action. Alternative 3 meets RAOs 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disturbed and worker risk will be increased due to the extended direct exposure to the contaminated material and associated industrial hazards. For the 200-W-42 Vitrified Clay Pipeline (VCP) and the associated unplanned release, UPR-200-W-163, Alternative 3 is the most protective of human health and the environment. Contaminants are removed, treated as appropriate, and disposed of at the on-site engineered facility.

Alternative 4 provides the greatest overall protectiveness of human health and the environment for the 216-U-8 Crib. Alternative 4 removes the exposure pathway by creating a barrier and significantly reduces infiltration, thereby supporting all four RAOs. Institutional controls will provide use limitations around the barrier. The engineered barrier will limit short-term exposure risks to workers. Alternative 4 also is protective for the 200-W-42 VCP and UPR-200-W-163, because the exposure pathway is removed and institutional controls provide use limitations around the barrier.

COMPLIANCE WITH ARARS

Alternative 1 does not comply with ARARs, because the waste sites currently exceed the RAOs.

Alternative 2 does not comply with ARARS, because the contaminants exceed human health and groundwater protection PRGs for an extended period of time.

Alternative 3 meets the ARARs for the 216-U-8 Crib, 200-W-42 VCP, and UPR-200-W-163 waste sites through the removal of the contaminated material and disposal at the ERDF.

Alternative 4 meets the ARARs through the use of an engineered barrier. The uranium and nitrogen as nitrate and nitrite contaminants at the 216-U-8 Crib are present at elevated levels to approximately 200 ft bgs and currently are present in groundwater (located at approximately 255 ft bgs). Preliminary fate and transport modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that the engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other existing contaminant sources in the groundwater, results in groundwater concentrations below the MCL. Appendix D of the FFS contains a detailed discussion of this modeling.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives 1 and 2 do not provide long-term effectiveness or permanence, because contaminants are not remedied and will remain after the industrial land-use timeframe (2150).

Alternative 3 provides reliability for the 216-U-8 Crib, because contaminants are removed and disposed of at the ERDF. The constituents exceeding groundwater protection values are present at elevated levels to approximately 200 ft bgs and currently are found in groundwater (located at approximately 255 ft bgs). Alternative 3 requires a significantly large excavation for the 216-U-8 Crib (approximately 982 by 872 ft at the surface of the open pit) and exposes workers to contaminants during the action. This alternative meets RAOs 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disturbed. Alternative 3 is most reliable and permanent for the 200-W-42 VCP and the associated unplanned release, UPR-200-W-163, because contaminant concentrations will be removed above the PRGs.

Alternative 4 is reliable for the 216-U-8 Crib. Alternative 4 meets RAOs 1, 2, and 3, because it reduces the exposure to contaminants beyond 2150 by limiting both human and ecological intrusion and reducing infiltration through the contaminated zone. Preliminary modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that the engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other contaminant sources already present from up-gradient sources, results in groundwater concentrations below the MCL. Analyses of cumulative risk and impact at the Hanford Site are conducted and reported on a site-wide scale via a composite analysis and other evaluations.

The proposed engineered barrier is designed to provide long-term isolation of contaminants contained within these waste sites. This is supported through the natural soil analogs present on the Hanford Site, which provide an indication of the long-term stability and effectiveness of evapotranspiration barriers that would exploit such locally available soil.

The residual risks to groundwater significantly decreases because of the reduced infiltration rate, coupled with natural radioactive decay. It is anticipated that groundwater monitoring will be required to corroborate the model results with the actual flux and resulting groundwater concentration, thereby supporting RAO 3. For the 200-W-42 VCP and associated unplanned release UPR-200-W-163, Alternative 4 provides reliability by reducing exposure through the use of an engineered barrier. During the design life of the barrier, the residual risk of contaminants is expected to decrease to acceptable levels because of natural radioactive decay.

SHORT-TERM EFFECTIVENESS

Alternative 1 would be effective in the short term, because it does not involve any remedial actions.

Alternatives 2 and 4 would be more effective in the short term when compared to Alternative 3, primarily because of their lower risk to remediation workers and limited impacts to the environment.

Alternative 3 will involve excavating contaminated soil and debris to a depth of 200 ft bgs, creating greater potential for short-term worker impacts (i.e., an increased exposure rate) during excavation, transportation, and disposal of the materials. Risks to workers from potential exposure to contaminated soil and fugitive dust would be greater. Because the U Plant Area is a highly disturbed area with limited habitat in proximity to the waste sites, short-term impacts to vegetation and wildlife are believed to be minimal. However, because of the deep excavations that would occur, this alternative would result in a greater impact to habitat in those areas used for backfill materials. Alternative 3 requires a significantly large excavation for the 216-U-8 Crib (approximately 982 by 872 ft at the surface of the open pit) and exposes workers to contaminants and associated industrial hazards (e.g., heavy equipment, heat stroke) during the action.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

All of the alternatives evaluated rely on natural attenuation in the form of radiological decay that is expected to result in reduced toxicity and volume.

Alternative 3 includes treatment. However, treatment is not anticipated, because the constituents are expected to meet the disposal facility waste acceptance criteria. Therefore, a reduction in toxicity, mobility, or volume of the contaminants is not expected.

IMPLEMENTABILITY

Alternative 1 would be easy to implement, because it requires no action.

Alternative 2 currently is used at all of the waste sites. The waste sites are under a surveillance and monitoring program where the area is posted with signs and/or restricted by fencing. In addition, access to the waste sites is controlled through Hanford Site access requirements, an excavation permit program, and a radiation work area permit program. The addition of monitoring wells or boreholes is easy to implement, although there currently is some coverage from the site-wide monitoring network.

Alternative 3 will be difficult to implement in the near term because of increased worker exposure from contaminated soil and debris; safety requirements associated with deep excavation; and the availability of backfill material, transportation, and disposal capacity for the contaminated material. Alternative 3 is not easy to implement for the 216-U-8 Crib because of the extreme depth of excavation. Excavation is neither practical nor cost effective at this depth because of the following:

- Potential impacts to existing facilities and the infrastructure (e.g., roads, utilities)
- Required ERDF capacity for disposal, laydown areas, and backfill material needs

- Increased risks to the workers, given that the contaminants impacting groundwater are at an estimated depth of 200 ft bgs
- Diminishing return of risk reduction versus cost expended.

Alternative 3 is implemented more easily for the 200-W-42 VCP and associated unplanned release UPR-200-W-163 because of its limited contaminant depth.

Alternative 4 is easy to implement. An evapotranspiration barrier was constructed at the Hanford Site, and similar barrier types were regulatory approved and constructed at other western arid sites. These barriers are easy to construct and maintain.

COST

Capital costs along with operation and maintenance costs are shown in Table 7 of this Proposed Plan. These costs are based on an individual waste site and do not reflect economies of scale that might be obtained by implementing a common alternative or aggregated remedies across multiple waste sites. The listed present worth is based on a discount rate of 3.2 percent, and the costs are estimated based on the +50/-30 percent accuracy in accordance with EPA guidance (EPA/540/G-89/004).

Group 3 – Representative Waste Site 216-U-12 Crib

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 provides no protection for human health and groundwater, because constituents remain above the acceptable values.

Alternative 2 is protective of human health exposure during the 150-yr timeframe, but exceeds the groundwater protection values for the 216-U-12 Crib.

Alternative 3 limits human health and environmental impacts by removing the contaminants and disposing of them in an on-site engineered facility. Alternative 3 requires a significantly large excavation for the crib (approximately 910 by 820 ft at the surface of the open pit) and exposes workers to contaminants during the action. This alternative meets RAOs 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disrupted and worker risk will be increased due to the extended direct exposure to the contaminated material and associated industrial hazards. Alternative 3 is the most protective of human health and the environment for the 216-U-5, 216-U-6, and 216-U-15 Trenches and the 216-U-12, 216-U-16 and 216-U-17 Cribs. Contaminants are removed, treated as appropriate, and disposed of at the on-site engineered facility.

Alternative 4 provides the greatest overall protection to human health and the environment for the 216-U-12, 216-U-16, and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches. Alternative 4 removes the exposure pathway by creating a barrier and significantly reduces infiltration, thereby supporting all four RAOs. Institutional controls will provide use limitations around the barrier. The engineered barrier also will limit short-term exposure risks to workers.

COMPLIANCE WITH ARARS

Alternative 1 does not comply with ARARs, because the waste sites currently exceed the RAOs.

Alternative 2 does not comply with ARARs for the 216-U-12 Crib, because the contaminants exceed the groundwater protection PRGs. Alternative 2 meets the ARARs for the 216-U-16 and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches given the institutional control period of 150 yr.

Alternatives 3 and 4 also meet the ARARs for these waste sites. Alternative 3 meets the ARARs by removing the contaminated material and disposing of it at the ERDF.

Alternative 4 meets the ARARs through the use of an engineered barrier. The nitrogen as nitrate and nitrite contaminant at the 216-U-12 Crib is present at elevated levels to approximately 200 ft bgs and currently is present in the groundwater (located at approximately 255 ft bgs). Preliminary fate and transport modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that the engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other existing contaminant sources in the groundwater, results in groundwater concentrations below the MCL. Appendix D of the FFS contains a detailed discussion of this modeling.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 does not provide long-term effectiveness or permanence. Contaminants are not remedied and will remain after the industrial land-use timeframe (2150).

Alternative 2 does not provide long-term effectiveness or permanence for the 216-U-12 Crib. For the 216-U-16 and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches, however, Alternative 2 does meet the effectiveness and permanence criteria, because the contaminants are expected to reach acceptable levels by 2150 (the end of the identified institutional control period).

Alternative 3, based on the conceptual site model, is a reliable and permanent alternative for the 216-U-5, 216-U-6, and 216-U-15 Trenches as well as the 216-U-16 and 216-U-17 Cribs, because contaminants above the PRGs will be removed. The nitrogen as nitrate and nitrite at the 216-U-12 Crib is present at elevated levels to approximately 200 ft bgs and currently is found in groundwater (located at approximately 255 ft). Alternative 3 requires a significantly large excavation at the 216-U-12 Crib (approximately 910 by 820 ft at the surface of the open pit) and exposes workers to contaminants during the action. Alternative 3 meets RAOs 1, 2, and 3. However, because of the extent of excavation, impacted surface area, and need for additional backfill material, it is anticipated that a significant area will be disrupted.

Alternative 4 is reliable for the 216-U-12 Crib. Alternative 4 meets RAOs 1, 2, and 3, because it reduces the exposure to contaminants beyond 2150 by limiting both human and ecological intrusion and reducing infiltration through the contaminated zone. Preliminary modeling was conducted to simulate the reduced infiltration associated with the placement of an engineered barrier. This modeling indicates that the engineered barrier reduces the flux of contaminants into groundwater to an amount that, in the absence of other contaminant sources already present from up-gradient sources, results in groundwater concentrations below the MCL. Analyses of cumulative risk and impact at the Hanford Site are conducted and reported on a site-wide scale via a composite analysis and other evaluations.

The proposed engineered barrier is designed to provide long-term isolation of contaminants contained within the 216-U-12, 216-U-16, and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches. This is supported through the natural soil analogs present on the Hanford Site, which provide an indication of the long-term stability and effectiveness of evapotranspiration barriers that would exploit such locally available soil.

The residual risks to groundwater significantly decrease because of the reduced infiltration rate, coupled with natural radioactive decay. It is anticipated that groundwater monitoring will be required to corroborate the model results with the actual flux and resulting groundwater concentration, thereby supporting RAO 3. For the 216-U-16 and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches, Alternative 4 provides reliability by reducing exposure through the use of an engineered barrier. During the design life of the barrier, the residual risk of contaminants is expected to decrease to acceptable levels because of natural radioactive decay.

SHORT-TERM EFFECTIVENESS

Alternative 1 would be effective in the short term, because it does not involve any remedial actions.

Alternatives 2 and 4 would be more effective in the short term when compared to Alternative 3, primarily because of their lower risk to remediation workers.

Alternative 3 will involve excavating contaminated soil and debris to a depth of 200 ft bgs, creating a greater potential for short-term worker impacts (i.e., an increase in exposure rates) during excavation, transportation, and disposal of the materials. Risks to workers from potential exposure to contaminated soil and fugitive dust would be greater. Because the U Plant Area is a highly disturbed area with limited habitat in proximity to the waste sites, short-term impacts to vegetation and wildlife are believed to be minimal. However, because of the deep excavations that would occur, this alternative would result in a greater impact to habitat in those areas used for backfill materials. Alternative 3 requires a significantly large excavation for the crib (approximately 910 by 820 ft at the surface of the open pit) and exposes workers to contaminants and associated industrial hazards (e.g., heavy equipment, heat stroke) during the action.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

All of the alternatives evaluated rely on natural attenuation in the form of radiological decay, which is expected to result in reduced toxicity and volume.

Alternative 3 includes treatment. However, treatment is not anticipated, because constituents are expected to meet the disposal facility waste acceptance criteria. Therefore, a reduction in toxicity, mobility, or volume of the contaminants is not expected.

IMPLEMENTABILITY

Alternative 1 would be easy to implement, because it requires no action.

Alternative 2 currently is used for all of the waste sites. The waste sites are under a surveillance and monitoring program where the area is posted with signs and/or restricted by fencing. In addition, access to the waste sites is controlled through Hanford Site access requirements, an excavation permit program, and a radiation work area permit program. The addition of monitoring wells or boreholes is easy to implement, although there currently is some coverage from the site-wide monitoring network.

Alternative 3 will be difficult to implement in the near term for the 216-U-12 Crib because of increased worker exposure from contaminated soil and debris; safety requirements associated with excavation; and the availability of backfill material, transportation, and disposal of the contaminated material. Alternative 3 is not easy to implement for the 216-U-12 Crib because of the extreme depth of excavation. Excavation is not practical at this depth because of the following:

- Potential impacts to existing facilities and the infrastructure (e.g., roads, utilities)
- Required ERDF capacity for disposal, laydown areas, and backfill material needs
- Increased worker risks, given that the contaminants impacting groundwater are at an estimated depth of 200 ft bgs
- Diminishing return of risk reduction versus cost expended.

Alternative 3 is implemented more easily for the 216-U-16 and 216-U-17 Cribs and 216-U-5, 216-U-6, and 216-U-15 Trenches because of their limited contaminant depth. Chapter 5.0 of the FFS contains a more detailed discussion of this alternative.

Alternative 4 is easy to implement. An evapotranspiration barrier was constructed at the Hanford Site, and similar barrier types were regulatory approved and constructed at other western arid sites. These barriers are easy to construct and maintain.

COST

Capital costs along with operation and maintenance costs are shown in Table 8 of this Proposed Plan. These costs are based on an individual waste site and do not reflect economies of scale that might be obtained by implementing a common alternative or aggregated remedies across multiple waste sites. The listed present worth is based on a discount rate of 3.2 percent, and the costs are estimated based on the +50/-30 percent accuracy in accordance with EPA guidance (EPA/540/G-89/004).

Group 4 – Representative Waste Sites 216-U-4 Reverse Well and the 216-U-4A French Drain

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 provides no protection for human health, because constituents remain above the acceptable values.

Alternative 2 is protective of human health exposure during the 150-yr timeframe. This alternative has the added benefit that the 216-U-4 Reverse Well and 216-U-4A French Drain waste sites are under the proposed 221-U Facility engineered barrier.

Alternative 3 limits human health and environmental impacts at the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains by removing the contaminants and disposing of them in an on-site engineered facility.

Alternative 4 is protective at the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains, because the exposure pathway is removed and institutional controls provide use limitations around the barrier. It should be noted that controls will need to be in place for 125 yr, the time required for the constituents to decay naturally.

COMPLIANCE WITH ARARs

Alternative 1 does not comply with ARARs, because the waste sites currently exceed the RAOs.

Alternative 2 meets the ARARs for these waste sites before the end of the 150-yr institutional control period. For the 216-U-4 Reverse Well and 216-U-4A French Drain waste sites, the combination of Alternative 2 with the proposed 221-U Facility engineered barrier would accelerate achieving the ARARs, because the pathway for exposure would be removed.

Alternative 3 meets the ARARs at the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains by removing the contaminated material and disposing of it at the ERDF.

Alternative 4 meets the ARARs at the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains through the use of an engineered barrier designed to be protective for the needed duration.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 does not provide long-term effectiveness or permanence, because contaminants are not remedied and remain at the waste sites.

Alternative 2 meets the effectiveness and permanence criteria for the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains, because the contaminants are expected to reach acceptable levels within 125 yr (25 yr earlier than the designated institutional control period). For the 216-U-4 Reverse Well and 216-U-4A French Drain waste sites, Alternative 2 would be used until the proposed barrier over the 221-U Facility is in place. This proposed barrier would provide additional effectiveness and permanence, as noted in the Alternative 4 discussion.

Alternative 3 is the most reliable and permanent alternative for the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains. Based on the conceptual site model, the contaminants above the PRGs will be removed.

Alternative 4 provides reliability by reducing exposure through the use of an engineered barrier to isolate the contaminants contained within the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains. During the design life of the barrier, the residual risk of contaminants is expected to decrease to acceptable levels because of natural radioactive decay.

SHORT-TERM EFFECTIVENESS

Alternative 1 would be effective in the short term, because it does not require any remedial actions.

Alternatives 2 and 4 would be more effective in the short term when compared to Alternative 3, primarily because of their lower risk to remediation workers.

Alternative 3 requires the excavation of contaminated soil and debris, creating a greater potential for short-term worker impacts (i.e., an increase in exposure) during excavation, transportation, and disposal of the materials. Risks to workers from potential exposure to contaminated soil and fugitive dust would be greater with Alternative 3 than with Alternative 4. Short-term impacts to vegetation and wildlife are minimal, because the U Plant Area is a highly disturbed area that has limited habitat in proximity to the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains. However, Alternative 3 would have a slightly greater impact to habitat in those areas used for backfill materials as well as additional worker safety associated with industrial hazards (e.g., heavy equipment, heat stroke).

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

All of the alternatives incorporate natural attenuation in the form of radiological decay that is expected to reduce toxicity and volume.

Alternative 3 includes treatment. However, treatment is not anticipated because constituents are expected to meet the disposal facility waste acceptance criteria. Thus, reduction in toxicity, mobility, or volume of the contaminants is not expected.

IMPLEMENTABILITY

Alternative 1 would be easy to implement because no action is performed.

Alternative 2 currently is used for all of the waste sites. The waste sites are under a surveillance and monitoring program where the area is posted with signs and/or restricted by fencing. In addition, access to the 216-U-4 Reverse Well and the 216-U-4A and 216-U-4B French Drains is controlled through Hanford Site access requirements, an excavation permit program, and a radiation work area permit program. The addition of monitoring wells or boreholes is easy to implement, although there currently is some coverage from the site-wide monitoring network.

Alternative 3 will be more difficult to implement in the near term because of increased worker exposure from contaminated soil and debris; safety requirements associated with excavation; and the availability of backfill material, transportation, and disposal of the contaminated material.

Alternative 4 is easy to implement. An evapotranspiration barrier was constructed at the Hanford Site, and similar barrier types were regulatory approved and constructed at other western arid sites. These barriers are easy to construct and maintain. In addition, the activities at the 216-U-4 Reverse Well and 216-U-4A French Drain waste sites can be coordinated easily with the proposed barrier for the 221-U Facility.

COST

Capital costs along with operation and maintenance costs are shown in Table 9 of this Proposed Plan. These costs are based on an individual waste site and do not reflect economies of scale that might be obtained by implementing a common alternative or aggregated remedies across multiple waste sites. The listed present worth is based on a discount rate of 3.2 percent. An additional cost is provided for the 216-U-4 Reverse Well and 216-U-4A French Drain waste sites for implementation of Alternative 2, based on the proposed 221-U Facility barrier. These costs are based on an assumption that the proposed barrier would be in place within the next 20 yr. All costs are estimated based on the +50/-30 percent accuracy in accordance with EPA guidance (EPA/540/G-89/004).

Group 5 – Representative Waste Site Unplanned Release UPR-200-W-19

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 is protective for the 2607-W7 Septic Tank and Tile Field and UPR-200-W-8 Burning Ground solid waste sites. The 2607-W7 Septic Tank and Tile Field was cleaned up in 1999 in accordance with WAC 246-272-18501, "Department of Health," "On-Site Sewage Systems," "Abandonment." No known hazardous substances were disposed of at these waste sites. Alternative 1 is not protective for the remaining waste sites in Group 5, because contaminants currently exceed human health PRGs.

Alternative 2 is protective of human health exposure during the 150-yr timeframe. This alternative has the added benefit of the 2607-W7 Septic Tank and Tile Field, UPR-200-W-118, and UPR-200-78 waste sites being under the proposed 221-U Facility barrier.

Alternative 3 limits human health and environmental impacts by removing the contaminants and disposing of them in an on-site engineered facility.

Alternative 4 is protective, because the exposure pathway is removed and institutional controls provide use limitations around the barrier. It should be noted that controls will need to be in place for 129 yr, the time required for the constituents to decay naturally. Alternative 2 is considered protective, because institutional controls are expected to be in place for 150 yr.

COMPLIANCE WITH ARARS

Alternative 1 complies with ARARs for the 2607-W7 Septic Tank and Tile Field (because this site was cleaned up in 1999 in accordance with WAC 246-272-18501) and UPR-200-W-8 Burning Ground solid waste sites. No known hazardous substances were disposed of at these waste sites. Alternative 1 does not comply with ARARs for the remaining waste sites, because they currently exceed the RAOs.

Alternative 2 meets the ARARs for the remaining waste sites within the identified 150-yr institutional control period timeframe. The combination of Alternative 2 along with the proposed 221-U Facility barrier would accelerate achieving the ARARs for the UPR-200-W-118 and UPR-200-78 waste sites, because the pathway for exposure would be removed.

Alternative 3 meets ARARs for all the Group 5 waste sites by removing the contaminated material and disposing of it at the ERDF.

Alternative 4 meets the ARARs for all the Group 5 waste sites with the use of an engineered barrier designed to be protective for the necessary duration.

LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 is effective for the 2607-W7 Septic Tank and Tile Field, because this site was cleaned up in 1999 in accordance with WAC 246-272-18501. Alternative 1 also is effective for the UPR-200-W-8 Burning Ground solid waste sites, because no known hazardous substances were disposed of at this waste site. Confirmatory sampling will be conducted at the solid waste sites to validate this information. Because the 2607-W7 Septic Tank and Tile Field is under the proposed 221-U Facility barrier, additional sampling is not planned. Alternative 1 does not provide long-term effectiveness or permanence for the remaining waste sites, because contaminants are not remediated and will remain at the waste sites.

Alternative 2 meets the effectiveness and permanence criteria, because the contaminants are expected to reach acceptable levels within 129 yr (21 yr earlier than the designated institutional control period). In addition, the anticipated areas of higher contamination at UPR-200-W-19 will be addressed concurrently with the remedies proposed for the 216-U-1 and 216-U-2 Cribs and the 241-U-361 Settling Tank because of proximity of the sites. For waste sites UPR-200-W-118 and UPR-200-W-78, Alternative 2 would be needed only until the proposed 221-U Facility barrier is in place. This proposed barrier would provide the additional effectiveness and permanence previously discussed under Alternative 4.

Alternative 3 is the most reliable and permanent alternative for the Group 5 waste sites because, based on the conceptual site model, contaminants are expected to be removed above the PRGs.

Alternative 4 provides reliability by reducing exposure through the use of an engineered barrier to isolate the wastes. During the design life of the barrier, the residual risk of contaminants is expected to decrease to acceptable levels because of natural radioactive decay.

SHORT-TERM EFFECTIVENESS

Alternative 1 would be effective in the short term, because it does not require any remedial actions.

Alternatives 2 and 4, when compared to Alternative 3, would be more effective in the short term because of the lower risk to workers.

Alternative 3 requires excavation of contaminated soil and debris, creating the potential for short-term worker impacts during excavation, transportation, and disposal of materials. The risk to workers from potential exposure to contaminated soil and fugitive dust increases with Alternative 3 when compared to Alternative 4. Short-term impacts to vegetation and wildlife are minimal, because the U Plant Area is a highly disturbed area that has limited habitat in proximity to the waste sites.

Reduction of Toxicity, Mobility, or Volume through Treatment

All of the alternatives incorporate natural attenuation in the form of radiological decay, which is expected to reduce toxicity and volume.

Alternative 3 includes treatment. However, treatment is not anticipated, because constituents are expected to meet the disposal facility waste acceptance criteria. Given this assumption, a reduction in toxicity, mobility, or volume of the contaminants is not expected.

Implementability

Alternative 1 would be easy to implement, because no action is required.

Alternative 2 currently is used for all of the waste sites. The waste sites are under a surveillance and monitoring program where the area is posted with signs and/or restricted by fencing.

Alternative 3 when compared to Alternative 4 would be more difficult to implement in the near term because of increased worker exposure from contaminated soil and debris; safety requirements associated with excavation; and the availability of backfill material, transportation, and disposal of the contaminated material.

Alternative 4 is easy to implement. A barrier was constructed at the Hanford Site, and similar barrier types were regulatory approved and constructed at other western arid sites. These barriers are easy to construct and maintain. In addition, these activities can be coordinated easily with the proposed 221-U Facility barrier for those waste sites (2607-W7, UPR-200-W-118, UPR-200-W-78, 216-U-4A, and 216-U-4) currently under the planned footprint.

Cost

Capital costs along with operation and maintenance costs are shown in Table 10 of this Proposed Plan. These costs are based on an individual waste site and do not reflect economies of scale that might be obtained by implementing a common alternative or aggregated remedies across multiple waste sites. The listed present worth is based on a discount rate of 3.2 percent. An additional cost for the implementation of Alternative 2 is provided for those waste sites under the proposed 221-U Facility barrier. These costs are based on an assumption that the proposed barrier would be placed within 20 yr. All costs are estimated based on the +50/-30 percent accuracy in accordance with EPA guidance (EPA/540/G-89/004).