Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

11-AMCP-0245

SEP 29 2011

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

200-CW-3 OPERABLE UNIT INTERIM REMEDIAL ACTION REPORT, DOE/RL-2011-58, REVISION 0

This letter transmits the approved 200-CW-3 Operable Unit Interim Remedial Action Report, DOE/RL-2011-58, Revision 0.

If you have any questions, please contact me, or your staff may contact, Al Farabee, of my staff, on (509) 376-8089.

Sincerely,

Jonathan A. Dowell, Assistant Manager
for the Central Plateau

AMCP:PGE

Attachment

cc: See Page 2

cc w/attach:
G. Bohnee, NPT
L. Buck, Wanapum
L. C. Buelow, EPA
S. Harris, CTUIR
J. A. Hedges, Ecology
R. Jim, YN
S. L. Leckband, HAB
N. M. Menard, Ecology
K. Niles, ODOE
D. Rowland, YN (4) plus 2 CDs
Administrative Record
Environmental Portal

cc w/o attach:
D. G. Black, CHPRC
R. L. Cathel, CHPRC
R. E. Piippo, MSA
J. G. Vance, MSA

DOE/RL-2011-58
Revision 0

200-CW-3 Operable Unit Interim Remedial Action Report

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

U.S. DEPARTMENT OF
ENERGY

Richland Operations Office

P.O. Box 550
Richland, Washington 99352

DOE/RL-2011-58
Revision 0

200-CW-3 Operable Unit Interim Remedial Action Report

Date Published
September 2011

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

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

P.O. Box 550
Richland, Washington 99352

R. D. Aardal
Release Approval

09/19/2011
Date

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Approval

U.S. Department of Energy, Richland Operations Office

D A Faraker — Signature

9/19/11 — Date

U.S. Environmental Protection Agency, Region 10

Electronic Approval via Letter — Signature

Dated 9/20/11 (pg. 2) — Date

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
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OFFICE OF
ENVIRONMENTAL
CLEANUP

SEP 20 2011

Mr. Al Farabee
Federal Project Director
Richland Operations Office
U.S. Department of Energy
P.O. Box 550, A5-11
Richland, Washington 99352

Re: 200-CW-3 Operable Unit Interim Remedial Action Report

Dear Mr. Farabee:

The U.S. Environmental Protection Agency (EPA) has reviewed the *200-CW-3 Operable Unit Interim Remedial Action Report* (DOE/RL-2011-58). EPA project staff at the Hanford Project Office have worked closely with the U.S. Department of Energy in the development of this document. EPA concurs with the conclusion of the report that all of the waste sites in the 200-CW-3 operable unit meet the interim action remedial action objectives. EPA project staff performed a final inspection prior to the completion of the report and found that the waste sites that received active remediation have been backfilled and revegetated in accordance with the 200-CW-3 Remedial Design/Remedial Action Work Plan.

The summary of waste site remediation activities, cleanup verification processes and cost information provided in this report will support development of final remedial action for the outer area of the Hanford 200 Area National Priorities List site.

If you have questions, please contact Dennis Faulk at 509 376-8631.

Sincerely,

Daniel D. Opalski
Director

cc: Jane Hedges, Ecology
Susan Leckband, HAB
Ken Niles, ODOE
Stuart Harris, CTUIR
Gabriel Bohnee, Nez Perce Tribe
Russell Jim, Yakama Nation
Admin. Record: 200-CW-3

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Figures

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Terms

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COA	code of account
COC	contaminant of concern
DOE	U.S. Department of Energy
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FS	feasibility study
ID	identification
MCL	maximum contaminant level
NA	not available
NPL	National Priorities List
OU	Operable Unit
QA	quality assurance
QC	quality control
RAG	remedial action goal
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1967*
RD/RAWP	remedial design/remedial action work plan
RESRAD	residual radioactivity
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RSVP	remaining sites verification package
RTD	removal, treatment, and disposal
SAP	sampling and analysis plan

Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UPR	unplanned release
VSP	Visual Sample Plan
WIDS	Waste Information Data System
WSRF	waste site reclassification form

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1 Introduction

Interim remedial actions have been implemented in the 200-CW-3 Operable Unit (OU) to mitigate impacts from the hazardous chemical and radioactive releases to the soil column. This interim remedial action report has been prepared in accordance with U.S. Environmental Protection Agency (EPA) guidance in *Close Out Procedures for National Priorities List Sites* (EPA 540-R-98-016) and documents cleanup actions performed on the Hanford Site in the 200-CW-3 OU. This report summarizes the interim remedial actions as documented in 200-CW-3 OU waste site specific Remaining Sites Verification Packages (RSVPs). This document also provides a summary of the background history of the Hanford Site (inclusive of the 200-CW-3 OU), construction information, costs, and performance data. Information provided herein presents input for future decision making, evaluation of technology, and cost comparison. This report addresses the 200-CW-3 OU waste sites identified in the following decision document, where remedial action objectives (RAOs) and goals have been achieved:

- *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6 and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (100 Area Remaining Sites)* (hereinafter referred to as the Remaining Sites ROD [EPA, 1999])
- *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington, August 2009* (EPA, 2009)

1.1 Hanford General Site Information

The Hanford Site, which is part of the DOE nuclear weapons complex, occupies approximately 1,517 km^2 (586 mi^2) and is located along the Columbia River in Benton, Franklin, and Grant Counties, and is northwest of the City of Richland in the Lower Columbia Basin in southeastern Washington State (Figure 1-1). From 1943 to 1990, the primary mission of the Hanford Site was the production of nuclear materials for national defense. From the early 1940s to approximately 1989, the Hanford Site mission included building the world's first large scale plutonium production facility; until the 1980s, the site was used to produce plutonium for nuclear weapons. Other activities included nuclear research, development, and nuclear materials production. These activities created a wide variety of chemical and radioactive wastes that were released into the environment. The Hanford Site mission is now focused on the cleanup of those wastes and ultimate closure of the Hanford Site.

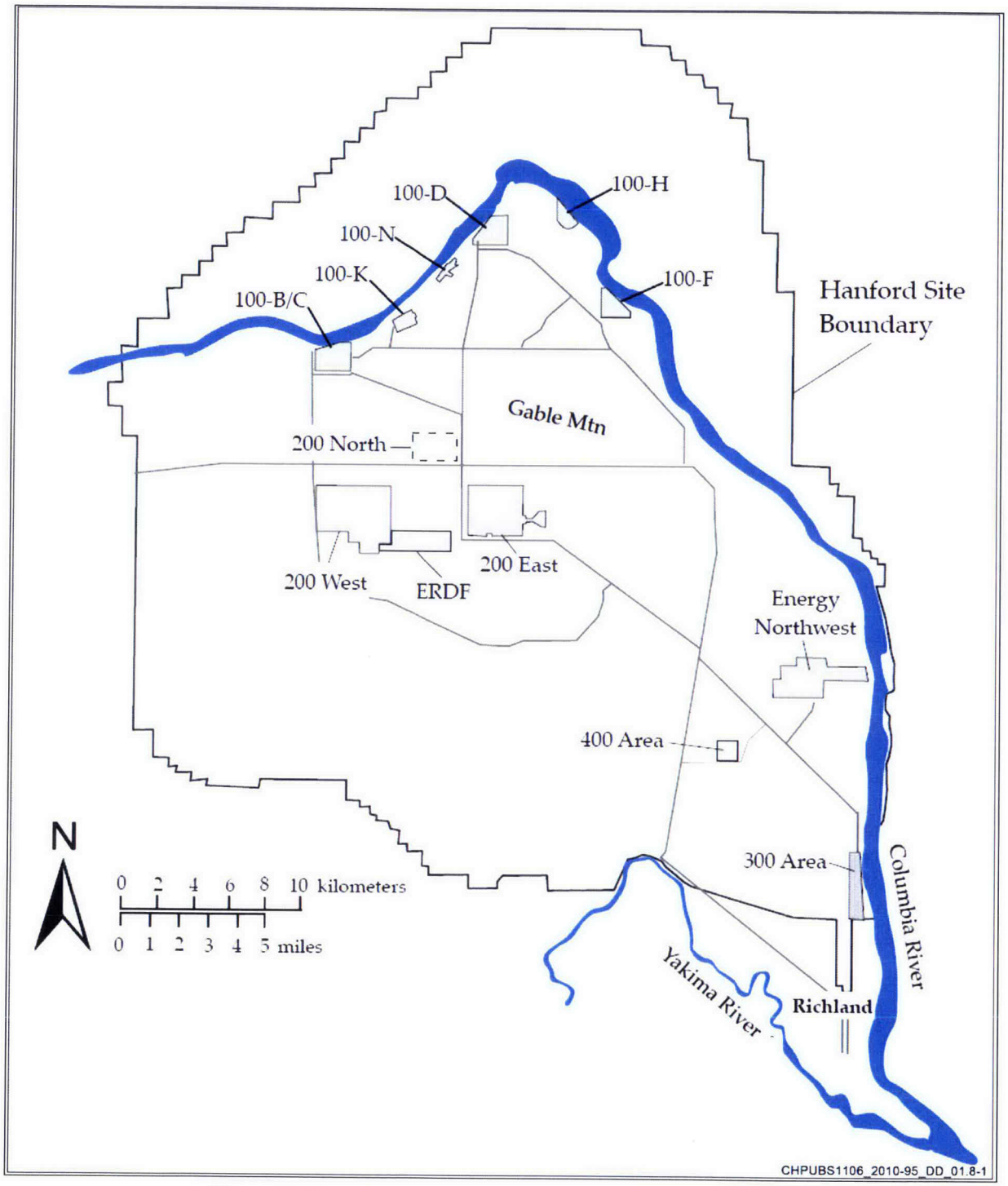

Figure 1-1. Location of the Hanford Site and the 200 North Area

1.1.1 200-CW-3 Operable Unit

The 200-CW-3 OU is located between the 200 East and West Areas on the Hanford Site, in the 200 North Area. Operations in the 200 North Area were primarily related to irradiated nuclear fuel rod storage.

Fuel rods were stored in water-filled basins while the decay of short lived radioisotopes occurred (also known as "cooling"). The 200-CW-3 OU includes areas of contamination resulting from the release of cooling water from the fuel storage basins into liquid disposal sites.

The 200-CW-3 OU located within the 200 North Area includes 16 remaining waste sites (Figure 1-2), four of which underwent remediation in calendar year 2007 while the remaining 12 were addressed between 2009 and 2011.

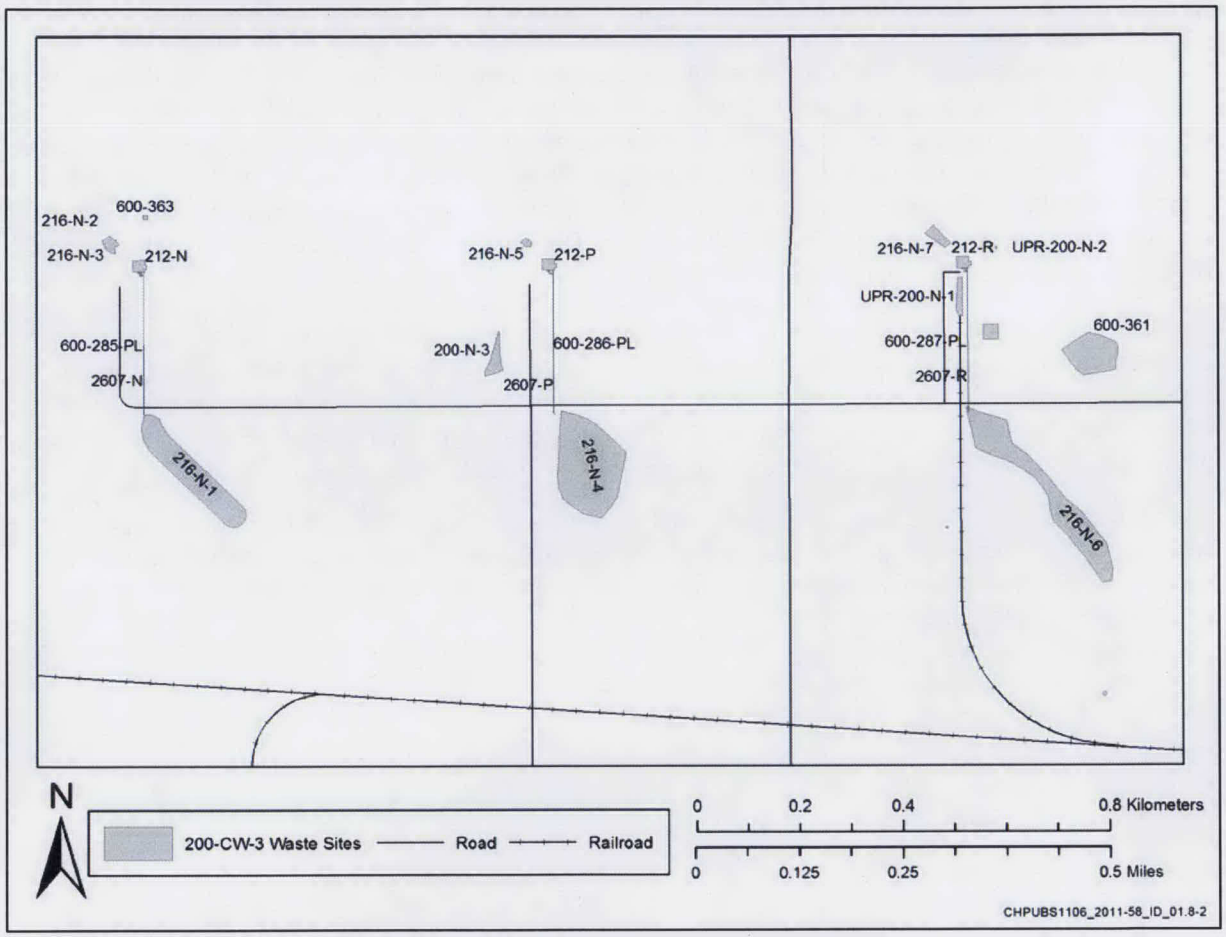

Figure 1-2. 200-CW-3 Operable Unit Waste Sites

1.2 Regulatory and Enforcement History

Statutory authority for this removal action is taken in accordance with CERCLA. Further governing requirements for compliance with CERCLA and the *Resource Conservation and Recovery Act of 1976* activities at Hanford are in accordance with the Tri-Party Agreement. The Hanford Site was proposed for inclusion in 53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites – Update 7," and was placed on the National Priorities List (NPL) on November 3, 1989 (54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites – Final Rule 10/04/89," October 4, 1989) by EPA. EPA placed the four aggregate areas (i.e., the 100, 200, 300, and 1100 Areas) on the NPL. The 200 Area NPL site consists of the 200 West and 200 East Areas, which contain waste management facilities and inactive irradiated-fuel reprocessing facilities. The site also includes the 200 North Area, formerly used for interim storage and staging of irradiated fuel, and the waste sites assigned to the 200-CW-3 OU.

1.3 Environmental Setting

The Hanford Site lies in a sediment filled basin on the Columbia Plateau in southeastern Washington. The 200-CW-3 OU waste sites are located in the 200 North Area, which is situated on the 200 Areas Plateau north of a relatively flat prominent terrace (Cold Creek Bar), on a flood channel formed during the late Pleistocene flooding. The elevation in the vicinity ranges from approximately 180 m (593 ft) in the northern part of the unit to about 170 m (560 ft) above mean sea level in the southern part. There are no natural surface drainage features within the 200 North Area.

The vadose zone beneath the 200 Areas ranges in thickness from approximately 55 m (180 ft) beneath the former U Pond in the 200 West Area to approximately 104 m (341 ft) in the southern portion of the 200 East Area to approximately 49 m (160 ft) along the western part of the 200 North Area. Basalt of the Columbia River Basalt Group and a sequence of overlying sediments comprise the local geology. Sediments in the vadose zone consist primarily of the Hanford formation, Cold Creek unit/silt dominated facies of the Cold Creek unit, and Ringold Formation. The caliche or calcic facies of the Cold Creek unit is also present in the 200 West Area.

Groundwater beneath the Hanford Site is found in an upper, primarily unconfined, aquifer system and in deeper, confined aquifers within the basalt. The Columbia River is the primary discharge area for both the unconfined and confined aquifers. The unconfined aquifer in the 200 North Area of the Central Plateau occurs in the Hanford formation. In general, groundwater flowing through the Central Plateau occurs in a predominantly easterly direction from the 200 West Area to the 200 East Area.

The nearest natural surface water body to the 200 North Area is West Lake (216-N-8 Pond) located approximately 0.8 km (0.5 mi) east. The potential for natural groundwater recharge within the 200 North Area is limited to precipitation infiltration. Estimates of recharge from precipitation at the Hanford Site range from 0 to 10 cm/yr (0 to 4 in/yr).

2 200-CW-3 Operable Unit Background

In anticipation of the inclusion of the 200 Areas of the Hanford Site on the CERCLA NPL in 1989, EPA, DOE, and the Washington State Department of Ecology (Ecology) entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement, Ecology et al., 1989). The purpose of the Tri-Party Agreement is to achieve compliance with the remedial action provisions of CERCLA and with treatment, storage, and disposal unit regulation and corrective action provisions of the *Resource Conservation and Recovery Act of 1976* (RCRA).

2.1 Remedial Action Decisions

The process for characterization and remediation of waste sites at the Hanford Site is addressed in the Tri-Party Agreement (Ecology et al., 1989). The Tri-Party Agencies determined that the waste sites of the 200-CW-3 OU located in 200 North Area were most closely aligned with liquid waste disposal sites in the 100 Area; therefore, the 200-CW-3 OU was considered as part of the 100 Area Remaining Sites. Combining these waste sites into the Remaining Sites ROD [EPA, 1999]), was intended to streamline the decision-making process for a significant geographical area of the 200 Areas NPL site and support DOE's vision of footprint reduction. In 2002, DOE Richland Operations Office, EPA, and Ecology renegotiated the 200 Areas waste site cleanup milestones under the Tri-Party Agreement. As part of these negotiations, DOE, EPA, and Ecology agreed to incorporate an evaluation of the 200-CW-3 OU waste sites into the 200-CW-1 OU feasibility study (FS) and remediation processes. The 200-CW-1 OU and the 200-CW-3 OU encompass all waste sites north of the 200 East and West Areas, within the Central Plateau. Land use for the 200 North Area is designated for reasonably anticipated future land use (for the purposes of the interim remedial actions at the 200-CW-3 OU, RAOs were selected that would support unrestricted land use). This is discussed in the Remaining Sites ROD (EPA, 1999) and the respective waste site remedial design/remedial action work plans (RD/RAWPs). In accordance with Remaining Sites ROD (EPA, 1999), sampling and analysis activities were conducted as part of this remedial action that identified the 200-CW-3 OU waste sites qualified for the RTD remedy.

This report documents remedial action completed at waste sites in the 200-CW-3 OU. A total of 16 waste sites are specifically identified in the scope of this report and are listed in Table 2-1. The locations of 200-CW-3 OU waste sites are shown in Figure 1-2. The remedial action for 200-CW-3 OU was divided into two phases with an RD/RAWP and sampling and analysis plan (SAP) developed for each phase.

Table 2-1. 200-CW-3 Operable Unit Waste Sites

Waste Site Phase 1	Waste Site Phase 2
216-N-2	200-N-3
216-N-3	216-N-1
216-N-5	216-N-4
216-N-7	216-N-6
	600-285-PL
	600-286-PL
	600-287-PL
	UPR-200-N-1
	UPR-200-N-2
	2607-N
	2607-P
	2607-R

2.2 Exposure and Land-Use Assumptions

The reasonably anticipated land use is important in CERCLA remedial actions in determining the appropriate extent of remediation. Future land use affects the type and frequency of exposures to residual contamination for both human and ecological receptors, thereby influencing the amount of cleanup needed. Decisions on future land use at the Hanford Site had not been made at the time the Remaining Sites ROD (EPA, 1999) was issued. In the absence of such decisions, cleanup objectives were developed that would support unrestricted future land use for the 100 Area (including the 200-CW-3 OU), such that future use of the land would not be precluded by contamination left from past Hanford Site operations. The Remaining Sites ROD (EPA, 1999) stated that remediation to this scenario would also be protective of ecological receptors.

Under the unrestricted surface use scenario represented by an individual in a rural-residential setting, a human living in the remediated area is conservatively assumed to consume crops raised in a backyard garden, meat and milk from locally raised livestock, and meat from game animals and fish. The following exposure pathways are used to consider an estimated dose from radionuclides in soil: inhalation; soil ingestion; ingestion of crops, meat, fish, and milk; and external gamma exposure. Unrestricted land use cleanup levels for chemicals or nonradionuclides are based on WAC 173-340-740(3) "Unrestricted Land Use Soil Cleanup Standards." The exposure pathway for residual nonradiological contamination is from ingestion of contaminated soil.

The 200-CW-3 OU will be addressed in the final ROD for the Outer Area (includes 200-CW-3 OU, 200-CW-1 OU and 200-OA-1 OU) and will incorporate current exposure and land-use assumptions through a remedial investigation/feasibility study (RI/FS). The RI/FS will incorporate applicable or relevant and appropriate requirements (ARARs) contained in current guidance and regulations to support final remedial action decisions that are protective of human health and the environment. As a result, the

assumptions that serve as the basis for establishing cleanup goals may be different from those reflected in the Remaining Sites ROD (EPA, 1999). Once final RAOs have been met for the OU, a final remedial action report will be prepared.

2.3 Remedial Action Requirements

Implementation of remedial actions at the 200-CW-3 OU waste sites in accordance with the Remaining Sites ROD (EPA, 1999) requires implementation of the selected cleanup remedy to address actual or threatened releases. The major components of the selected remedy of RTD include the following:

- Plan and implement remedial action according to approved RD/RAWP and SAP documents.
- Remove and stockpile any necessary uncontaminated overburden for backfilling excavated areas when feasible.
- Follow standard construction practices for excavation and transportation of hazardous materials and follow as low as reasonably achievable practices for remediation workers; dust suppression during excavation to be employed as necessary.
- Treat, as necessary, to meet Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria.
- Backfill excavated areas and revegetate in accordance with approved RD/RAWPs.
- Identify institutional controls to prevent exposure to contamination by limiting land or resource uses if needed.
- Demonstrate that residual contamination concentrations are protective of human health and the environment.

As outlined in the Remaining Sites ROD (EPA, 1999), RAOs are met by implementing the selected remedy with an "observational approach." The observational approach consists of two main steps: (1) compilation of available data and the "test as you go" methodology, and (2) characterization and RTD as needed. This first step relies on recorded information from historical process operations and information from investigations addressing nature and extent of contamination. Once an understanding of process history and field conditions is reached, the observation approach proceeds with characterization (i.e., sampling and analysis) and RTD as needed. The candidate waste sites do not proceed to RTD if characterization demonstrates that the waste site conditions meet remedial action goals (RAGs) (Table 2-2).

RTD of the waste sites in the 200-CW-3 OU included removing contaminated soil and debris present within site boundaries. During excavation, radiological field screening may have been used as a "tracer" to locate areas of contamination as defined in *Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites (216-N-2, -3,-5 and -7) in the 200-CW-3 Operable Unit* (DOE/RL-2009-65) and *Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2007-54).

Table 2-2. 200-CW-3 Operable Unit Remedial Action Goals[a]

Radiological Contaminant of Concern	Hanford Site-Specific Background Activity (pCi/g)	Remedial Action Goals		
		Direct Exposure (pCi/g)	Soil Cleanup Level for Groundwater Protection (pCi/g)	Soil Cleanup Level for River Protection (pCi/g)
Americium-241	N/A	31.1	1,577,000	1,577,000
Cesium-137	1.1	6.2	NA [b]	NA [b]
Cobalt-60	0.008	1.4	NA [b]	NA [b]
Europium-152	N/A	3.3	NA [b]	NA [b]
Europium-154	0.033	3.0	NA [b]	NA [b]
Europium-155	0.054	125	NA [b]	NA [b]
Nickel-63	N/A	4,026	NA [b]	NA [b]
Plutonium-238	0.004	37.4	1,123	1,123
Plutonium-239/240	0.025	33.9	718,600	718,600
Strontium-90	0.18	4.5	NA [b]	NA [b]
Technetium-99	N/A	15	15 [c]	15 [c]
Thorium-232	1.3	1.3	NA [b]	NA [b]
Tritium (H-3)	N/A	510	35.5	106.7
Uranium-233/234	1.1	1.1	1.1 [d]	1.1 [d]
Uranium-235	0.11	1.0	1.0 [c]	1.0 [c]
Uranium-238	1.1	1.1	1.1 [d]	1.1 [d]

Nonradiological Contaminant of Concern	Hanford Site-Specific Background Concentration (mg/kg)	Remedial Action Goals		
		Direct Exposure (mg/kg)	Soil Cleanup Level for Groundwater Protection (mg/kg)	Soil Cleanup Level for River Protection (mg/kg)
Antimony	5 [e]	32	6.0 [d]	6.0 [d]
Arsenic	6.5	6.5 [e]	6.5 [e]	6.5 [e]
Barium	132	5,600	NA [b]	NA [b]
Cadmium	0.81 [e]	80	NA [b]	NA [b]
Chromium Total	18.5	80,000	NA [b]	NA [b]
Chromium (VI)	N/A	400	8.0	2.2
Lead	10.2	353	NA [b]	NA [b]
Manganese	512	11,200	NA [b]	NA [b]
Mercury	0.33	24	NA [b]	NA [b]
Zinc	67.8	24,000	NA [b]	NA [b]
Polychlorinated Biphenyls	N/A	0.5	NA [b]	NA [b]

Notes:

[a] Site RAGs are taken from the RD/RAWPs (DOE/RL-2006-69 and DOE/RL-2007-55), where available, without further consideration of updated toxicity data or amendments (2004) to cleanup regulations in WAC 173-340.

[b] RESRAD predicts constituent will not reach groundwater within 1,000 years based on 100 Area generic site model using soil column layers and depths.

[c] The remedial action goal is below the practical quantitation limit (PQL). The value presented is the PQL.

[d] The calculated soil concentration cleanup level of 0.185 pCi/g is below the Hanford Specific Background Activity of 1.1 pCi/g. Therefore the soil concentration protection of groundwater defaults to 1.1 pCi/g.

[e] Where cleanup levels are less than background or required detection limit (RDLs), cleanup levels default to background or RDLs per Ecology 1996, WAC 173-340-700(6)(d) and WAC 173-340-707(2), respectively. The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers (the basis is documented in DOE/RL-96-17, Rev 5, 2.1.2.1).

Abbreviations: NA = Not Applicable (see note c above) N/A = Not Available RAG = Remedial Action Goal
U = Analyte was not detected above detection limits. Detection limits are below RAGs.

The division of the site excavation into decision units for demonstration that cleanup goals have been met is a function of the applicable RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to soils within 4.6 m (15 ft) of the ground surface. This soil zone is referred to as the shallow zone. The groundwater protection and river protection RAGs are applicable to soils deeper than 4.6 m (15 ft) below the ground surface. This soil zone is referred to as the deep zone. If a site is relatively clean, and will meet the direct exposure cleanup criteria throughout the site excavation, it is appropriate to handle the entire site as a shallow zone decision unit.

A brief explanation regarding the remedial action decision units and cleanup verification sampling is provided in the 200 Area remaining site verification packages where remediation is required. Discussion regarding the following rationale is included for:

- Using a single shallow zone decision unit or dividing the site into separate shallow and deep zone decision units;
- Division of the site into other decision units (e.g., overburden, staging areas, sorting cells, decontamination areas)
- Sampling dates and the number of samples collected per decision unit are discussed.
- If any focused sampling was conducted, a summary of this activity and rationale is also included.

Upon completion of remediation at each waste site, verification sampling and analysis was completed to verify attainment of cleanup criteria for all contaminants of concern (COCs). If analytical results indicate that cleanup criteria have not been achieved, then excavation will resume followed by additional verification sampling and analysis. Remediation proceeds until it can be demonstrated through a combination of field screening and verification sampling that cleanup goals have been achieved.

In focused sampling, process knowledge and judgment are used to limit the number of samples from a site and focus sample collection on locations that are expected to have highest contamination levels. The subsequent evaluation is based on the maximum values. Statistical sampling uses composite values and summary statistics for decision making. Based on experience to date, focused sampling is considered appropriate for confirmatory sampling at the 200-CW-3 OU waste sites while statistical sampling is applicable for sites at which remedial action is complete.

Table 2-3 summarizes specified RAOs associated with the selected remedy and method for achieving the objectives through 200-CW-3 OU remedial actions.

Table 2-3. 200-CW-3 Operable Unit Remedial Action Objectives

Remedial Action Objective	200-CW-3 Compliance Methods
RAO 1: Protect human and ecological receptors from exposure to contaminants in soil, structures, and debris by dermal exposure, inhalation or ingestion of radionuclides, inorganics, or organics.	Protection will be achieved by reducing concentrations of, or limiting exposure pathways to, contaminants in the upper 4.6 m (15 ft) of the soil exposure scenario. The levels of reduction will be such that for radionuclides the EPA CERCLA risk range of 10^{-4} to 10^{-6} increased excess lifetime cancer risk will be achieved. To address this objective, the total dose for radionuclides shall not exceed 15 mrem/yr above Hanford Site background for 1,000 years following remediation and state of Washington *Model Toxics Control Act*, Method B, levels for inorganics and organics.
RAO 2: Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions.	Protection will be such that contaminants remaining in the soil after remediation do not result in an adverse impact to groundwater that could exceed maximum contaminant levels (MCLs) and non-zero MCL goals under the *Safe Drinking Water Act*. Protection of the Columbia River from adverse impacts of contaminants remaining in the soil after remediation that do not result in an impact to groundwater and, therefore, the Columbia River, that could exceed the ambient water quality criteria under the *Clean Water Act* for protection of fish. Since there are no ambient water quality criteria for radionculides, MCLs will be used.

Sources:

Clean Water Act of 1972, Pub. L. 107-303, as amended, 33 USC 1251, et seq.

WAC 173-340, "Model Toxics Control Act—Cleanup," *Washington Administrative Code*, Olympia, Washington.

Safe Drinking Water Act of 1974, Public Law 93-523, as amended, 42 USC 300f, et seq.

Upon demonstration that the RAOs have been attained for a waste site, the status of the waste site is reflected as a "reclassification." A reclassification to "no action" is appropriate when a waste site is shown to meet the RAOs without any remedial actions. If a waste site meets RAOs following remedial actions, the site is reclassified to "interim closed out" status. The use of the term "close out" in this context referring to individual waste sites should not be confused with the "close out reports" used for delisting NPL sites (EPA, 2000a).

2.4 Remedial Design Summary

The general design and approach for remediation of the 200-CW-3 OU waste sites is documented in the *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-69) and *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites in the 200-CW-3 Operable Unit* (DOE/RL-2007-55). Both of these RD/RAWPs, DOE/RL-2006-69 and DOE/RL-2007-55, describe the approach utilized to remediate the 200-CW-3 OU waste sites and were prepared as specified in the Remaining Sites ROD (EPA, 1999).

3 Chronology of Events

A chronology of major events associated with remediation of the interim remedial action for the sites within the 200-CW-3 OU are presented in Table 3-1. The chronology includes infrastructure documents, initiation and completion of field activities, and issuance of cleanup verification documents and waste site reclassification forms.

Table 3-1. 200-CW-3 Operable Unit Interim Action Chronology

Date	Event
1999	*Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (EPA, 1999).
2006	*Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-65).
2007	*Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-69).
2007	Confirmatory sampling conducted at 216-N-2, 216-N-3, 216-N-5, and 216-N-7. Excavation commenced and completed at 216-N-5 and 216-N-7. *Remaining Sites Verification Package for the 216-N-5 Waste Site, 212-P Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-36). *Remaining Sites Verification Package for the 216-N-2 Waste Site, 212-N Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-37). *Remaining Sites Verification Package for the 216-N-3 Waste Site, 212-N Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-38). *Remaining Sites Verification Package for the 216-N-7 Waste Site, 212-R Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-39).
2008	*Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2007-54). *Remedial Design/Remedial Action Work Plan for 200 North Area Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2007-55).
2009	*Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA, 2009). Confirmatory sampling conducted at 216-N-1, 216-N-4, 216-N-6, 200-N-3, 600-285-PL, 600-286-PL, 600-287-PL, UPR-200-N-1, UP-200-N-2, 2607-N, 2607-P, and 2607-R. Excavation commenced at 216-N-1. *Remaining Sites Verification Package for the 600-285-PL, 600-286-PL, and 600-287-PL Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-84).

Table 3-1. 200-CW-3 Operable Unit Interim Action Chronology

Date	Event
2010	*Remaining Sites Verification Package for the 200-N-3 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-87).
	Remaining Sites Verification Package for the UPR-200-N-2 Waste Site Located in the 200-CW-3 Operable Unit (DOE/RL-2009-88).
	Remaining Sites Verification Package for the UPR-200-N-1 Waste Site Located in the 200-CW-3 Operable Unit (DOE/RL-2009-90).
	Excavation complete and verification sampling completed at 216-N-1.
	Excavation commenced and completed and verification sampling completed at 216-N-4 and 216-N-6.
	Excavation commenced and completed and verification sampling completed at 600-286-PL and 600-287-PL.
2011	*Remaining Sites Verification Package for the 216-N-1 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2010-64).
	Remaining Sites Verification Package for the 216-N-4 Waste Site Located in the 200-CW-3 Operable Unit (DOE/RL-2010-108).
	Remaining Sites Verification Package for the 216-N-6 Waste Site Located in the 200-CW-3 Operable Unit (DOE/RL-2010-111).

4 Remediation Activity Summary

Field operations supporting remedial actions at the 200-CW-3 OU begin in 2007 and were completed in 2011. The work was completed under two RD/RAWP documents, SAP documents, and remedial action subcontracts. The cleanup actions of seven waste sites resulted in the disposal of approximately 60,238 metric tons (66,401 U.S. tons) of contaminated soil and debris to ERDF from the 200-CW-3 OU. Tables 4-1 and 4-2 present summaries of the remedial action approach and waste disposal activities for each waste site. Details summarized from waste site specific RSVPs and related remediation activities are presented in the following subsections. Figure 1-2 shows waste site locations.

The data resulting from the remedial actions from all waste sites in the 200-CW-3 OU will be evaluated against the final cleanup standards developed for the Outer Area. Those standards are in development and will coordinate two separate baseline risk assessments; a baseline risk assessment for the River Corridor and a baseline risk assessment (including a detailed site-specific ecological assessment) for the final remedial action for the Outer Area. When complete, the risk assessment for the Outer Area will include the 200-CW-3 waste sites to support final closure.

Table 4-1. Remedial Action Approach

Site ID	Site Type	Site Name and Aliases	Remedial Action
200-N-3	Depression/Pit	Ballast Pits	none
216-N-1	Pond	212-N Swamp, 216-N-1 Covered Pond, 216-N-1 Swamp	RTD
216-N-2	Trench	212-N #1 Trench, 212-N Storage Basin Crib #1, 216-N-2 Trench	none
216-N-3	Trench	212-N #2 Grave, 212-N #2 Trench, 212-N Storage Basin Crib #2, 216-N-2 Trench	none
216-N-4	Pond	212-P Swamp, 216-N-4 Swamp	RTD
216-N-5	Trench	212-P Grave, 212-P Storage Basin Crib, 212-P Trench, 216-N-5 Trench	RTD
216-N-6	Pond	212-R Swamp, 216-N-6 Swamp	RTD
216-N-7	Trench	212-R Grave, 212-R Storage Basin Crib, 212-R Trench, 216-N-7 Trench	RTD
600-285-PL	Radioactive Process Sewer	Pipeline from 212-N to 216-N-1 Pond	none
600-286-PL	Radioactive Process Sewer	Pipeline from 212-P to 216-N-4 Pond	RTD
600-287-PL	Radioactive Process Sewer	Pipeline from 212-R to 216-N-6 Pond	RTD
UPR-200-N-1	Unplanned Release	Unplanned Release at the 212-R Railroad Spur	none
UPR-200-N-2	Unplanned Release	Unplanned Release Near Well Pump House #2, Well Pump House East of 212-R	none
2607-N	Septic Tank	2743-N Guard House Septic Tank and Tile Field	none

Table 4-1. Remedial Action Approach

Site ID	Site Type	Site Name and Aliases	Remedial Action
2607-P	Septic Tank	2743-P Guard House Septic Tank and Tile Field	none
2607-R	Septic Tank	2743-R Guard House Septic Tank and Tile Field	none

Table 4-2. ERDF Waste Disposal Summary for the 200-CW-3 Operable Unit

WIDS Site ID	Site Type	Volume of Contaminated Soil/Debris removed (Direct Disposal) and Disposed to ERDF metric tons (U.S. tons)
216-N-1	Pond	1,537 (1,694)
216-N-4	Pond	32, 952 (36,323)
216-N-5	Trench	1,288 (1,420)
216-N-6	Pond	7,409 (8,167)
216-N-7	Trench	2,631 (2,900)
600-286-PL	Radioactive Process Sewer	6,710 (7,397)
600-287-PL	Radioactive Process Sewer	7,711 (8,500)
	Total	**60,238 (66,401)**

4.1 200-N-3

The 200-N-3 waste site was a series of pits located southwest of the 212-P Building, northwest of the intersection of two gravel roads, one leading to 212-P, and the other leading to 212-N. Each pit is approximately 12 m (39 ft) across, and is comprised of soil containing large amounts of gravel. Some metal pipes, wood, electrical insulators, metal cans, and rusted drums were noted during a site visit in 2004. The total dimensions of the waste site are 82 m (269 ft) in length with a 20 m (66 ft) width. No signs or postings distinguish the area.

4.1.1 History

The exact source and extent of contamination is unknown. Available information suggests the pits were used as a source of rock for the Hanford Site railroad track beds. Noted depressions were still visible during a site visit in 1996 and again in 2009 during walk-through preparations for confirmatory sampling activities. No historical or visual evidence exists of backfilling, compacting, or turning the debris.

In general industry, ballast is a common term for heavy materials, especially used as the base material for roads and railroads. A "ballast pit" is a source for this material. Drawings from the 1950s and historical references suggest the site identified as 200-N-3 was the latter type of ballast pit, a source of gravel base material for the nearby railroad tracks. Later, it appears that the depressions were used as a dumping area for general debris. All historical sources were consistent in their assertions that the site was not known or suspected to contain radiological contamination.

4.1.2 Investigation

In July 2009, focused, discrete samples were collected from three sample locations within the 200-N-3 waste site, based on the presence of debris at these locations. Radiological screening was performed prior to and during sampling. Surveys were performed at 1-foot increments to a depth of approximately 4.6 m (15 ft) as prescribed by the applicable SAP (DOE/RL-2007-54). No survey readings were above background levels. Additionally, no staining, discoloration, or saturated media were identified during the observational phase of the sampling at each 1-foot interval. As a result, discrete samples were only obtained at the 4.6 m (15 ft) depth to verify that no COCs were present at concentrations that would exceed the Look-Up Values in the shallow zone and potentially migrate to the deep zone.

4.1.3 Statement of Protectiveness

The 200-N-3 waste site meets the objectives for the "no action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in *Tri-Party Agreement Handbook Management Procedures, Guideline Number TPA-MP-14* (RL-TPA-90-0001). There is no deep zone for the 200-N-3 waste site; therefore, no institutional controls are required.

4.2 216-N-1

The 216-N-1 waste site is a pond that received overflow cooling water from the 212-N Fuel Storage Facility via a subgrade pipeline (600-285-PL). The dimensions for this waste site are approximately 152.4 m (500 ft) in length, and 30.48 m (100 ft) in width. The location of the 216-N-1 pond is approximately 274 m (900 ft) south, southeast of the 212-N Building, which has been demolished.

4.2.1 History

The pond consisted of a natural depression in the terrain. While in operation, the discharged water was dispersed by evaporation to the air and by percolation into the ground. The site had been backfilled with approximately 0.61 to 1.83 m (2 to 6 ft) of clean soil during previous deactivation activities.

Investigative sampling was performed in May 2009 per the guidance prescribed in the SAP (DOE/RL-2007-54). Discrete soil samples were collected at locations expected to contain highest concentrations of COCs based on historical and process knowledge and at locations showing radiological and/or visual indicators (such as soil staining). Radiological indicators (dose rate readings above background) were found in one location, the outlet of the pipeline into the pond. One contaminant (cesium-137) was found above action levels at a depth of approximately 2.13 to 2.44 m (7 to 8 ft) below ground surface (bgs). Contaminants at all other sample locations were below their respective Look-Up Values.

4.2.2 Excavation Operations

The selected remedy of RTD commenced at the 216-N-1 waste site on November 5, 2009, and was completed on December 29, 2009. RTD activities involved the removal and disposal of contaminated soil from the 216-N-1 waste site to ERDF. The final excavation area was approximately 440 m^2 (4,740 ft^2), as measured at ground surface with a slope of 1.5 to 1, to a total depth of 3.1 m (10 ft). Approximately 1,537 metric tons (1,694 U.S. tons) of material from the site were disposed at ERDF.

4.2.3 Verification Sampling

Verification samples were collected on January 29, 2010. Five focused or discrete samples were collected from the remediated area using a combination of a statistical and judgmental sampling design. The number of samples was determined using Visual Sample Plan (VSP) software to generate a statistical sampling design with a random start and 95 percent upper confidence limit. In addition to the three statistically-based samples, two focused samples were collected. Soil samples were collected at the surface of the excavation and at a 4.6 m (15 ft) depth, in accordance with the applicable SAP (DOE/RL-2007-54).

4.2.4 Statement of Protectiveness

The results of verification sampling following implementation of the RTD remedy at the 216-N-1 waste site demonstrate that the waste site meets the cleanup standards specified in the Remaining Sites ROD (EPA, 1999) and RD/RAWP (DOE/RL-2007-55). The results summarized in this report demonstrate that residual COC concentrations in the soil at the 216-N-1 waste site area support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-1 waste site; therefore, no institutional controls are required.

4.3 216-N-2

The 216-N-2 waste site is a trench that was 15.24 m (50 ft) in length by 3.05 m (10 ft) in width and 2.13 m (7 ft) deep prior to backfilling.

4.3.1 History

The trench received basin water and sludge cleanout from the 212-N Building during the shutdown of the area. When the trench was no longer needed for disposal, it was backfilled. Any aboveground piping was placed in the trench prior to backfilling.

4.3.2 Investigation

Focused, discrete samples were collected from test pits at depths of 3.0 and 4.6 m (10 ft and 15 ft). The 3.0 m (10 ft) depth was chosen as the most probable location for accumulation of contaminants and at the 4.6 m (15 ft) depth as is it is the separation depth between shallow and deep zones. In addition, field screening was used to establish site radiological contamination levels as well as a "tracer" to locate areas of chemical contamination. Each bucket of soil was radiologically surveyed, and on average, readings were comparable to the background readings. No hose or piping were found during the test pit excavation.

4.3.3 Statement of Protectiveness

The 216-N-2 waste site meets the objectives for the "no action" remedy described in the RD/RAWP (DOE/RL-2006-69) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the 216-N-2 waste site; therefore, no institutional controls are required.

4.4 216-N-3

The 216-N-3 waste site is a trench that was 15.24 m (50 ft) in length by 6.10 m (20 ft) in width and 1.83 m (6 ft) deep prior to backfilling.

4.4.1 History

The trench received basin water and sludge cleanout from the 212-N Building basin during the shutdown of the area. When the trench was no longer needed for disposal, it was backfilled. Any aboveground piping was placed in the trench prior to backfilling.

4.4.2 Investigation

Focused, discrete samples were collected March 1, 2007, from test pits at depths of 3.0 m (10 ft) and 4.6 m (15 ft). The 3.0 m (10 ft) depth was chosen as the most probable location for accumulation of contaminants and at the 4.6 m (15 ft) depth as is it is the separation depth between shallow and deep zones. In addition, field screening was used as a "tracer" to locate areas of chemical contamination. Each bucket of soil was radiologically surveyed, and on average, readings were comparable to the background readings. No hose or piping were found during the test pit excavation.

4.4.3 Statement of Protectiveness

The 216-N-3 waste site meets the objectives for the "no action" remedy described in the RD/RAWP (DOE/RL-2006-69) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the 216-N-3 waste site; therefore, no institutional controls are required.

4.5 216-N-4

The 216-N-4 waste site is a pond that received overflow cooling water from the 212-P Fuel Storage Facility via a subgrade vitrified clay pipeline (600-286-PL). The dimensions provided for this waste site are 152.4 by 60.96 m (500 by 200 ft), which yields a calculated surface area of 9,290.30 m^2 (100,000 ft^2).

4.5.1 History

The pond is situated 274 m (900 ft) south-southeast of the 212-P Building, which has been demolished. The pond consisted of a natural depression in the terrain while in operation. The discharged water was dispersed via evaporation to the air and infiltration into the ground. Historical records indicate the site was deactivated in June 1952 and backfilled with 0.61 to 1.83 m (2 to 6 ft) of clean soil.

Initial investigative sampling was performed May 22 through June 2, 2009, to determine the nature and extent of contaminants in the 216-N-4 waste site soil. These results served three primary purposes: (1) to confirm the selected remedy, (2) to support design of the RTD implementation, and (3) to support waste characterization and disposal. The waste site was characterized in accordance with the RD/RAWP (DOE/RL-2007-55) and the SAP (DOE/RL-2007-54). Soil sampling, analysis, and radiological screening confirmed that RTD was the appropriate remedy selected for this site.

The analytical results from the sampling campaign were compared to the Deep Zone and Shallow Zone Look-Up Values to determine whether remediation was required. The analytical results from the center of

the waste site representing the flow of the discharge exceeded the Shallow Zone Look-Up Values for cesium-137 and strontium-90.

4.5.2 Excavation Operations

The selected remedy of RTD at 216-N-4 waste site began in December 2009 and was completed in July 2010. RTD activities involved the removal of contaminated soil from the 216-N-4 waste site and disposal at ERDF.

Radiological field screening provided real-time input to guide the excavation in addition to the investigative sampling results. The maximum vertical excavation depth was set at 4.6 m (15 ft) bgs. The final excavation area was 7,430 m^2 (79,975.85 ft^2) measured at ground surface with a slope of 1.5 to 1.0. The base (floor) of the excavation varied from roughly 1.22 to 4.6 m (4 ft to 15 ft) bgs. Approximately 32,952 metric tons (36,323 U.S. tons) of media (soil) were removed from the site and disposed at ERDF.

4.5.3 Verification Sampling

Verification sampling was performed in August and September 2010 following a gridded radiological survey indicating no presence of radiological contamination. Discrete samples were collected from the remediated area using a statistical sampling design. The number of samples and sample locations were determined using VSP software and a statistical sampling design with random start and 95 percent upper confidence limit in accordance with the SAP (DOE/RL-2007-54) resulting in 20 samples. Samples were collected at the surface of the excavation as well as at 4.6 m (15 ft) bgs.

4.5.4 Statement of Protectiveness

The results of verification sampling following implementation of the RTD remedy at the 216-N-4 waste site demonstrate that the waste site meets the cleanup standards specified in the Remaining Sites ROD (EPA, 1999) and RD/RAWP (DOE/RL-2007-55). The results summarized in this report demonstrate that residual COC concentrations in the soil at the 216-N-4 waste site area support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-4 waste site; therefore, no institutional controls are required.

4.6 216-N-5

The 216-N-5 waste site is a trench that received basin water and sludge from the 212-P Building during shutdown of the area. The trench is approximately 24 m (80 ft) in length by 4.6 m (15 ft) in width and 1.8 m (6 ft) deep prior to backfilling. When the trench is no longer needed for disposal, it is backfilled. Any aboveground piping is placed in the trench prior to backfilling.

4.6.1 History

Focused, discrete investigative samples were collected on February 26, 2007, from test pits at depths of 3.0 and 4.6 m (10 and 15 ft), with collection of an additional sample at 2.4 m (8 ft), composed of small, crushed shards of clay pipe, which represented the highest radiological field reading during the test pit excavation. Each bucket of soil was radiologically surveyed, and on average, readings below 2.7 m (9 ft) were comparable to the background readings. No other hose or piping was found during the test pit excavation.

The analytical results from the sampling campaign were compared to the Deep Zone and Shallow Zone Look-Up Values, to determine whether remediation was required. The analytical results from the crushed clay pipe sample exceeded the Shallow Zone Look-Up Values for americium-241, cesium-137,

colbalt-60, europium-152, plutonium-239/240, and strontium-90. The 3.0 and 4.6 m (10 and 15 ft) test pit samples were less than the applicable Look-Up Values.

4.6.2 Excavation Operations

The selected remedy of RTD commenced at 216-N-5 waste site on April 30, 2007, and was completed on May 11, 2007. RTD activities involved the removal of contaminated soil and crushed pipe material from the 216-N-5 waste site. Radiological field screening was ongoing during remediation to determine the remedial action boundaries for both depth and width of the excavation. The final excavation area was 316 m^2 (3,360 ft^2) measured at ground surface with a slope of 1.5 to 1.0. The final depth of excavation was 4.6 m (15 ft) bgs. Approximately 1,288 metric tons (1,420 U.S. tons) of media (soil) were removed from the site and disposed at ERDF.

4.6.3 Verification Sampling

Once the trench was excavated and contaminated soil and debris were disposed, the site was divided into grids and radiologically surveyed prior to sampling and analysis. The survey results verified all grids were less than site background and all radiological postings were removed prior to the final sampling. A multi-incremental sampling design for verification sampling was executed on March 16, 2007, in accordance with the 216-N-2, -3, -5, and -7 SAP (DOE/RL-2006-65).

The excavated trench was divided into two decision units consisting of the sidewalls as one decision unit and the trench bottom as the other decision unit. One sample plus two duplicates were collected from each decision unit. Each unit was divided into 100 grids, with a sample portion collected from each grid 0 to 10 cm (0 to 4 in.) in depth, and accumulated in one container, which is referred to as the "parent" sample for analysis.

4.6.4 Statement of Protectiveness

The results of verification sampling following implementation of the RTD remedy at the 216-N-5 waste site demonstrate that the waste site meets the cleanup standards specified in the Remaining Sites ROD (EPA, 1999) and RD/RAWP (DOE/RL-2006-69). The results summarized in this report demonstrate that residual COC concentrations in the soil at the 216-N-5 waste site area support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-5 waste site; therefore, no institutional controls are required.

4.7 216-N-6

The 216-N-6 waste site is a pond that received overflow cooling water from the 212-R Fuel Storage Facility through a subgrade 46 cm (18 in.) diameter vitrified clay pipeline (600-287-PL). The dimensions for this waste site are 152.4 by 45.72 m (500 by 150 ft), which yields a calculated surface area of 6,967.72 m^2 (75,000 ft^2).

4.7.1 History

The pond is situated 274 m (900 ft) south-southeast of the 212-R Building, which has been demolished. The pond consisted of a natural depression in the terrain while in operation. The discharged water was dispersed through evaporation and infiltration into the ground. Historical records indicate the site was deactivated in June 1952 and backfilled with 0.61 to 1.83 m (2 to 6 ft) of clean soil.

Initial investigative sampling was performed June 9 through June 15, 2009, to determine the nature and extent of contaminants in the 216-N-6 waste site soil. These results served three primary purposes: (1) to confirm the selected remedy, (2) to support design of RTD implementation, and (3) to support waste

characterization and disposal. The waste site was characterized in accordance with the RD/RAWP (DOE/RL-2007-55) and the SAP (DOE/RL-2007-54). Soil sampling, analysis, and radiological screening confirmed that RTD was the appropriate remedy selected for this site.

The analytical results from the sampling campaign were compared to the Deep Zone and Shallow Zone Look-Up Values to determine whether remediation was required. The analytical results from the center of the waste site representing the flow of the discharge exceeded the Shallow Zone Look-Up Values for cesium-137, europium-152, strontium-90, and arsenic.

4.7.2 Excavation Operations

The selected remedy of RTD commenced at the 216-N-6 waste site in July 2010 and was completed in August 2010. RTD activities involved the removal of contaminated soil from the 216-N-6 waste site and disposal at ERDF.

Radiological field screening provided real-time input to guide the excavation in addition to the investigative sampling results. The maximum vertical excavation depth was set at 4.6 m (15 ft) bgs. The final excavation area was 2,474 m^2 (26,625.8 ft^2) measured at ground surface. Additionally, the excavation was finished with a slope of 1.5 to 1.0, to a range of depths with the base of the excavation varying from roughly 1.21 to 2.43 m (4 to 8 ft). Approximately 7,409 metric tons (8,167 U.S. tons) of media (soil) were removed from the site and disposed at ERDF.

4.7.3 Verification Sampling

Verification sampling was performed in September 2010 following a gridded radiological survey indicating no presence of radiological contamination. Discrete samples were collected from the remediated area using a statistical sampling design. The number of samples and sample locations were determined using VSP software and a statistical sampling design with a random start and 95 percent upper confidence limit in accordance with the SAP (DOE/RL-2007-54) resulting in 17 samples. Samples were collected at the surface of the excavation as well as at 4.6 m (15 ft) bgs.

4.7.4 Statement of Protectiveness

The results of verification sampling following implementation of the RTD remedy at the 216-N-6 waste site demonstrate that the waste site meets the cleanup standards specified in the Remaining Sites ROD (EPA, 1999) and RD/RAWP (DOE/RL-2007-55). The results summarized in this report demonstrate that residual COC concentrations in the soil at the 216-N-6 waste site area support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-6 waste site; therefore, no institutional controls are required.

4.8 216-N-7

The 216-N-7 waste site was a trench that received basin water and sludge from the 212-R Building during shutdown of the area. The trench was approximately 24.3 m (80 ft) in length by 4.6 m (15 ft) in width and 1.8 m (6 ft) deep prior to backfilling. When the trench was no longer needed for disposal, it was backfilled. Typically, any aboveground piping was placed in the trench prior to backfilling.

4.8.1 History

Focused, discrete investigative samples were collected on March 14, 2007, from test pits at depths of 3.0 and 4.6 m (10 and 15 ft), with collection of an additional sample at 2.7 m (9 ft), which represented the highest radiological field reading during the test pit excavation. Each bucket of soil was radiologically

surveyed. On average, readings below 2.7 m (9 ft) were comparable to the background readings. No other hose or piping were found during the test pit excavation.

The analytical results from the sampling campaign were compared to the Deep Zone and Shallow Zone Look-Up Values, to determine whether remediation was required. The analytical results from the highest radiological reading at 2.7 m (9 ft) exceeded the Shallow Zone Look-Up Values for cesium-137 and europium-152. The 3.0 and 4.6 m (10 and 15 ft) test pit sample were below their applicable Look-Up Values.

4.8.2 Excavation Operations

The selected remedy of RTD commenced at the 216-N-7 waste site on May 21, 2007, and was completed on June 21, 2007. RTD activities involved the removal of contaminated soil from the 216-N-5 waste site. Radiological field screening was ongoing during remediation to determine the remedial action boundaries for both depth and width of the excavation. The final excavation area was 713.5 m^2 (7,680 ft^2) measured at ground surface with a 1.5 to 1.0 slope. The final depth of excavation was 4.6 m (15 ft) bgs. Approximately 2,631 metric tons (2,900 U.S. tons) of media (soil) were removed from the site and disposed at ERDF.

4.8.3 Verification Sampling

Once the trench was excavated and contaminated soil and debris disposed, the site was divided into grids and radiologically surveyed prior to sampling and analysis. The survey results verified all grids were below site background; therefore, all radiological postings were removed prior to the final sampling. A multi-incremental sampling design for verification sampling was executed on June 26, 2007, in accordance with the applicable SAP (DOE/RL-2006-65).

The excavated trench was divided into two decision units consisting of the sidewalls as one decision unit and the trench bottom as the other decision unit. One sample plus two duplicates were collected from each decision unit. Each unit was divided into 100 grids, with a sample portion collected from each grid 0 to 10.1 cm (0 to 4 in.) in depth, and accumulated in one container, which is referred to as the "parent" sample for analysis.

4.8.4 Statement of Protectiveness

The results of verification sampling following implementation of the RTD remedy at the 216-N-7 waste site demonstrate that the waste site meets the cleanup standards specified in the Remaining Sites ROD (EPA, 1999) and RD/RAWP (DOE/RL-2006-69). The results summarized in this report demonstrate that residual COC concentrations in the soil at the 216-N-7 waste site area support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-7 waste site; therefore, no institutional controls are required.

4.9 600-285-PL

The 600-285-PL waste site is a 46 cm (18 in.) diameter vitrified clay underground pipeline that serviced the 212-N Building.

4.9.1 History

The pipeline was used to transfer overflow cooling water from the 212-N Fuel Storage Facility basin to the 216-N-1 pond. The pipeline is estimated to have carried approximately 946,000,000 L (250,000,000 gal) of low activity cooling water. Historical information found indicates no leaks or unplanned releases were associated with the pipeline. Historical radiological survey information at

various points along the pipeline showed no radiological dose above background and no radiological contamination.

4.9.2 Investigation

On June 3, 2009, focused, discrete samples were collected from the 600-285-PL outfall. Per the applicable SAP (DOE/RL-2007-54), radiological screening was performed prior to and during sampling. Surveys were performed near the origin of the pipeline located at the building the pipeline serviced via a manhole and at the discharge point of the pipeline into the pond. The culvert and the pipeline radiological survey readings did not exceed background. A portion of the pipeline was removed and pulverized before laboratory analysis.

4.9.3 Statement of Protectiveness

The 600-285-PL waste site meets the objectives for the "no further action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the 600-285-PL waste site; therefore, no institutional controls are required.

4.10 600-286-PL

The 600-286-PL waste site is a 46 cm (18 in.) diameter vitrified clay underground pipeline that serviced the 212-P Building.

4.10.1 History

The pipeline was used to transfer overflow cooling water from the 212-P Fuel Storage Facility basin to the 216-N-4 pond. The pipeline is estimated to have carried approximately 946,000,000 L (250,000,000 gal) of low activity cooling water. Historical information found indicates no leaks or unplanned releases were associated with the pipeline. Historical radiological survey information at various points along the pipeline showed no radiological dose above background and no radiological contamination.

4.10.2 Investigation

On June 9, 2009, focused, discrete samples were collected from the 600-286-PL outfall. Per the applicable SAP (DOE/RL-2007-54), radiological screening was performed prior to and during sampling. Surveys were performed near the origin of the pipeline located at the building the pipeline serviced via a manhole and at the discharge point of the pipeline into the pond. The culvert and the pipeline radiological survey readings did not exceed background. A portion of the pipeline was removed and pulverized before laboratory analysis.

During remediation of the 216-N-6 waste site, radiologically contaminated sediment was discovered at the outfall end of the 600-287-PL. This discovery prompted further investigation into the 600-286-PL pipeline. It was determined that radiologically contaminated sediment was present in the pipeline, thus requiring entire pipeline removal. Demolition activities at the 200 North facilities may have contributed to the change in the "as found" conditions of the pipeline noted during the initial investigation by introducing contamination to the pipelines. The contaminants were contained in moist sediment inside the

pipeline, were not found on other internal surfaces of the pipeline, and were neither embedded in the vitreous clay material of the pipelines nor the soil outside the pipeline.

4.10.3 Excavation

No excavation was required based on the initial investigation (6/9/2009) results. However, based on the discovery during the 216-N-4 excavation, the DOE (On-Scene-Coordinator) extended the excavation activities to include the 600-286-PL waste site.

RTD of the 600-286-PL waste site commenced September 2010 and concluded October 2010. The extent of the soil excavation was determined using radiological field screening for cesium-137 or strontium-90 as indicators of potential contamination (as described in the SAP). Using this method, the pipeline and adjacent soil was excavated. The soil in the excavated area was radiologically surveyed and excavated until radiological dose rate readings were at or below the measured area background and no radiological contamination was detected. The final vertical extent of the excavation ranged from 1.5 to 3.65 m (5 to 12 ft) below grade along the path of the pipeline.

4.10.4 Verification Sampling

Once the pipeline and contaminated soil were removed, the site was radiologically surveyed prior to verification sampling and analysis. On November 18, 2010, discrete samples were collected from the surface of the remediated excavation area using a statistical sampling design. Using VSP software, a student's t-test statistical sampling design with a random start and a 95 percent upper confidence limit was used to determine the number and locations of samples covering the base and slopes of the excavated area of the 600-286-PL waste site in accordance with the applicable SAP.

4.10.5 Statement of Protectiveness

The 600-286-PL waste site meets the objectives for the "no further action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no further action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the 600-286-PL waste site; therefore, no institutional controls are required.

Additionally, upon completion of the subsequent excavation activities, the analytical results from the verification sampling in 2010 were also compared to the Deep Zone and Shallow Zone Look-Up Values. The evaluation determined that the RAOs and RAGs were met, thus confirming the waste site status of "no action" remains applicable. Final remedial action evaluations and decisions for this waste site will be made under the final remedial action process for the Outer Area.

4.11 600-287-PL

The 600-287-PL waste site is a 46 cm (18 in.) diameter vitrified clay underground pipeline that serviced the 212-R Building.

4.11.1 History

The pipeline was used to transfer overflow cooling water from the 212-R Fuel Storage Facility basin to the 216-N-6 pond. The pipeline is estimated to have carried approximately 946,000,000 L

(250,000,000 gal) of low activity cooling water. Historical information found indicates no leaks or unplanned releases were associated with the pipeline. Historical radiological survey information at various points along the pipeline showed no radiological dose above background and no radiological contamination.

4.11.2 Investigation

On June 9, 2009, focused, discrete samples were collected from the 600-287-PL outfall. Per the applicable SAP (DOE/RL-2007-54), radiological screening was performed prior to and during sampling. Surveys were performed near the origin of the pipeline located at the building the pipeline serviced via a manhole and at the discharge point of the pipeline into the pond. The culvert and the pipeline radiological survey readings did not exceed background. A portion of the pipeline was removed and pulverized before laboratory analysis.

During remediation of the 216-N-6 waste site, radiologically contaminated sediment was discovered in the outfall end of the 600-287-PL. Further investigation of 600-287-PL determined that radiologically contaminated sediment was present, thus requiring entire pipeline removal. Demolition activities at the 200 North facilities may have contributed to the change in the "as found" conditions of the pipeline noted during the initial investigation by introducing contamination to the pipelines. The contaminants were contained in moist sediment inside the pipeline were not found on other internal surfaces of the pipeline, and were neither embedded in the vitreous clay material of the pipelines nor the soils outside the pipeline.

4.11.3 Excavation

No excavation was required based on the initial investigation (6/9/2009) results. However, based on the discovery during the 216-N-6 excavation, the DOE (On-Scene-Coordinator) extended the excavation activities to include the 600-287-PL waste site.

The RTD of the 600-287-PL waste site commenced October 2010 and concluded November 2010. The extent of the soil excavation was determined using radiological field screening for cesium-137 or strontium-90 as indicators of potential contamination (as described in the SAP). Using this method, the pipeline and adjacent soil were excavated. The soil in the excavated area was radiologically surveyed and excavated until radiological dose rate readings were at or below the measured area background, and no radiological contamination was detected. The final vertical extent of the excavation ranged from 1.5 to 3.65 m (5 to 12 ft) below grade along the path of the pipeline.

4.11.4 Verification Sampling

Once the pipeline and contaminated soil were removed, the site was radiologically surveyed prior to verification sampling and analysis. On December 19, 2010, discrete samples were collected from the surface of the remediated excavation area using a statistical sampling design. Using VSP, a student's t-test statistical sampling design with a random start and a 95 percent upper confidence limit was used to determine the number and locations of samples covering the base and slopes of the excavated area of the 600-287-PL waste site in accordance with the applicable SAP.

4.11.5 Statement of Protectiveness

The 600-287-PL waste site meets the objectives for the "no further action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels

remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the 600-287-PL waste site; therefore, no institutional controls are required.

Additionally, upon completion of the subsequent excavation activities, the analytical results from the verification sampling in 2010 met the RAGs for direct exposure, groundwater protections, and river protection. The evaluation determined that the RAOs were met, thus confirming the 600-287-PL waste site status of "no action" remains applicable. Final remedial action evaluations and decisions for this waste site will be made under the final remedial action process for the Outer Area.

4.12 UPR-200-N-1

The UPR-200-N-1 waste site is an unplanned release (UPR) site situated along a railroad in the spur extending south of the 212-R Building. Dimensions of the subject UPR site are approximately 91.4 m (300 ft) long and 2.4 m (8 ft) wide.

4.12.1 History

The exact extent of contamination at the UPR-200-N-1 waste site is unknown. Based on historical information, the source of contamination has been attributed to activities involving contaminated rail cars. These activities can be divided into two categories: (1) transportation of irradiated fuel to and from 212-R in water-filled rail cars (1944 to 1952), and (2) performance of maintenance work on contaminated rail cars at 212-R (1982 to 1986).

4.12.2 Investigation

In July 2009, the waste site was investigated using field observations and focused sampling and analysis to determine if hazardous or radiological contaminants were present. Radiological field screening of the ground surface guided focused sampling along with visual inspections. Three borehole locations were selected. Radiological surveys were conducted of the borehole contents to determine potential locations for obtaining discrete samples. The survey results indicated that the soil sample was below radiological background levels and, based upon visual inspections, no evidence existed to support the identification of discrete sample locations. As a result, discrete samples were obtained at each borehole at the approximate midpoint (1.5 to 2.1 m [5 to 7 ft] bgs) and at the 4.6 m (15 ft) depth in accordance with the applicable SAP (DOE/RL-2007-54).

4.12.3 Statement of Protectiveness

The UPR-200-N-1 waste site meets the objectives for the "no further action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the UPR-200-N-1 waste site; therefore, no institutional controls are required.

4.13 UPR-200-N-2

The UPR-200-N-2 waste site is a UPR near the Number 2 Well Pumphouse, east of the 212-R Building.

4.13.1 History

The waste site is a 6.1 by 6.1 m (20 by 20 ft) area posted with a lightweight chain and Underground Radioactive Material warning signs. The source of contamination is unidentified.

4.13.2 Investigation

On July 9 through 24, 2009, focused, discrete samples were collected from the UPR-200-N-2 waste site at 0.9 and 4.6 m (3 and 15 ft). Radiological screening was performed prior to and during sampling. Surveys were performed at one foot increments to the depth of 4.6 m (15 ft) prescribed by the applicable SAP (DOE/RL-2007-54). Survey readings did not exceed background.

4.13.3 Statement of Protectiveness

The UPR-200-N-2 waste site meets the objectives for the "no further action" remedy described in the RD/RAWP (DOE/RL-2007-55) and the Remaining Sites ROD (EPA, 1999). The results presented show that residual soil concentrations support reasonably anticipated future land uses discussed in the decision documents (for the purposes of this remedial action, RAOs were developed that would support unrestricted use). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. These results support the "no action" determination and reclassification to "no action" status in accordance with the process described in RL-TPA-90-0001. There is no deep zone for the UPR-200-N-2 waste site; therefore, no institutional controls are required.

The data resulting from this remedial action will be evaluated against the final cleanup standards developed for the Outer Area. Those standards are in development and will coordinate two separate baseline risk assessments; a baseline risk assessment for the River Corridor and a baseline risk assessment (including a detailed site-specific ecological assessment) for the final remedial action for the Outer Area. When complete, the risk assessment for the Outer Area will include the 200-CW-3 OU waste sites (including UPR-200-N-2) to support final closure.

4.14 2607-N

The 2607-N waste site is a septic tank waste site consisting of a septic tank and tile/drain field designed to provide sanitary service to the 2743-N guard station. The guard station was demolished and the septic system abandoned in 1952. Historical and process knowledge and physical configuration provided justification to reclassify the site to "rejected." As a best management practice, focused samples were collected from the drain field with analytical results compared to the Look-Up Values established for the 200-CW-3 OU waste sites. Results meet the RAGs, thus bolstering the justification to change the waste site status to "rejected."

4.15 2607-P

The 2607-P waste site is a septic tank waste site consisting of a septic tank and tile/drain field designed to provide sanitary service to the 2743-P guard station. The guard station was demolished and the septic system abandoned in 1952. Historical and process knowledge and physical configuration provided justification to reclassify the site to "rejected." As a best management practice, focused samples were collected from the drain field with analytical results compared to the Look-Up Values established for the 200-CW-3 OU waste sites. Results meet the RAGs, thus bolstering the justification to change the waste site status to "rejected."

4.16 2607-R

The 2607-R waste site is a septic tank waste site consisting of a septic tank and tile/drain field designed to provide sanitary service to the 2743-R guard station. The guard station was demolished and the septic system abandoned in 1952. Historical and process knowledge and physical configuration provided justification to reclassify the site to "rejected." As a best management practice, focused samples were collected from the drain field with analytical results compared to the Look-Up Values established for the 200-CW-3 OU waste sites. Results meet the RAGs, thus bolstering the justification to change the waste site status to "rejected."

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5 Performance Standards and Construction Quality Control

This chapter addresses the process for demonstrating achievement of performance standards, including attainment of RAGs and maintaining the required quality controls during remedial activities.

5.1 Attainment of Performance Standards

The remedial actions described in Sections 4.1 through 4.16 of this report were performed in order to identify and reduce potential threats to human health and the environment from the 200-CW-3 OU waste site contamination. Following remediation activities at a waste site, an evaluation against identified performance standards (RAOs and RAGs) is conducted in order to ensure the standards were met.

5.1.1 Performance Standard Documentation

Attainment of the RAO performance standards, and interim closure of individual 200-CW-3 OU waste sites, are documented in the remaining sites verification packages (RSVPs). These documents provide remediation information as described in Section 2.3 to support the formal reclassification in the waste site reclassification forms (WSRFs) listed in Table 5-1.

Table 5-1. Summary of 200-CW-3 Operable Unit Verification Packages

Site Name	Document Name	WSRF	Status
200-N-3	*Remaining Sites Verification Package for the 200-N-3 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-87)	2009-027	No Action
216-N-1	*Remaining Sites Verification Package for the 216-N-1 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2010-64)	2010-033	Interim Closed Out
216-N-2	*Remaining Sites Verification Package for the 216-N-2 Waste Site, 212-N Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-37)	2007-016	No Action
216-N-3	*Remaining Sites Verification Package for the 216-N-3 Waste Site, 212-N Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-38)	2007-017	No Action
216-N-4	*Remaining Sites Verification Package for the 216-N-4 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2010-108)	2010-091	Interim Closed Out
216-N-5	*Remaining Sites Verification Package for the 216-N-5 Waste Site, 212-P Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-36)	2007-013	Interim Closed Out
216-N-6	*Remaining Sites Verification Package for the 216-N-6 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2010-111)	2010-092	Interim Closed Out
216-N-7	*Remaining Sites Verification Package for the 216-N-7 Waste Site, 212-R Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-39)	2007-018	Interim Closed Out
600-285-PL	*Remaining Sites Verification Package for the 600-285-PL, 600-286-PL,and 600-287-PL Waste Sites Located in the*	2009-022	No Action

Table 5-1. Summary of 200-CW-3 Operable Unit Verification Packages

Site Name	Document Name	WSRF	Status
	200-CW-3 Operable Unit (DOE/RL-2009-84)		
600-286-PL	*Remaining Sites Verification Package for the 600-285-PL, 600-286-PL,and 600-287-PL Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-84)	2009-023	No Action
600-287-PL	*Remaining Sites Verification Package for the 600-285-PL, 600-286-PL,and 600-287-PL Waste Sites Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-84)	2009-024	No Action
UPR-200-N-1	*Remaining Sites Verification Package for the UPR-200-N-1 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-90)	2009-031	No Action
UPR-200-N-2	*Remaining Sites Verification Package for the UPR-200-N-2 Waste Site Located in the 200-CW-3 Operable Unit* (DOE/RL-2009-88)	2009-028	No Action
2607-N	NA	2010-016	Rejected
2607-P	NA	2010-017	Rejected
2607-R	NA	2010-018	Rejected

Interim Closed out = Waste site meets RAOs following remedial actions

NA = not applicable

No Action = Meets RAOs without any remedial actions

Rejected = Does not require remediation based on qualitative information

WSRF = Waste Site Reclassification Form

5.1.2 Remedial Action Objectives and Goals

Remedial action objective performance standard attainment involves comparisons of soil analytical data to RAGs (Table 5-2), and is evaluated using the following general steps:

- Identify the units within a site for cleanup verification, and conduct sample collection and analysis for COCs
- Calculate and evaluate the maximum values for the identified units against the decision rules for achieving the RAGs

RAGs are specific numeric targets developed to ensure achievement of the applicable RAOs identified in the Remaining Sites ROD (EPA, 1999). The RAGs applicable to the 200-CW-3 OU waste sites, along with the process for verifying attainment of the RAGs, are described in the two 200-CW-3 OU RD/RAWP documents (DOE/RL-2006-69 and DOE/RL-2007-55), and are summarized in Table 5-2.

5.1.3 Contaminant Identification

The COCs for 200-CW-3 OU waste sites were identified based on existing information for the site and the COPCs listed in the Remaining Sites ROD (EPA, 1999). The final list of relevant contaminants is provided in Table 5-3 and is applicable to the sixteen 200-CW-3 OU waste sites.

Following the process described in this section, residual soil concentrations at all of the sites addressed in this report were shown to meet the RAO performance standards established for reasonably anticipated future land use in the 200-CW-3 OU. The waste sites individually meet the established cleanup objectives summarized in Table 5-2. Closeout of individual waste sites was based on the evaluation of analytical laboratory results from verification or confirmatory soil samples that were analyzed by contract laboratories using EPA approved methods. The resulting data for each waste site were subjected to a data quality assessment (DQA) and determined to be suitable for their intended use to support closure decisions.

Table 5-2. Summary of Achieved Performance Standards

Regulatory Requirement	Remedial Action Goals[a]	Evaluation Method
Direct Exposure—Radionuclides	Attained total dose for radionuclides that does not exceed 15 mrem/yr above background over 1,000 years.	Confirmed residual concentrations of radionuclide COCs are below background or less than one-tenth the single radionuclide soil concentration equivalent to a 15 mrem/yr dose rate calculated by residual radioactivity (RESRAD).
Direct Exposure—Nonradionuclides	Reduced concentration of inorganics and organics to WAC 173-340, Method B, levels.	Confirmed all individual COC concentrations are below the direct exposure criteria.
Risk Requirements—Nonradionuclides	Attained a hazard quotient of <1 for all individual noncarcinogens.	Confirmed all individual COC concentrations are below Hanford Site-specific background value and any calculated individual hazard quotients are <1.
	Attained a cumulative hazard quotient of <1 for noncarcinogens.	Confirmed all individual COC concentrations are below Hanford Site-specific background value and any calculated cumulative hazard quotient is <1.
	Attained an excess lifetime cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	Confirmed all individual COC concentrations are below background levels and any excess lifetime cancer risk calculated for these constituents meet the $<1 \times 10^{-6}$ criteria.
	Attained a cumulative excess lifetime cancer risk of $<1 \times 10^{-5}$ for carcinogens.	Confirmed all individual COC concentrations are below background levels and any cumulative excess lifetime cancer risk calculated for these constituents meet the $<1 \times 10^{-5}$ criteria.
Groundwater/River Protection—Radionuclides	Attained single COC groundwater and river protection RAGs.	Confirmed maximum residual concentrations of radionuclide COCs were detected below groundwater and river protection exposure criteria. Values calculated by RESRAD that are protective of the groundwater are also protective of the Columbia River, since contaminant pathway to the Columbia River is through the groundwater.
	Attained national primary drinking water standards 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	Confirmed maximum residual concentrations of beta/gamma radionuclide COCs were detected below groundwater and river protection exposure criteria.

Table 5-2. Summary of Achieved Performance Standards

Regulatory Requirement	Remedial Action Goals[a]	Evaluation Method
	Attained drinking water standards[b] for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5.[c]	Confirmed maximum residual concentrations of alpha emitting radionuclide COCs were detected below groundwater and river protection exposure criteria. RESRAD calculations predict that the only alpha-emitting radionuclide COCs with the potential to reach groundwater within 1,000 years are the uranium isotopes.
	Attained total uranium standard of 21.2 pCi/L.[d]	For uranium-233/234 and uranium-238, the groundwater MCL of 21.2 pCi/L corresponds to a soil concentration of 0.185 pCi/g. However, the Hanford Site-specific background for these two uranium isotopes is 1.1 pCi/g. The RAG therefore defaults to 1.1 pCi/g. Confirmed maximum residual concentrations of uranium isotopes were detected less than RAGs.
Groundwater/River Protection—Nonradionuclides	Attained individual nonradionuclide groundwater and river cleanup requirements.	Confirmed maximum detected results for all nonradionuclides are below the RAGs for protection of groundwater.

Source: WAC 173-340, "Model Toxics Control Act—Cleanup"

a. Remaining Sites ROD (EPA, 1999).

b. "National Primary Drinking Water Regulations" (40 CFR 141).

c. *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).

d. Based on the isotopic distribution of uranium in the 100 Areas, 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI Calculation 0100X-CA-V0038).

Table 5-3. Contaminants of Concern for the 200-CW-3 Operable Unit

Nonradionuclide	Radionuclide
Antimony	Americium-241
Arsenic	Cesium-137
Barium	Cobalt-60
Cadmium	Europium-152
Chromium (III)	Europium-154
Chromium (VI)	Europium-155
Lead	Nickel-63
Manganese	Plutonium-238
Mercury	Plutonium-239/240
Zinc	Strontium-90
Polychlorinated Biphenyls	Technetium-99
	Thorium-232
	Tritium (H-3)
	Uranium-233/234
	Uranium-235
	Uranium-238

5.2 Attainment of Final Remedial Action Performance Standards

Final remedial action evaluations and decisions for the 200-CW-3 OU waste sites will be made under the final remedial action process for the Outer Area. The final RODs are required (40 CFR 300) and would include the 200-CW-3 OU, in order to identify the final remedy decision. The final ROD would include any adjustments to the remedy(s) identified in the Remaining Sites ROD (EPA, 1999), if necessary, to ensure protection of human health and the environment.

In addition to the information and data that originally established the basis for remedial actions under the Remaining Sites ROD (EPA, 1999), final remediation action decisions will incorporate new information acquired through characterization of interim closed waste sites. Development of the final remedy ROD will incorporate data and information collected during the RI/FS and ecological baseline risk assessment.

The final Outer Area ROD development process will incorporate evaluation of ecological protection requirements, although the Remaining Sites ROD (EPA, 1999) included general objectives for protection of ecological receptors based on meeting the reasonably anticipated land use cleanup levels. Finally, exposure assumptions that formed the basis for development of the future land use scenario will be evaluated and may be adjusted to reflect current ARARs and land use decisions. The basis for demonstrating that final remedial actions are protective of groundwater will be updated according to current ARARs.

The final ROD will integrate historical and current characterization information, as well as current ARARs. Waste sites remediated under the Remaining Sites ROD (EPA, 1999) will ultimately be evaluated by the lead agency and lead regulatory agency against decisions and requirements documented in the final Outer Area ROD. Upon satisfactory completion of the final remedial actions for the 200-CW-3 OU, EPA will issue a certificate of completion to DOE.

5.3 Quality Control

The quality assurance (QA) and quality control (QC) programs used throughout the remediation activities are identified in the applicable RD/RAWPs (DOE/RL-2006-69 and DOE/RL-2007-55) and SAPs (DOE/RL-2006-65 and DOE/RL-2007-54). Samples that were used to demonstrate achieving the cleanup objectives for individual waste sites were collected and analyzed in accordance with these documents, which were approved by DOE and the lead regulatory agency. The SAP documents contained a quality assurance project plan to establish the objectives, functional activities, methods, and QA/QC measures associated with the sampling and analysis activities. Verification data sets used to support waste site closure underwent a DQA to ensure suitability for their intended use. Results of the DQA are documented in the RSVPs for individual waste sites.

6 Final Inspection and Certifications

Based on evaluation of the approved interim closure documentation referenced in Table 5-1 and final inspections of the 200-CW-3 OU waste sites, interim remedial actions have been completed and RAOs have been achieved. Final inspections of the interim remedial actions were conducted on September 12, 2011, and included the DOE, EPA, and CHPRC representatives. The inspections were conducted for each of the waste sites included in the 200-CW-3 OU,. The inspections were conducted to verify that the sites had been backfilled with clean materials and revegetated as required by the applicable interim action RODs. No deficiencies were noted by either agency during the review. The waste sites have been reclassified in Waste Information Data System (WIDS) (RL-TPA-90-0001) as "interim closed out," "no-action," or "rejected."

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7 Operations and Maintenance Activities

For the 200-CW-3 OU waste sites, there are no waste site-specific operations and maintenance activities; therefore, this chapter is not applicable.

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8 Project Cost Summary

This chapter presents a summary of the available estimated cost and actual project costs associated with the remedial actions and backfill/revegetation operations performed between 2007 and 2011, as addressed in Chapter 4 of this report. All cost data are intended to represent the fully burdened costs for the work performed, including all applicable direct and indirect overhead charges.

The Remaining Sites ROD (EPA, 1999) included confirmatory sampling cost estimates for seven of the 200-CW-3 OU waste sites. Sampling costs to determine if sites 216-N-1, 216-N-2, 216-N-3, 216-N-4, 216-N-5, 216-N-6, and 216-N-7 "plugged in" to the RTD remedy were estimated at $397,591. No remediation costs were included for those waste sites.

The *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision Hanford Site, Benton County, Washington* (EPA, 2009), included estimated costs for remediation of additional "plugged in" 200-CW-3 OU waste sites. The estimated costs for remediation of 200-N-3, UPR-200-N-1, UPR-200-N-2, 2607-N, 2607-P, 2607-R, 600-285-PL, 600-286-PL, and 600-287-PL were estimated at $714,075.

Table 8-1 provides a summary of the costs of work performed for the sites and activities addressed in this report (totaling approximately $8.6 million). Table 8-2 was generated to present waste disposal unit costs for work performed (averaged $125/U.S. ton). Note that Table 8-1 includes waste sites that were closed by both confirmatory sampling and by verification sampling. The confirmatory sampling sites may be identified by the absence of waste disposal quantities. Table 8-2 only includes waste sites closed by verification sampling.

Table 8-1. Summary of Actual Remedial Action Costs and Waste Quantity for 200-CW-3 Operable Unit Waste Sites

Waste Site	Site Type	Waste Quantity metric tons (U.S. tons)	Total $
200-N-3	Depression/Pit	0	82,000
216-N-1	Pond	1,537 (1,694)	776,300
216-N-2	Trench	0	100,000*
216-N-3	Trench	0	100,000*
216-N-4	Pond	32,952 (36,323)	2,511,300
216-N-5	Trench	1,288 (1,420)	562,100*
216-N-6	Pond	7,409 (8,167)	2,235,400
216-N-7	Trench	2,631 (2,900)	1,146,400*
600-285-PL	Radioactive Process Sewer	0	12,500
600-286-PL	Radioactive Process Sewer	6,710 (7,397)	497,600
600-287-PL	Radioactive Process Sewer	7,711 (8,500)	572,500
2607-N	Septic Tank	0	500
2607-P	Septic Tank	0	500
2607-R	Septic Tank	0	500
	Totals	**60,238 (66,401)**	**8,597,600**

* The costs associated with waste sites 216-N-2, -3, -5, and -7 were reported as a combined value upon the completion of remediation activities in 2007. The costs included in this table were estimated based on volume of soil removed and sampling completed.

8.1 Cost Collection Method

Costs associated with the 200-CW-3 OU were assigned on the basis of the original remediation estimate, adjusted for the total volume of soil remediated, as compared to the originally estimated volume. Soil volumes were tracked by the field engineers and by the ERDF waste profile.

Table 8-2. Summary of Waste Disposal Unit Costs for the 200-CW-3 Operable Unit Waste Sites Remedial Actions

Waste Site	Site Type	Duration	Waste Quantity	Total Cost	Average Cost
		months	metric tons (U.S. tons)	$K	$/metric ton ($/U.S. ton)
216-N-1	Pond	1	1,537 (1,694)	776,300	505 (458)
216-N-4	Pond	7	32,952 (36,323)	2,511,300	76 (69)
216-N-5	Trench	1	1,288 (1,420)	562,100	436 (396)
216-N-6	Pond	2	7,409 (8,167)	2,235,400	302 (274)
216-N-7	Trench	1	2,631 (2,900)	1,146,400	436 (395)
600-286-PL	Radioactive Process Sewer	2	6,710 (7,397)	497,600	74 (67)
600-287-PL	Radioactive Process Sewer	2	7,711 (8,500)	572,500	74 (67)
	Totals		**60,238 (66,401)**	**8,301,600**	**138 (125)**

Data present in this summary are intended to include project and ERDF costs for excavation and load out, waste transportation and disposal at ERDF, sampling and backfill costs, and work instruction and RSVP development. Costs include labor, equipment and materials, and subcontract services.

Unit costs for small soil contamination sites (216-N-1, 216-N-5, and 216-N-7) varied ranging from $395/U.S. ton to $458/U.S. ton. The major factor in the higher relative unit costs was the short excavation and small quantity of waste. Unit costs for large soil contamination sites (216-N-4, 216-N-6, 600-286-PL, and 600-287-PL) varied significantly ranging from $67/U.S. ton to $274/U.S. ton. A factor decreasing the unit cost for 216-N-4 was the longer excavation duration and large waste quantity. The pipelines' unit costs were lower due to low investigative sampling costs prior to excavation.

Costs presented in this report have not been escalated to reflect present-value dollars.

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9 Observations and Lessons Learned

This report of the remediation of the 200-CW-3 OU waste sites provides the opportunity to identify project successes, areas for improvement, and lessons learned. The prime contractors, subcontractors, DOE, and EPA successfully worked together during remedial action operations. In doing so, the work was performed safely without any lost-time injuries. There are numerous lessons to be learned from the remedial activities of the 200-CW-3 OU waste sites, which are discussed in the text following.

During remediation of the first phase of waste sites, completed in 2007, test pits were advanced to approximately 4.6 m (15 ft) bgs, and used the original soil to fill the test pits following sampling. Analytical results indicated two of the waste sites were contaminated, requiring RTD to a total depth of approximately 4.6 m (15 ft) bgs due to original soil having been placed back into the test pit. At both sites, the contamination was located at depths significantly above 4.6 m (15 ft) and would not have required RTD to that depth had the test pits not been backfilled with the impacted soil. Excavation to a lesser depth would have saved money and reduced waste. Following the sampling of the 200-CW-3 OU waste sites completed in 2009, the test pits were filled with clean material. Remediation at these waste sites was conducted to the depth of the contamination, rather than directly to 4.6 m (15 ft), reducing costs as well as amounts of waste disposed at ERDF.

The use of super dump trucks for waste transfer to ERDF was implemented during the remediation of the 200-CW-3 OU waste sites conducted between 2009 through 2011. Use of super dump trucks instead of roll-off cans minimized load handling and queue area needed for load transfer. During future waste-disposal activity, costs could be reduced further by optimizing the number of haul trucks that would eliminate field crew downtime and improve efficiency.

The 216-N-6 waste site was located in proximity to radiologically contaminated cask well railcars, which were located on the railroad near the waste site. As a result, the soil contamination area/radiological buffer area was increased to accommodate a vehicle survey and tarp tie-down station approximately 100 m (328 ft) east of the railroad. This increased distance reduced the background radiation level, which had been elevated due to the cask well railcar radioactivity, and allowed for the surveying of personnel and equipment to be released from the radiologically posted areas.

Additional cost savings were achieved by the implementation of radiological field screening with the SAM-940 instrument, which employs the NaI (sodium iodide) detector. The SAM-940 provided real-time in situ isotopic identification. Excavation was minimized utilizing this technology, as the SAM-940 was capable of identifying the radiological indicator (cesium-137) at the low levels required to screen the excavation area. This helped determine if residual contamination was present that required further remediation. The technology was successfully used during remediation at all three ponds in the 200-CW-3 OU. Remediation activities guided by the SAM-940 were verified by soil sampling, which indicated no further remediation was required, thereby, potentially reducing costs for multiple remediation evolutions as well as sampling and analysis costs.

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