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

14-AMRP-0194

MAY 2 2 2014

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

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton
Richland, Washington 99354

Addressees:

300 AREA REMEDIAL DESIGN REPORT/REMEDIAL ACTION WORK PLAN, DRAFT A

The Hanford Site 300 Area Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1 was signed in November 2013. In accordance with CERCLA and the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), Draft A of the 300 Area Remedial Design Report/Remedial Action Work Plan is submitted for review. The following three documents comprise of the 300 Area Remedial Design Report/Remedial Action Work Plan:

1. Integrated Remedial Design Report/Remedial Action Work Plan for the 300 Area (300-FF-1, 300-FF-2, & 300-FF-5 Operable Units), DOE/RL-2014-13, Draft A
2. Remedial Design Report/Remedial Action Work Plan for 300-FF-2 Soils, DOE/RL-2014-13-ADD1, Draft A
3. Remedial Design Report/Remedial Action Work Plan Addendum for the 300 Area Groundwater, DOE/RL-2014-13-ADD2, Draft A

These are "primary documents" as described in 9.2 of the Tri-Party Agreement. In accordance, please provide written comments with supporting pertinent sources of authority or references upon which the comments are based within 45 days of receipt of this letter unless specifically extended by the lead regulatory agency. The "lead regulatory agency" is the U.S. Environmental Protection Agency, as defined in 5.6 of the Tri-Party Agreement.

MAY 22 2014

If you have any questions, please contact me, or your staff may contact Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

Ray J. Corey, Assistant Manager
for the River and Plateau

AMRP:KMT

Attachments

cc w/attachs:
G. Bohnee, NPT
R. Buck, Wanapum
S. Harris, CTUIR
S. Hudson, HAB
R. Jim, YN
N. M. Menard, Ecology
K. Niles, ODOE
D. Rowland, YN
Administrative Record
Environmental Portal

cc w/o attachs:
R. E. Day, CHPRC
L. M. Dittmer, CHPRC
R. A. Kaldor, MSA
R. E. Piippo, MSA

DOE/RL-2014-13-ADD1
Draft A

Remedial Design Report/ Remedial Action Work Plan for 300-FF-2 Soils

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

For External Review

DOE/RL-2014-13-ADD1
Draft A

STANDARD APPROVAL PAGE

Title: Remedial Design Report/Remedial Action Work Plan for 300-FF-2 Soils

Author Name: J. M. Capron

Approval: J. A. Lerch, Mission Completion & Environmental Compliance Manager

Signature [signature] Date 5/7/14

The approval signature on this page indicates that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

DOE/RL-2014-13-ADD1
Draft A

Remedial Design Report/ Remedial Action Work Plan for 300-FF-2 Soils

Date Published
May 2014

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

For External Review

Contents

Appendices

Figures

Tables

This page intentionally left blank.

Terms

ACM	asbestos-containing material
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CTA	container transfer area
CVP	cleanup verification package
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FS	feasibility study
LDR	land disposal restricted
MAP	mitigation action plan
MTCA	"Model Toxics Control Act – Cleanup"
NCP	"National Oil and Hazardous Substances Contingency Plan"
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RAO	remedial action objective
RAWP	remedial action work plan
RCBRA	river corridor baseline risk assessment
RCC	River Corridor Closure (Project)

RCRA	*Resource Conservation and Recovery Act*
RDR	remedial design report
RESRAD	RESidual RADioactivity
RI	remedial investigation
ROD	record of decision
RTD	remove, treat, and dispose
SAP	sampling and analysis plan
SNF	spent nuclear fuel
SPA	staging pile area
STOMP	Subsurface Transport Over Multiple Phases
TBC	to be considered
TRU	transuranic
TSD	treatment, storage, and disposal
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VPU	vertical pipe unit
WAC	*Washington Administrative Code*

1 Introduction

The *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (hereafter referred to as the 300 Area ROD) (EPA 2013) defines selected remedies for the 300 Area of the Hanford Site. In general, these selected remedies can be grouped into three categories:

- Remove, treat, and dispose (RTD) for waste sites in the 300-FF-2 Operable Unit (OU), with interim pipeline void filling and surface barriers for waste sites associated with long-term retained facilities
- Uranium sequestration for the vadose zone and periodically rewetted zone for soils and sediments greater than 4.6 m (15 ft) below ground surface (bgs) in the 300-FF-1 and 300-FF-2 OUs
- Monitored natural attenuation for groundwater in the 300-FF-5 OU.

The *Integrated Remedial Design/Remedial Action Work Plan for the 300 Area (300-FF-1, 300-FF-2, & 300-FF-5 Operable Units)* (hereafter referred to as the Integrated RDR/RAWP) (DOE/RL-2014-13) addresses overarching common elements and integration considerations for these three categories. This addendum supplements the Integrated RDR/RAWP in addressing implementation requirements specific to the first category: temporary stabilization and remediation by RTD of 300-FF-2 waste sites.

The 300-FF-2 OU (Figure 1-1) is composed of waste sites that fall into four general categories: waste sites in the 300 Area industrial complex; outlying waste sites north and west of the industrial complex; general content burial grounds within and around the industrial complex; and transuranic (TRU)-contaminated burial grounds. The selected remedy is protective of future industrial uses of the 300 Area industrial complex and the 618-11 Burial Ground, and residential use for the remaining areas.

Remedial actions have been ongoing at the 300-FF-2 OU since 2001 under the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (EPA 2001). Approximately thirty 300-FF-2 waste sites were also remediated earlier due to their proximity to 300-FF-1 waste sites remediated under the *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington* (EPA 1996). These previous and ongoing remediation activities have been performed in accordance with the applicable revision of DOE/RL-2001-47, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (hereafter referred to as the interim action RDR/RAWP). The interim actions have established much of the document and process framework needed to successfully implement the scope of the 300 Area ROD. Upon approval, this addendum and the Integrated RDR/RAWP replace the interim action RDR/RAWP, but remedial designs, plans, and other regulatory agreements approved under interim actions shall remain in effect except where this addendum explicitly describes otherwise. Existing lower tier documents that reference the interim action RDR/RAWP may continue to be used with the understanding that these references are superseded by this approved addendum and the associated Integrated RDR/RAWP (DOE/RL-2014-13).

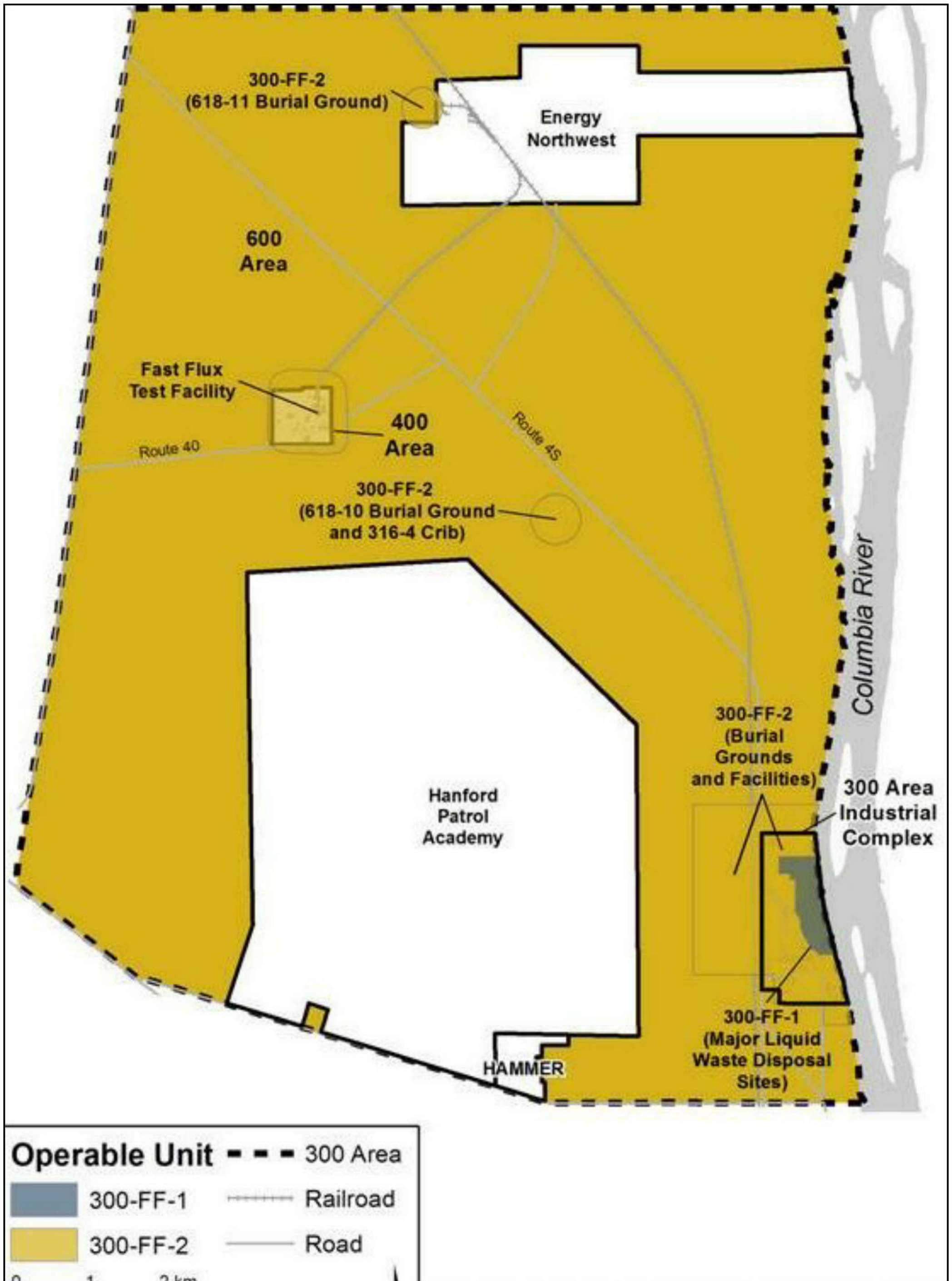


Figure 1-1. 300-FF-1 and 300-FF-2 Operable Units

1.1 Purpose

The primary purpose of this addendum is to provide the RDR/RAWP to describe the design and implementation of the remedial action process required for RTD and interim stabilization of 300-FF-2 waste sites by the 300 Area ROD. In addition, this document addresses the requirements for completion of the remedial action process and the closeout/verification process for the 300-FF-2 waste sites in accordance with the 300 Area ROD. The contents of this document will be reviewed and revised as appropriate to reflect changes to the design and work plans for remedial action. In the meantime, any adjustments will be documented in the unit manager's meeting minutes and/or via change notices, as necessary.

1.2 Scope

This addendum supplements the Integrated RDR/RAWP to provide the RDR and RAWP for RTD and interim stabilization of 300-FF-2 waste sites. The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) lists the RDR and the RAWP as two separate documents. However, this document streamlines the requirements; the RDR and RAWP are combined to cover both the remedial designs and remedial actions.

1.2.1 Remedy Components and Waste Sites

This addendum addresses the following components of the 300 Area ROD:

- Removal of contaminated soil and associated debris from waste sites
- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility
- Disposal of contaminated materials at the Hanford Site's Environmental Restoration Disposal Facility (ERDF); the Waste Isolation Pilot Plant in Carlsbad, New Mexico; or other disposal facilities approved in advance by the U.S. Environmental Protection Agency (EPA)
- Backfilling and recontouring of excavated areas followed by appropriate infiltration control measures
- Installation of temporary surface barriers above specific portions of waste sites associated with long-term retained facilities
- Void-fill grouting of specific portions of pipeline waste sites associated with long-term retained facilities
- Institutional controls associated with access for active remediation areas.

The 300-FF-2 waste sites with a selected RTD remedy in the 300 Area ROD are identified in Table 1-1. If additional waste sites that may require remediation are identified beyond those listed in the table, they will be discussed with the U.S. Department of Energy, Richland Operations Office (DOE-RL) and EPA for appropriate disposition. Summary information for all 300-FF-1 and 300-FF-2 waste sites is provided in Appendix A. Forty of the waste sites identified in Table 1-1 have already been addressed and reclassified under interim actions. Activities for these waste sites may be limited to verification that the interim actions taken remain protective under the 300 Area ROD requirements without further action.

Table 1-1. 300-FF-2 Waste Sites Addressed by this Remedial Design Report/ Remedial Action Work Plan

Selected Remedy	Waste Site
RTD to industrial cleanup levels	300 RLWS, 300 RRLWS, 300-11, 300-121, 300-123[a], 300-15, 300-16[a], 300-175, 300-2[a], 300-214, 300-218[a], 300-219[a], 300-22, 300-224[a], 300-24[a], 300-249[a], 300-251[a], 300-255, 300-257[a], 300-258[a], 300-263, 300-265, 300-268[a], 300-269, 300-270[a], 300-273[a], 300-274[a], 300-276[a], 300-277, 300-279[a], 300-28[a], 300-280, 300-281[a], 300-283[a], 300-284, 300-286[a], 300-289, 300-291, 300-293[a], 300-294, 300-296, 300-32[a], 300-34, 300-4, 300-40[a], 300-43[a], 300-46[a], 300-48[a], 300-5, 300-6[a], 300-7, 300-80[a], 300-9, 313 ESSP[a], 316-3[b], 331 LSLT1, 331 LSLT2, 333 WSTF[a], 340 COMPLEX, 3712 USSA[a], 618-11, UPR-300-1, UPR-300-10, UPR-300-11, UPR-300-12, UPR-300-2, UPR-300-38[a], UPR-300-39[a], UPR-300-4[a], UPR-300-40[a], UPR-300-42[a], UPR-300-45[a], UPR-300-48, UPR-300-5
RTD to residential cleanup levels	300-287, 300-288, 300-290, 316-4, 400 PPSS, 400-37, 400-38, 600-290[a], 600-367, 600-63, 618-10, UPR-600-22

Notes:

a Waste site has been remediated and reclassified under the interim action ROD. Further activities may be limited to verification that the interim action remediation attains the protectiveness criteria of the 300 Area ROD.

b The 300 Area ROD also associates the 316-3 waste site with the enhanced monitored natural attenuation remedy, and final site reclassification should consider implementation of both remedy components. Under the interim action ROD, this site was determined to require no action based on site-specific evaluation. Further activities for this site under this remedial design report/remedial action work plan addendum may be limited to verification that the interim action evaluation also attains the protectiveness criteria of the 300 Area ROD.

ROD = Record of Decision

RTD = remove, treat, dispose

The following are not within the scope of this document:

- Contaminated buildings are being demolished and removed in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act of* 1980 (CERCLA) action memoranda (DOE-RL 2005, 2006a, 2006b) and an associated removal action work plan (DOE/RL-2004-77, *Removal Action Work Plan for the 300 Area Facilities*). Potential releases from those buildings may have resulted in waste sites that have been previously addressed or are within the scope of this document.

- Operation and closure of *Resource Conservation and Recovery Act* (RCRA) treatment, storage, and disposal (TSD) units will be performed in accordance with the Hanford Facility Dangerous Waste Permit. There are currently two permitted RCRA TSD units within the general 300 Area: the 325 Hazardous Waste Treatment Units (325 HWTU) and the 400 Area Waste Management Unit (400-40).

- The 324 Building is planned to be closed under a site-specific closure plan (DOE/RL-96-73, *324 Building Radiochemical Engineering Cells, High-Level Vault, Low-Level Vault, and Associated Area Closure Plan*) in coordination with the applicable action memorandum (DOE-RL 2006a). (The associated 300-296 waste site is within the scope of this RDR/RAWP.)

1.2.2 Retained Facilities and Associated Waste Sites

The U.S. Department of Energy (DOE) has determined that certain buildings and utilities within the 300 Area need to be retained to support the ongoing mission of the Pacific Northwest National Laboratory and the Hanford Site. These facilities, shown in Figure 1-2, are expected to be retained through at least 2027. In addition, the 324 Complex must be retained temporarily (interim retained) in order to safely remediate highly contaminated portions of the underlying 300-296 waste site. Other waste sites, listed in Table 1-2, are located partly or wholly under or immediately adjacent to facilities and utility corridors that will be retained, restricting the capability to complete RTD at these sites until the retained facilities are removed. Accordingly, the selected remedy for 300-FF-2 waste sites includes a component for interim stabilization using temporary surface barriers (e.g., asphalt or other suitable impermeable material) and pipeline void filling (e.g., by grouting or use of other suitable stabilizing agent).

1.2.3 Waste Sites Containing Principal Threat Waste

Principal threat wastes are those source materials considered to be highly toxic and/or highly mobile that generally cannot be reliably contained and/or would present a significant risk to human health and/or the environment should exposure occur. Three waste sites in the 300-FF-2 OU are anticipated to contain principal threat waste that will be addressed under this RDR/RAWP. The "National Oil and Hazardous Substances Contingency Plan" (NCP) (40 *Code of Federal Regulations* [CFR] 300) establishes an expectation that treatment will be used to address principal threats, and considerations specific to these sites are included within this RDR/RAWP. The waste sites that may contain principal threat wastes are as follows:

- The 618-10 and 618-11 Burial Grounds contain vertical pipe units (VPUs), consisting of approximately 4.6-m (15-ft)-long pipes up to 0.6 m (22 in.) diameter with open ends. Highly radioactive containers of waste were disposed in many of these VPUs and covered with fill material. The 618-11 Burial Ground also includes caissons that were used for similar disposal, but differ in construction. The caissons are approximately 3-m (10-ft)-long pipes up to 2.4 m (8 ft) in diameter installed vertically in the subsurface with open bottoms. An angled chute extended from each caisson towards the surface for disposal access. Waste forms within some of these VPUs and caissons may be considered principal threat waste.

- The 300-296 waste site consists of highly radioactive contaminated soil beneath the 324 Building B Hot Cell. Cesium-137 and strontium-90 are the primary isotopes present, and the most highly contaminated soils are considered principal threat waste.

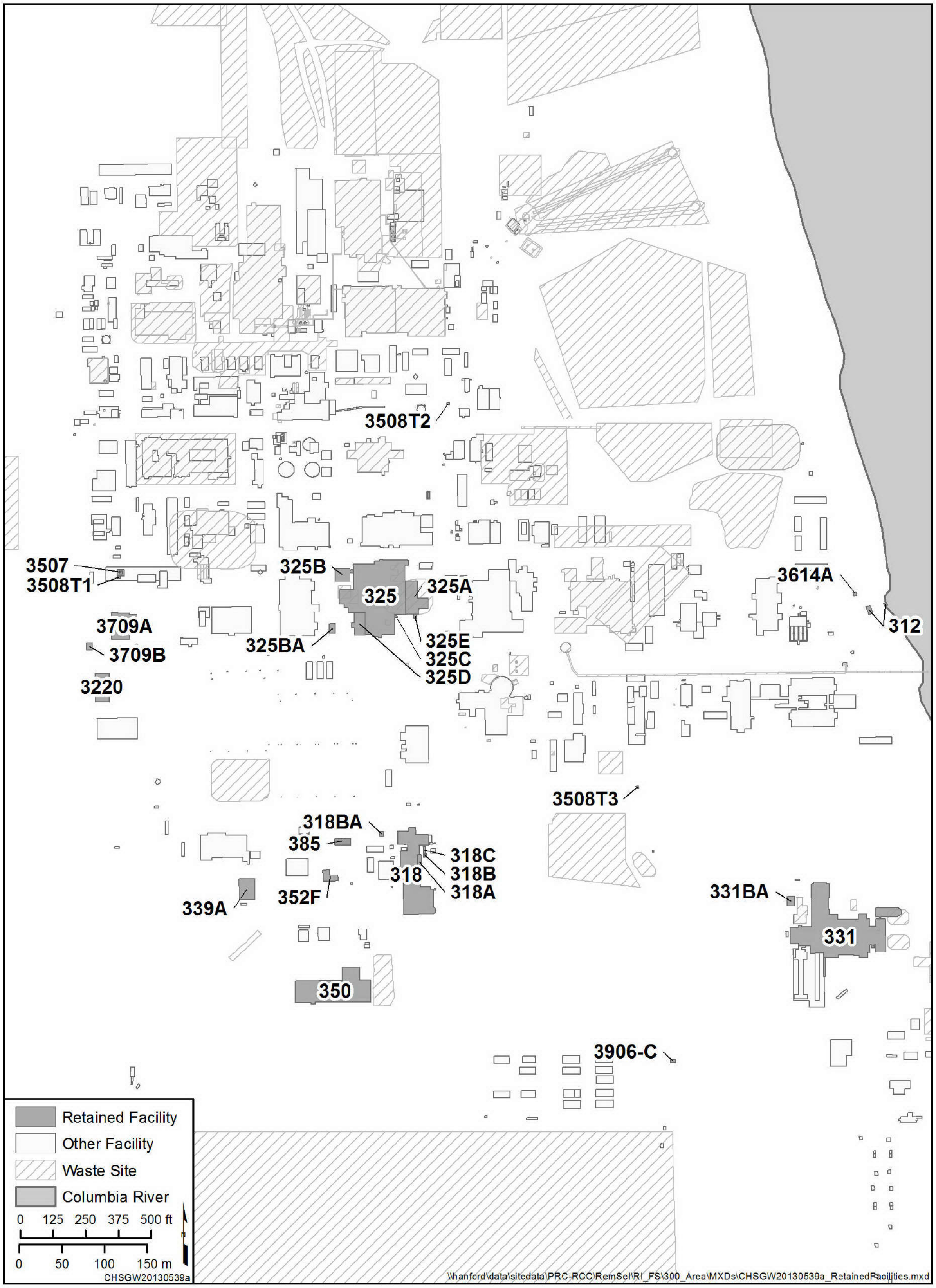


Figure 1-2. Long-Term Retained Facilities in the 300 Area Industrial Complex

Table 1-2. 300 Area Waste Sites Affected by Retained Facilities

Waste Site	Facility Interference
300-5, Fire Station Fuel Tanks	3709-A and 3709-B
300-15, Process Sewer System	Multiple facilities and utility corridors
300-121, 3621D Stormwater Runoff Drain	Overhead electrical lines
300-214, Retention Process Sewer	Multiple facilities and utility corridors
300-265, Pipe Trench between 324 and 325	324 Complex & 325 Complex
300-269, 331A Building Foundation	331A Building foundation
300-296, Soil Contamination Below the 324 Building	324 Complex[a]
300-RLWS, Radioactive Liquid Waste Sewer	Multiple facilities and utility corridors
300-RRLWS, Retired Radioactive Liquid Waste Sewer	Multiple facilities and utility corridors
331-LSLT-1, Life Sciences Lab Trench 1	331 Complex
331-LSLT-2, Life Sciences Lab Trench 2	331 Complex
UPR-300-10, Unplanned Release	325 Complex
UPR-300-12, Unplanned Release	325 Complex
UPR-300-48, Unplanned Release	325 Complex
325 WTF[b], Waste Storage	325 Complex
400-37, Underground Fuel Oil Tank	4732-B Building
400-38, Underground Fuel Oil Tank	4722-A Building foundation

Notes:

a The 324 Complex will be interim retained to support safe remediation of highly contaminated soil at the 300-296 waste site.

b The 325 WTF site is a *Resource Conservation and Recovery Act* treatment, storage, and disposal unit and is not included in the scope of this addendum.

1.3 Report Organization

The essential elements of this RDR/RAWP are present in Sections 1.0 through 5.0, which comprise the main body of the report. The appendices present additional information and guidance. The contents of each section are briefly described below:

- Section 1.0, "Introduction," presents the purpose, scope, and this overview of the report's organization. Additional introductory and background information can be found in the integrated RDR/RAWP.
- Section 2.0, "Basis for Remedial Action," presents the objectives, cleanup levels, verification of waste, and applicable or relevant and appropriate requirements (ARARs).
- Section 3.0, "Remedial Action Design and Planning," presents the design and remediation planning components and process.

- Section 4.0, "Remedial Action Management and Approach" presents the details for field-implementation of the selected remedy and institutional controls specific to 300-FF-2 remediation.
- Section 5.0, "Waste Management Plan," presents waste storage, transportation, packaging, handling, and labeling as applicable to waste streams for each waste site.
- Section 6.0, "References," contains all reference information used for the main body of the report.
- Appendix A, "Waste Site Information," presents a general description and status of all 300-FF-1 and 300-FF-2 waste sites.
- Appendix B, "Guidance for Cleanup Verification Packages," presents a detailed description of the cleanup verification process to aid in development and review of cleanup verification packages (CVPs).
- Appendix C, "Revegetation Plan for the 300 Area," presents the revegetation plan for the 300 Area.
- Appendix D, "Cleanup Levels," presents a summary of the development of the contaminant-specific numerical cleanup values.
- Appendix E, "Air Monitoring Plan for the 300 Area Waste Sites Remedial Action," presents the air monitoring plan for remediation of wastes sites at the 300 Area industrial core and immediate surrounding area.

2 Basis for Remedial Action

The 300 Area ROD (EPA 2013) selected remedial action for specific 300-FF-2 waste sites based on a determination that remaining unremediated sites present an unacceptable risk to human health and the environment. The Integrated RDR/RAWP (DOE/RL-2014-13) provides the associated remedial action objectives (RAOs), which provide a narrative statement of the extent to which cleanup is necessary under the ROD. This chapter then provides the associated analyte-specific soil cleanup levels and requirements for their application, as well as the ARARs for 300-FF-2 remedial action.

2.1 Cleanup Levels

To achieve RAOs, numerical cleanup levels for industrial and residential land use were calculated during the 300 Area remedial investigation/feasibility study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*) and promulgated by the 300 Area ROD (EPA 2013). The cleanup levels are based on restoring groundwater to drinking water levels, protecting groundwater and the Columbia River, and protecting industrial use in all areas. In addition, DOE and EPA have agreed to residential cleanup levels that must be met outside the 300 Area industrial complex and the 618-11 Burial Ground.

Soil cleanup levels for direct contact human health receptors were developed using standard approaches, consistent with state and federal guidance. Direct contact cleanup levels for nonradionuclides are based on risk calculations provided in the Washington State's "Model Toxics Control Act – Cleanup" (MTCA) procedures. Direct contact cleanup levels for radionuclides are calculated based on an excess lifetime cancer risk of $1x10^{-4}$ or a radiological dose of 15 mrem/yr. For each radionuclide, the lower of the risk or dose-based calculations is used as the cleanup level.

Soil cleanup levels for groundwater and surface water protection were also developed based on current state and federal guidance and, consistent with guidance, incorporate site-specific data from the 300 Area. Soil cleanup levels are described below based on a residential scenario with irrigation and based on an industrial scenario without irrigation. One main difference between the scenarios is the amount of water infiltrating the soil to reach groundwater. The industrial scenario is based on natural precipitation, no irrigation, runoff management from surfaces such as pavement, and marginal vegetation cover. The industrial scenario assumes that a moderate 25 mm/yr of precipitation reaches groundwater. In residential areas, irrigation provides an increased amount of water to the soil, and a relatively high 72 mm/yr of water is assumed to reach groundwater. The irrigated residential scenario is used to identify the potential for groundwater and surface water contamination to occur from waste sites due to higher groundwater recharge rates associated with the irrigation of crops and was used to develop the residential cleanup levels.

Residential cleanup levels for areas outside of the 300 Area industrial complex and the 618-11 Burial Ground, and industrial cleanup levels for waste sites inside the 300 Area industrial complex and the 618-11 Burial Ground, are presented in Appendix D of this RDR/RAWP (Table D-1).

Cleanup levels are calculated for single contaminants. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated (as described in Section 2.2.2) to ensure that the waste site meets total risk limits as specified in CERCLA and the NCP. When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the RAOs.

The river corridor baseline risk assessment (RCBRA) (DOE/RL-2007-21) and the RI/FS report (DOE/RL-2010-99) evaluated ecological risks at 300 Area interim remediated waste sites with upland habitats for potential ecological risks. The RI/FS used information from the RCBRA and from other sources to evaluate the risk to populations and communities of ecological receptors, and determined that interim remedial actions that achieved interim action ROD cleanup levels for protection of human health were also protective of ecological receptors and there was no ecological risk at remediated waste sites within the 300-FF-2 OU. Further, the 300 Area RI/FS report (DOE/RL-2010-99) concluded that there were no contaminants of ecological concern or ecological risk to populations and communities due to the 300-FF-2 and 300-FF-5 OUs in riparian, near-shore, and river environments. These conclusions considered the size of waste sites relative to ecological receptor home ranges. The 300 Area ROD (EPA 2013) then determined that, for 300-FF-2 waste sites that have not been remediated under interim actions, residual contamination will not be sufficient to adversely impact populations and communities of ecological receptors once human health cleanup levels are achieved. As such, no further evaluation of ecological risks will be performed for individual waste sites addressed under this RDR/RAWP.

2.1.1 Cleanup Levels for Industrial Land Use

The 300 Area ROD cleanup levels for an industrial land-use scenario are included in Table D-1 for radiological and nonradiological constituents. The methodology used to arrive at these values for the direct exposure and groundwater and river protection pathways is summarized in Appendix D of this document and in the 300 Area ROD (EPA 2013).

For radionuclides, the 300 Area industrial land-use scenario assumes that the exposure pathways for residual contamination will be (1) direct exposure to radiation, (2) ingestion of soil containing residual contamination, (3) inhalation of particles in the air from residual contamination, and (4) protection of groundwater based on attainment of federal drinking water standards. It is assumed that drinking water is not obtained from groundwater sources and food products are not grown on the site. Groundwater is considered to be a potential future drinking water source that must be restored to drinking water standards in a reasonable time frame, as established in the 300 Area ROD (EPA 2013). The assumptions used for the 300 Area industrial land-use scenario are summarized in Appendix D of this document. Major assumptions include the following:

- **Direct Exposure Route.** The industrial land-use scenario assumes an adult worker is located in the area of residual contamination for approximately 1,500 hr/yr inside a building and 500 hr/yr outdoors for a period of 30 years (these correspond to a typical work year for an adult worker). When the worker is outdoors, it is assumed that clean fill does not provide shielding from residual contamination. Furthermore, it is assumed that indoor exposure to external radiation is 40% of the outdoor levels (based on the shielding provided by the building from direct exposure to radiation from residual contaminants in the soil).
- **Soil Ingestion Route.** The scenario assumes that a worker ingests 25 g of contaminated soil each year.
- **Inhalation Route.** The scenario assumes that the air contamination inside a building is 40% of the outside air particle concentration (which is assumed to be 0.0002 g/m^3 from residual soil contamination).

- **Groundwater Protection.** Based on attainment of federal drinking water standards, soil cleanup levels for groundwater and surface water protection were calculated using the STOMP (Subsurface Transport Over Multiple Phases) code. The consideration of lesser amounts of irrigation in areas with institutional controls for industrial use allows higher soil cleanup levels to be protective of the same federal drinking water standards.

The key modeling parameters that affect the direct exposure cleanup levels for radionuclides are (1) the depth of cover/clean fill over residual contamination (none is assumed for the 300 Area), and (2) the time spent on the former waste site location, both indoors and outdoors (approximately 1,500 hr/yr inside a building and 500 hr/yr outdoors). Other parameters affect the modeling results but are not as significant as these two items.

Cleanup levels for nonradionuclides in the 300 Area industrial land-use scenario are based on *Washington Administrative Code* (WAC) 173-340-745(5), which assumes that the exposure pathway for residual contamination will be from ingestion of contaminated soil. Soil cleanup levels are calculated using the equations provided by WAC 173-340-745(5), Method C for carcinogens and noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a person weighing 70 kg ingests soil at a rate of 50 mg/day, with an exposure frequency of 40% and a gastrointestinal absorption rate of 100%. For carcinogens, the calculation is based on achieving a lifetime cancer risk goal of $1\text{x}10^{-5}$ for an exposure duration of 20 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

The key assumptions in the 300 Area industrial land-use scenario that affect the groundwater protection determination are (1) vegetation not requiring irrigation will be grown on the waste site after the cleanup is complete, or the waste site will be resurfaced to reduce water infiltration (thus allowing for a higher, 0.91, evapotranspiration coefficient to be used); and (2) no water will be applied to former waste site locations for irrigation purposes. These assumptions can only be modified if it can be demonstrated that there will be no negative impact on groundwater quality from residual contamination at former waste site locations (which requires EPA approval in advance).

Finally, it is assumed that (1) no sensitive human subpopulations (e.g., children) are permitted to come into contact with residual soil or debris contamination from waste sites (i.e., the cleanup levels are based on exposures to adults); (2) the period of analysis for evaluation of site risks and groundwater protection is 1,000 years; and (3) direct exposure of onsite workers to residual contamination to a depth of 4.6 m (15 ft) may occur (this represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities).

One thousand years was used as a reasonable endpoint for modeling calculations performed to support development of the 300-FF-2 OU preliminary remediation goals. The *Risk Assessment Guidance for Superfund (RAGS)* (EPA 1989) notes that consideration of multigenerational effects is useful when assessing risk posed by long-lived radionuclides. A 1,000-year time period is considered to be a reasonable endpoint for modeling, based on the following considerations:

- A 1,000-year time frame has been recognized by several regulatory programs as being long enough to identify health impacts for residual contaminants. Although some long-lived radioactive materials may remain on these sites as part of the cleanup and disposal process, the peak dose occurs in less than 1,000 years for most.

- When predicting thousands of years into the future, uncertainties become very large because of major potential changes in the geohydrologic regime at the site over long periods of time. The consequences of exposure to residual radioactivity at levels approaching background are small, and considering the large uncertainties, long-term modeling is considered to be of little value.
- Time frames greater than 1,000 years are considered to be more appropriate for evaluating long-term performance of disposal facilities, as opposed to residual contaminants at sites that have undergone a cleanup action.

2.1.2 Cleanup Levels for Unrestricted Land Use

The cleanup levels for a residential land-use scenario are included in Appendix D, Table D-1 for radiological and nonradiological constituents. The methodology used to arrive at these values is summarized in Appendix D of this document and in the 300 Area ROD (EPA 2013). For the purpose of using the RESidual RADioactivity (RESRAD) dose model, unrestricted future use in the 300 Area is represented by an individual resident in a rural-residential setting. This resident is assumed to consume and irrigate crops raised in a backyard garden; consume animal products (e.g., meat and milk) from locally raised livestock or meat from game animals (including fish); and live in a residence on the waste site. The exposure pathways considered in estimating dose from radionuclides in soil are inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. Based on EPA guidance, this individual is conservatively assumed to spend 60% of his/her lifetime (15 hr/day; 350 days/yr) indoors on site and 12% of their time (3 hr/day; 350 days/yr) outdoors on site. The assumptions used for the 300 Area unrestricted land-use scenario are also described in Appendix D of this document.

Soil cleanup levels for nonradionuclides in the 300 Area residential land-use scenario are calculated using the MTCA Method B equations provided by WAC 173-340-740(3) for carcinogens and noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a resident with an average body weight 16 kg (35 lb) over the period of exposure ingests soil at a rate of 200 mg/day (73 g/yr), with a frequency of contact of 100% and a gastrointestinal absorption rate of 100%. For individual nonradionuclide carcinogenic chemicals, the calculation is based on achieving an excess lifetime cancer risk goal of 1×10^{-6} for an exposure duration of 6 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

Soil cleanup levels for the protection of groundwater and surface water are based on site-specific data for the 300 Area and current federal drinking water standards (EPA 2013). Soil cleanup levels for the protection of groundwater and surface water were calculated based on site-specific data and specific parameters using the STOMP code with a one-dimensional model for all contaminants except uranium. For uranium, the STOMP code was used with a two-dimensional model that includes the effects of uranium's more complex sorption behavior. For highly mobile contaminants (retardation coefficient < 2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. For the 300 Area industrial complex and 618-11 Burial Ground, a groundwater recharge rate of 25 mm/yr was used for the long term, representing a permanently disturbed soil with cheatgrass (*Bromus tectorum*) vegetative cover. For areas outside the 300 Area industrial complex and 618-11 Burial Ground where cleanup levels are based on a residential scenario, a groundwater recharge rate of approximately 72 mm/yr was used representing an irrigated condition. Based on this model, no soil cleanup level for groundwater or river protection is calculated for some contaminants because they are calculated to not reach the groundwater within 1,000 years at levels that contaminate groundwater above drinking water standards (or would contaminate the river above surface water standards).

For the residential land-use scenario, it is assumed that the period of analysis for evaluation of site risks and groundwater protection is 1,000 years, and direct exposure of onsite residents to residual contamination to a depth of 4.6 m (15 ft) may occur (this represents a reasonable estimate of the soil depth that could be excavated and distributed at the soil surface as a result of site development activities).

2.2 Application of Cleanup Levels

2.2.1 Cleanup Levels Based on Vadose Zone Depth

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below the ground surface per WAC 173-340-740(6)(d). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) or more below ground surface are referred to as being in the deep zone whereas the materials above 4.6 m (15 ft) bgs are referred to as being in the shallow zone. The direct exposure cleanup levels are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection cleanup levels are applicable to soils in both the shallow and the deep zones. However, if a site 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 regardless of the depth of the excavation. This is advantageous for site closeout because a site that does not require a separate deep zone evaluation will also have no requirement for deep zone institutional controls.

The RAOs call for prevention of human exposure to the upper 4.6 m (15 ft) of soil, structures, or debris with contaminants of concern (COCs) at concentrations above cleanup levels and management of contaminated soils below 4.6 m (15 ft). Generally, this would entail RTD of soils below 4.6 m (15 ft) exceeding cleanup levels in Table D-1 for groundwater and river protection for waste sites in the scope of this addendum. It is anticipated that (under limited circumstances) factors such as nature and form of contaminated material, implementability, cost, volume, and impacts to ecological and cultural resources may be used to evaluate the extent of excavation at depths greater than 4.6 m (15 ft). Appropriate remedy selection change documentation (e.g., a memorandum-to-file, explanation of significant differences, or ROD amendment, based on the nature of the exception) will be prepared and public involvement will be provided for, if necessary. Regardless of these factors, protection of groundwater and the Columbia River must be achieved for any contamination left below 4.6 m (15 ft) (i.e., alternative remedial measures must be evaluated).

The soil cleanup levels apply to soil and structures (including pipelines and debris). Cleanup levels do not apply to constituents that are an integral part of manufactured structures. Application of soil cleanup levels to sediment and scale within pipelines and similar structures may be over-conservative, depending on site-specific conditions. Where there are exceedances of cleanup levels in sediment/scale data, but not in corresponding underlying soil, alternative demonstrations of RAO attainment may be used with EPA approval. For example, the EPA may approve use of a matrix-correction approach to adjust contaminant concentrations to consider a combined scale and pipeline wall matrix. The EPA may also approve qualitative demonstrations of protectiveness based on site-specific considerations.

2.2.2 Multiple Contaminant Concentrations

Cumulative effects associated with the presence of multiple radionuclide or nonradionuclide contaminants at waste sites must be evaluated to ensure that the waste site meets total risk limits as specified in CERCLA, the NCP, and MTCA. The following standards must be met for cumulative effects of multiple contaminants:

- Total excess cancer risk from all nonradionuclide constituents must not exceed $1x10^{-5}$.
- Total of all toxicity hazard quotients for nonradionuclide constituents must be a hazard index of less than 1.
- Cumulative risk of all radionuclides must not exceed the CERCLA risk range of 10^{-4} to 10^{-6} or a radiological dose of 15 mrem/yr, where that limitation is more conservative.
- Summation of the predicted groundwater dose from all beta- and photon-emitting radionuclides must be less than 4 mrem/yr.

The 2007 MTCA cleanup regulation, WAC 173-340-708(8)(e), provides a method to determine compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs). Mixtures of carcinogenic PAHs are considered as a single hazardous substance, and the cleanup levels established for benzo(a)pyrene are used as the cleanup levels for mixtures of carcinogenic PAHs. Cleanup verification samples are analyzed to determine the concentration of each carcinogenic PAH listed in Table 2-1 (from Table 708-2 of the 2007 MTCA cleanup regulation). Following the criteria of Appendix B, statistical values representing the PAH COC concentrations for each decision unit are calculated or the maximum detected value is selected when the COC is detected in fewer than 50% of the samples (and for focused samples). The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor in Table 2-1 to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table D-1 to determine compliance. The results of this determination are included in the waste site CVP as described in Appendix B.

2.2.3 Discovery of Additional Contaminants

Contaminants of concern were selected in the 300 Area ROD (EPA 2013), which included a risk assessment. In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the DOE and EPA project managers for determination of a path forward.

Table 2-1. Toxic Equivalency Factors for Carcinogenic Polyaromatic Hydrocarbons [a]

CAS Number	Carcinogenic Polyaromatic Hydrocarbons	Toxic Equivalency Factors
50-32-08	Benzo(a)pyrene	1
56-55-3	Benzo(a)anthracene	0.1
205-99-2	Benzo(b)fluoranthene	0.1
207-08-9	Benzo(k)fluoranthene	0.1
218-01-9	Chrysene	0.01
53-70-3	Dibenz(a,h)anthracene	0.1
193-39-5	Indeno(1,2,3-cd)pyrene	0.1

Notes:

a From WAC 173-340-708(8)(e), Table 708-2.

CAS = Chemical Abstract Services

2.3 Verification of Waste Site Cleanup

Appendix B provides guidance for the process by which CVPs are prepared and reviewed. The purpose of the CVP is to document that the relevant waste site has been remediated in accordance with the applicable ROD and that the RAOs under the applicable land-use scenario have been achieved. Site-specific data evaluations are presented in the CVP to demonstrate that the waste site, following remediation, does not pose an unacceptable risk to human health and is protective of groundwater and the river.

The primary determination of the successful completion of remediation is the comparison of quantified residual soil analyses against cleanup levels in appropriate tables. In addition, site-specific factors such as the concentration of the contaminants at depth, the type of waste site (solid or liquid), and calculations of residual site risks are used to verify that remaining concentrations of contaminants are protective of direct exposure and groundwater and the Columbia River (see Appendix B). Development of a site-specific contaminant distribution model may be necessary to more accurately describe actual site conditions and show that contaminant concentrations decrease with soil depth. Use of analogous sites and process knowledge, or a test pit or borehole, may be needed to establish the distribution of contaminants with respect to soil depth. A site-specific contaminant distribution model, using actual field data, will more accurately predict potential impacts of vadose zone soil contaminants on groundwater and the river. The model information will be used to determine if the residual concentrations of contaminants in the unsaturated vadose zone are protective of groundwater and the river, or if further excavation of remaining contamination in the unsaturated vadose zone is required. Results will be documented in the CVP.

2.4 Applicable or Relevant and Appropriate Requirements

The NCP (40 CFR 300) and the 300 Area ROD require that the remedial actions comply with ARARs established in the ROD. The purpose of this section is to summarize how each of the ARARs identified in the ROD will be met during 300-FF-2 remedial action.

Activities associated with the remedial action for the source area waste sites covered under the ROD are expected to occur on site, as that term is defined under the NCP. As a result, the remedial actions described in this document must meet the substantive, but not administrative, requirements of the ARARs established in the RODs. In the event that any portion of the remediation work occurs at an offsite location (e.g., waste treatment at an offsite facility), the work is required to comply with all applicable requirements. The sites addressed by the 300 Area ROD and ERDF are reasonably close to one another, and the wastes meeting the ERDF waste acceptance criteria (WCH-191) are compatible for the selected disposal approach. Therefore, the waste sites and ERDF are considered to be a single site for response purposes.

If any requirement that might be an ARAR for the remedial action is promulgated subsequent to issuance of the 300 Area ROD, the DOE and EPA will review the requirement and determine if compliance with the new requirement is necessary to ensure that the remedy is protective of human health and the environment, in accordance with 40 CFR 300.430(f). If necessary to ensure protection of human health and the environment, the selected remedy will be revised to incorporate the newly promulgated ARAR.

2.4.1 Chemical-Specific ARARs

Chemical-specific ARARs are typically health- or risk-based regulatory values or methodologies that are applied to site-specific media and used to establish cleanup criteria. Chemical-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards":** Establishes methodology for calculating soil cleanup levels based on unrestricted land use (WAC 173-340-740(3)); adjustments to calculated cleanup levels to take into account cumulative effects of multiple contaminants and exposure pathways, adjustments based on state and federal law, and adjustments in consideration of natural background levels and practical quantitation limits (WAC 173-340-740(5)); points of compliance where cleanup levels must be attained (WAC 173-340-740(6)); and monitoring protocols for sampling, analysis, and statistical methods used to determine compliance (WAC 173-340-740(7)). Soil cleanup levels for residential land use have been selected in the ROD. Sampling and analysis requirements and locations will be addressed in accordance with a sampling and analysis plan (SAP) for each waste site undergoing remediation; considerations for cumulative effects of multiple contaminants will be documented in closeout documentation as described in Appendix B.

- **WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties":** Establishes methodology for calculating soil cleanup levels where industrial land use represents the reasonable maximum exposure (WAC 173-340-745(5)), and adjustments to cleanup levels to take into account cumulative effects of multiple contaminants and exposure pathways, adjustments based on state and federal laws, and adjustments in consideration of natural background levels and practical quantitation limits (WAC 173-340-745(6)). Soil cleanup levels for industrial land use have been selected in the ROD. Sampling and analysis requirements and locations will be addressed in accordance with a SAP for each waste site undergoing remediation; considerations for cumulative effects of multiple contaminants will be documented in closeout documentation as described in Appendix B.

- **WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection":** Establishes methodology for determining soil concentrations that will not cause contamination of groundwater at levels that exceed groundwater cleanup levels. Soil cleanup levels to ensure protection of groundwater have been selected in the ROD, using alternative fate and transport modeling as allowed in WAC 173-340-747(8).

- **WAC 173-340-7490, WAC 173-340-7493, WAC 173-340-7494, "Terrestrial Ecological Evaluation Procedures":** Define goals and procedures for evaluating whether a release to soil may pose a threat to the terrestrial environment and establishes methods for determining site-specific cleanup levels for protection of terrestrial plants and animals. Site-specific cleanup levels were developed using the "Site-Specific Ecological Evaluation" procedures (WAC 173-340-7493). Based on the ecological risk assessment, once human health cleanup levels are achieved, residual contamination will be below levels that have the potential to adversely impact populations and communities of ecological receptors.

- **WAC 246-247-035(1)(a)(ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopting by reference 40 CFR 61.92):** Requires that airborne emissions from all combined operations at the Hanford Site not exceed 10 mrem/yr effective dose equivalent to any member of the public. For source waste site remedial actions, standard construction techniques such as use of water spray to control fugitive emissions of radioactively contaminated dust and particles will be used to meet this ARAR.

2.4.2 Action-Specific ARARs

Action-specific ARARs typically are technology- or activity-based requirements or limitations triggered by a particular type of action such as excavation, transport, and/or disposal of hazardous waste. Action-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells":** These regulations are applicable for the location, design, construction, and decommissioning of resource protection wells, which include wells and soil borings that may be created or impacted by remedial actions. The remedial action will comply with substantive requirements of this ARAR by compliance with established site well construction and maintenance procedures. Specific sections of WAC 173-160 that may be applicable to remedial actions involving wells or soil borings are as follows:
  - WAC 173-160-161, "How Shall Each Water Well Be Planned and Constructed?"
  - WAC 173-160-171, "What Are the Requirements for the Location of the Well Site and Access to the Well?"
  - WAC 173-160-181, "What Are the Requirements for Preserving the Natural Barriers to Groundwater Movement Between Aquifers?"
  - WAC 173-160-400, "What Are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?"
  - WAC 173-160-420, "What are the General Construction Requirements for Resource Protection Wells?"
  - WAC 173-160-430, "What Are the Minimum Casing Standards?"
  - WAC 173-160-440, "What Are the Equipment Cleaning Standards?"
  - WAC 173-160-450, "What Are the Well Sealing Requirements?"
  - WAC 173-160-460, "What Is the Decommissioning Process for Resource Protection Wells?"

- **WAC 173-400, "General Regulations for Air Pollution Sources":** Authority to implement the national air quality standards has been delegated to the State of Washington and is implemented via WAC 173-400. These regulations define methods of control to be used to minimize the release of air contaminants associated with fugitive emissions resulting from materials handling, construction, demolition, or other operations. Emissions are to be minimized through application of best available control technology. Specific sections of WAC 173-400 that may be applicable to source waste site remedial action are as follows:
  - **WAC 173-400-040, "General Standards for Maximum Emissions":** Subsections (2) "Visible emissions," (4) "Fugitive emissions," and (9) "Fugitive dust" include substantive requirements applicable to source waste site remedial action. Compliance with these requirements will be achieved by the use of fixatives and water sprays to control emissions of contaminated dust and particulates.
  - **WAC 173-400-075, "Emission Standards for Sources Emitting Hazardous Air Pollutants":** This section identifies emission standards for hazardous air pollutants from various sources and adopts, by reference, "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61. These sources are, for the most part, industry specific and not expected to be encountered or implemented as part of 300 Area source waste site remediation, with the exception of standards for asbestos emissions (discussed under the ARAR entry for 40 CFR 61 Subpart M) and radionuclide emissions (discussed under the ARAR entry for WAC 246-247).
- **WAC 173-460, "Controls for New Sources of Toxic Air Pollutants":** These requirements are considered applicable if a treatment technology that involves air emissions is necessary during implementation of the source waste site remedial action. No treatment requirements have been identified at this time that would be required to meet the substantive requirements of WAC 173-460. Treatment of some waste encountered during the remedial action may be required to meet the ERDF waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques, and the provisions of WAC 173-460 would not be an ARAR. If the need for any treatment technology with air emissions potentially subject to WAC 173-460 is identified, DOE will notify the EPA and an evaluation of WAC 173-460 requirements will be conducted.
- **WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"; WAC 246-247, "Radiation Protection – Air Emissions":** These standards specify that airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/yr effective dose equivalent to any member of the public or hypothetically maximally exposed individual. (WAC 173-480-040/WAC 246-247-035) The radionuclide emission standard applies to fugitive, diffuse, and point-source air emissions generated during excavation or treatment of source waste site contaminated soil. Compliance with the standard is determined on a Hanford Site-wide basis and is documented in the annual radionuclide air emissions report for the Hanford Site. WAC 246-247-075 and WAC 173-480-070 require monitoring for emissions of radioactive material. WAC 173-480-060 and WAC 246-247-040(3) requires the application of best available radionuclide control technology to control radioactive air emissions for new emission units; WAC 246-247-040(4) requires use of as low as reasonably achievable--based control technology for existing emission units. WAC 173-480-050 requires that all emission units make every reasonable effort to maintain radioactive materials in effluents to residential areas to levels that are as low as reasonably achievable. Standard construction techniques such as using water spray to control fugitive emissions of contaminated dust and particulates will be used to meet emission standards of WAC 173-480 and WAC 246-247 when excavating source waste sites.

- **40 CFR 61 Subpart M, "National Emission Standard for Asbestos":** 40 CFR 61.140 and 40 CFR 61.145 define regulated asbestos-containing material (ACM) and regulated removal and handling requirements, and specify sampling, inspection, handling, and disposal requirements for regulated sources having the potential to emit asbestos. No visible emissions are allowing during handling, packaging, and transport of ACM. 40 CFR 61.150 identifies requirements for the removal and disposal of asbestos from demolition and renovation activities, and also specifies no visible emissions. Buried ACM may be encountered during excavation of source waste sites and on pipelines or other structures excavated as part of remedial action. Asbestos-containing material associated with remedial actions will be handled consistent with the applicable or relevant requirements of 40 CFR 61.140, 40 CFR 61.145, and 40 CFR 61.150.
- **40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions":** 40 CFR 761.50(b)1, 2, 3, 4, and 7 and (c) establish general requirements for the storage and disposal of polychlorinated biphenyl (PCB) wastes including liquid PCB wastes, PCB items, PCB remediation waste, PCB bulk product wastes, and PCB/radioactive wastes at concentrations exceeding 50 ppm PCBs. Specific handling and disposal requirements are established for PCB liquids, articles, and PCB containers in 40 CFR 761.60(a), (b), and (c), respectively. PCB remediation waste requirements are established in 40 CFR 761.61. Substantive requirements of these provisions would generally be applicable to PCB wastes encountered during remedial action for source waste sites. Remedial action will comply with these requirements through adherence to waste management procedures (see Chapter 5) and receiving facility waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*.)
- **WAC 173-303, "Dangerous Waste Regulations":** WAC 173-303 establishes a variety of substantive requirements applicable to generation, storage, treatment, and disposal of materials designated as dangerous waste. Dangerous waste will comply with the identified requirements through adherence to waste management procedures (see Chapter 5) and, for disposal, the receiving facility's waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*) . Specific provisions of WAC 173-303 identified in the ROD as ARARs are as follows:
  - **WAC 173-303-016, "Identifying Solid Waste," and WAC 173-303–017, "Recycling Processes Involving Solid Waste":** These sections establish criteria for identifying materials that are and are not solid wastes, including materials that are or are not solid wastes when recycled in certain ways.
  - **WAC 173-303-070, "Designation of Dangerous Waste":** Establishes the method for determining if a solid waste is regulated as a dangerous waste.
  - **WAC 173-303-073, "Conditional Exclusion of Special Wastes":** Excludes certain relatively low-hazard wastes from many of the requirements of WAC 173-303 and establishes alternative management provisions for such wastes.
  - **WAC 173-303-077, "Requirements for Universal Waste":** This section exempts universal waste (i.e., certain batteries, mercury-containing equipment, and lamps) from most of the requirements of WAC 173-303 in lieu of alternative, less stringent management requirements.

- **WAC 173-303-120, "Recycled, Reclaimed, and Recovered Wastes":** Describes requirements for persons who recycle materials that are solid and dangerous wastes. Certain recyclable materials, including scrap metal, spent refrigerants, spent antifreeze, and lead acid batteries, are subject to less stringent standards under WAC 173-303-120 when being recycled.
- **WAC 173-303-140, "Land Disposal Restrictions":** Establishes treatment requirements and prohibitions for land disposal of dangerous waste. Provisions incorporate treatment standards for federal RCRA hazardous or mixed (hazardous and radioactive) wastes, in addition to establishing requirements for land disposal of certain state-only (nonfederally regulated) dangerous waste.
- **WAC 173-303-170, "Requirements for Generators of Dangerous Waste":** Establishes requirements for generators of solid waste, including requirement to determine if the waste is regulated as a dangerous waste; requirements for generators who accumulate dangerous waste on site in tanks, containers, or containment buildings for a period of 90 days or less; and requirements for generators who treat waste in on-site containers, tanks, or containment buildings within 90 days of waste generation.
- **WAC 173-303-200, "Accumulating Dangerous Waste On-Site":** Establishes requirements for accumulating dangerous waste on site in containers, tank systems, or containment buildings. Invokes various substantive standards for management of dangerous waste in containers and tanks. Container waste storage exceeding 90 days would be subject to the substantive requirements of WAC 173-303-630.
- **WAC 173-303-630, "Use and Management of Containers":** Establishes requirements for storing dangerous waste in containers. Invokes various substantive standards, including provision of secondary containment for containers holding liquids or ignitable or reactive wastes.
- **WAC 173-303-64620(4), "Requirements" (corrective action):** Requires corrective action for releases of dangerous waste and dangerous constituents, and establishes minimum standards for implementing actions. Corrective action performed under CERCLA authority must be consistent with these standards. The process, selected action, and implementation of the remedial action for the 300 Area remedial action satisfies this requirement.

- **WAC 173-350, "Solid Waste Handling Standards":** These regulations establish minimum standards for the proper handling and disposal of nondangerous, nonradioactive solid waste. Performance standards of WAC 173-350-040 require that solid waste facilities be designed, constructed, operated, and closed in a manner that does not pose a threat to human health or the environment, and that comply with other applicable environmental laws. WAC 173-350-300 establishes requirements for on-site storage of solid waste in containers, and for collection and transportation in a manner that avoids littering or releases. Remedial action will comply with these requirements through adherence to the waste management procedures in Chapter 5.

2.4.3 Location-Specific ARARs

Location-specific ARARs are restrictions or requirements placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the ROD are discussed below.

- **36 CFR 800, "Protection of Historic Properties," 36 CFR 60, "National Register of Historic Places":** These provisions require that federal agencies consider the impacts of their actions on properties that are on or are eligible for the National Register of Historic Places. The remedial action will comply with these requirements through an assessment and mitigation of impacts to properties listed on or eligible for inclusion on the National Register of Historic Places.

- **43 CFR 10, "Native American Graves Protection and Repatriation Regulations":** These provisions are applicable to any sites should Native American remains be found, and provide requirements for federal agency responsibilities with regard to any such discoveries. The remedial action will comply with these requirements through an assessment and mitigation of any Native American remains within the 300 Area prior to remedial action or discovered during remedial action, as prescribed in this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- ***Archeological and Historic Preservation Act of 1974*; 36 CFR 65, "National Landmarks Program":** These requirements are applicable to the recovery and preservation of artifacts in areas where an action may cause irreparable harm, loss, or destruction of significant artifacts. The remedial action will comply with these requirements through an assessment and mitigation of archeological and historic sites within the 300 Area prior to undertaking remedial action, as prescribed within this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- **50 CFR 402, "Interagency Cooperation – Endangered Species Act of 1973":** These requirements pertain to the conservation of critical habitat upon which endangered or threatened species depend. Consultation with the U.S. Department of Interior is required or, in the case of anadromous fish species, consultation with the National Marine Fisheries Service. The remedial action will comply with these requirements through an assessment and mitigation of endangered species or their habitat within the 300 Area prior to remedial action, as prescribed in this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- ***Migratory Bird Treaty Act of 1918*:** These requirements are applicable to the protection of migratory bird species associated with the 300 Area, including upland species and waterfowl. The remedial action will comply with these requirements by following guidance prescribed in DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, and through performance of site-specific ecological resource reviews prior to remedial action. (See Section 3.5, "Mitigation Action Plan.")

- **WAC 232-12-292, "Habitat Buffer Zone for Bald Eagles":** This regulation requires protection of eagle habitat to maintain eagle populations. Bald eagles have not been historically present in the 300 Area, but should they be encountered, any disruptive work performed near or within an area of potential roosting or nesting must be performed to the specifications described in DOE/RL-94-150, *Bald Eagle Management Plan for the Hanford Site, South Central Washington*.

- **50 CFR 83, "Rules Implementing the Fish and Wildlife Conservation Act of 1980":** This regulation requires preservation and conservation of nongame fish and wildlife and their habitats. The remedial action will comply with these requirements by following guidance prescribed in DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, and through performance of site-specific ecological resource reviews prior to remedial action. (See Section 3.5, "Mitigation Action Plan.")

2.4.4 Other Criteria, Advisories, or Guidance to be Considered for this Remedial Action

In addition to ARARs, "to-be-considered" (TBC) provisions consisting of nonpromulgated criteria, advisories, and guidance may be identified in the selected remedy to help guide cleanup in situations where promulgated ARARs are unavailable for particular contaminants or situations. TBCs are evaluated along with ARARs, and identified in the ROD. TBC guidance identified in the 300 Area ROD consists of the following two items:

- **OSWER Directive 9285.7-55, *Guidance for Developing Ecological Soil Screening Levels*:** To-be-considered guidance that provides a set of risk-based soil screening levels for several soil contaminants for protection of terrestrial plants and animals. Based on the ecological risk assessment, once human health cleanup levels are achieved, residual contamination will be below levels that have the potential to adversely impact populations and communities of ecological receptors.
- **DOE/EIS-0222F , *Final Hanford Comprehensive Land Use Plan Environmental Impact Statement*:** The DOE-selected land use for the 300 Area involves industrial land use for associated waste sites. The selected remedial action considers this guidance through the establishment of RAOs and cleanup standards for industrial land use within the 300 Area industrial complex and the 618-11 Burial Ground.

3 Remedial Action Design and Planning

This chapter describes the framework for remedial action designs and other associated planning documents. Due to interim actions in the 300 Area, many of the components described in this chapter have already been completed and implemented in ongoing waste site remediation.

3.1 Remedial Action Planning

The remedial action schedules for cleanup of the Hanford Site are driven by a set of milestones that have been established as part of the Tri-Party Agreement (Ecology et al. 1989), and which may be renegotiated as remediation proceeds. Schedule milestones associated with cleanup of the 300-FF-2 OU under the 300 Area ROD are summarized in Table 3-1. These milestones are shown in Figure 3-1 along with selected other 300 Area milestones to show integration points. Milestones presented in Draft A are based on a draft milestone change notice.

Cost estimates for remediation of remaining 300-FF-2 OU waste sites were prepared as part of the 300 Area RI/FS (DOE/RL-2010-99) and subsequently carried forward into the 300 Area ROD (EPA 2013). The estimates were prepared with an accuracy of -30% to +50% to support evaluation of remedial alternatives and selection of a remedy. Cost estimates are updated based on design work. In accordance with CERCLA requirements, an explanation of significant differences will be pursued by the Tri-Parties if remediation costs change significantly from those identified in the ROD.

3.1.1 Detailed Remediation Planning

Project schedules are developed in accordance with the procedures of the performing contractor at several different levels consistent with the project work breakdown structure. The work breakdown structure-based schedules promote complete and consistent compliance with DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets,* and cost and schedule control systems criteria. Large-scale (multi-year) projects encompassing multiple smaller projects (e.g., each waste site remediation can be considered a single project, while the entire project is to remediate all waste sites) are generally planned and scheduled using a phased approach. Near-term (less than 1 year) work is usually planned and scheduled at a detail activity level using logic ties to establish and maintain a true critical-path schedule. Logic-driven, critical-path schedules, commonly referred to as the critical-path method, are used to manage and control the daily progress of the work and provide early warning of problem areas. Forecast planning and scheduling (1 to 2 years) can be performed at the task-package level, and long-range planning and scheduling (greater than 2 years) is performed at the work package or cost account levels. Planning elements at the work package level include, but are not limited to or bound by, remedial design, procurement, remedial actions, and site closures.

Some of the tiered planning documentation (e.g., remedial designs) may require approval by the lead regulatory agency, if requested. When reviews are required, DOE shall provide the documentation to the lead regulatory agency for review and approval. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules, including those for procurement. Specific processes for remedial design reviews and approvals are provided in Section 3.2.

Table 3-1. Summary of Tri-Party Agreement Milestones for 300-FF-2 Waste Site Remediation

Milestone	Description	Due Date/ Complete Date
M-16-XX-1	Complete remedial actions for the following waste sites: 300-2, 300-4, 300-6, 300-7, 300-9, 300-11, 300-16, 300-22, 300-24, 300-28, 300-32, 300-34, 300-40, 300-43, 300-46, 300-48, 300-80, 300-123, 300-218, 300-219, 300-224, 300-249, 300-251, 300-255, 300-257, 300-258, 300-268, 300-270, 300-273, 300-274, 300-276, 300-279, 300-281, 300-283, 300-284, 300-286, 300-293, UPR-300-1, UPR-300-2, UPR-300-4, UPR-300-5, UPR-300-11, UPR-300-38, UPR-300-39, UPR-300-40, UPR-300-42, UPR-300-45, 313 ESSP, 333 WSTF, 3712 USSA, 340 Complex, and 600-290. Complete remedial actions through backfill, but excluding revegetation for the 316-3 waste site. Enhanced monitored natural attenuation and final site reclassification are outside the scope of this milestone. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2016
M-16-XX-2	Complete remedial actions for the following waste sites: 300-263, 316-4, 600-367, and 618-10. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2020
M-16-XX-3	Complete remedial actions through revegetation for accessible portions (not impacted by interim and long-term retained facilities and their associated utilities) for the following waste sites: 300 RLWS, 300 RRLWS, 300-15, 300-214. Complete required interim stabilization for the following waste sites: 300 RLWS, 300 RRLWS, 300-5, 300-15, 300-121, 300-175, 300-214, 300-269, 331 LSLT1, 331 LSLT2, 400-37, 400-38, UPR-300-10, UPR-300-12, and UPR-300-48. Complete remedial actions for the following waste sites: 300-280, 300-287, 300-288, 300-289, 300-290, 300-291, and 300-294. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2017

Table 3-1. Summary of Tri-Party Agreement Milestones for 300-FF-2 Waste Site Remediation

Milestone	Description	Due Date/ Complete Date
M-16-XX-4	Complete remedial actions for waste sites 300-277, 300-296, and 600-63, which are associated with interim retained facilities. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	TBE
M-16-XX-5	Complete remedial actions for waste sites listed in M-16-XX-3 including: 300 RLWS, 300 RRLWS, 300-5, 300-15, 300-121, 300-175, 300-214, 300-269, 331 LSLT1, 331 LSLT2, 400-37, 400-38, UPR-300-10, UPR-300-12, and UPR-300-48. Complete remedial actions for the 300-265 waste site. Complete remedial actions for the 400-PPSS waste site. Complete revegetation of the 300 VTS waste site. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	TBE
M-16-XX-6	Complete remedial actions for the 618-11 Burial Ground, including remediation, backfill, revegetation, and closeout of the trenches, vertical pipe units, and caissons. Complete remedial actions for the UPR-600-22 waste site. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2024

Notes:

RDR/RAWP = remedial design report/remedial action work plan

ROD = Record of Decision

TBE = to be established

UPR = unplanned release

VTS = vitrification test site

This page intentionally left blank.

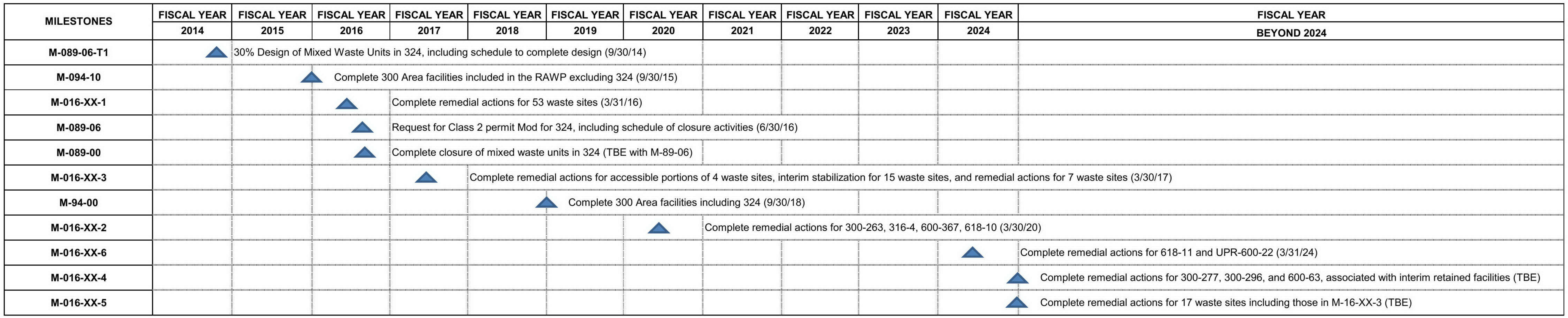


Figure 3-1. Tri-Party Agreement Milestones for 300 Area CERCLA Cleanup

This page intentionally left blank.

3.1.1.1 Remedial Action Design

Remedial designs are prepared by the remediation contractor and include all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to perform the remediation. Project plans, procedures, and work packages will define the data-gathering requirements to ensure worker health and safety and to eventually prove the waste sites meet remediation goals and standards. Project procedures will define the "how to" of obtaining data and controlling the site activities. Planning documentation is discussed further in Section 3.3. Scope of work, design drawings, and specifications will also provide the necessary technical tools to procure subcontractors, as needed.

3.1.1.2 Remedial Actions

Remedial action includes implementing the remedial design and project plans. The implementation will include, but will not be limited to, subcontractor oversight, excavation, material handling, waste treatment, analytical system operations, worker health and safety, radiological controls, data gathering, and overall daily conduct of operations. Subcontractor oversight occurs through administration of subcontract documents. Project specifications and procedures define the "how to" of excavation, material handling, analytical system operation, data gathering, and overall daily conduct of operations. Appropriate worker health and safety and radiological control requirements are included in site health and safety plans, permits, and job hazard analyses included in work packages.

3.1.1.3 Site Verification and Closeout

Site verification and closeout includes, but is not limited to, data collection (including samples and photographs), data evaluation, data interpretation, preparation of documentation, and EPA approval that the RAOs have been met via waste site reclassification or other documentation.

3.2 Remedial Action Design

Remedial action design includes all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to perform the remedial action. Project plans will define the data-gathering requirements to ensure worker health and safety and to eventually prove that the waste sites meet remediation goals and standards. Project procedures and work packages define the "how to" of obtaining data and controlling the site activities. DOE shall provide the remedial action designs to the lead regulatory agency for review and approval, if requested. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules for issuing requests for proposals. Remedial action designs that were prepared and initiated or approved under the interim action ROD, and where the remedy has not significantly changed the designed work, will not require new review and approval.

The following process will be followed to implement the remedial action design review and approval process and may be modified at the 300 Area unit manager's meeting or via other documentation (e.g., Tri-Party Agreement change notice):

- When requested, DOE shall provide the draft remedial design package and design schedule to the lead regulatory agency at the unit manager's meetings, or deliver to the local field office.
- The lead regulatory agency shall provide notice to DOE in a timely manner, if approval is warranted, usually within 3 to 5 days.
- The lead regulatory agency review period is generally 2 weeks. If additional review time is necessary, the review period can be increased up to 4 weeks. If more than 4 weeks is required due to

the complexity of the project, DOE and the lead regulatory agency shall agree to the review period, as necessary. To minimize impacts to the schedule, additional review time should be communicated early in the process.

- Review comments and issues shall be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, shall be documented in the unit manager's meetings, letters, or other forums, as agreed.
- DOE shall provide a copy of the final remedial design package, with comments incorporated, to the lead regulatory agency at the unit manager's meetings, deliver to the local field office, or otherwise transmit.
- A documented approval should be communicated to DOE by the lead regulatory agency within a reasonable time frame. The approval should reference the specific design and indicate that approval by the lead regulatory agency is warranted.

3.3 Other Remedial Action Planning Documents

Additional planning documentation for remedial action includes work packages and procedures, the SAP, health and safety plan(s), the mitigation action plan (MAP), air monitoring plans, technical performance specifications, and safety analysis/hazard classifications. Many of these planning documents have previously been prepared and issued under the interim action RDR/RAWP. As described in the following subsections, the existing documents may continue to be used under this RDR/RAWP, with the understanding that references to the interim action RDR/RAWP are superseded by this approved addendum and the associated Integrated RDR/RAWP (DOE/RL-2014-13).

3.3.1 Work Packages and Procedures

Work packages and procedures are used to provide guidance to site workers during field work execution. They define the scope, operations, progression of field work, personnel control requirements, radiological posting requirements, and analytical system guidance. Work packages and procedures are developed by multi-disciplinary involvement following a graded approach. The personnel responsible for compliance with this RDR/RAWP are included in the development process for work packages to ensure that applicable requirements are incorporated or addressed. The site superintendent must then execute field operations in compliance with these work packages.

3.3.2 Sampling and Analysis Plan

DOE/RL-2001-48, *300 Area Remedial Action Sampling and Analysis Plan*, will be revised to reflect appropriate changes under the new 300 Area ROD (EPA 2013). Until approval of that revision, the current SAP revision will continue to be used. This SAP provides direction for sampling efforts to support excavation guidance, waste characterization, worker health and safety, and site closure for 300-FF-2 remediation. The SAP includes quality assurance project plans that define the strategy to control the quality and reliability of the analytical data and establish associated protocols for data management. The field analytical team must perform all sampling and analysis efforts in compliance with the applicable SAP and any site-specific sampling instructions or agreements developed in accordance with that SAP. New or revised SAPs are provided by DOE to the EPA for review and approval.

3.4 Health and Safety Plan

Health and safety plans for waste site remediation within the 300 Area have been developed to provide direction for general site health and safety measures associated with the remedial action scope. All remedial action contractor project personnel will be trained on the applicable health and safety plan. Job hazard analyses are developed for task-specific controls and are included in work packages.

3.5 Mitigation Action Plan

A MAP was prepared for the 300 Area in 2002 (DOE/RL-2002-19). The document was developed to fulfill the requirement for a "natural resource mitigation plan," as specified in the 300-FF-1 ROD (EPA 1996). Consistent with the selected remedy in the ROD, the MAP was developed with input from affected stakeholders. The MAP states the methods for mitigation and restoration, as well as the species inhabiting the 300 Area.

The MAP presents a framework for limiting disturbances to natural and cultural resources during remedial action projects and identifies opportunities for site restoration and revegetation, as appropriate. The MAP is intended to be used as a guidance document where mitigation and restoration are required.

Key objectives of the 300 Area MAP (DOE/RL-2002-19) are to avoid, minimize, rectify, reduce/eliminate, or compensate for impacts to natural resources incurred as the result of remedial action and construction. Prior to remedial action or the construction of support areas, cultural and ecological resource reviews are conducted to determine if the proposed activities in these areas will impact natural or cultural resources. The first line of action is to avoid or minimize impacts by siting activities in areas with the least potential for impact. When impacts to natural or cultural resources are unavoidable, the project is given recommendations to minimize impacts. Additional mitigation may be required if criterion for a threshold area of disturbance or habitat quality is met. Habitat quality thresholds are described in the biological resource management plan (DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*).

Not all biological resources are considered mitigable resources at the Hanford Site. For projects that do not exceed the thresholds for rectification or compensation as defined by DOE/RL-96-32, mitigation actions are discussed in the project planning documents or site-specific ecological resource reviews. Avoidance and minimization mitigation for low-quality invasive plant species on highly disturbed sites or nonvegetated areas is employed only as necessary to reduce impacts to site-specific resources such as nesting birds. The duration of activities and foreseeable land use are also accounted for in mitigation planning.

Where site revegetation is appropriate for compensatory mitigation purposes (i.e., active revegetation as compensation for the destruction of high-quality habitat for the construction of layback and staging areas) or for site stabilization, the 300 Area MAP outlines methods of site preparation to facilitate successful revegetation by native species (DOE/RL-2002-19). Waste sites will be revegetated with native species that will survive without irrigation. The purpose of this sustainable revegetation is to provide dust control and reduce infiltration from precipitation. Subsequent land development design, although outside the scope of this RDR/RAWP, will include engineered runoff controls for parking lots and roof runoff to prevent residual contaminants from migrating to groundwater. Graveled areas will generally not be appropriate for areas that are over residual subsurface contamination but may be used on a case-by-case basis with EPA approval.

3.6 Air Monitoring Plan

The substantive requirements applicable to radioactive air emissions resulting from remediation activities are to quantify potential emissions, monitor the emissions, and identify and employ best available radionuclide control technology. Exemption from these requirements may be requested if the potential-to-emit for the activity or emission unit would result in a total effective dose equivalent of less than 0.1 mrem/yr. Implementation of these elements fulfills the ARARs identified in Section 2.4. The use of best available radionuclide control technology includes, but is not limited to, dust suppression (e.g., water, water sprays, fixatives) and the use of other standard engineering controls (e.g., high-efficiency particulate air filter vacuum cleaners). The project-specific air monitoring plan for remediation of waste sites at the 300 Area industrial core and immediate surrounding area is provided in Appendix E. Air monitoring plans for other waste site remediation project areas are approved by the lead agencies and maintained separately from this RDR/RAWP. Additional air monitoring plans may be developed and approved as changes to this document, or as stand-alone documents.

3.7 Technical Performance Specifications

Technical performance specifications are prepared as needed to support remedial actions. Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. Technical performance specifications may include the following areas:

- Earthwork and excavated material handling
- Survey and decontamination station
- Waste profiles
- Basic electrical materials and methods
- Lighting.

Each technical specification establishes quality and workmanship requirements and defines how quality is measured.

3.8 Safety Analysis/Emergency Preparedness

Hazards associated with the proposed remedial actions addressed in this document are examined based on anticipated inventories of radioactive and/or hazardous materials and appropriate controls identified, and the hazard categorization is documented as warranted. Hazard categorization documentation, as well as analysis of radioisotopes and hazardous material for emergency response planning for the 300-FF-2 OU waste sites, will be prepared before initiating excavation operations.

4 Remedial Action Management and Approach

The Integrated RDR/RAWP (DOE/RL-2014-13) identifies the overall remedial action management and approach for implementation of all aspects of the 300 Area ROD (EPA 2013). This chapter describes the components of the project team, change management approach, remedial action operations, and waste site closure processes specific to RTD and interim stabilization by void-fill grouting and surface capping at 300-FF-2 waste sites.

4.1 Project Team

The project team for 300-FF-2 soil remediation consists of the lead and regulatory agencies identified in the Integrated RDR/RAWP (DOE/RL-2014-13), as well as DOE-RL's selected contractor(s). The contractor project managers are responsible for leading project teams in remedial action implementation. The project teams contain the personnel necessary to perform the remedial actions in a safe, efficient, and compliant manner.

4.2 Remedial Action Change Management

Change management will be performed as described in the Integrated RDR/RAWP (DOE/RL-2014-13). The contractor project manager is responsible for tracking all changes and obtaining appropriate reviews by staff for changes affecting 300-FF-2 waste site remediation. The project manager will discuss the proposed change with DOE-RL, and DOE-RL will then discuss the type of change that is necessary with the EPA. As the lead regulatory agency, the EPA is responsible to determine the significance of the change.

4.3 Remedial Action Operations

The components of the selected remedy addressed by this addendum are identified in Section 1.2.1. This section describes general mobilization and RTD operations for waste sites. For waste sites or portions of waste sites that cannot be remediated due to interference from retained facilities and associated utilities, the 300 Area ROD (EPA 2013) specifies consideration of interim stabilization measures, which are described below. Lastly, this section identifies institutional controls associated with remedial action operations.

4.3.1 Mobilization and Site Preparation

Mobilization and site preparation include the following activities that are necessary to prepare the site for excavation:

- Establishing site utility services as required.
- Constructing roads, field support facilities, container survey stations, and decontamination stations. Hanford Site roadways are constructed of existing site materials, except the surface course, which is imported. Field support facilities provide a changing area, lunchroom, and construction offices at individual sites. The changing area includes lockers, benches, and storage for both clean and contaminated personal protective equipment (PPE).

- Stripping the existing vegetation and debris. Stripping removes surface and near-surface materials (including vegetation and roots, cobbles, and boulders) that may be stockpiled (where practicable) and used later as a top dressing and planting medium for revegetation. For sites where topsoils contain hazardous debris material or do not meet cleanup levels, the material is not stockpiled for reuse. In these cases, stripping may still be performed, with resulting material managed for disposal as waste, or surface material may be removed as part of general excavation activities without a discrete surface-stripping effort.
- Removing overburden material. Clean overburden may be segregated and stockpiled on site for later use as backfill material.
- Removing slabs and foundations of demolished buildings.

4.3.2 Remove, Treat, and Dispose

This subsection address activities specific to RTD remediation of waste sites. During all aspects of RTD, dust control will be maintained on the haul roads, at the excavation site, and in the staging areas. Use of water for dust control at the excavation site will be minimized. Soil fixatives (e.g., soil cement) will be applied to open excavation sites during periods of extended inactivity and/or when potential concerns arise about health issues or the spread of contamination.

Under the RTD process, contaminated soils and engineered structures containing contamination (e.g., pipelines, drums, caissons, and VPUs) with COCs exceeding cleanup levels will be remediated up to 4.6 m (15 ft) bgs to meet cleanup levels for direct exposure, groundwater, and surface water protection as identified in Chapter 2. Remediation will continue below 4.6 m (15 ft) bgs where site nonuranium COC concentrations exceed cleanup levels for groundwater and surface water protection. Where site COC exceedances of groundwater and surface water protection cleanup levels below 4.6 m (15 ft) bgs are limited to uranium in soil, RTD or phosphate sequestration may be performed for those soils, as approved by the EPA. Considerations and implementation for potential phosphate sequestration will be determined on a site-by-site basis.

Engineered structures at waste sites identified for RTD, including pipelines, may be left in place if it can be demonstrated that residual contamination is not present or is present at residual concentrations that achieve RAOs. The cleanup levels do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying cleanup levels to sediment/scales within pipelines or other structures. When asbestos in nonfriable form (e.g., asbestos in the pipe matrix, asbestos impregnated in tar paper-wrapped water pipes) is encountered in the shallow zone, as in pipelines, and no other CERCLA hazardous waste is associated with the pipelines other than asbestos in nonfriable form, remediation of such pipelines is not required (DOE-RL et al. 2005c).

4.3.2.1 Excavation

Excavation involves removing clean and contaminated soil, debris, and anomalous waste present within the site boundaries. For all burial grounds and dump sites, materials will be excavated with standard construction equipment using one or more of the following techniques to sort and disposition waste:

- **0.3-m (1-ft) Horizontal Lifts.** The exposed surface of each lift will be visually observed, radiologically screened, sorted as necessary to remove anomalous material and large debris, and then excavated using heavy equipment and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.

- **0.3-m (1-ft) Diagonal (Sloping) Lifts.** The exposed surface of each lift will be visually observed as it is raked down the face of an excavation slope using heavy equipment. Material will be radiologically surveyed at the bottom of the slope, sorted as necessary, and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.
- **Bulk Excavate and Spread.** Material will be bulk excavated using heavy equipment, and then spread onto the ground in approximately 0.3-m (1-ft) layers. The shallow layer of material will then be radiologically screened and sorted.
- **Direct-Load Lifts.** The surface of each lift will be visually observed, radiologically screened, sorted (if necessary), and then excavated and loaded into containers using heavy equipment. This technique is best suited for areas with little visible debris.

In excavation areas where there are large quantities of observed lead-containing materials (e.g., lead bricks, lead slag) intermixed with the soil, a variation of these excavation/sorting methods may be used. Observation, sorting, and radiological surveys for removal of the large materials and nonlead anomalous materials will be performed using one or more of the above-described methods. The remaining materials may then be identified as meeting the RCRA definition of "soil" per 40 CFR 268.2 and considered hazardous/dangerous due to lead contamination. In such cases, the soil will be sampled in accordance with the 300 Area SAP and transported to the ERDF or other approved facility for treatment (stabilization) and subsequent disposal. Treatment of debris may be conducted on site on a case-by-case basis in accordance with WCH-539, *Treatment Plan for Macroencapsulation of 300-FF-2 Debris*.

Additional excavation/waste retrieval methods in support of remediation of the 618-10 and 618-11 Burial Grounds may be used and are discussed in WCH-127, *600 Area Remediation Design Solution Technology Assessment and Deselection Report*. These methods include technologies such as overcasing, in situ vitrification, and manually or remote-operated excavation.

Sluicing (use of water) is not an acceptable excavation method. Selection of the excavation/sorting method will be made by remedial action project management, and the method may be changed to another approved method based on the type of material being excavated. Alternate excavation/sorting methods (e.g., vacuum systems, metal detectors) may be proposed by the project on a case-by-case basis and implemented with concurrence from the DOE and EPA project representatives. During the excavation process, care will be taken to prevent the breakage or puncture of unopened or sealed cans, jars, and containers.

Material from waste sites that are not burial grounds (e.g., acid neutralization pit) or the periphery of burial grounds (e.g., plumes) where anomalous material is not encountered does not require mechanical sorting. This material may be directly loaded into containers after enough information is gathered to characterize the waste. Material that has been excavated using one of the approved sorting techniques will be directed in one of the following ways.

- Material that is above cleanup levels and within the ERDF waste acceptance criteria (WCH-191) will be loaded into plastic-lined roll-off containers on project haul trucks at the excavation site. The loaded containers will be covered (i.e., by folding and securing the liner over the load) and surveyed prior to being transported to a container transfer area (CTA) using the project haul trucks. If contamination is found on a container exterior, the container will be decontaminated using standard equipment and techniques. In the unlikely event that a container cannot be decontaminated using standard methods, advanced techniques will be implemented as necessary. Released containers will be offloaded and staged in the CTA until applicable shipping papers are completed. When the shipping papers have been completed, ERDF transport vehicles will enter the CTA, pick up the full containers, and haul them to the ERDF.

- Anomalous waste (e.g., drums, intact containers, elemental lead, unknown materials) and/or above-cleanup-level material that is not within ERDF waste acceptance criteria (WCH-191) will be set aside within the area of contamination (AOC) or within designated staging piles for further characterization and final disposition. Waste that is subsequently identified for ERDF disposal or staging will be directed as described previously, with the exception that drummed waste may be transported in standard ERDF containers or by other means such as flatbed trailers or cargo vans. Concreted drums at the 618-10 and 618-11 Burial Grounds will be processed differently as described later in this section. Excavated material that must be sent to facilities other than ERDF for treatment and/or disposal will be stockpiled or drummed and staged within the AOC or within designated staging pile areas (SPAs) until loaded for offsite shipment. Identification of an appropriate treatment and/or disposal facility and arrangements for loading and transporting excavated material to facilities other than ERDF will be made on a case-by-case basis by the project in coordination with the River Corridor Closure (RCC) Project waste management representatives. Prior to shipment, an offsite acceptability determination in accordance with 40 CFR 300.440 must be obtained from the EPA for receipt, storage, treatment, and disposal of CERCLA waste at the identified treatment/disposal facility.

- Land disposal restricted (LDR) waste or containers of LDR waste that are not within the ERDF waste acceptance criteria may need repackaging or treatment to comply with the ERDF waste acceptance criteria (WCH-191). Land disposal restricted waste that has been placed into a container will not be placed back into the AOC (i.e., on the land). Land disposal restricted waste may be removed from a container and placed directly into another container, even within the designated AOC boundary, as long as no land placement occurs. Containerized LDR waste that needs to be placed on the ground for treatment or repackaging will be done within a SPA.

- Material that is free of anomalous waste and below cleanup levels may be stockpiled on site for use as backfill material. In certain situations, soil may be placed over material excavated within a waste site or discovered within a staging pile as a temporary measure. Such action may be undertaken to minimize an imminent threat to the worker (e.g., a high-dose item is uncovered, and a temporary soil cover is appropriate to control worker exposure). Temporary covering with soil may also be undertaken to prevent windborne dispersal of excavated material or highly contaminated soil and to maintain segregation from other waste site materials. These temporary measures may be undertaken while plans are developed for safe re-excavation and removal of waste site materials. In these instances lead regulator notification will be made.

- Non-LDR material that has been packaged may be returned to an excavation area or SPA in situations where the dose rates, contamination levels, free liquids, or other abnormalities have subsequently been determined to exceed normal transport requirements. In these situations, when repackaging is necessary, the previously excavated material will be reloaded into the transportation container. Notification to the lead regulatory agency is generally not required for these actions. The exception is LDR waste, which shall be managed in accordance with the third bullet above.

- An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b).

- If suspect spent nuclear fuel (SNF) is discovered, it must be managed as SNF and is not eligible for disposal in ERDF. Shielded bunkers will be used for interim storage of the SNF with minimum specifications of (1) a 1.8-m (6-ft)-tall security fence, and (2) a bunker constructed of concrete shielding blocks including a heavy metal lid or concrete shielding block cover. Spent nuclear fuel will be characterized for shipment to the Canister Storage Building facility until an offsite storage or disposal facility authorized to manage SNF becomes available (DOE-RL et al. 2005b).
- If TRU material is discovered, it must be identified as either contact-handled TRU waste or remote-handled TRU waste and managed in accordance with the waste acceptance criteria of the receiving facility (WCH-126, *600 Area Remediation Design Solution Waste Packaging, Transportation, and Disposal Requirements*).
- At the 618-10 and 618-11 Burial Grounds, some high-activity waste and possibly small amounts of plutonium-contaminated liquid waste were sealed in concreted 208-L (55-gal) drums. Some concreted drums also contained an additional 2.5 or 5 cm (1 or 2 in.) of lead shielding. One type of drum had a 20-cm (8-in.)-diameter galvanized metal culvert centered in the 208-L (55-gal) drum, surrounded by concrete on the bottom and sides. The culvert may also have lead wrapped around it, depending on shielding requirements. High-activity liquid or solid waste was placed in the culvert. The culvert was capped with a lead plate and concrete poured in to fill the void space. Another type of drum had the waste placed inside the container and then concrete poured around the containers to provide shielding and to prevent shifting of contents. Opening these concrete drums for examination and processing would present a very high risk due to the radiological contents. Excavation techniques allow for examination of the drum condition and the condition of the concrete cap. If the outer drum is intact and the concrete cap is seen to be intact, the concrete is reasonably expected to be intact. When the concrete in these drums is intact, it meets the macroencapsulation standard of 40 CFR 268.42 for radioactive lead solids. When the outer drum is not intact, but the concrete within the outer drum can be seen as intact on the sides and the top, the concrete can reasonably be expected to be intact. Intact concrete waste will be overpacked with an absorbent filling the annulus between the concreted drum and the overpack drum to preclude migration of potential liquids. In this form, the overpacked drum can be disposed in the ERDF. If the concrete in these drums is not intact, the drums will be overpacked and an absorbent will be added. Macroencapsulation will be performed either at the waste site and then disposed at ERDF, or the macroencapsulation treatment will be performed at ERDF prior to disposal. If macroencapsulation treatment is performed at the waste site, a treatment plan will be developed and approved by the lead regulatory agency.
- For the 618-10 and 618-11 Burial Ground trenches, treatment of liquid waste in bottles, up to 3.8 L (1 gal) per bottle, will occur in a tray or box within the excavation. Bottles will be placed in a spaced pattern into a containment structure within an excavated trench. Bottles will be covered with Portland cement-based grout and then crushed and mixed into the grout. Crushing may be performed individually or in a batch process. The treatment requirements are met by mixing the liquid into grout which immobilizes metals and radioactive metals expected in the waste and neutralizes acids. A grab sample from each treatment batch will be subjected to laboratory analysis to confirm that the treated waste falls below the LDR limits for COCs in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised). Liquid waste treated in this manner will be subsequently handled as bulk waste as described below or may be transported for disposal as a monolith within an acceptable container.

Excavated material will be surveyed and characterized for appropriate disposition prior to undertaking disposal of materials. When excavation of a waste site is complete, exposed dig faces will be evaluated to verify that remedial action goals have been met. When cleanup levels have been met and backfill concurrence is obtained from the lead regulatory agency, site backfill will be authorized. (Note: Unless specified otherwise, the term “backfill” as used in this document refers to filling in the excavation once post-waste site remediation sampling has demonstrated that cleanup levels have been met.) Clean backfill material is obtained from clean material storage areas, approved/clean rubble, and local borrow sites. Excavations are backfilled as described in Section 4.4.4.

4.3.2.2 Material Handling and Transportation

All contaminated materials (including excavated soils, debris, disposable protective clothing, air filters, and trash) require proper packaging, handling, and transportation in accordance with the waste management plan prescribed in Chapter 5. Contaminated bulk materials will be hauled in the standard ERDF open-top, hinged-gate roll-off boxes that are designed for a maximum capacity of either approximately 18.1 metric tons (20 tons) or 22.7 metric tons (25 tons). The bulk containers will be transported on roll-on/roll-off trailers with hydraulic dumping capabilities that are towed by conventional tractor units. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans.

Weighed containers will be transported from the remediation site to the ERDF over existing Hanford Site roadways. Each shipment of soil/debris transported to the ERDF will be referenced to a waste profile that is intended to provide an upper bound on the concentrations of contaminant materials found at the site. The waste profile is in effect until the characteristics of the excavation site have changed significantly. Empty containers returning from the ERDF will be removed from the ERDF tractor trailers in the CTA and rolled on to project haul trucks for refilling. The CTA helps to maintain a continuous flow of materials through the transportation system by allowing excavation to continue for a limited time if the trucks running to the ERDF are not operating, or it allows ERDF trucks to continue to run for a limited time if the excavators are not operating.

The containers are inspected for the presence of water prior to placing a liner or waste into the container. When water is found in a container with an estimated volume of 151 L (40 gal) or less (less than a depth of 1.27 cm [0.5 in.] in the bottom of the container), the water will typically be used as an aid for dust suppression in the adjacent radiological excavation, staging pile, or radiological debris piles in a manner that is consistent with regulator-approved work plans. When water is found in the container with an estimated volume greater than 151 L (40 gal), lead regulatory agency approval will be sought to use the water as an aid for dust suppression in the adjacent radiological excavation, staging pile, or radiological debris pile, or direction from the agency to process the water through other means.

Transportation and handling for offsite treatment and/or disposal of contaminated material will be coordinated on a case-by-case basis. All offsite shipments will be conducted using equipment and methods that are compliant with applicable U.S. Department of Transportation (DOT) regulations and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*.

4.3.2.3 Vertical Pipe Unit Remedial Action Operations

Remediation of the 618-10 and 618-11 Burial Grounds requires the removal, treatment, and disposal of approximately 144 VPUs located within the burial grounds that were used for disposal of 300 Area low- to high-activity waste, including TRU waste. Vertical pipe units that are determined to be low-level waste or mixed low-level waste will be treated, as necessary, and disposed at the ERDF. Suspect TRU waste will be packaged for shipment and storage at the Central Waste Complex, pending shipment to the Waste Isolation Pilot Plant for disposal. Additional nondestructive analysis and repackaging may be performed at the Central Waste Complex.

An in situ treatment process will be used during VPU remediation due to the presence of highly dispersible alpha radiological materials and potential reactive materials. Treatment processes may involve placing a structure around exposed VPUs and then stabilizing contents under a Portland cement grout. Other methods may include installation of an over-casing around VPUs and then augering contents followed by Portland cement stabilization. After stabilization, waste will be removed by conventional excavation methods, as a monolith, or by a remote retrieval system and packaged for disposal or storage, as appropriate.

4.3.2.4 300-296 Waste Site Remediation

Highly contaminated soils within the 300-296 waste site will be excavated using remote excavation methods. These soils will be retrieved through the 324 Building B Cell floor and placed in other hot cells within the facility. These cells provide additional shielding to workers. Removal of the 324 Building and the soil in the hot cells will then be performed under the applicable action memorandum (DOE-RL 2006a) and a facility-specific closure plan. Following removal of the 324 Facility, RTD will be performed for remaining, less highly contaminated 300-296 soils exceeding cleanup levels.

4.3.2.5 Soil and Debris Characterization

Soil and debris characterization will be based on the observational approach and performed in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised). This approach relies on available historical information and limited field investigations combined with a "characterize-and-remediate-in-one-step" methodology. The latter methodology consists of site excavation and monitoring at sites where remedial action and cleanup goals have been selected. Remediation will continue until a combination of field screening results, sampling results, and/or observed absence of waste debris indicates that cleanup goals have been achieved.

4.3.2.6 Decontamination

Decontamination to support excavation activities will generally be performed using dry methods (e.g., wiping and high-efficiency particulate air-filtered vacuum cleaners) to the extent possible. When the use of wet methods (e.g., pressure washers and steam cleaners) is required to achieve decontamination objectives and the associated water or cleaning solutions are not collected, work will be conducted by trained site workers in accordance with the following best management practices.

4.3.2.7 General Best Management Practice

This applies to all equipment cleaning/decontamination activities within a waste site.

- Decontamination activities are typically performed within active excavation areas of the AOC.
- The amount of water used to clean equipment will be minimized.
- Only raw or potable water will be used.
- Soaps, detergents, or other cleaning agents that would be regulated as a hazardous waste will not be added to wash water.
- Pressure washing will normally use cold water (hot water may be used to avoid icing).
- Steam cleaning will be used only after other methods prove to be ineffective.

- Decontamination practices will be documented in the daily log.
- Personnel responsible for equipment decontamination will be trained to this best management practice.

4.3.2.8 Ongoing Remediation Site Best Management Practice

This applies to equipment being washed and/or decontaminated within sites that have ongoing remediation, or at a decontamination area established outside of the waste sites.

- Equipment washing/decontamination will be located in areas with ongoing waste removal or in a centralized area that supports multiple remedial actions.
- Spent wash water and associated contamination will be kept within active areas of the AOC or within the decontamination area if located outside of the AOC.
- Pre- and post-washing/decontamination contaminant surveys are not required.
- The project may opt to collect wash water for reuse in the excavation or to be sent for treatment.

4.3.2.9 Completed Remediation Site Best Management Practice

This applies to equipment being washed and/or decontaminated within sites that have achieved preliminary remediation goals.

- At the "completion" of excavation activities at a site, the project may opt to transport the equipment to a nearby site that is being remediated (by excavation) to perform equipment washing/decontamination (as described above), or to utilize a defined decontamination area.
- A pre- and post-survey will be performed on the washing/decontamination area to assess and remediate (if required) areas affected by the activity. When the washing/decontamination is set up in an area of a site that has apparently attained the preliminary remediation goals, sampling of the area will be performed in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised), including site-specific work instructions, as applicable.
- The project may also opt to perform other methods of equipment washing and/or decontamination for a completed site (e.g., wrap the equipment for transfer to a decontamination pad, provide for a temporary facility at the site to collect wash water, fix the contamination to the equipment).

4.3.3 Pipeline Void Filling and Temporary Surface Barriers

Due to ongoing use of some buildings and supporting in-ground infrastructure (e.g., utility lines), some of the waste sites identified in Table 1-1 will not be available for RTD for an extended period. Temporary surface barriers and void-filling in pipelines will be used to reduce the mobility of contaminants until the RTD activity can be performed.

For waste sites in Table 4-1 that exceed applicable cleanup levels and that are adjacent to the long-term retained facilities, temporary surface barriers will be installed and maintained. Details associated with installation of surface barriers will be documented in project drawings and will be included in the administrative record. Surface barriers are intended to reduce infiltration and contaminant flux to groundwater. Design of the barriers will be established on a site-by-site basis as approved by the EPA.

Table 4-1. Waste Site Surface Barrier Locations and Construction

Waste Site	Surface Barrier Type	Location
300 RLWS	Asphalt	Primarily east to west under Spruce Street
300 RRLWS	Asphalt	Primarily east to west under Spruce Street
300-5	Asphalt	South side of the 300 Area Fire Station (3790A Building)
300-121	Concrete	Immediately southwest of the former 3621D Building
300-214	Asphalt	Primarily east west under Spruce Street
300-265[a]	Asphalt and concrete	East to west under Spruce Street
331-LSLT1	Geomembrane	East side of the 331 Building
331-LSLT2	Geomembrane	East side of the 331 Building
400-37	Asphalt	Southeast side of the 4732B Building
400-38	Asphalt	East side of the 4722A Building foundation

Notes:

a Partial remediation and interim stabilization of the 300-265 site will be delayed until after demolition of the 324 Facility.

Surface barriers will typically be constructed of asphalt, but similarly impermeable materials (e.g., concrete, water-resistant synthetic membranes) that decrease water infiltration into contaminated soils may also be used. Surface barriers also will be designed to direct surface runoff away from waste sites to the extent practical. Surface barriers are not required for waste sites with interim interferences (i.e., those associated with the 324 Building). Surface barriers are also not required for portions of waste sites abandoned-in-place in areas that have otherwise undergone remediation and revegetation. These portions typically consist of small process sewer segments that remain in place because of active utility interferences or remain in the ground within the operational boundary of an active facility. Surface barriers are also not required if the waste site lies beneath an active facility that already meets the intention of a surface barrier, as listed in Table 4-2. The surface barrier types and locations described in this section are approved by the EPA. Any exception to the installation and maintenance of surface barriers must be approved by the EPA.

Table 4-2. Waste Sites Considered as Interim Stabilized

Waste Site	Existing Barrier	Location
300-175	Grouted french drain	South-central 300 Area
300-269	331A Building foundation	Southeast 300 Area
UPR-300-10	325 Building	South-central 300 Area
UPR-300-12	325 Building	South-central 300 Area
UPR-300-48	325 Building	South-central 300 Area

Pipelines with uranium and/or mercury contamination that exceeds cleanup levels for groundwater and river protection that are inaccessible for the RTD remedy because of their close proximity to long-term facilities will be void filled to the maximum extent practicable as defined in the RD/RAWP to immobilize radionuclides (and elemental mercury in waste site 300 RRLWS) in the pipelines for groundwater protection.

Pipeline void filling will be performed by installing fill and vent ports to a selected segment of piping. Grout, epoxy, or other suitable stabilizing material will be introduced to the piping segment using industry-standard techniques. Void-filling material can either be pumped or gravity fed into a piping segment. Void-filling material will be allowed to cure prior to initiating remedial actions on piping segments, if applicable. When only a portion of void-filled piping is remediated, the end location of piping to remain in place will be recorded with global positioning system coordinates, documented on project drawings, and included in the administrative record. In addition, a monument will be installed at ground surface to document the location of the pipe end. Both the monument and project drawings will facilitate future remedial actions after interferences associated with the long-term retained facilities are removed. Void filling may not be required on intact pipelines that pose elevated hazards to workers (e.g., 300-265). Also, pipeline void filling may not be required for piping segments associated with interim retained facilities (e.g., the 324 Building) or piping segments abandoned-in-place in areas that have otherwise undergone remediation and revegetation. Piping segments abandoned in place are primarily process sewer segments that remain in the ground north of Apple Street or remain within the operational boundary of an active facility.

When the long-term facilities are no longer in use and are removed, waste sites and pipelines will be remediated as described in this RDR/RAWP. The long-term retained facilities are described further in Section 1.2.2.

4.3.4 Implementation of Institutional Controls for Waste Site Remediation

Institutional controls are required before, during, and after the active phase of remedial action implementation where institutional controls are necessary to protect human health and the environment. Institutional controls are used to control access to residual contamination in soil above standards for unlimited use and unrestricted exposure. Institutional controls are required during remedial action and after cleanup is complete, or until the site meets the requirements for unrestricted land use as defined in Section 2.0. Cleanup to industrial levels in the 300 Area industrial core is based on the mandate of restricted land and groundwater use, until such time that contaminant concentrations are conducive to unrestricted use. Accordingly, DOE may choose to demonstrate that unrestricted use cleanup levels have been attained in areas designated for industrial use.

The Integrated RDR/RAWP (DOE/RL-2014-13) provides additional description of the institutional controls specified under the 300 Area ROD (EPA 2013). Details for implementation are described in DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Action Sites* (as revised). Remedial action planning, including siting of haul roads, SPAs, and support areas, shall consider the ROD requirement to prevent enhanced recharge at sites with soil concentrations exceeding residential (irrigation-based) groundwater and surface water protection cleanup levels. Dust-suppression water used during remediation will be limited to that necessary to prevent airborne emissions. Irrigation (including landscape watering) is prohibited at waste sites within the industrial zone. Active irrigation systems that may impact waste sites will be deactivated, and the installation of new systems is prohibited. Existing landscapes may be converted to dryscapes utilizing xeriscaping techniques, should operational facilities choose to do so. Drainage control and construction/maintenance of surface barriers, as described in Section 4.3.3, will also be used to restrict enhanced recharge at waste sites.

Implementation of the ROD requirement to provide signage and access control for waste sites with contamination above cleanup levels is described below.

- Along the Columbia River, a sign set has been placed at or above the high water line (at approximately the same line as the no trespassing signs). The sign set consists of one each in English and Spanish. The signs are located so that the distance for viewing from the river is approximately 152 m (500 ft). The English language sign reads as follows:

  WARNING: HAZARDOUS AREA
  DO NOT ENTER
  Area May Contain Hazardous Soil and Water
  For Information Call: 509-376-7501

  The Spanish language sign reads as follows:

  ADVERTENCIA: AREA DE PELIGRO
  NO ENTRE
  Esta area puede contener tierra y fuentes de agua que son peligrosas.
  Para Informacion Llame al (509) 376-7501

- One large sign is located north of the 300 Area. Additional smaller signs are located at roads leading to the 618-10 and 618-11 Burial Ground areas. These signs read as follows:

  WARNING: HAZARDOUS AREA
  Area May Contain Hazardous Soil
  Only Authorized Personnel Allowed
  For Information Call: 509-376-7501

- Signs placed at key access roads into the 300 Area industrial zone read as follows:

  WARNING: HAZARDOUS AREA
  Area May Contain Hazardous Soil
  Observe All Signs and Hazard Postings
  Only Authorized Personnel Allowed
  For Information Call: 509-376-7501

- Signs may also be placed in temporary security fence openings when necessary to accommodate special shipments.

Following remediation, institutional controls restricting land use to industrial uses or restricting excavation of deep zone soils with contaminants above shallow zone cleanup levels will be identified in the waste site closeout documentation, as necessary, and in accordance with the requirements of Section 4.4.5.

4.4 Site Verification and Closeout

Site verification and closeout includes sample collection, demonstration of attainment of RAOs, cleanup documentation, site closure, and site release, as summarized in the following subsections.

4.4.1 Verification Sample Collection

Verification samples of the residual soil from the excavated site, any clean soil stockpiles intended for use as backfill material, and residual soil from SPAs (if applicable) will be collected in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised), including site-specific work instructions or other documented agreements for verification sample collection. Results from the verification samples will be used to demonstrate attainment of the RAOs.

4.4.2 Attainment of Remedial Action Objectives

The general approach for verifying attainment of RAOs involves the following steps:

- Calculating summary statistics appropriate to the verification data set
- Evaluating summary statistics against the appropriate cleanup levels
- If needed, modeling exposure and risk to future site inhabitants
- If needed, modeling future impacts to groundwater and the Columbia River.

A detailed description of the process for verifying attainment of the RAOs is provided in Appendix B of this document.

4.4.3 CERCLA Cleanup Documentation

Subsequent to determining that the RAOs have been attained, waste site reclassification documentation will be prepared, typically including a supporting CVP or other closeout documentation. The waste site reclassification documentation will document the remedial action process, verification sampling results (if applicable), and attainment of the RAOs under the appropriate land use at a site; and will support the eventual removal of the OU from the National Priorities List. In some cases, DOE may choose to evaluate compliance with unrestricted use cleanup levels in the industrial zone in order to eliminate unnecessary institutional controls for the site. Waste site reclassification documentation may be prepared for groups of sites or individual sites, as needed, in accordance with the guidance provided in Appendix B. Closeout documentation may also be used to support other CERCLA closeout documentation (e.g., remedial action reports, construction completion reports, and National Priorities List deletion packages).

4.4.4 Backfill, Regrade, and Revegetation

Once attainment of the RAOs under the appropriate land use has been verified, the site will be recontoured and/or backfilled and revegetated following guidance in Appendix C. A general recontour/backfill design will be developed based on the final excavated site and surrounding area topography, as well as the amount of stockpiled overburden/below cleanup level material that has been released for use as backfill material. As needed, additional backfill material may be transported to the excavated site from approved Hanford Site borrow areas. Recontouring and backfilling operations will be performed using standard construction equipment.

Waste sites within the 300 Area "industrial core zone and contiguous areas" (including the 618-11 Burial Ground) will be backfilled and regraded in a manner that will support future industrial reuse of the site. The slope of the regrade topography will provide positive drainage away from areas where residual subsurface contamination could result in adverse groundwater impacts. The grading, to the extent practicable, will maximize the amount of large flat areas and minimize rolling contours or depressions where water may accumulate. Outlying sites should be backfilled and revegetated in a manner that matches the local area contours.

In order to support industrial use, planting of native vegetation will be delayed for portions of the 300 Area until completion of industrial use. Currently, the only remediated and backfilled site requiring delayed revegetation is the 300-VTS waste site. The area around this site is utilized by the U.S. Department of Defense in support of operations to support deactivation of naval vessels. This area will be revegetated when the U.S. Department of Defense activity is completed at this site. Other waste sites that may warrant delayed revegetation will be identified by DOE and will require the concurrence of the EPA Remedial Project Manager.

4.4.5 Site Release

The DOE will continue to manage the land in the 300 Area of the Hanford Site as long as necessary to support remedial actions and other missions. The release of land areas for industrial or unrestricted uses will depend on the following: (1) release of the individual waste sites, and (2) the completion of other work in the OU, such as decontamination and decommissioning of facilities, as well as final cleanup verification under CERCLA.

Where deed notices or other institutional controls are used in accordance with the 300 Area ROD (EPA 2013), DOE will not allow activities that would interfere with the remedial action prior to EPA approval. In addition, DOE will take necessary measures, such as filing deed notices in appropriate county offices and enforcing such land-use limitations through contractual mechanisms, to ensure the continuation of these restrictions prior to any transfer or lease of the property to any private party in accordance with the statutory requirements of Section 120(h) of CERCLA and the regulatory requirements of 40 CFR 373. A copy of any restriction notification will be given to any prospective purchaser/transferee before any transfer or lease by DOE. The DOE will provide the EPA with written verification that these restrictions are in place. In addition, unless and until cleanup levels that would support unlimited use and unrestricted exposure are attained, a reevaluation of the remedial action will occur as part of the CERCLA 5-year review for the 300-FF-2 OU. For more information on requirements applicable to institutional controls, refer to the Integrated RDR/RAWP (DOE/RL-2014-13) and the 300 Area ROD (EPA 2013).

This page intentionally left blank.

5 Waste Management Plan

Waste management activities will be performed in accordance with the applicable ARARs identified in Section 2.4 and RCC Project internal procedures. The requirements specified by the ARARs and other applicable guidance will address waste storage, transportation, packaging, handling, and labeling as they specifically apply to waste streams from each waste site. This process is illustrated in Figure 5-1.

5.1 Waste Designation Methods

Wastes will be designated for disposition based on historical data, process knowledge, engineering calculations, sampling and analysis, or combinations thereof. Each of these methods and their applications is described as follows:

- Historical data (e.g., analytical results) may be used to designate waste forms that have previously been characterized. In addition, previous and current 300 Area remediation projects have designated significant quantities of buried solid waste. The waste forms in this category are readily identified and are known for their hazardous material content.
- Process knowledge will be used to designate waste for which process knowledge provides sufficient information. Waste forms such as asbestos-containing floor tiles and pipe lagging do not require sampling and analysis because these will be designated as ACMs based on visual observation. Elemental lead debris, paint debris, and lead acid batteries are other examples where designation will be based on process knowledge.
- Engineering calculations may be performed to estimate the weight or volume of a hazardous waste in a certain matrix (e.g., calculating lead-based paint content on pump housings).
- Sampling and analysis will be used for designation of wastes when the above-mentioned methods are not appropriate or available. Sampling and analysis is required for liquids and most of the anomalous waste forms. Where sampling is needed, historical data, process knowledge, and/or engineering calculations may be used to reduce the suite of analyses required. All sampling activities supporting waste designation will be performed in accordance with the appropriate 300 Area SAP.

Specific types of waste that are initially designated based on sampling results may be designated using one of the other methods (e.g., historical data) as the waste is unearthed during the excavation. All excavation operations will be observed by personnel assigned to assist with the designation process.

5.2 Waste Stream-Specific Management

Various waste streams will be encountered during the course of remedial actions. Each waste stream will require specific processing and disposal. Similar types of waste will be managed uniformly. Management of waste streams that are projected to be encountered during the course of remedial actions are summarized in the following subsections.

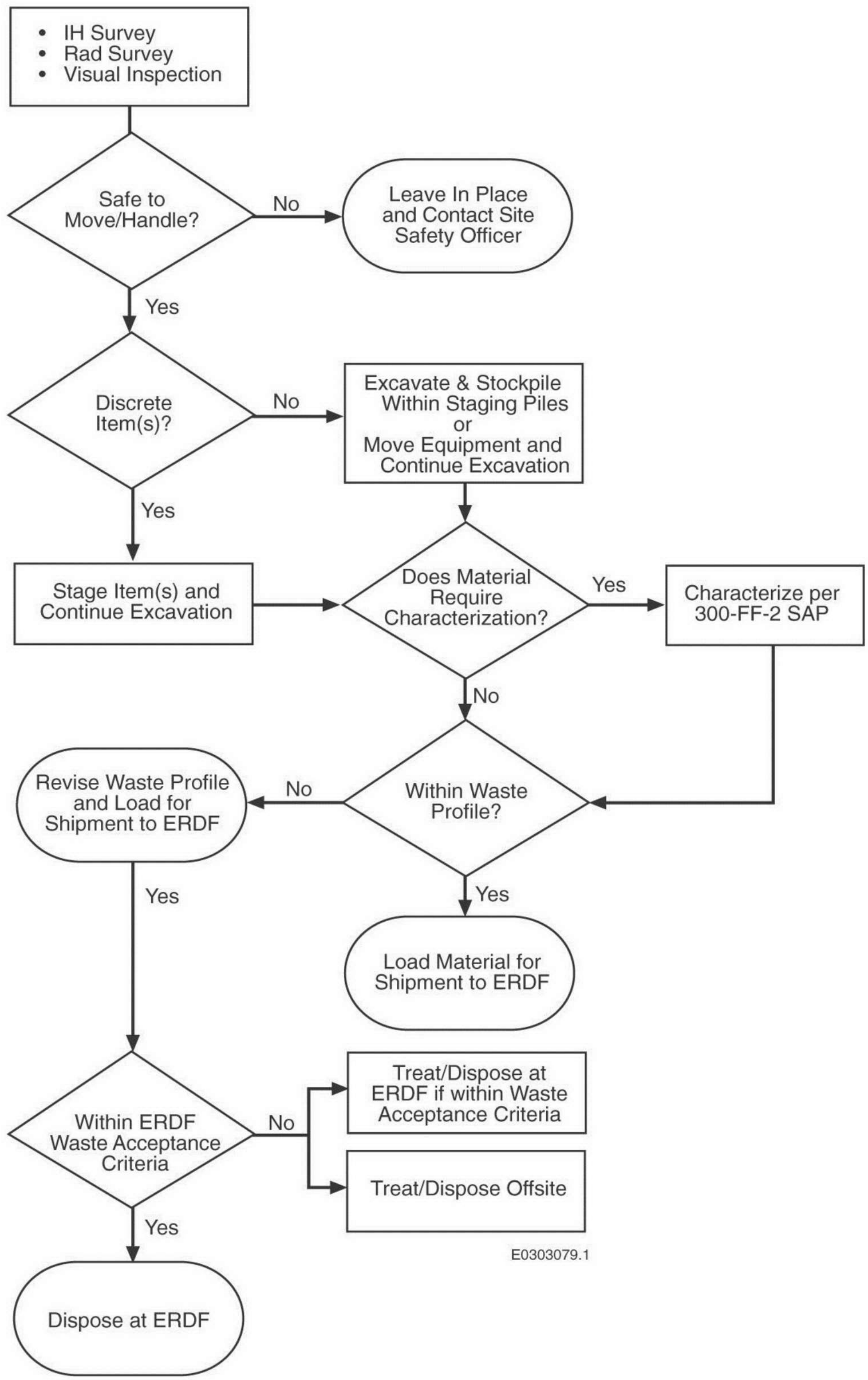


Figure 5-1. Logic Flow Diagram for Disposition of Buried Waste and Co-Mingled Soil

5.2.1 Miscellaneous Solid Wastes

Miscellaneous solid waste that has contacted potentially contaminated materials will be segregated from other materials and will generally be transported to the ERDF for disposal. Miscellaneous solid waste that has not contacted contaminated media and that has been radiologically released may be disposed offsite at a permitted disposal facility, disposed in an onsite limited purpose or inert landfill, or recycled, as appropriate. Examples of miscellaneous solid waste include (but are not limited to) filter paper, wipes, PPE, cloth, plastic, equipment, tools, pumps, wire, metal and plastic piping, and materials from cleanup of unplanned releases.

At the 618-10 and 618-11 Burial Grounds, some nonhazardous miscellaneous solid waste destined for disposal at ERDF is generated in support areas adjacent to the burial ground. For compliance with the nuclear facility fire hazard analyses, this nonhazardous waste may be taken into the burial ground trenches and mixed with soil prior to loading into an ERDF disposal container.

5.2.2 Low-Level Radioactive Waste

Low-level radioactive waste, including soil, concrete, debris, and structures, will be removed during excavation. Plastic, paper, and other compactible waste will also be generated as part of the remediation activities. Debris that has contacted contaminated media may be disposed at the ERDF if the waste acceptance criteria can be met. If the waste acceptance criteria cannot be met, the waste will be shipped to an appropriate offsite facility, depending on the waste designation. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440.

At the 618-10 and 618-11 Burial Grounds, some nonhazardous miscellaneous solid waste destined for disposal at ERDF is generated in support areas adjacent to the burial ground. For compliance with the nuclear facility fire hazard analyses, this nonhazardous waste may be taken into the burial ground trenches and mixed with soil prior to loading into an ERDF disposal container.

At the 618-10 and 618-11 Burial Grounds, nonhazardous radioactive waste may be processed similarly to mixed waste. For example, radiological conditions may warrant that nonhazardous radioactive waste be mixed with grout prior to disposal to mitigate potential personnel exposure and potential for an airborne radioactive material release. In these cases, an approved treatment plan will not be required.

5.2.3 Hazardous and/or Mixed Waste (Both Radioactive and Hazardous)

Hazardous and/or mixed waste that meets the LDR treatment standards and the most current ERDF waste acceptance criteria may be disposed in the ERDF. Wastes that do not meet the ERDF acceptance criteria may be staged until treated to meet the criteria and will be handled on a case-by-case basis. Depending on the waste designation, the waste may be shipped to an appropriate offsite facility deemed acceptable by the EPA in accordance with 40 CFR 300.440.

5.2.4 Spent Nuclear Fuel

Waste identified as suspect SNF will be evaluated against the criteria in applicable DOE orders and guides to determine if the material is, in fact, subject to management as SNF. Waste categorized as SNF is not eligible for disposal at the Hanford Site. Spent nuclear fuel will be transported to the Canister Storage Building facilities in the 200 Area for storage until an offsite facility capable of managing high-level waste becomes available. Any SNF will be packaged directly at the remediation site as necessary for transport to the 212H Canister Storage Building, where additional packaging may be performed for interim storage. In accordance with 40 CFR 300.440, the EPA will approve the receiving facilities for

SNF prior to shipment. Should the Canister Storage Building facilities not be available, other locations may be approved by the EPA on a case-by-case basis (DOE-RL et al. 2005b).

5.2.5 Transuranic Waste

Appropriate characterization, packaging, and processing will be performed to meet the receiving facility waste acceptance criteria and DOT regulations regarding transportation of TRU-contaminated waste. This activity may take place at the Waste Receiving and Processing Facility for contact handled-TRU waste and at a planned future processing facility for remote handled-TRU waste.

5.2.6 Liquid

5.2.6.1 Liquids from Unplanned Releases

If a release occurs, the notification of contractor spill release support is required. The reporting requirements will be met as prescribed by DOE O 232.1A, *Occurrence Reporting and Processing Operations*. The contractor point of contact will determine the actions required to address the spill and determine if the lead regulatory agency needs to be notified.

Spills (unplanned releases) that occur in clean areas that are being used in support of a CERCLA remediation are appropriate for disposal at the ERDF, when the following conditions exist:

1. The spill occurred from equipment supporting the CERCLA activity.
2. The waste meets the ERDF waste acceptance criteria (WCH-191).
3. The spill occurred within the CERCLA OU boundary or onsite area.

A "clean area" is defined as an area supporting a CERCLA remediation activity that is not contaminated with the contaminants of concern found in the active remediation areas (DOE-RL et al. 2007).

Liquid that is not treated to meet the ERDF acceptance criteria will be shipped to the 2025-E Effluent Treatment Facility (ETF) or an appropriate offsite facility. The ETF is an approved noncontiguous onsite facility pursuant to CERCLA Section 104(d)(4) to store and treat liquid waste generated from remedial actions, provided the waste acceptance criteria can be met.

5.2.6.2 Decontamination Fluids

Decontamination fluids (i.e., water and/or nonhazardous cleaning solutions) from cleaning equipment and tools used in the OU may be discharged to the ground in accordance with Section 4.3.2. If decontamination fluids are collected and they are above the collection criteria, they will be designated and transported to the ETF. Small volumes of nondangerous decontamination fluids may be stabilized to eliminate free liquids and then disposed to the ERDF if the waste acceptance criteria can be met.

5.2.6.3 Liquid Remaining in Pipes

Liquids that may remain in pipelines to be remediated will be collected to the extent reasonably practicable, designated, and transported to the ETF or other facility as authorized by the lead regulatory agency. If the liquid is water and contains contaminants in levels below those listed in WAC 173-200 or groundwater cleanup standards in WAC 173-340-720, it may be used as dust suppressant. Water above the WAC 173-200 or WAC 173-340-720 limits may be used as dust suppressant following approval by the lead regulatory agency.

Pipeline removal may be a planned remedial action or an activity made necessary by an unplanned discovery. Projects perform historical research to locate buried pipelines and learn as much as possible about their past functions and what liquids they may currently hold. Based upon that research, and observations and data gathered during remedial action, a graded approach will be used for spill control practices implemented during pipeline removal. The most stringent efforts will be used for pipes containing or expected to contain dangerous waste liquids. To the extent practicable, those pipelines will be tapped and liquids drained, containerized, and properly disposed.

Mitigative measures required in most cases will lie somewhere below those extremes. Spill control practices (spill kits, absorbents, liners, catch basins, etc.) will be used to minimize the quantities of nondangerous waste liquids that may be released to the soil. Pipelines will not be deliberately breached unless their contents are known or measures are in place to positively contain any liquids that may be discharged. Proposed pipeline remediation will be discussed with the regulators so they understand the approach to be used, spill controls that will be employed, and uncertainties or risks of unknown liquids or inadvertent discharges.

5.2.7 Used Oil and Hydraulic Fluids

Used oil and hydraulic fluids generated during operation of machinery at the waste sites will be radiologically released and sent offsite for recycling or disposal, as appropriate, or may be stabilized in accordance with ERDF waste acceptance criteria (WCH-191) and disposed to ERDF if the fluid contacted contaminated media associated with the waste site.

5.2.8 Returned Sample Waste

Screening and analysis of both solid and liquid samples may be conducted at the waste sites, offsite or onsite laboratories, and/or the Radiological Counting Facility. These samples may be returned to the OU. Unused samples and associated laboratory waste from offsite analyses will be managed by the applicable laboratory in accordance with contract specifications. Waste from field screening and onsite laboratories will be managed depending on whether it has been altered by analysis. Altered samples will be contained and disposed at the ETF, ERDF, or other appropriate facilities as authorized by the lead regulatory agency, depending on waste designation. Unaltered liquid waste generated during sample screening and analysis may be discharged to the ground near the point of generation, if it is below the collection criteria limits, or disposed at the ETF, ERDF, or other appropriate facilities if it is above the collection criteria. Some liquids may be neutralized and/or stabilized to meet the disposal facility's waste acceptance criteria. Pursuant to 40 CFR 300.440, DOE-RL approval is required before returning unused samples or waste from onsite or offsite laboratories. Approval of this RDR/RAWP constitutes DOE-RL remedial project manager approval for shipment of offsite and onsite laboratory sample waste back to the waste site of origin.

5.2.9 618-10 and 618-11 Concreted Drums

At the 618-10 and 618-11 Burial Grounds, some high-activity waste and possibly small amounts of plutonium-contaminated liquid waste were sealed in concreted 208-L (55-gal) drums. Some concreted drums also contained an additional 2.5 or 5 cm (1 or 2 in.) of lead shielding. One type of drum had a 20-cm (8-in.)-diameter galvanized metal culvert centered in the 208-L (55-gal) drum, surrounded by concrete on the bottom and sides. The culvert may also have lead wrapped around it, depending on shielding requirements. High-activity liquid or solid waste was placed in the culvert. The culvert was capped with a lead plate and concrete poured in to fill the void space. Another type of drum had the waste placed inside the container and then concrete poured around the containers to provide shielding and to prevent shifting of contents. Opening these concrete drums for examination and processing would present a very high risk due to the radiological contents. If the outer drum is intact and the concrete cap is seen to be intact, the concrete is reasonably expected to be intact. When the concrete in these drums is intact, it meets the macroencapsulation standard of 40 CFR 268.42 for radioactive lead solids. When the outer drum is not intact, but the concrete within the outer drum can be seen as intact on the sides and the top, the concrete can reasonably be expected to be intact. Intact concrete waste will be overpacked with an absorbent filling the annulus between the concreted drum and the overpack drum to preclude migration of potential liquids. In this form, the overpacked drum can be disposed in the ERDF. If the concrete in these drums is not intact, the drums will be overpacked and filled with absorbent. Macroencapsulation will be performed either at the waste site and then disposed at ERDF, or the macroencapsulation treatment will be performed at ERDF prior to disposal.

5.3 Waste Handling, Packaging, and Labeling

Materials requiring collection will be placed in containers appropriate for the material and the receiving facility. Although ERDF containers will be used for most wastes, an alternative "truck and pup" style of container may be used for nonradionuclide-contaminated waste.

Waste moved outside of the AOC must meet all substantive requirements of WAC 173-303 and DOT requirements, as appropriate. In addition, PCB wastes will be managed in accordance with substantive provisions of 40 CFR 761, and asbestos waste will be managed in accordance with 40 CFR 61. Waste will be packaged, marked, and labeled in accordance with ARARs. If waste is determined to be SNF or TRU waste, it will be packaged in accordance with the appropriate criteria as determined at the time of shipment to an approved facility.

5.4 Storage

In general, waste unearthed in support of this RDR/RAWP will be disposed at the ERDF or other approved onsite or offsite facility. As necessary, waste will be stored within the AOC, in onsite container storage areas, in staging piles, or at the ERDF as described in the following subsections.

5.4.1 Area of Contamination

Waste that is excavated and held (i.e., not immediately transported to the ERDF) for further analysis, treatment, or any other reason will be typically managed within the AOC. The AOC approach was discussed in the NCP (55 FR 8666) with regard to remedial actions under CERCLA. The guidance states that the AOC can be equated to a RCRA landfill where movement within the area would not be considered land disposal and would not trigger the requirements of Subtitle C, such as 90-day storage or LDRs. Any movement of soil outside of the AOC but within the CERCLA onsite area will trigger compliance with all ARARs, such as RCRA provisions for management of dangerous waste. The AOC for each waste site will be delineated in the project drawings and are considered part of this RDR/RAWP. These drawings may be provided to the lead regulatory agency upon request.

5.4.2 Container Storage Areas

Items that are not amenable to storage within the AOC, and that can readily and safely be removed (e.g., bagged PPE and sample returns), may be managed outside of the AOC within container storage areas. Container storage will also be used for ancillary waste generated in support of the remedial action (e.g., spill cleanup material). Substantive requirements of 40 CFR Subpart I and WAC 173-303-630 must be met for container storage areas storing regulated dangerous waste. If container management occurs on soil, the area may be subject to sampling after all waste is removed and the area is no longer needed for container management.

5.4.3 Staging Piles

As an alternative to storage within the AOC or in containers, waste that is not immediately transported to the ERDF or other EPA-approved disposal facility may be stored in staging piles. The staging piles must be operated in accordance with the standards and design criteria prescribed in 40 CFR 264.554, paragraphs (d) through (k). General requirements for the staging piles include the following.

- Staging piles are used only during remedial operations for temporary storage at a facility and must be located within the contiguous property where the wastes to be managed in the staging piles originated.
- The SPA must be designed to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment and minimize or adequately control cross-media transfer. To protect human health and the environment, this can include installation of berms, dust control practices, or using plastic liners/covers, as appropriate. A release of a hazardous substance outside the SPA confines into the underlying soil or ambient air will be considered a release into the environment, and immediate notification under CERCLA will be pursued in accordance with 40 CFR 302, if the quantity involved exceeds a reportable quantity over a 24-hour period, and/or in accordance with other regulation(s), as applicable. However, if hazardous substances are discovered within the confines of an approved staging pile, it is not considered a release (DOE-RL et al. 2005a).
- The staging pile must not operate for more than 2 years (measured from the first time remediation waste is placed into the pile), except when the EPA grants an operating term extension. A record of the date when remediation waste was first placed in the staging pile must be maintained until final closeout of the site is achieved.
- Ignitable or reactive waste must not be placed in a staging pile unless it has been treated or mixed before being placed in the pile so that the waste no longer meets the definition of ignitable or reactive waste, or the waste is managed in order to protect it from exposure to any material or condition that may cause it to ignite or react.
- Incompatible wastes may not be placed in the same staging pile, unless the requirements in 40 CFR 264.17(b) have been met. The incompatible materials must be separated or they must be protected from each other with a dike, berm, wall, or other device. Remediation waste may not be piled on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 264.17(b).
- Within 180 days after the operating term of the SPA located in a previously uncontaminated area expires, the SPA must be closed in accordance with 40 CFR 264.258(a) and 40 CFR 264.111, or 40 CFR 265.258(a) and 40 CFR 265.111. This includes removing all remediation waste, contaminated containment system components, contaminated structures and equipment, and leachate.

Approval of this RDR/RAWP by the EPA constitutes general authorization to operate staging piles during remediation of the 300-FF-2 OU. Specific SPA locations will be identified on project drawings and approved by the EPA in unit manager's meetings or other documented means of communication. Field operation of staging piles within the referenced regulatory provisions will be accomplished through the following controls:

- The SPA will be surrounded with a minimum of a 15-cm (6-in.) berm to control run-on/runoff prior to use.

- Dust control practices will be deployed consistent with soil piles managed in the AOC, including the use of crusting agents, as necessary, to minimize migration/leaching or contaminants into underlying soil.
- Surveys of the SPA will be performed prior to waste placement to ensure no cross-media transfer or staging of waste on previously contaminated areas. A staging pile shall be remediated within 180 days after the operating period per 40 CFR 264.554(j) and (k).
- Gross sorting of waste will be performed within the AOC to identify and remove drums or other containers from the bulk soil prior to moving the soil to the staging piles. Additional sorting may be required on bulk soil prior to moving the soil to the SPA. Any dangerous or unknown waste identified will be packaged and managed appropriately (drums) within the SPA and within close proximity to the specific staging pile. Drums will be properly labeled, managed, and inspected weekly, or as described in RCC Project waste management procedures.

Once characterization and designation of the material is completed, the waste will be loaded into containers for transport to the ERDF or shipped on site or off site for treatment and/or disposal, as appropriate. To close out the SPAs after the waste has been removed, samples of the residual soil will be collected in accordance with the current 300 Area SAP; specific sampling details may be presented in a site-specific sampling instruction prepared in accordance with the SAP. In cases where staging piles for industrial waste sites are located in an uncontaminated area, if the sample results meet unrestricted cleanup levels, no further action or assessment is necessary. If the sample results exceed the unrestricted cleanup levels but are below the industrial cleanup levels, institutional controls will be applied to the SPA consistent with a waste site.

5.4.4 Environmental Restoration Disposal Facility Drummed Waste Staging Area

On a case-by-case basis, a staging area may be available at the ERDF for drummed wastes from the 300 Area remedial action sites that require special handling and/or treatment not currently available, such as thermal treatment of a mixed radioactive/dangerous waste. Drummed waste will be characterized at the site prior to transport to the ERDF staging area. All drummed waste sent to the ERDF staging area will be stored in accordance with requirements prescribed by the ERDF ROD amendment (EPA 2002).

5.5 Waste Transportation

Packaging, marking, and labeling for transportation will be in accordance with DOT 49 CFR requirements, procedures, and the ARARs, as appropriate. With appropriate documentation (e.g., safety analysis report for packaging or risk-based exemption), packaging exceptions to DOT requirements that provide an equivalent degree of safety during transportation may be used for waste shipments. Coordination and preparation of these documents will be approved by the DOE-RL. ERDF roll-off-type containers will be used for most bulk wastes. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans. Containers will be sealed and shipped to the identified disposal facility as quickly as economically feasible. Waste will be transported in accordance with WAC 173-303, DOT regulations, and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, as appropriate.

5.6 Waste Treatment

When necessary, treatment is one of the selected remedy elements for the 300 Area waste sites. Treatment may be conducted at the site, at ERDF (in special cases), or at an EPA-approved offsite facility. Remediation of the VPUs at the 618-10 and 618-11 Burial Grounds, which may contain principal threat waste, includes integrated treatment, as described in Section 4.3.2.3.

If LDR wastes are encountered, the requirements of 40 CFR 268 will be applied, unless a treatability variance is approved by the EPA. Offsite treatment must be performed at a facility approved by the EPA in accordance with 40 CFR 300.440. Return of treated waste from offsite treatment facilities for disposal at ERDF will require additional authorization from DOE-RL. Disposal of waste forms at the Waste Isolation Pilot Plant is considered equivalent to land disposal treatment.

Treatment will be required for LDR material unless a treatability variance or ARAR waiver is requested by DOE-RL and approved by the regulatory agencies. If LDR wastes are encountered, the requirements of 40 CFR 268 and WAC 173-303-140 will be applied. Should LDR material be encountered, it will be temporarily stored within the AOC or staging piles and disposed in accordance with applicable regulations. If treatment is required to address LDR wastes, DOE-RL will obtain regulatory agency approval. An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b). Debris material may be treated in accordance with WCH-539, *Treatment Plan for Macroencapsulation of 300-FF-2 Operable Unit Debris*.

Elemental mercury is known to exist in certain 300 Area underground piping systems (e.g., the Retired Radioactive Liquid Waste System). Radiological dose rates associated with these piping systems preclude phase separation (retrieval) of the elemental mercury. Therefore, piping containing elemental mercury will be stabilized by injecting an amended (sulfur-containing) grout. Following stabilization, the segments will be removed and placed in waste packages. The packaged piping debris will then be macroencapsulated with grout prior to disposal at ERDF.

This page intentionally left blank.

6 References

36 CFR 60, "National Register of Historic Places," *Code of Federal Regulations,* as amended.

36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*, as amended.

36 CFR 800, "Protection of Historic Properties," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 264.554, "Staging Piles," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

40 CFR 300, "National Oil and Hazardous Substances Contingency Plan," *Code of Federal Regulations*, as amended.

40 CFR 302, "Designation, Reportable Quantities, and Notification," *Code of Federal Regulations*, as amended.

40 CFR 373, "Reporting Hazardous Substance Activity when Selling or Transferring Federal Real Property," *Code of Federal Regulations*, as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

43 CFR 10, "National American Graves Protection and Repatriation Regulations," *Code of Federal Regulations*, as amended.

49 CFR 100 through 185, "Transportation," *Code of Federal Regulations*, as amended.

50 CFR 83, "Rules Implementing the Fish and Wildlife Conservation Act of 1980," *Code of Federal Regulations,* as amended.

50 CFR 402, "Interagency Cooperation – Endangered Species Act of 1973," *Code of Federal Regulations,* as amended.

55 FR 8666, "National Oil and Hazardous Substances Contingency Plan," *Federal Register,* Vol. 55, No. 46, p. 8666.

Archeological and Historic Preservation Act of 1974, 16 U.S.C. 469-469c, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE O 232.1A, *Occurrence Reporting and Processing Operations,* as amended, U.S. Department of Energy, Washington, D.C.

DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets*, as amended, U.S. Department of Energy, Washington, D.C.

DOE/EIS-0222-F, 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005, *Action Memorandum #1 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2006a, *Action Memorandum #2 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland ,Washington.

DOE-RL, 2006b, *Action Memorandum #2 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland ,Washington.

DOE-RL, Ecology, and EPA, 2005a, *100 Area Unit Managers' Meeting Minutes*, CCN 123732, dated June 23, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2005b, *100 Area Unit Managers' Meeting Minutes*, CCN 128832, dated December 5, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2005c, *100 Area Unit Managers' Meeting Minutes*, CCN 129623, dated July 28, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2007, *100 Area Unit Managers' Meeting Minutes*, CCN 133749, dated April 12, 2007, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE/RL-94-150, 2013, *Bald Eagle Management Plan for the Hanford Site, South Central Washington*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-32, 2001, *Hanford Site Biological Resources Management Plan*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-19, 2002, *Mitigation Action Plan for the 300 Area of the Hanford Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-73, 2005, *324 Building Radiochmeical Engineering Cells, High-Level Vault, Low-Level Vault, and Associated Area Closure Plan*, Rev. 3, U.S Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-36, 2011, *Hanford Sitewide Transportation Safety Document*, Rev. 1E, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-41, 2009, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-47, 2009, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* , Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-48, 2011, *300 Area Remedial Action Sampling and Analysis Plan*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-77, 2007, *Removal Action Work Plan for 300 Area Facilities*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-21, 2011, *River Corridor Baseline Risk Assessment, Volume II: Human Health Risk Assessment*, Volume II, Parts 1 and 2, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2014-13, *Integrated Remedial Design/Remedial Action Work Plan for the 300 Area (300-FF-1, 300-FF-2, & 300-FF-5 Operable Units)*, Rev. 0, U.S. Department of Energy, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order,* 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1989, *Risk Assessment Guidance for Superfund (RAGS)*, Volume I – Human Health Evaluation Manual (HHEM) (Part A Baseline Risk Assessment), Interim Final, Office of Emergency and Remedial Response, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1996, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington*, July 1996, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, April 2001, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2002, *Amended Record of Decision for the Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Migratory Bird Treaty Act of 1918, 16 U.S.C. 703, et seq.

OSWER Directive 9285.7-55, 2003, *Guidance for Developing Ecological Soil Screening Levels*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended.

WAC 173-200, "Water Quality Standards for Ground Waters of the State of Washington," *Washington Administrative Code*, as amended.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 2007.

WAC 173-350, "Solid Waste Handling Standards," *Washington Administrative Code*, as amended.

WAC 173-400, "Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," *Washington Administrative Code*, as amended.

WAC 232-12-292, "Habitat Buffer Zone for Bald Eagles," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended.

WCH-126, 2007, *600 Area Remediation Design Solution Waste Packaging, Transportation, and Disposal Requirements*, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH-127, 2007, *600 Area Remediation Design Solution Technology Assessment and Deselection Report*, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH-191, 2014, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* Rev. 3, Washington Closure Hanford, Richland, Washington.

WCH-539, 2013, *Treatment Plan for Macroencapsulation of 300-FF-2 Operable Unit Debris*, Rev. 2, Washington Closure Hanford, Richland, Washington.

Appendix A

300 Area Waste Site Information

This page intentionally left blank.

A1. 300 Area Waste Site Summary

A summary of the 300-FF-1 and 300-FF-2 Operable Unit waste sites that have undergone or will be undergoing remedial design and remedial action are presented in this appendix as Table A-1. The information for waste sites that are included in Table 1 of the *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (300 Area ROD) (EPA 2013) identifies the decision under that ROD, and their dispositioning under earlier RODs (EPA 1996, 2001). The 300 Area ROD was developed concurrently with ongoing remedial actions; as a result, 43 sites remediated or evaluated under the interim action ROD (EPA 2001) were not quantitatively evaluated in development of the 300 Area ROD. These sites therefore have a remediation decision under the 300 Area ROD, which is reflected in Table A-1. However, further activities for these waste sites may be limited to verification that interim actions taken remain protective under the 300 Area ROD requirements.

Since the 300-FF-2 ROD in 2001, sites remediated using the plug-in approach were documented in Explanations of Significant Difference (ESDs) (EPA 2004, 2009). A third ESD (EPA 2011) addressed waste handling considerations and did not include any documentation of additional sites considered with the plug-in mechanism. The 2009 ESD (EPA 2009) also included a change in the way plug-in waste sites were reported. The new provision authorized that additions of plug-in and candidate sites would be documented in annual "Fact Sheets" included in the Tri-Party Agreement Administrative Record.

Fact sheets were published annually in 2010, 2011, and 2012 by the U.S. Department of Energy to identify the plug-in and candidate sites that met the criteria to add them to the 300-FF-2 ROD (EPA 2001). Waste sites that were added in this manner are documented in the following references:

- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2010* (DOE-RL 2010)
- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2011* (DOE-RL 2011).
- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2012* (DOE-RL 2012).
- No fact sheet was issued for fiscal year 2013.

Information related to current site knowledge and status was also compiled from the following resources:

- Waste Information Data System (WIDS)
- Stewardship Information System (SIS)
- BHI-00012, *300-FF-2 Operable Unit Technical Baseline Report*
- BHI-00768, *100 and 300 Area Burial Ground Remediation Study*
- DOE/RL-96-42, *Limited Field Investigation Report for the 300-FF-2 Operable Unit*
- DOE/RL-99-40, *Focused Feasibility Study for the 300-FF-2 Operable Unit*
- OSR-2010-0002, *300 Area Orphan Sites Evaluation Report.*

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300 RLWS, 300 Area Radioactive Liquid Waste Sewer	Consists of a network of underground, double-encased stainless-steel pipe (encased in reinforced-fiberglass or plastic pipe as secondary containment) draining to the 340 Complex. Replaced the original radioactive liquid sewer (300 RRLWS, Retired Radioactive Liquid Waste Sewer) in 1979.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300 RRLWS, 300 Area Retired Radioactive Liquid Waste Sewer System	A network of 5-, 8-, 10-, and 15-cm (2-, 3-, 4-, and 6-in.) single-walled stainless steel piping and carbon steel fittings buried between 3 and 6 m (10 and 20 ft) below grade. A separate 8-cm (3-in.) carbon steel transfer line installed in 1960 connected the 309 Building to the 340 Complex. The system was replaced with the double-encased pipe of the 300 Area Radioactive Liquid Waste System (300 RLWS).	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300 VTS, 300 Area Vitrification Test Site	The site was used in the 1980s and 1990s as a field demonstration site for the vitrification (glassification) of soils containing waste simulates.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00009. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action.
300-1, Old N. Richland Auto Maintenance Yard	Reclassified to "No Action" by WSRF 98-081, 2/24/1999. No Decision Document.	300 Area ROD (EPA 2013), No Additional Action.
300-2, Contaminated Light Water Disposal	Contaminated Light Water Disposal Site. On September 29, 1965, a major contamination event occurred at the 309 Building, Plutonium Recycle Test Reactor (PRTR). When radionuclide contamination (due to neutron activation) was detected in the secondary coolant water stream going to the Columbia River, the water was pumped to the ground. About 189,250 L (50,000 gal) of secondary coolant water containing short-lived radionuclides was disposed to the ground. At no time did release of reactor material (transuranics or fission products) to the secondary coolant occur. Also see 300-283.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Also see 300-283. No Action. WSRF 2013-039, RSVP CCN 171178. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-4, Substation Soil Contamination	The site consists of the contaminated soil inside the southwest corner of the fenced (active) electrical substation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-5, Fire Station Fuel Tanks, Fire Station	The site was two underground fuel tanks, the pump island, ancillary piping, and contaminated soil. The tanks were removed in 1992.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-6, 366/366A Fuel Oil Bunkers	This site is the former location of four fuel oil underground storage tanks. Residual petroleum-related soil contamination remains with potential radiological contamination from adjacent waste sites. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-7, Undocumented Solid Waste Burial Ground	The site is a small rise that extends to the north and west from the 300 Area North Parking Lot. Surface debris piles can be seen and subsurface disturbances have been identified with ground-penetrating radar. Currently, the site is covered with natural vegetation. Some of the visible surface debris consists of concrete, trash, and cables.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-8, Aluminum Recycle Storage Area	The site consisted of six irregularly shaped soil contamination areas. The area was used to stage aluminum scrap from fuel fabrication operations to be sold to salvage contractors.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-9, Solid Waste Burial Ground	In 1952, an area of contamination was accidentally uncovered while installing poles for a new power line. This burial ground was supposedly used to dispose of solid uranium waste in 1944.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-10, Burial Trench West of Process Trenches	Reclassified to “Closed Out” by WSRF 99-105, 12/17/1997. TPA change form (Control Number 116) lists the site as Closed Out.	300 Area ROD (EPA 2013), No Additional Action.
300-11, Pumphouse Underground Gasoline Tank	The site was releases to the soil that were discovered following the removal of an underground gasoline tank in September 1992.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-15, 300 Area Process Sewer System	The site is an underground process sewer extending throughout the 300 Area for the disposal of process wastes such as steam condensate, cooling water, and nonregulated liquids. The piping consists primarily of 20-cm (8-in.) vitrified clay pipes with acid-proof joints, as well as cast-iron, stainless-steel, carbon steel, and polyvinyl chloride. 300-15:2 Process Sewer North of Apple St.; Remediated and Interim Closed Out; RSVP CCN 170618; WSRF 2012-120, 3-21-13.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). See subsites. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-16, Solid Waste Near 314 Building	On March 6, 1992, May 4, 1994, and September 22, 1995, radioactive contamination (yellow-cake uranium) was discovered on the bottom ends of several utility poles that had been removed. 300-16:1 Utility Pole NW of 314 Bldg. Interim Closed Out, RSVP CCN 163709, WSRF 2011-105, 1-18-2012. 300-16:2 Utility Pole East of 314 Bldg; Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300-16:3 Utility Pole SE of 314 Bldg; Remediated and Interim Closed Out; RSVP CCN 162824, WSRF 2011-100, 11-28-2011.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). See subsites. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-18, SCA #4, Surface Contamination Area #4	The site was identified during routine surveillance activities in 1993 as soil and metal shavings with contamination levels of 3,000 to 4,000 disintegrations per minute and six pieces of contaminated concrete reading 2,000 to 4,000 disintegrations per minute.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed. See CVP-2005-00004. 300 Area ROD (EPA 2013), No Additional Action.
300-22, 309 Building B-Cell Cleanout Leak	The site is an unplanned release from a parted hose coupling that contaminated the ground outside the emergency airlock of the 309 Building on September 20, 1962.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-24, Soil Contamination at the 314 Metal Extrusion Building	The oxide burner operations caused contamination to spread and be deposited on the south side of the facility near the southwest corner of the building and outside the door to the facility. WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-28, Contamination Found Along Ginko Street	Contaminated asphalt and soil beneath Ginko Street found during excavation activities associated with the installation of a fiber optic telephone system in 1994. WSRF includes 300-28, 300-43, 300-48, 300-249, and 300-16:3 waste sites (300-161 removed; rejected 98-180).	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-29, 305-B Berm	The site was a U-shaped soil berm that surrounded the east wing of the 305-B Chemical Waste Storage Building.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was reclassified to no action per WSRF 2004-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-32, 333 Building Remaining Soils after D&D	This site is the former 333 N Fuels Manufacturing Building; New Fuel Cladding Facility. The remaining concrete slab and associated piping have been removed. RTD memo CCN 164401. EPA remediation and sampling approval CCN 169058.	Candidate Waste Site; 300-FF-2 ESD (EPA 2009). Went RTD CCN 164401. Interim Closed Out; RSVP CCN 170617; WSRF 2013-006, 3-21-13. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-33, 306W Metal Fabrication Development Building Releases. (With 300-256 and 300-41)	The site is the contaminated soil around and under the 306W Building. The area around the 306W Building is paved and posted as having underground radioactive contamination.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2010-058. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-34, 300 Area Process Sewer Leak	The site was a release to soil that was discovered during excavation to install a new manhole (PS-87). PS-87 is a 0.7-m (2.3-ft)-diameter sewer opening with a round metal cover at grade.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-37	PCB Leak to Soil at 335A. WSRF 2013-108 CCN 172456. 8/15/2013.	Rejected.
300-39	309 Bldg. Fuel Storage Basin. WSRF 2013-096 CCN 172455. 8/13/2013.	Rejected.
300-40, Corroded Vitrified Clay Process Sewer Pipe	This leg of pipe collected rain water drainage from the 311 Tank Farm and the 303-F floor drains. The piping also collected effluent from the 311 Stillhouse. WSRF includes 300-40, UPR-300-40, UPR-300-39, UPR-300-45 Waste Sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-41, 306E Neutralization Tank. (With 300-33 and 300-256)	The site consists of a neutralization tank and valve pit. The tank may contain uranium and thorium sludge.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2010-058. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-43, Unplanned Release Outside 304 Building	The site is uranium-contaminated soil around the 304 Building (formerly the 304 Concretion Facility) in the 300 Area. The site also includes residual contamination remaining in the 304 Storage Area (304 SA). WSRF includes 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180)	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-45, Bird Droppings Area	Reclassified to “Closed Out” by WSRF 99-110, 5/13/1998. TPA change form (Control Number 118) lists the site as Closed Out.	300 Area ROD (EPA 2013), No Additional Action.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-46, Soil Contamination and French Drains Surrounding 3706 Building	This site estimates the extent of uranium, transuranic and chemical contamination of the 3706 Building and the surrounding area. Remediated and Interim Closed Out; RSVP CCN 171316; WSRF 2013-007, 5/17/13.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 171316; WSRF 2013-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-48, Thorium Oxide and Fuel Fab Chemical Wastes Around 3732 Building	This site is the 3732 Building foundation and the surrounding soil contamination. The site appears as a gravel-covered mound. WSRF includes 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180)	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Also in the 300-FF-2 ROD. Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-53, UPR East of 303-G	Reclassified to “Closed Out” by WSRF 99-014, 2/12/1999.	300 Area ROD (EPA 2013), No Additional Action.
300-57	335 90-Day Waste Accumulation Area. WSRF 2013-104 CCN 172456. 8/15/2013	Rejected
300-80, incorrectly described as 314 Building Stormwater Runoff, Misc Stream #268	The site was a square concrete structure adjacent to the 314 Building and next to a fenced stairway leading down. The site was covered by a steel plate marked with a sign “Radioactive material, internally contaminated.” WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-109, 333 Building Stormwater Runoff, Misc Stream #455	DOE/RL-95-82, *Inventory of Miscellaneous Streams*, states the injection well is below grade. A site visit on October 26, 1998, could not visually identify any surface features resembling a drain north of the 333 Building. The site was revisited on November 11, 1998, with a facility representative. A white PVC pipe emerges laterally from the asphalt in the approximate location described in DOE/RL-95-82, *Inventory of Miscellaneous Streams*.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim closed out. See CVP-2010-00004. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-110, 333 Building Stormwater Runoff, Misc Stream #456	The site is a 0.41-m (1.4-ft)-diameter drain with a metal grate labeled “Internal Radioactive Contamination” due to its proximity to the 618-1 Burial Ground. The drain has a dirt bottom that is approximately 0.61 m (2 ft) below the surface of the asphalt and an overflow line that drains to the process sewer.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-121, 3621D Building Stormwater Runoff, Misc Stream #403, Injection Well #26	The site is a french drain with a concrete base. The drain is covered by a 1.4-m (4.5-ft) metal lid. The lid appears to fit flush with the concrete base and is labeled “Confined Space” and has “FD 26” written on it. The site is surrounded by sandy soil and rocks.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-123, 366 Bldg. Fuel Oil Bunker Loading Station French Drain	The site is a french drain that received steam condensate from the 366 Building fuel oil bunker loading station. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-161	3707D Building Stormwater Runoff, Miscellaneous Stream #441. Remediated with 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180).	Rejected; WSRF 98-180. Remediated with 300-28 RSVP, WSRF 2011-100, 10-31-2011.
300-175, 3714 Building Steam Condensate, Misc Stream #434	The site is a 36-cm (14.2-in.)-diameter concrete french drain with a metal cover. The inside is dry and filled with cobbles. There are no steam lines entering the site, and no steam lines are visible inside the drain.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-214, 300 Area Retention Process Sewer	The site is an underground carbon steel and polyvinyl chloride pipeline connecting the 300 Area laboratory facilities (308, 324, 325, 326, 327, and 329 Buildings) to the 307 Retention Basins. The Retention Process Sewer (RPS) provides radioactive monitoring and transport of nonhazardous, potentially radioactive process waste.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-218, 314, 314A, and 314B Buildings	This site consists of the former 314 and 314A Building areas. All above-grade portions of the buildings have been demolished, but below-grade portions are suspected of being contaminated. WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-219, 300 Area Waste Acid Transfer Line	This site consists of the transfer lines connecting the various components of the 300 Area Acid Treatment Plant (WATS) and the 300 Area Uranium Recovery Operations. Remediated with 300-224 WATS and 333 WSTF.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-223	384 Powerhouse Day Tanks. WSRF 2001-042 CCN 171757. 7/8/2013.	Final Closed Out.
300-224, WATS and U-Bearing Piping Trench	The site is a subsurface concrete pipe trench with concrete block and metal plate covers. The pipe trench has several sections that allow piping connections to be made between process operations in the 313 Building, the 303-F Building, the 311 Tank Farm, the 333 Building, the 334-A Building, and the 334 Tank Farm. Remediated with 300-219 and 333 WSTF.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-231, Transformer Pad	Vitrification Test Site Transformer Pad. WSRF 2013-109 CCN 172456. 8/15/2013	Consolidated.
300-249, 304 Building, Residual Rad Contamination	304 Building, Residual Rad Contamination. WSRF includes 300-28, 300-43, 300-48, 300-249, and 300-16:3 waste sites (300-161 removed; rejected 98-180).	Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-251, Unplanned Release Outside 303-K Building	The site consists of uranium contaminated soil around and under the 303-K Building (also known as the 303-K Contaminated Waste Storage). The 303-K Building was removed and clean closed on July 22, 2002.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2011-042. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-253, 384-W Original Brine Pit	Reclassified to "No Action" by WSRF 99-042, 5/26/1999.	300 Area ROD (EPA 2013), No Additional Action.
300-255, 309 Tank Farm Contaminated Soil	The site is contaminated soil located inside the 309 Building Tank Farm fenced area. The source of the contamination was probably the piping related to tanks 309-TW-1, 309-TW-2, and 309-TW-3.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-256, 306E Fabrication and Testing Laboratory Releases. (With 300-33 and 300-41)	The site is contaminated soil under and around the 306E Building. The area around the 306E Building is paved and posted as having underground radioactive contamination.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2010-058. 300 Area ROD (EPA 2013), No Additional Action. Reclassify to Final Status.
300-257, 309 Process Sewer to River	The site is process sewer piping that was originally connected to the 309 Buildings Rupture Loop Holding Tank. The tank was removed in the late 1970s, but the piping remains. RESRAD calc brief done for outfall (overflow) to the river.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). No Action. WSRF 2010-074; RSVP CCN 171702, 6/27/13. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-258, Abandoned Pipe Trench	The site is an abandoned subsurface concrete pipe trench. The top of the pipe trench is level with the ground surface and is covered with metal plates to allow vehicle traffic on the north side of the 306E Building to drive over the pipe trench. Between the 333 Building fence and the 334 Tank Farm, the trench is primarily surrounded by gravel.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2011-082. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-259, Contamination Area Surrounding 618-1 Burial Ground	The Contamination Area is located in the northeast corner of the 300 Area, north and east of the 618-1 Burial Ground.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2009-059. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-260, Contaminated Soil West of 313 Building	The site is currently surrounded by light posts and a yellow rope, but no signs of any kind are present. A small amount of equipment and large wooden boxes are stored inside the roped area.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). No Action. See WSRF 2010-074; CCN 155798. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-262, Contaminated Soil West of South Process Pond	The contaminated soil was discovered in 1994 during excavation activities to install a utility pipeline.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and closed. See CVP-2003-00002. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-263, 324 Building Diversion Tank	The site is an inactive catch tank. The tank was set up to hold contaminated process solutions that were too hot to send directly to the crib without additional treatment. After the tank was put on line, it was intended to be used as a diversion tank in the event of a radioactive release from the facility (324 Building). Shortly after the tank was installed, the 340 Complex came on line. At that time, the piping system to the diversion tank in the 324 yard was bypassed and capped. Since that time, the 324 Building has transferred its waste to the 340 Complex.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-264, 327 Building Post Irradiation Testing Laboratory (PTL)	The 327 Building was demolished by D4 in May 2012 with residual soil contamination removed in June 2012. DOE-RL and EPA agreed that GPERS surveys and radiological soil samples were sufficient for Interim Close Out. WSRF 2012-038, CNN 166408, 6/13/2012.	RTD Waste Site; Action Memorandum (DOE-RL 2006). Remediated and Interim Closed Out. See WSRF 2012-038, CCN 166408, 6/13/2012. Rejected, WSRF 2013-110 CCN 172455. 8/13/2013.
300-265, Pipe Trench Between 324 and 325 Buildings	The site is a 5-cm (2-in.) underground encased stainless-steel waste transfer line encased within a 10-cm (4-in.) fiberglass-reinforced epoxy pipe. Inside the pipeline are two other stainless-steel Schedule 40 pipes, one is 3/8 in. and the other is 3/4 in.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-268, 3741 Building Foundation	The contamination related to this building was a result of passive dust from machining irradiated uranium, graphite, and other metallic samples from the 305 Test Pile. The contamination, if remaining, would be associated with any remaining concrete foundation. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-269, 331-A Virology Laboratory Foundation	The site is a rectangular concrete building foundation. Air conditioner units are installed on the concrete foundation to support the adjacent 331 facility.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-270, Unplanned Release at loading dock east of 313 Building	The “unplanned release” is a milky-white flow of water that came out of a pipe located below the loading dock on the east side of the 313 Building. The pipe drains stormwater from the roof of the 313 Building. The release was on to the surface of the ground, in an area of compacted gravel and soil. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-006. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-273, Fuel Oil Transfer Pipeline	This site is an encased underground pipeline that transferred fuel oil from the 366 fuel oil bunkers to underground day tanks at the 384 Powerhouse. Remaining soils also have the potential for radiological contamination from adjacent waste sites. WSRF 2011-107 includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-274, Surface Debris	This site consists of surface debris (transite, wood, asphalt, metal, and broken glass) located across the 300-FF-1 Operable Unit. The segment of the 300-274 waste site near the 618-4 Burial Ground was found to contain PCB oil-stained soil to a depth of 4.6 m (15 ft).	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; WSRF CCN 171182; WSRF 2011-091. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-275, Potential Landfill on River Edge	This site consists of surface debris (asbestos-containing shingles and concrete, trash) and subsurface debris of unknown type.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Site has been remediated and interim closed. See WSRF 2008-059. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-276, 3607 Sanitary System Misc. Components	The site includes the surface and subsurface sewer system components downstream of manhole SS6. Remediated and Interim Closed Out; RSVP CCN 162933; WSRF 2011-102.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Interim Closed Out. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-277, 300 Area Queue Soil Contamination	300 Area Queue Soil Contamination.	Accepted Site. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-279, 3716 Automotive Repair Building Fuel Tanks.	3716 Automotive Repair Building Fuel Tanks. No Action. See WSRF 2012-034, RSVP CCN 166822, 7/16/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-280, Construction Debris Disposal Pit	Construction Debris Disposal Pit West of George Washington Way.	Candidate Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-281, Suspected Septic Tank	Suspected Septic Tank Near 325 Building. No Action. See WSRF 2012-036, CCN 166635, 7/5/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-282, Crib Near 3717-B Building	Crib Near 3717-B Building. Rejected. See WSRF 2011-052, 6/8/11, CCN 159272.	Candidate Waste Site. Rejected. DOE-RL 2011, 300 Area Fact Sheet. Not included in 300 Area Final ROD.
300-283, Contaminated Light Water Disposal Site #2.	Contaminated Light Water Disposal Site #2. On September 29, 1965, a major contamination event occurred at the 309 Building, Plutonium Recycle Test Reactor (PRTR). When radionuclide contamination (due to neutron activation) was detected in the secondary coolant water stream going to the Columbia River, the water was pumped to the ground. About 189,250 L (50,000 gal) of secondary coolant water containing short-lived radionuclides was disposed to the ground. At no time did release of reactor material (transuranics or fission products) to the secondary coolant occur. Also see 300-2.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. Also see 300-2. No Action. See WSRF 2012-053, RSVP CCN 166820, 7/16/2012. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-284, Sandblasting Area Near 3221 Building	Sandblasting Area Near 3221 Building. Residue removed by other remediation in the area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-285	300 Area Steam Condensate French Drains/Dry Wells, Ten French Drains and Dry Wells in 300 Area.	Not Accepted.
300-286, Potentially Contaminated French Drain	Three 300 Area Potentially Contaminated French Drain/Drywells. No Action. See WSRF 2012-037, RSVP CCN 166821, 7/16/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-287, Transite Debris West of Route 4 South	Transite Debris West of Route 4 South.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
300-288, Garnet Sand in Gravel Pit 6	Piles of Garnet Sand/Soil Mixture Within Gravel Pit 6.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-289, Stained Soil Area North of 300 Area	Stained Soil Area North of 300 Area.	Candidate Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-290, Rad Debris Area East of Horn Rapids Landfill.	Radiological Debris Area East of Horn Rapids Disposal Landfill. This site consists of debris, mostly rusted metal automotive parts, scraps of crumpled sheet metal, electrical wire debris, and engine gaskets in a posted Radiological Material Area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
300-291, Garnet Sand West of 350-A Paint Shop	Garnet Sand West of 350-A Paint Shop.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-292	315 Water Filter Plant Waste Pipeline Segments.	Rejected per WSRF 2011-038. CCN 165748. No ROD or ESD. Reclassify to Final Status.
300-293, 300 Area Misc. Pipelines.	300 Area Misc. Pipelines. The site was divided into two subsites: 300-293:1, 300 Area Misc. Pipelines - less than 2.5 ft bgs; No Action per WSRF 2011-056, 6/22/2011; CCN 160008. 300-293:2, 300 Area Misc Pipelines - greater than 2.5 ft bgs. No Action. See WSRF 2012-030, RSVP CCN 166650.	Candidate Waste Site. No Action. See Subsites. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-294, Garnet Sand East of 350 Building.	Garnet Sand East of 350 Building. Residue removed by other remediation in the area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-295	384 Powerhouse Coal Ash Waste Pipeline Segments.	Rejected per WSRF 2011-039. CCN 165749. No ROD or ESD. Reclassify to Final Status.
300-296, Soil Contamination Under 324 Bldg B-Cell	Soil Contamination Under 324 Bldg B-Cell Sump.	Accepted Site. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
303-MSA, 303-M Storage Area	The storage pad was painted (including the curbs and area within about 0.9 m [3 ft] outside the curb) to fix all radioactive contamination. The storage pad was posted with “fixed radioactive contamination” signs on its surface.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
303-M UOF, 303M Uranium Oxide Facility	The facility was used to oxidize pyrophoric uranium metal turnings and chips and zircalloy-2 fines generated during fuel fabrication machining operations in the 333 Building. The metal turnings were received in 114-L (30-gal) drums filled with water for fire prevention. The metal turnings were removed, screened, hand fed into a shredder/chopper, and small bags of metallic fines were placed inside a burner chamber for oxidation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
305-B SF, 305-B Storage Facility	The 305-B Storage Facility was used to store, segregate, repackage, and sample hazardous and radioactive mixed waste generated by Pacific Northwest National Laboratory (PNNL) research laboratories in the 300 Area. (TSD Facility; EPA Signature Not Required on WSRF.)	Closure activities completed by WCH 8/7/2006 per WSRF 2008-051 in the Administrative Record. Letters #0070792 #0079299. Also see CCN170838. Final Closed Out per WSRF 2008-051 CCN 171756. 7/8/2013.
307 RB	307 Retention Basins. WSRF 2013-103 CCN 172455. 8/13/2013.	Rejected.
309-TW-1	309 Holdup Tanks, Tank #1. WSRF 2013-097 CCN 172455. 8/13/2013.	Rejected.
309-WS-1	309 Plutonium Recycle Test Reactor Vault. WSRF 2013-100 CCN 172455. 8/13/2013.	Rejected.
309-TW-2	309 Holdup Tanks, Tank #2. WSRF 2013-098 CCN 172455. 8/13/2013.	Rejected.
309-WS-2	309 Rupture Loop Annex (Rm. 20) . WSRF 2013-101 CCN 172455. 8/13/2013.	Rejected.
309-TW-3	309 Holdup Tanks, Tank #3. WSRF 2013-099 CCN 172455. 8/13/2013.	Rejected.
309-WS-3	309 Brine Tank. WSRF 2013-102 CCN 172455. 8/13/2013.	Rejected.
311 MT1, 311 Tank Farm Methanol Tank #1	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
311 MT2, 311 Tank Farm Methanol Tank #1	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
311-TK-40	300 Area Waste Acid Treatment System (WATS). WSRF 2001-100 CCN 171755. 7/8/2013.	Final Closed Out.
311-TK-50	300 Area Waste Acid Treatment System (WATS). WSRF 2001-101 CCN 171755. 7/8/2013.	Final Closed Out.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
313 ESSP, 313 East Site Storage Pad	The site is a large concrete pad with an asphalt ramp that connects the pad to Ginko Street. Previously, the site staged radiological waste from 313 Building operations and, during fuel fabrication operations, staged mixed waste from the 313 Centrifuge and uranium waste from the 313 Filter Press. The unit was also used to stage raw materials received by rail cars. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-005. 300 Area ROD (EPA 2013), Reclassify to Final Status.
313 MT, 313 Bldg. Methanol Storage Tank	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
316-1, South Process Pond	South Process Pond.	EPA 1996, CVP-2003-00002, Interim Closed Out, WSRF 2000-112. 300 Area ROD (EPA 2013), Enhanced Attenuation.
316-2, North Process Pond	North Process Pond.	EPA 1996, CVP, BHI-01298 Closed Out, WSRF 99-050. 300 Area ROD (EPA 2013), Enhanced Attenuation.
316-3, 307 Disposal Trenches	The site consisted of two trenches, each 180 m (600 ft) long, 9.1 m (30 ft) wide at the east end, tapering to 3.0 m (10 ft) wide at the west end. The depth varied from 3.7 m (12 ft) to 8.2 m (27 ft). Each contained a 13-cm (5-in.) vitrified clay pipe that ran the entire length of the unit. The trenches ran in an east and west direction, approximately 6.1 m (20 ft) apart. From 1953 to 1963, effluent below discharge limits was released from the 307 Retention Basins and discharged to these trenches. When the trenches were taken out of service in 1963 the contaminated sediments were excavated and transported to the 618-10 Burial Ground. The trenches were backfilled with process pond scrapings in 1965, and a large portion of the location has been paved and fenced. In 1991 three boreholes were drilled through the trenches. Contamination was only found in the backfill.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. WSRF 2012-099. RSVP CCN (Pending). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels, Enhanced Attenuation.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
316-4, 321 Cribs, 300 North Cribs, 316-N-1, 616-4)	The site consists of two bottomless tanks buried 3 m (10 ft) below grade and resting on gravel strata. The tanks are 0.6 m (2 ft) apart, with a stainless steel overflow pipe connecting them just below the top of each tank. A total of 895.4 kg (1,974 lb) of uranium was discharged to the cribs as uranium-bearing organic wastes from the 321 Building between 1948 and 1954.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site partially excavated, tanks removed and backfilled; deep soil contamination remains. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
316-5, 300 Area Process Trenches	300 Area Process Trenches.	EPA 1996, CVP, BHI-01164 Closed Out, WSRF 98-108. 300 Area ROD (EPA 2013), Enhanced Attenuation.
331 LSLDF, Life Sciences Lab Drain Field	The site consists of an abandoned drain field. The unit is fed by one diversion box and four septic tanks. The unit discharged sanitary wastewater, and potentially animal waste, to the soil column. The site was abandoned in place after the waste system was connected to the 300 Area Sanitary Sewer.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). No Action; RSVP CCN 141797; WSRF 2008-020. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
331 LSLT1, Life Sciences Lab Trench No. 1	The site is an abandoned leaching trench that has been backfilled. The site was a rectangular excavation and includes connecting waste transfer lines. The 331 Leaching Trenches disposed of sanitary and animal wastes to the soil column.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
331 LSLT2, Life Sciences Lab Trench No. 2	The site is an abandoned leaching trench that has been backfilled. The site was a rectangular excavation and includes connecting waste transfer lines. The 331 Leaching Trenches disposed of sanitary and animal wastes to the soil column.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
333 ESHWSA, East Side Hazardous Waste Storage Area	The storage area is part of the asphalt paved area near the northeast corner of the 333 Building, within the building fence line. The area provided temporary storage for miscellaneous hazardous wastes in barrels, buckets, cans, and/or drums.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
333 LHWSA	618-1 Burial Ground, 618-1:1, 618-1:2, 333 LHWSA, UPR-300-13, UPR-300-14.	Remediated and Interim Closed Out with 618-1. See CVP-2010-00001. WSRF 2010-028. Reclassify to Final Status.
333-TK-7	300 Area Waste Acid Treatment System (WATS). WSRF 2001-109 CCN 171755. 7/8/2013.	Final Closed Out.
333-TK-11	300 Area Waste Acid Treatment System (WATS). WSRF 2001-105 CCN 171755. 7/8/2013.	Final Closed Out.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
333 WSTF, 333 West Side Tank Farm.	333 West Side Tank Farm. The site was an above-grade tank farm containing three cylindrical tanks that stood upright within a concrete containment basin. Remediated with 300-218 and 300-224 WATS.	RTD Waste Site; See DOE-RL 2011, 300 Area Fact Sheet. Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.
340 Complex, 340 Radioactive Liquid Waste Handling Facility	The 340 Complex consists of the 340, 340-A, 340-B, and 3707-F Buildings, and two office trailers. Other 340 complex systems include the 307 Retention Basins, two tanks in an underground vault, six aboveground tanks in 340A, underground transfer pipes, load-out and decontamination equipment, and instrumentation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
3712-USSA, 3712 Bldg. Uranium Scrap Storage Area.	3712 Bldg. Uranium Scrap Storage Area. The 3712 USSA was a uranium metal storage unit. Fires occurred in 1979 from an inadequately cured billet and in 1985 from uranium fines.	RTD Waste Site; DOE-RL 2011, 300 Area Fact Sheet. Interim Closed Out; 8/16/2011; WSRF 2011-046; CCN 160789. 300 Area ROD (EPA 2013), Reclassify to Final Status.
400 PPSS, Process Pond & Sewer System	Consists of underground piping, a control structure, and two percolation ponds.	300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-36	4843 Waste Inspection Facility. WSRF 2013-107 CCN 172456. 8/15/2013.	Rejected.
400-37, Fuel Oil Tank South of 4732-B	This site is an underground fuel storage tank that may have been filled with sand and abandoned in place. It is near the southeast corner of the 4732-B Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-38, Fuel Oil Tank East of 4722-A	This site is an underground fuel storage tank that may have been filled with sand and abandoned in place. It is near the remaining concrete pad from the former 4722-A Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-41, Stained Soils near 4723 Building		Candidate, DOE-RL 2012, 300 Area Fact Sheet.
427 HWSA	427 Building Hazardous Waste Storage Areas. WSRF 2013-105 CCN 172456. 8/15/2013.	Rejected.
600-22, UFO Landing Site	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
600-46, Cutup Oil Dump (300 Area)	Letter 022804, 1995, "Voluntary Cleanup of the 300-FF-2 "CUTUP" Oil Dump Site at Hanford," to D. L. Duncan, U.S. Environmental Protection Agency, from R. G. McLeod, U.S. Department of Energy, Richland Operations Office, October 16.	WSRF 98-079. Closed Out. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-47, Dumping Area North of 300-FF-1	The site consisted of several areas of debris and irrigation pipes, four underground radioactive material areas, and one small soil contamination area. Debris included concrete, brick, cinder block, glass, stainless steel, plastic, tar roofing paper, wire, pipe, bottles, and screen.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00005. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-63, 300-N Lysimeter Area	The site is potentially contaminated soil and equipment. In 1978, the Buried Waste Test Facility was established to investigate recharge and radionuclide migration at the Hanford Site. Six drainage lysimeters 7.6 m (25 ft) deep and two weighing lysimeters 1.5 m (5 ft) deep were installed. Trace amounts of cobalt-60 and tritium were placed in lysimeters and migration of the contaminants was monitored.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
600-117, 300 Area Treated Waste Disposal Facility (310 TEDF)	Closed by D4 with a Facility Status Change Form. Decision Document: DOE-RL, 2006b, "Transmittal of Approved Action Memorandum Associated with Engineering Evaluation/Cost Analysis #3 for the 300 Area, DOE/RL-2005-87," CCN 131082 dated November 30, 2006, to P. L. Pettiette, Washington Closure Hanford, from S. L. Sedgwick, U.S. Department of Energy, Richland Operations Office, Richland, Washington.	Interim Closed Out. See WSRF 2012-117, 12/6/2012. WSRF CCN 171182. Rejected per WSRF 2013-112, 8/13/2013.
600-243, Petroleum Contaminated Soil	The site is a treatment facility for petroleum-contaminated soil using bioremediation technology.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Site has been remediated and interim closed. See WSRF 2007-033. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-259, Inactive Lysimeter Site East End, Special Waste Form Lysimeter	The special waste form lysimeter was constructed in the summer of 1983 and consisted of 10 soil-filled caissons around a central access caisson.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00008. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
600-276, Hanford Geotechnical Engineering and Development Facility, GEDF, Cold Test Facility, Little Egypt	The site is a large open field with a high mound of soil in the center surrounded with light posts and chain. A vehicle gate is posted "Authorized Personnel Only." The facility became operational in 1982 to test burial ground subsidence control alternatives. The original site consisted of three test areas. Each test area was a cluster of buried simulated waste with a center monitoring caisson. Several pipes extend vertically through the surface of the soil in some areas. A small pallet containing damaged bags of bentonite is located in the southeast corner of the area adjacent to some vertical pipes.	Candidate Waste Site; 300-FF-2 ESD (EPA 2009). Not Accepted. (See also 600-367.)
600-278, Bioremediation Pad in Gravel Pit 9	Petroleum-contaminated soil from beneath two 384 powerhouse day tanks was taken to Pit 9 for bioremediation. According to HNF-19536 bioremediation was successful. See SIS.	No Decision Document. Interim Closed Out. WSRF 2003-054, 5/4/2004.
600-290:1, Contaminated Pad West of 618-13	CVP for 618-13 Burial Ground and 600-290:1 Pad and Loading Dock near 618-13. The waste site is in the 300-FF-2 "Plug-In" Waste Site Factsheet covering fiscal year 2010, the first annual report documenting remediation using the plug-in approach of waste sites located in 300-FF-2. Available online at: http://www2.hanford.gov/ARPIR/?content=findpage&AKey=0084211	DOE-RL 2010, 300 Area Fact Sheet E1009034. Remediated with 618-13. CVP-2009-00005. WSRF 2009-055. WSRF 2009-032. 300 Area ROD (EPA 2013), Reclassify to Final Status with 618-13.
600-290:2; 300 West Storage Area	Contaminated Equipment Storage Area. No Action. See WSRF 2012-028, RSVP CCN 166657, 7/5/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
600-352-PL, Retention Process Sewer.	342 Lift Station to 310 Retention Transfer System.	Candidate Waste Site. DOE-RL 2012, 300 Area Fact Sheet. Final Consolidated; WSRF 2013-118.
600-367, Burial Pit Near Little Egypt	Pit was excavated to bury the remains of equipment and office trailer burned in a 1980s range fire.	300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
600-386, Segment 5 Battery Remnant Area #1 in 300-FF-2	Accepted Discovery Site. Orphan site (OSR-2011-0002). In 300-FF-2 Operable Unit. Located north of TEDF, west of Stevens Ave., and south of the 618-10 waste site. RSVP CCN 167254, Interim Closed Out, WSRF 2012-051, 8/8/2012.	Discovery Site. Accepted. RTD. DOE-RL 2012, 300 Area Fact Sheet. Interim Closed Out. Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-1, Burial Ground No. 1, 318-1	The site consists of at least two trenches. It received waste from the 321 Building, 3741 contaminated machining operation, and 3706 Laboratory. Reports mention burial of a bronze crucible reading 179 mr/hr. Some buried waste may have been dissolved after a nitric acid tank leak in 1965.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2010-00001. WSRF 2010-028. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-2, Burial Ground No. 2, 318-2	The site consisted of three trenches containing waste from fuel fabrication and laboratory activities. Automobile batteries were found on the surface prior to surface stabilization in 1989. They were left in place and covered with 0.6 m (2 ft) of clean backfill material.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00010. WSRF 2006-062. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-3, Burial Ground No. 3, Dry Waste Burial Ground No. 3	The site consisted of a pit. Inventory included uranium-contaminated construction debris from the 311 Building and construction/demolition debris from remodeling of the 313, 303-J, and 303-K Buildings.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00005. WSRF 2006-035. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-4, Burial Ground No. 4, 318-4	The burial ground was a single disposal pit measuring approximately 32 m (105 ft) by 160 m (525 ft). Little historical information is available. It is believed to have operated from 1955 through 1961. Excavation found 786 drums containing depleted uranium waste in addition to piping, miscellaneous debris, and soil contaminated with lead, barium, oil, and PCBs.	RTD Waste Site; 300-FF-1 ROD (EPA 1996). Remediated and Interim Closed Out. See CVP-2003-00020. WSRF 2003-055. Reclassify to Final Status.
618-5, Burial Ground No. 5, 318-5	Single burning pit and storage area for aluminum silicate and bronze crucibles surrounded by two fences. Contained uranium-contaminated trash, uranium-contaminated aluminum silicate, and bronze crucibles, with radiation levels up to 200 mr/hr.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2003-00021. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
618-7, Solid Waste Burial Ground No. 7, Burial Ground #7, 318-7	Used for disposal of hundreds of drums containing zircaloy chips from the process of machining the ends of zircaloy-clad fuel elements at the 321, 3722, and 3732 Buildings. The chips may be contaminated with beryllium and uranium. They were considered to be pyrophoric and were put into 113.6-L (30–gal) iron drums that were filled with water prior to disposal. Other low-level material contaminated with uranium and thorium was also buried at the site.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). Site has been remediated and interim closed. See CVP-2008-00002. WSRF 2008-050. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-8, Burial Ground No. 8, 318-8, Early Solid Waste Burial Ground	It is suspected that the site contained debris from expansion and remodeling of the 313 Building in 1954. A parking lot was constructed over a majority of the site.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00006. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
618-9, 300 West Burial Ground, 318-9, Dry Waste Burial Ground No. 9.	An Expedited Response Action was conducted in 1991-1992 to remove drums that contained uranium-contaminated organic solvents (hexone and kerosene). After removing 42 solvent-containing drums and more than 80 empty drums, plus scrap process equipment and debris, the soil of the empty trench was sampled and analyzed for organic and inorganic chemicals, metals, radioactive materials, and pesticides. Soil gas testing was performed to determine if organic vapors remained in the soil. No contaminants were found at concentrations above risk-based standards so the trench was backfilled and revegetated. EPA, 1991, *Expedited Response Action Appr oval for 618-9 Burial Ground*, February 1991, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. DOE/RL-91-38, 1992, *Engineering Evaluation of the 618-9 Burial Ground Expedited Response Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.	Expedited Response Action (EPA 1991) (DOE/RL-91-38). Remediated and Interim Closed Out. See WSRF 98-075. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-10, 300 North Solid Waste Burial Ground, 318-10	The site consists of 12 trenches and 94 VPUs. Trenches range in size from 97.5 m (320 ft) long by 21 m (70 ft) wide by 7.6 m (25 ft) deep to 15 m (50 ft) long by 12 m (40 ft) wide by 7.6 m (25 ft) deep. Vertical pipe units are 56-cm (22-in.)-diameter, 4.6-m (15-ft)-long waste receptacles constructed by welding five 208-L (55-gal) bottomless drums together. The column of drums were buried vertically. When they reached their waste capacity level, they were backfilled and topped with concrete. The walls of the typical drums used in the VPUs are expected to have lost integrity. The site contains a broad spectrum of low- to high-activity dry wastes, primarily fission products and some transuranic (TRU) waste from the 300 Area. Low-level wastes are buried in trenches, and medium- to high-activity beta/gamma wastes are mostly in the VPUs. Some higher activity wastes were placed in concrete-shielded drums and disposed in the trenches. The total quantity of plutonium or other transuranic elements within the 618-10 Burial Ground is estimated to be much less than the 618-11 Burial Ground (1 to 2 kg, or 2 to 4 lb) dispersed throughout the waste site. In addition to a small amount of transuranic-contaminated waste, records indicate that the 618-10 Burial Ground trenches also contain high-activity waste and buried drums of oil. During stabilization activities at the 618-10 Burial Ground in 1983, a noticeable puddle of oil appeared from beneath the soil surface after heavy equipment drove over a portion of the waste site, indicating a potential loss of drum integrity. The site perimeter is fenced and marked with concrete markers and posted with underground radioactive material signs. The site was surface stabilized with an additional 0.6 to 0.9 m (2 to 3 ft) of clean material and vegetated with grasses in 1983. The site operated from 1954 to 1963.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-11, Y Burial Ground, 318-11, 300 Wye Burial Ground	Site consists of 3 trenches, approximately 50 VPUs, and 4 large-diameter caissons. The trenches are 270 m (900 ft) long by 15 m (50 ft) wide (surface dimensions) and 7.6 m (25 ft) deep. The vertical pipe storage units (caissons) are 56-cm (22-in.)-diameter by 4.6-m-(15-ft)-long and were made by welding five 208-L (55-gal) drums together. The welded drums formed a cylinder that was buried vertically. The large-diameter caissons were constructed of 2.4-m (8-ft)-diameter corrugated metal pipe, 3 m (10 ft) long, with the top of the caisson being 4.6 m (15 ft) below grade, connected to the surface by an offset 9-cm (36-in.)-diameter pipe with a dome-type cap. These units were buried with approximately 4.6 m (15 ft) of space between them and are open to the soil at the bottom. A second caisson configuration involves a single 2.4-m (8-ft)-diameter by 3-m (10-ft)-long horizontal corrugated metal pipe caisson, 6.1 m (20 ft) below grade with two 61-cm (24-in.)-diameter chutes. The site contains a variety of low- to high-activity waste (including fission products and plutonium) from the 300 Area. It is believed that some elements of the buried inventory are chemically reactive in water and in air and could, under the right conditions, become pyrophoric. The trenches were used for contact-handled waste. Remote-handled waste was deposited in VPUs or into the caissons. The calculated total mass of plutonium in the 618-11 Burial Ground based on historical records and process knowledge is about 2,442 g, which includes 23 g in the trenches, 493 g in the VPUs, and 2,032 g in the caissons. The burial ground trenches also contain high-activity waste. In January 1999, levels of tritium that greatly exceeded concentrations usually found in area groundwater were identified in a well immediately downgradient of 618-11. Subsequent investigation indicated that the tritium was probably due to lithium-aluminate targets disposed in the burial ground and originated from a group of three caissons located near the north-central portion of the burial ground. However, in view of the fact that the targets had relatively low external dose rates, it is also possible that they may have been disposed to the trenches in the same general area. Shortly after the site was closed it was covered with 1.2 m (4 ft) of soil. The site was surface stabilized in 1983 with an additional 0.6 m (2 ft) of clean material and vegetated with grass. The burial ground is in close proximity to the Energy Northwest Hanford Generating Station #2 nuclear reactor, which presents unique circumstances for maintaining safeguards. The site operated from 1962 to 1967.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-13, Burial Ground 318-13, 303 Building Contaminated Soil Burial Site	The site was originally a single-use site for disposal of uranium–contaminated soil removed from the 303 Building perimeter in 1950. Covered with 0.6 m (2 ft) of clean soil. Reportedly later served as a safety shield for hexone drums stored in buildings west of the mound (prior to burial in the 618-9 Trench). Concrete foundation exists directly west of mound.	RTD; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). Remediated and Interim Closed Out. CVP-2009-00005. WSRF 2009-032. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
4831 LHWSA	4831 Laydown Hazardous Waste Storage Area. WSRF 2013-106 CCN 172456. 8/13/2013.	Rejected.
UPR-300-1, 316-1A, 307-340 Waste Line Leak	The site was a release to the soil in the area between the 307 Retention Basins and the 340 Building. The release consisted of process effluent contaminated by transuranic fission products.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-2, Releases at 340 Facility	The site appears to be multiple releases from ongoing decontamination and waste handling activities starting in January 1954.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-4, Contaminated Soil Beneath 321 Building	The site is the soil beneath and south of the 321 Building. The site represents a number of releases that occurred from 1945 to 1988. This time period covers the development of the REDOX, PUREX processes, and numerous other pilot operations.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. RSVP CCN 172326; WSRF 2012-110. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-5, Spill at 309 Storage Basin	The site was a release that contaminated the storage basin area, the filter vault, the stack base, the truck stall, and the truck ramp outside the 309 Building. The waste was low-level radioactive water. The primary isotope was cesium-137.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-10, Contamination Under 325 Building	This release occurred in the radioactive waste sewer line that served the 325-B Hot Cells between the west basement wall of room 32 and the north foundation wall of room 202 of the 325 Building. It included waste from dissolution of highly radioactive samples including irradiated reactor fuels.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-11, Underground Radioactive Liquid Line Leak	The site was a release to the soil that involved a 1.22-m (4-ft)-diameter column of gravel-covered soil in the 340 Complex yard, located immediately south of the 340 Vault. The release occurred around and below a leaking flanged-tee that connected the Retired Radioactive Liquid Waste Sewer (RRLWS) to the 340 Vault.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
UPR-300-12, Contaminated Soil Beneath 325 Building	The site was an unplanned release that occurred in the basement floor on the east side of the 325-A Building. The waste migrated through cracks in the floor to the soil beneath the building. The site received radioactive rinse water overflow containing nitrate ions, promethium-147, fission products, and transuranic nuclides.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-13, UPR-300-14	618-1 Burial Ground, 618-1:1, 618-1:2, 333 LHWSA, etc.	Remediated and Interim Closed Out with 618-1. See CVP-2010-00001;WSRF 2010-028. Reclassify to Final Status.
UPR-300-17, Metal Shavings Fire	The site was the asphalt area at the southeast corner of Building 333. The waste consisted of oily rags and other waste material, including what was believed to be uranium shavings.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. RSVP CCN 152208; WSRF 2010-014. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
UPR-300-38, Soil Contamination Beneath 313 Building	The site is the contaminated soil beneath the 313 Building, as well as the concrete foundation. The full extent of contamination will not be determined until the 313 Building foundation has been removed and soil remediation occurs. The contamination resulted from multiple unplanned release events. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-004. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-39, Sodium Hydroxide Leak at 311 Tank Farm	About 1954, an unplanned release occurred in the 311 Tank Farm when one of two (37,854-L [10,000-gal]) tanks leaked a 50% sodium hydroxide solution into the soil. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001).. Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-40, Acid Release at 303-F Pipe Trench	Release to the soil between the 311 Tank Farm and the 303-F Building. Uranium-bearing acid containing nitric and sulfuric acid with uranium in solution and chromic acids with copper and zinc in solution. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001) . Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-41, 340 Building Phosphoric Acid Spill	Reclassified as Closed Out per WSRF 99-011, 2/24/1999. No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	300 Area ROD (EPA 2013), No Additional Action.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
UPR-300-42, 300 Area Powerhouse Fuel Oil Spill	The oil spill was caused by an overflow of a former underground tank due to a valve failure. The remaining soil may also contain radiological contamination. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-45, 303-F Building Uranium-Bearing Acid Spill	The release was to the soil beneath the transfer piping adjacent to the 303-F Building. The release was identified as nitric and sulfuric acid with uranium in solution. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001) . Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-46, Contamination North of 333 Building	The release was a layer of radioactively contaminated soil found during a pipe trench excavation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim closed out. See CVP-2010-00004. WSRF 2010-009. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-48, 325 Building Basement Topsy Pit	The site is radioactively contaminated soil that occurred as a result of a release through a crack in the process sewer underneath the 325 Building foundation in room 30 under a sewer drain pipe elbow.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-600-22, WPPSS Windrow Site, 600-21	The area was contaminated prior to 1972 with particulate fallout from burial activities in the 618-11 Burial Ground. The contaminated area was covered by scraping the affected ground into windrows, which are a series of small parallel berms, approximately 0.6 m (2 ft), 0.9 m (3 ft) wide and 91 m (100 yd) long. The berms are arranged to form a triangle approximately 137 m (150 yd) by 91 m (100 yd) long. Perimeter berms are approximately 1.2 m (4 ft) tall.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

CCN = correspondence control number
CVP = cleanup verification package
D4 = Deactivation, Decontamination, Decommissioning, and Demolition
ESD = explanation of significant differences
PVC = polyvinyl chloride
ROD = record of decision
RSVP = remaining sites verification package
RTD = remove-treat-dispose
SIS = Stewardship Information System
UPR = unplanned release
VPU = vertical pipe unit
WSRF = waste site reclassification form

A2. References

BHI-00012, 1995, *300-FF-2 Operable Unit Technical Baseline Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00768, 1996, *100 and 300 Area Burial Ground Remediation Study*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00002, 2003, *Cleanup Verification Package for the South Process Pond (WIDS Site 316-1), the Retired Filter Backwash Pond (WIDS Site 300 RFBP), 300-262 Contaminated Soil, and Unplanned Release Sites UPR-300-32, UPR-300-33, UPR-300-34, UPR-300-35, UPR-300-36, UPR-300-37, and UPR-300-FF-1,* Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00020, 2004, *Cleanup Verification Package for the 618-4 Burial Ground*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00021, 2004, *Cleanup Verification Package for the 618-5 Burial Ground*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00004, 2005, *Cleanup Verification Package for the 300-18 Waste Site*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00005, 2005, *Cleanup Verification Package for the 600-47 Waste Site*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00007, 2005, *Cleanup Verification Package for the 300-8 Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00008, 2006, *Cleanup Verification Package for the 600-259 Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00009, 2006, *Cleanup Verification Package for the 300 VTS Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00005, 2006, *Cleanup Verification Package for the 618-3 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00006, 2006, *Cleanup Verification Package for the 618-8 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00010, 2006, *Cleanup Verification Package for the 618-2 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2011-00004, 2011, *Cleanup Verification Package for the 314 Building Waste Sites,* Rev. 0, Washington Closure Hanford, Richland, Washington.

DOE/RL-91-38, 1992, *Engineering Evaluation of the 618-9 Burial Ground Expedited Response Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-82, 1995, *Inventory of Miscellaneous Streams*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-42, 1996, *Limited Field Investigation Report for the 300-FF-2 Operable Unit*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-99-40, 2000, *Focused Feasibility Study for the 300-FF-2 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2006, "Transmittal of Approved Action Memorandum Associated with Engineering Evaluation/Cost Analysis #2 for the 300 Area, DOE/RL-2005-84," CCN 127831 dated May 10, 2006, to P. L. Pettiette, Washington Closure Hanford, from S. L. Sedgwick, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2010, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2010*, AR/PIR Document Number E1009034, October 2010, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2011, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2011*, AR/PIR Accession Number 1109011799, August 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2012, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2012*, *- Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 2001 Interim Action Record of Decision for 300-FF-2*, AR/PIR Accession Number 1301070488, September 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1991, *Expedited Response Action Approval for 618-9 Burial Ground*, February 1991, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 1996, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units*, *Hanford Site, Benton County, Washington,* July 1996, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit*, *Hanford Site, Benton County, Washington,* April 2001, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2004, *Explanation of Significant Difference for the 300-FF-2 Operable Unit Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2009, *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2011, *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area, Record of Decision for the 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site, Benton County, Washington,* November 2013, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

OSR-2010-0002, 2010, *300 Area Orphan Sites Evaluation Report*, Rev. 0, Washington Closure Hanford, Richland, Washington.

OSR-2011-0002, 2011, *100-F/IU-2/IU-6 Area-Segment 5 Orphan Sites Evaluation Report*, Rev. 0, Washington Closure Hanford, Richland, Washington

Waste Site Reclassification Form, Control Number 2004-100, *300-29,* January 2005, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2007-033, *600-243*, November 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-020, *331 LSLDF,* October 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-051, *305-B SF*, August 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-059, *300-275*, August 2009, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2010-058, *300-33, 300-256, 300-41*, U.S. Department of Energy, September 2010, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2010-074, *300-260*, U.S. Department of Energy, January 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-038, *300-292*, U.S. Department of Energy, May 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-042, *300-251*, U.S. Department of Energy, September 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-046, *3712 USSA*, U.S. Department of Energy, August 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-056, *300-293:1*, U.S. Department of Energy, July 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-082, *300-258*, U.S. Department of Energy, September 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-091, *300-274*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-100, *300-28, 300-43, 300-48, 300-249, and 300-16:3*, U.S. Department of Energy, November 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-102, *300-276*, U.S. Department of Energy, December 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-106, *300-219, 300-2234, 333 WSTF*, U.S. Department of Energy, January 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-107, *300-6, 300-123, 300-268, 300-273, and UPR-300-42*, U.S. Department of Energy, January 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-004, *UPR-300-38*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-005, *313 ESSP*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-006, *300-270*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-007, *UPR-300-40, UPR-300-39, and UPR-300-45*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-028, *600-290:2*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-030, *300-293:2*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-034, *300-279*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-034, *300-279*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-037, *300-286*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-038, *300-264*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-053, *300-283*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-110, *UPR-300-4*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-117, *600-117*, U.S. Department of Energy, December 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-120, *300-15:2*, U.S. Department of Energy, April 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-007, *300-46*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-039, *300-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-096, *300-39*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-097, *309-TW-1*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-098, *309-TW-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-099, *309-TW-3*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-100, *309-WS-1*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-101, *309-WS-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-102, *309-WS-3*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-103, *307-RB*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-104, *300-57*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-105, *400 HWSA*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-106, *4831 LHWSA*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-107, *400-36*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-108, *300-37*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-109, *300-231*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-110, *300-264*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-111, *313 URO*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-112, *600-117*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Appendix B

Guidance for Preparation of Cleanup Verification Packages

This page intentionally left blank.

Contents

Tables

B1. Purpose

The purpose of this appendix is to provide guidance to assist both authors and readers of documents for final closeout of Hanford Site 300 Area waste sites in accordance with the final action *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (hereafter referred to as the 300 Area ROD) (EPA 2013), and the TPA-MP-14 procedure in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*. The waste site reclassification form (WSRF) is the documentation of approval of the lead agencies for individual waste site reclassification. The WSRF may be incorporated within a larger document for format and presentation purposes, but the document is considered to be a supporting attachment. For previous interim and final waste site reclassifications in the 300-FF-1 and 300-FF-2 Operable Units, cleanup verification packages (CVPs) were written to reclassify radioactive liquid effluent sites and burial grounds while remaining sites verification packages were written to reclassify sites termed "candidate sites" or "remaining sites." Under the 300 Area ROD, CVPs will be used as the primary supporting document for waste site reclassification. A CVP is not required if appropriate reclassification basis can be provided in a stand-alone WSRF or via supporting attachments other than a CVP. Authors will use this appendix as guidance for preparing final reclassification documentation.

B2. Objective

The overall objective of the CVPs under the 300 Area ROD (EPA 2013) is to demonstrate that, under the appropriate land-use scenario, the relevant waste sites have been remediated and may be reclassified to final closeout status. The 300 Area ROD provides the U.S. Department of Energy, Richland Operations Office, with the authority and guidelines to conduct continuing remedial actions at waste sites in the 300 Area and to propose waste sites for final closeout. The 300 Area ROD specifies the remedial action objectives (RAOs), and associated cleanup levels (CULs) that define the extent to which the waste sites require cleanup to protect human health and the environment.

B3. Scope

The scope of this guidance is limited to the CVPs for the 300-FF-2 Operable Unit remedial actions covered by this remedial design report/remedial action work plan (RDR/RAWP). This is a guidance document, not a requirements document, and deviations from the guidance are acceptable.

The following are potential examples where it may be appropriate to deviate from this guidance:

- For approximately 43 sites that were remediated or determined not to require remediation and received associated interim reclassification prior to issuance of the 300 Area ROD, but did not receive quantitative evaluation during development of the ROD. The remedy selected for these sites was remove, treat, and dispose to preserve the intent of the interim action remedy being implemented during ROD development. Because CVPs and remaining sites verification packages have already been written under interim actions for these sites, additional final reclassification supporting documentation may be limited to numerical demonstration that the interim action activities remain protective under the CULs of the 300 Area ROD.

- For sites that are identified for "no additional action" under the 300 Area ROD, final WSRFs may be prepared with no further explanation or supporting documentation.

- For small sites with limited analytical data sets, the lead agencies may agree to attach the analytic data and/or a simple comparison table to the TPA-MP-14 WSRF (RL-TPA-90-0001) with a location map and a brief description of the action(s) performed. No other effort may be needed for reclassification or cleanup verification of such waste sites.

- Site-specific guidance from the lead agencies may specifically provide an alternate method for a portion of the CVP or for an entire CVP. This site-specific guidance should be documented, and specifically noted in the CVP as approved by the lead agencies.
- Continuing process improvements may require deviation from this guidance in an effort to improve the closeout documents. These process changes will be incorporated into this appendix during future revisions of this document. Material process changes and decision-maker concurrence with material CVP changes will be documented in meeting minutes, in Tri-Party Agreement Change Notices, or by chronicling other correspondence.

The remainder of this guidance describes the typical steps involved in the preparation of the CVP closeout documents.

B4. Cleanup Verification Packages

B4.1 Executive Summary

The executive summary restates (at a higher level) the contents of the CVP. This includes a table documenting the achievement of CULs and RAOs for the given waste site. Table B-1 is provided as an example.

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain radionuclide total excess cancer risk of <1 x 10^{-4} over 1,000 years.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Maximum radionuclide excess cancer risk estimated using a sum of fractions evaluation is 1.22 x* 10^{-5}. **Or:** *Site-specific radionuclide excess cancer risk calculated by RESRAD is 1.1 x* 10^{-6}.	*NA* *Yes* *Yes*
Direct Exposure – Nonradionuclides	Attain individual COC CULs.	**Example Language:** *All individual COC concentrations are below the CULs.*	*Yes*
Meet Nonradionuclide Risk Requirements	Attain a hazard quotient of <1 for all individual noncarcinogens.	**Example Language:** *The hazard quotients for individual nonradionuclide COCs in the shallow zone and overburden are less than 1.*	*Yes*
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	**Example Language:** *The cumulative hazard quotient (enter value) is less than 1 for the shallow zone and overburden.*	*Yes*

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
	Attain an excess cancer risk of <1 x 10^{-6} for individual carcinogens.	**Example Language:** *Excess cancer risk values for individual nonradionuclide COCs are less than 1 x 10^{-6}.*	*Yes*
	Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	**Example Language:** *Total excess cancer risk (enter value) is less than 1 x 10^{-5}.*	*Yes*
Groundwater/ River Protection – Radionuclides	Attain single radionuclide COC groundwater and river protection CULs.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Residual concentrations of radionuclide COCs meet soil CULs for the protection of groundwater and the Columbia River* [c].	*NA* *Yes*
	Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. [a]	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Compliance is demonstrated by individual components meeting CULs in Table D-1 of Appendix D. (If these are not attained see Section D.5.)*	*NA* *Yes*
	Meet drinking water MCL for alpha emitters.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *There are no alpha-emitting COCs for this site.* **Or:** *No alpha-emitting COCs are predicted to migrate to groundwater within 1,000 years.*	*NA* *NA* *Yes*
	Meet total uranium drinking water standard of 30 µg/L MCL (40 CFR 141.66). [a]	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Residual concentrations of total uranium are less than CULs for uranium metal in Table D-1 of Appendix D and Table 4 of the Final ROD.*	*NA* *Yes*

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/ River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river CULs.	**Example Language:** *Residual concentrations of COCs meet soil CULs for the protection of groundwater and the Columbia River.* [b]	*Yes*

Example Footnotes:

a “National Primary Drinking Water Regulations” (40 *Code of Federal Regulations* 141.66).

b Under the Final ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

COC = contaminant of concern

CUL = cleanup level

MCL = maximum contaminant level

NA = not applicable

The WSRFs may be prepared for individual waste sites or for groups of sites, and are prepared in accordance with TPA-MP-14. The WSRF may be incorporated within the CVP document, or the CVP may be presented as an attachment to the WSRF, but the WSRF serves as the documentation of approval of the lead agencies for waste site reclassification. There is no further, separate approval of the CVP. A sample WSRF is provided below.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Reclassification Category: Interim ☐ Final ☒

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐ RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The [WIDS Number and Site Name] waste site is located within the 300-FF-2 Operable Unit and is identified as a waste site requiring remediation in the *Hanford Site 300 Area, Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site, Benton County, Washington* (300 Area ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2013). The [WIDS Number] waste site consisted of contaminated soils around and beneath the [XXX] Building.

Remediation of the [WIDS Number] waste site was conducted between [Dates]. Approximately XXXX bank cubic meters (BCM) (XXXX bank cubic yards [BCY]) of soil, rock, building debris, and piping were removed from the excavation and disposed to the Environmental Restoration Disposal Facility (ERDF).

The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Final Closed Out.

Basis for reclassification:

Following remediation, verification sampling for the [WIDS Number] waste site was conducted on [Dates]. The sample results were evaluated in comparison to the cleanup levels (CULs) and remedial action objectives (RAOs) from the 300 Area ROD (EPA 2013) and DOE/RL-2014-13, *Remedial Design Report/Remedial Action Work Plan for the 300 Area,* (300 Area RDR/RAWP), Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2014). In accordance with this evaluation, the verification sampling results support a reclassification of the [WIDS Number] waste site to Final Closed Out. The current site conditions achieve the CULs and RAOs established by the 300 Area ROD (EPA 2013) and the 300 Area RDR/RAWP (DOE-RL 2014). The waste site was remediated to achieve cleanup levels for an industrial land use scenario and to protect groundwater and the Columbia River. The results of verification sampling show that residual contaminant concentrations meet human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection in the shallow zone (i.e., surface to 4.6 m [15 ft] deep). The contamination in the vadose zone was removed to meet the industrial cleanup levels. The [WIDS Number] waste site does not meet the CULs and RAOs for unrestricted (residential) land use; therefore, institutional controls to maintain industrial land use are required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the* [WIDS Number and Site Name] (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Regulator comments:

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☒ Yes ☐ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

Institutional control required to maintain industrial land use. Please see the *Cleanup Verification Package for the* [WIDS Number and Site Name] (attached).

DOE Project Director (printed)	Signature	Date
N/A Ecology Project Manager (printed)	Signature	Date
EPA Project Manager (printed)	Signature	Date

B4.2 Statement of Protectiveness

This section is a paragraph stating that the waste site attains RAOs of the relevant ROD and discussing the pertinent future land use for the area. Whether or not institutional controls are necessary is explained. Table 1-1 of this RDR/RAWP Addendum identifies the land use specified for all waste sites requiring remediation. Where industrial land use is identified, the CVP author should evaluate whether or not residential CULs have also been attained. If so, appropriate demonstration should be included within the CVP with a summary statement here, and an institutional control for industrial land use does not need to be applied to the site. If residential CULs are not attained, this should be briefly identified, but a detailed demonstration should not be presented within the CVP.

B4.3 Site Description and Background

The site history, waste disposal history, site physical dimensions, and location are summarized in this section of the CVP, and a figure(s) showing the vicinity map and/or site plan are provided.

B4.4 Field Screening Sampling Activities (If Applicable)

Field screening sampling prior to remediation is appropriate if the location, nature, and potential contamination are not well known. The purpose of this section is to summarize results of field screening sampling activities (if any) performed for waste sites. The type of information to be provided would include objectives and dates of site visits, dates of sampling, participation by the U.S. Department of Energy, Richland Operations Office or regulatory agencies, and any findings or determinations (e.g., nature and extent of contamination, visible description of staining, waste form) that resulted from the site visit.

B4.4.1 Geophysical Investigations

This section describes geophysical surveys performed at the site including figures showing possible nature and extent of below-ground features.

B4.4.2 Sample Design for Field Screening

The purpose of this section is to summarize the site-specific work instruction or other documentation/processes leading to sampling (e.g., a phased approach using focused sampling and/or statistical sampling with sample numbers and locations determined by Visual Sample Plan[1] [VSP] software). This section typically includes a figure showing locations of samples and a sample summary table similar to Table B-2 with a discussion of the contaminants of concern, providing an explanation of how they were derived (e.g., based on professional judgment, process knowledge, waste characterization, analogous site information, visible inspection of waste forms). An example of a VSP sample design is discussed at the end of Section B4.5.

[1] Visual Sample Plan is a site map-based user-interface statistical sample design program. **Reference:** PNNL-19915, 2010, *Visual Sample Plan 6.0 User's Guide*, available at http://vsp.pnnl.gov/documentation.stm, Pacific Northwest National Laboratory, Richland, Washington.

Table B-2. Field Screening Sample Summary

Sample Location	Sample Media	Sample Number	WSP Coordinate Locations	Depth (m bgs)	Sample Analysis
Example Information					
Septic tank	*Septic tank contents*	*J01XN2*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA, VOA*
		J01XN6			*Hexavalent chromium*
Duplicate septic tank samples	*Septic tank contents*	*J01XN3*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA, VOA*
		J01XN7			*Hexavalent chromium*
Ash located east of septic tank	*Ash*	*J01XN1*	*N 147917 E 580882*	*0.5*	*ICP metals, PCB, pesticides, mercury, SVOA*
		J01XN5			*Hexavalent chromium*
Equipment blank	*Silica sand*	*J01XN4*	*NA*	*NA*	*ICP metals, mercury, SVOA, PCB, pesticides*

Source: Field Sampling, Logbook xxxxxx. Reference, WCH xxxx

bgs = below ground surface

GEA = gamma energy analysis

ICP = inductively coupled plasma

NA = not applicable

PCB = polychlorinated biphenyl

SVOA = semivolatile organic analysis

VOA = volatile organic analysis

WSP = Washington State Plane

B4.4.3 Field Screening Sample Results

The purpose of this section is to describe the results of field screening sampling activities and compare sampling results to the CULs, as appropriate. This section also documents the recommendation of remedial action for the given waste site. Analytical data from field screening sampling are typically provided in an appendix to the CVP.

B4.5 Remedial Action Summary

A description of the excavation and disposal activities for remedial action is given in this section, which may include figures of pre- and post-remediation topographic contours. Appropriate information includes the dates of waste site excavation, description (and photographs if applicable) of materials excavated, disposal location of waste material, general excavation dimensions and elevations, locations of overburden and staging piles (if applicable), and amount of material disposed from the site. Pre- and post-remediation photographs and site maps showing pre-remediation Waste Information Data System boundaries compared to post-remediation site boundaries may be provided. Maps showing post-remediation site contours should be provided if available. Waste volumes provided are for a general sense of scale only.

Additionally, the CVP will discuss significant materials that may have been left at the site (if any) and what significant materials were removed. A summary of field screening or in-process sampling activities (if applicable) that guided remedial actions is also included.

B4.6 Verification Sampling Activities

This section describes the information used to develop the sampling designs for cleanup verification sampling, including reference to appropriate documents and dates of sampling.

B4.6.1 Contaminants of Concern for Verification Sampling

Waste site contaminants of concern (COCs) identified for cleanup verification, typically via a site-specific verification sampling instruction, are listed in this section. The rationale for the final site COC list is discussed in this section.

B4.6.2 Verification Sample Design

A brief explanation regarding the remedial excavation decision units and cleanup verification sampling is included in this section. Statistical sample designs for cleanup verification sampling of waste sites are typically developed in a work instruction using VSP software. However, a statistical sample design may not be appropriate for all waste sites, and focused sampling may be agreed upon with the lead agencies. Focused samples may also be agreed upon to obtain additional information where waste site anomalies occurred.

The description of the verification sample design typically includes information pertaining to the location, individual Hanford Environmental Information System (HEIS) sample numbers, Washington State Plane coordinates, and analytical methods requested for all samples collected. This information is typically presented in a table with an accompanying figure showing the sample locations overlain on a map of the area including the remediation footprint of the waste site(s).

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below ground surface (bgs) per WAC 173-340-740(6)(d) (Ecology 2007). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) or more bgs are referred to as being in the deep zone, whereas the materials above 4.6 m (15 ft) bgs are referred to as being in the shallow zone. The direct exposure CULs are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection CULs are applicable to soils in both the shallow and the deep zones. However, if a site 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 regardless of the depth of the excavation. This is advantageous for site closeout because a site that does not require a separate deep zone evaluation will also have no requirement for deep zone institutional controls. A discussion regarding the rationale for decision unit selection is given. Decision units may be identified based on depth, spatial, and/or process history considerations.

Sampling dates and the number of samples collected per decision unit are also discussed in this section. If any focused sampling was conducted, a summary of this activity and its rationale is also included.

B4.6.3 Visual Sample Plan Statistical Sampling Designs

The VSP software uses the remediation footprint of the site to develop a systematic grid for verification soil sample collection. The development of a statistical sampling design is typically presented in the verification sampling work instruction. The statistical sampling design is typically briefly presented in the CVP as a figure, a table, and brief text discussing the associated statistical assumptions for the waste site. The VSP software determines the number and coordinates of sampling locations for a statistically defensible sampling design within the sampling area.

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level (WAC 173-340-740[7]) (Ecology 2007). The working hypothesis (or "null" hypothesis) is that the mean value at the site is equal to or exceeds the action threshold (the site is "dirty"). The alternative hypothesis is that the mean value is less than the threshold (the site is "clean"). The VSP software calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

VSP uses a nonparametric systematic sampling approach with a random start to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the site conceptual model and analogous information (i.e., data from similar sites) indicate that typical parametric assumptions may not be true.

Both parametric and nonparametric equations rely on assumptions about the population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. Alternatively, if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation was used.

The Washington State Department of Ecology (Ecology) publication *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. Therefore, a systematic grid sampling design with a random start is selected for use in VSP. Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used.

B4.6.3.1 Inputs for VSP Calculation of Number of Samples

The VSP software equation used to calculate the number of samples for a statistical sample design is based on a Sign test (see Gilbert et al. 2001 for discussion). For a typical waste site, the null hypothesis is rejected in favor of the alternative if the mean is sufficiently smaller than the threshold. The number of samples to collect is calculated such that, if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

To use VSP to calculate the number of samples, n, it is necessary to have some estimate of the sample standard deviation (S). A standard deviation value of 40% of the unit action level has been assumed (see Table B-3). Using this standard deviation value and an acceptable gray region width (typically 50% of the action level) in VSP, the number of verification samples to collect in this example is 12.

Table B-3. VSP User Inputs.

Parameter	Value	Basis
S	0.40	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.40 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point (EPA et al. 2000, p. 5-26). A value of 0.40 is used because 0.40 is a larger estimated standard deviation than 0.30. Choosing a value of 0.40 implies that a larger sample size will be calculated when all other inputs are equal. Thus, 0.40 is a more conservative value than 0.30.
Δ	0.50	This is the width of the grey region. It is a user-defined value relative to a unit action level. The value of 0.50 is a MARSSIM-suggested default value balancing unnecessary remediation cost with sampling cost (EPA et al. 2000, p 2-9).
α	5%	This is the error rate associated with deciding a dirty site is clean when the true mean is equal to the Action Level. It is a maximum error rate since dirty sites with true means above the Action Level will be easier to detect. A value of 5% is chosen as a practical balance between health risks and sampling cost (EPA 2006, pp. 56, 57).
β	20%	This is the error rate associated with deciding a clean site is dirty when the true mean is at the lower bound of the gray region (LBGR). It is the maximum such error rate outside of the gray region, because cleaner sites with true means less than the LBGR will be less likely to fail. A value of 20% is chosen as a practical balance between unnecessary remediation cost and sampling cost (EPA 2006, pp. 56, 57).
$Z_{1-\alpha}$	1.64485	This is a value automatically calculated by VSP based on the user-defined value of α. (α = 5%; see above.)
$Z_{1-\beta}$	0.841621	This is a value automatically calculated by VSP based on the user-defined value of β. (β = 20%; see above.)
MARSSIM overage	20%	MARSSIM (EPA et al. 2000, p. 2-31) suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n.

DQO = data quality objective
MARSSIM = *Multi-Agency Radiation Survey and Site Investigation Manual* (EPA et al. 2000)
VSP = Visual Sample Plan

B4.7 Verification Sampling Results

The verification samples collected are submitted to offsite laboratories certified to perform the requisite analyses using U.S. Environmental Protection Agency (EPA)-approved analytical methods. The laboratory-reported analysis data from the sampling are used in the statistical calculations (as appropriate) and are included in appendices to the CVP.

The primary statistical calculation to support cleanup verification is the 95% UCL on the arithmetic mean of the data. All UCL calculations are performed with EPA's ProUCL software[2]. The 95% UCL values for detected COCs in statistical data sets are calculated for each decision unit according to the following:

- If there are five or more detections of a given COC within a data set, and the COC is detected in 25% or more of the total samples, a UCL is calculated. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are less than five detections of a given COC within a data set, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If a given COC within a data set is detected in five or more samples, but is detected in 25% or less of the total samples, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are no detections of a COC within a data set, then there is no calculation or further evaluation performed for the COC.

For the statistical evaluation of primary/duplicate sample pairs, the following is applied to determine the value to be used in the UCL calculation:

- If detections are reported for both the primary and duplicate, the maximum concentration is used.
- If one detection and one nondetection are reported, the detected concentration is used.
- If both the primary and duplicate are reported as nondetects, the higher detection limit is used (as a nondetect within ProUCL).

The statistical values represent the COC concentrations for each decision unit (e.g., overburden, shallow zone, or deep zone soils). All UCL calculations are performed with EPA's ProUCL software. For sample results that are nondetects (i.e.., a "U" is included with the data flags), the full reported minimum detectable activity (radionuclides) or practical quantitation limit (nonradionuclides) value is used as the concentration. Data are then identified as detected (1) or nondetected (0) in the ProUCL data input. In cases that ProUCL output identifies more than one potential UCL for a given data set, the UCL with the highest value is chosen. ProUCL cannot compute UCLs for data sets with less than five results; therefore, analysis of any statistical data sets with less than five results will be determined in consultation with the lead regulatory agency. The 95% UCL calculation brief is included in an appendix to the CVP.

For focused sampling, no statistical evaluation is performed and the maximum detected value is used for comparison with the CULs.

Comparisons of quantified COC results against the CULs for the waste site are summarized in appropriate tables. Comparison to statistical contaminant concentrations and comparisons to focused sampling results are presented in separate tables. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Ecology Cleanup Levels and Risk Calculations (CLARC) Database or other reference databases for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered COCs and are not included in tables for

2 ProUCL may be downloaded at http://www.epa.gov/osp/hstl/tsc/software.htm.

comparison to CULs even though results for these constituents are routinely provided by the laboratories. Where asbestos is identified as a site COC, verification of cleanup completion may be based on visual identification of no residual asbestos-containing material by a certified asbestos inspector, and should be described in the CVP.

Contaminants of concern were selected in the 300 Area ROD based upon the 300 Area Remedial Investigation/Feasibility Study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*), which included a risk assessment. In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the DOE and EPA Project Managers for determination of a path forward.

Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 may be detected in waste site samples, but are excluded from evaluation in these tables because these isotopes are not related to the operational history of the Hanford Site. The thorium and radium detected in environmental samples are associated with background quantities of uranium naturally present in soil.

The laboratory-reported data results for all constituents are stored in a project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are included as an attachment to the 95% UCL calculation.

B4.8 Verification Sample Data Evaluation

This section describes the evaluation of the sampling data in terms of comparison to the CULs, the radionuclide risk requirements, and the nonradionuclide risk requirements. Ideally, evaluation of the results listed in the tables reporting the sample results indicates that all COCs were quantified below CULs. In this case, residual concentrations of site COCs are protective in relation to the requirements for direct exposure and groundwater and river protection.

B4.8.1 Comparison of Sample Data to the CULs

Typically, with the exception of a few contaminants, evaluation of the results from verification sampling at a waste site against the CULs in Table D-1 will indicate that all COCs are quantified below the CULs. Exceedance of cleanup levels for direct exposure or groundwater and river protection will seldom occur but would trigger additional cleanup, a site-specific risk analysis, or other evaluation based on the likelihood of a threat to human health. Residential and industrial soil CULs to be protective of groundwater and the river were calculated based on federal drinking water standards as described in Section 8.2 of the 300 Area ROD (EPA 2013). Parameters specific to a residential or industrial scenario were used in modeling calculations. Specifically, the residential scenario assumed a groundwater recharge rate of 72 mm/yr, representing an irrigated condition, while the industrial scenario assumed a groundwater recharge rate of 25 mm/yr, representing no irrigation. The consideration of lesser amounts of irrigation in areas with institutional controls for industrial use allows higher soil CULs to be protective of the same federal drinking water standards.

Per the MTCA Cleanup Regulation (Ecology 2007), WAC 173-340-708(8), compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs) is determined by considering mixtures of carcinogenic PAHs as a single hazardous substance and using the cleanup levels established for benzo(a)pyrene as the cleanup level for mixtures of carcinogenic PAHs. Statistical values representing the PAH COC concentrations for each decision unit are calculated, or the maximum detected value is selected per the guidelines in Section B.4.6 and for focused samples. The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor as shown in Table B-4b to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table D-1 to determine compliance. The result of the determination of the total toxic equivalent concentration of benzo(a)pyrene is shown in Table B-4a and is included in Table B-4b.

Table B-4a. Toxic Equivalent Concentrations of Benzo(a)Pyrene [a]

Carcinogenic Polyaromatic Hydrocarbons	Maximum or Statistical Result (mg/kg)	Toxic Equivalency Factors (Unitless)	Toxic Equivalent BAP Concentration mg/kg
Benzo[a]pyrene	*0.005*	1	*0.005*
Benzo[a]anthracene	*0.005*	0.1	*0.0005*
Benzo[b]fluoranthene	*0.004*	0.1	*0.0004*
Benzo[k]fluoranthene	*0.0076*	0.1	*0.00076*
Chrysene	*0.06*	0.01	*0.0006*
Dibenz[a,h]anthracene	*0.024*	0.1	*0.0024*
Indeno[1,2,3-cd]pyrene	*0.04*	0.1	*0.004*
Total Toxic Equivalent Concentration of Benzo(a)pyrene			*0.01366*

a From WAC 173-340-708(8)(e), Table 708-2 (Ecology 2007)

BAP = benzo(a)pyrene

An example table showing a comparison of the statistical or maximum results as determined in the 95% UCL calculation to the direct exposure cleanup levels and groundwater and river protection cleanup levels is shown in Table B-4b. All cleanup verification sampling results from either the industrial or residential land use areas will initially be compared against cleanup levels for residential land use. If the verification sampling results are less than residential CULs the comparison table for cleanup verification will report the comparison against residential CULs because institutional controls to preserve industrial land use are not required for waste sites that meet residential CULs. However, if residential CULs cannot be met (and the waste site is within the industrial zone), the comparison table for cleanup verification will report the comparison against industrial CULs and institutional controls to preserve industrial land use will be required to be stated in the CVP and WSRF.

The ecological risk evaluations have concluded that 300-FF-2 interim remedial actions that achieved interim action ROD CULs to protect human health were also protective of ecological receptors, as described in Section 2.4.4 of the RDR/RAWP. No further evaluation or screening of potential ecological risk is performed in CVPs.

Table B-4b. Comparison of Maximum or Statistical Contaminant of Concern Concentrations to Residential Cleanup Levels[a]

COC	Maximum or Statistical Result [b] (pCi/g)	Radionuclide Shallow Zone CULs (pCi/g)	Radionuclide Groundwater and River Protection CULs (pCi/g)	Does the Statistical Result Exceed CULs? [c]
Example Residential Results:				
Cesium-137	*0.036*	*4.4*	*NA*	*No*
Strontium-90	*0.49*	*2.3*	*NA*	*No*
COC	**Maximum or Statistical Result[b] (mg/kg)**	**Nonradionuclide Direct Exposure CULs (mg/kg)**	**Nonradionuclide Groundwater and River Protection CULs (mg/kg)**	**Does the Statistical Result Exceed CULs?[c]**
Example Residential Results:				
Arsenic	*3.5 (<BG)*	*20*	*20*	*No*
Beryllium	*0.35 (<BG)*	*160*	*NA*	*No*
Chromium (total)	*9.0 (<BG)*	*120,000*	*NA*	*No*
Chromium (hexavalent)	*0.6*	*2.1*	*2.0*	*No*
Copper	*13.0 (<BG)*	*3,200*	*3,400*	*No*
Lead	*10.4*	*250*	*1,480*	*No*
Manganese	*318 (<BG)*	*11,200*	*NA*	*No*
Mercury	*0.03*	*24*	*8.5*	*No*
Nickel	*10.0 (<BG)*	*1,600*	*NA*	*No*
Vanadium	*38.6 (<BG)*	*400*	*NA*	*No*
Zinc	*47.8 (<BG)*	*24,000*	*NA*	*No*
Benzo(a)pyrene	*0.01366[d]*	*0.14*	*NA*	*No*
Chrysene	*0.06*	*137*	*NA*	*No*

Example Footnotes:

a CULs obtained from Appendix D, Table D-1 of this document.

b Background (BG) values from the remedial investigation/feasibility study gap analysis (ECF-HANFORD-11-0038) are used for antimony, boron, cadmium, lithium, mercury, molybdenum, and silver. Background values for all other radionuclides and metals are obtained from DOE/RL-92-24 and DOE/RL-96-12.

c Under the 300 Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

d Evaluation of the compliance of benzo(a)pyrene with cleanup levels includes the toxic equivalency concentrations of the carcinogenic PAHs in Tables 2-1 and B-4a.

--	= not applicable	CUL	= cleanup level
BG	= background	NA	= not available; no cleanup level calculated
COC	= contaminant of concern	RDL	= required detection limit
WAC	= *Washington Administrative Code*		

While not identified as COCs, the analytes in Table B-4c were detected above background levels in the example cleanup verification samples. These detections were below risk-based cleanup levels calculated during development of the 300 Area ROD. Therefore, these constituents do not warrant consideration as COCs. Data for all analytes are included in the appendices.

Table B-4c. Example Detected Waste Site Analytes Not Identified as COCs

Anthracene	Dibenz(a,h)anthracene	Phenanthrene
Benzo(a)anthracene	Fluoranthene	Pyrene
Benzo(b)fluoranthene	Fluorene	

B4.8.2 Evaluation of Attainment of Radionuclide and Nonradionuclide Risk Requirements

This section discusses how the verification sampling data are used in demonstrating attainment of radionuclide and nonradionuclide risk requirements.

B4.8.2.1 Radionuclide Evaluation of Risk and Dose

In addition to meeting the radionuclide CULs of Table D-1 the residual soil radionuclide activities must also meet the risk and radiological dose standards of 40 CFR 300 for direct exposure and 40 CFR 141 for protection of groundwater. The individual radionuclide cleanup verification statistical or focused data values may be entered into the RESidual RADioactivity (RESRAD) computer code (current version 6.5 [ANL 2009]) to predict the direct exposure cancer risk and the impact on groundwater and the river from residual radionuclide activities. General RESRAD input parameters for evaluation of carcinogenic risk per the Final ROD are presented in Tables D-4 and D-5 of Appendix D. Separate RESRAD runs are performed for separate decision units of a waste site area (e.g., the excavation footprint, overburden, and staging pile areas). Per Section 7.1.2 of the 300 Area ROD, the cancer risk limit for soil radionuclide CULs was set at a $1x10^{-4}$ risk limit or 15 mrem/yr for isotopes where the latter is more conservative. Soil radionuclide CULs must also meet the multi-contaminant total cancer risk limit of $1x10^{-4}$. These soil risk limits are applied to both the industrial and residential scenarios.

The "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) (40 CFR 300.430) establishes that CERCLA cleanups should generally achieve a level of residual risk of 10^{-4} to 10^{-6}. However, EPA guidance states that the upper boundary of the risk range is not a discrete line at 10^{-4} and a specific risk estimate around 10^{-4} may be considered acceptable, if justified based on site-specific conditions. If this circumstance occurs appropriate discussion shall be presented in the CVP. The results of the RESRAD radionuclide cancer risk predictions for the all-pathways scenarios for the units of the waste site area are typically presented as excess lifetime cancer risk (ELCR) versus time (years). These ELCR determinations represent the cancer risk contributions from soils at relevant time periods. Because of radioactive decay, the risk usually decreases over time and the maximum predicted ELCR occurs at the present time. However, there may be instances where radionuclides decay to more radioactive daughter products causing risk to increase over time. All ELCR predictions must be less than the individual and total cancer risk limit of $1x10^{-4}$ to meet the CULs. The RESRAD computations are shown in detail in calculation briefs presented in an appendix to the CVP. A figure may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

Alternatively, for waste sites with few radionuclide COCs at concentrations well below the individual radionuclide CULs, Table B-5a provides a typical comparison of the shallow zone (including overburden) radionuclide cleanup verification statistically quantified values to direct exposure single radionuclide $1x10^{-4}$ cancer risk values using a sum of fractions evaluation. The columns on the left side of Table B-5a are the COCs and the 95% UCL values, corrected for background, as appropriate. Uranium background is subtracted from the analyses for all soil samples but background for other radionuclides is only subtracted from the overburden soil analysis. This accounts for anthropogenic and naturally occurring radionuclide background in surface soils. Only uranium background concentrations are accounted for in shallow and deep zone soils by subtracting uranium isotope concentrations from the statistical values or maximum values. The fourth column presents the single radionuclide $1x10^{-4}$ cancer risk equivalence activity, and the last two columns present the statistical values divided by the cancer risk equivalence activity. In the Table B-5a example for residential cleanup the total predicted radionuclide cancer risk based on sum of fractions determination is less than $1x10^{-4}$ so no further evaluation is necessary. However, the Table B-5b sum-of-fractions evaluation for an industrial cleanup is greater than $1x10^{-4}$, so further evaluation using RESRAD with site-specific input parameters is necessary.

Table B-5a. Sum-of-Fractions Evaluation of Radionuclide Direct Exposure Risk for Residential Cleanup

COCs	95% UCL Statistical Values (pCi/g)		Activity Equivalent to $1x10^{-4}$ cancer risk [a] (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Example Results:					
Cesium-137	0.044 (ND)	0 (<BG) (ND)	4.4	0.010	0
Cobalt-60	0.047 (ND)	0.049 (ND)	1.4	0.034	0.035
Europium-152	0.100 (ND)	0.15 (ND)	3.3	0.030	0.045
Europium-154	0.14 (ND)	0.14 (ND)	3	0.047	0.047
Europium-155	0.12 (ND)	0.08 (ND)	125	0.001	0.001
Sum of Fractions				0.122	0.128
Cancer Risk				$1.22 x10^{-5}$	$1.28 x10^{-5}$

Example Footnotes:

a Single radionuclide $1x10^{-4}$ cancer risk equivalence values and derivation methodology are presented in Table 4 of the 300 Area ROD (EPA 2013).

COC = contaminant of concern

ND = not detected (in all samples in the data set)

Table B-5b. Attainment of Radionuclide Direct Exposure Cleanup Levels for Industrial Cleanup

COCs	Shallow Zone Focused Sample Analyses (pCi/g)	Activity Equivalent to $1x10^{-4}$ cancer risk [a] (pCi/g)	Fraction
Example Results:			
Americium-241	0.711	210	0.0034
Cesium-137	0.126	4.4	0.0286
Plutonium-239/240	0.356	245	0.0015
Plutonium-241	3.33	12,900	0.0003
Technetium-99	1.19	166,000	0.0001
Uranium-233/234	77.5 (amount above BG)	167	0.4641
Uranium-235	7.14 (amount above BG)	16	0.4462
Uranium-238	86.3 (amount above BG)	167	0.5168
Sum of Fractions			1.4610
Cancer Risk			$1.46x10^{-4}$

Example Footnotes:

a Single radionuclide $1x10^{-4}$ cancer risk equivalence values and derivation methodology are presented in Table 4 of the 300 Area ROD (EPA 2013).

b Uranium background is subtracted from the analyses for all soil samples, but background for other radionuclides is only subtracted from the overburden soil analyses.

BG = background
COC = contaminant of concern

B4.8.2.2 Nonradionuclides Evaluation of Risk Standards

The comparison tables, using Table B-4b as an example, provide a comparison of the nonradionuclide cleanup verification maximum or statistical values to the direct exposure, groundwater protection, and river protection CULs.

Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For COCs with noncarcinogenic effects, WAC 173-340 specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose (WAC 173-340-200). Hazard quotients for individual noncarcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-1 of WAC 173-340 (2007) as shown in Table D-2a. Similarly, the cancer risks for individual carcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-2 of WAC 173-340 (2007), as shown in Table D-2b. Where residential land use cleanup and risk standards cannot be met in the industrial land use areas of the 300 Area, the industrial hazard quotient and cancer risk must be calculated by substituting the appropriate industrial land use daily intake factor from Equations 745-1 and 745-2 of WAC 173-340 (2007) in Tables D-2c and D-2d of Appendix D into the spreadsheets.

Calculation and application of hazard quotient and cancer risk for residential and industrial land use under WAC 173-340 (2007) is discussed further in Table D-2 of Appendix D. Values for the reference doses (RfDs) and cancer potency factors (CPFs) for use in calculating the hazard quotient and cancer risk in are provided in Table D-3.

Individual hazard quotients and the sum of individual hazard quotients for a waste site must be less than 1.0. For cumulative carcinogenic COCs, the cumulative excess cancer risk must be less than $1x10^{-5}$. For multiple carcinogenic COCs, the risks of the individual COCs (described above) are summed. If no risk associated with a single COC exceeds $1x10^{-6}$ for residential land use or $1x10^{-5}$ for industrial land use, and if the sum of the individual COC risk does not exceed $1x10^{-5}$, then the carcinogenic risk requirements have been met.

Typically, the results of evaluation of the attainment of noncarcinogenic and carcinogenic individual and cumulative risk standards are presented in a calculation brief that is included in an appendix to the CVP.

Site-Specific Evaluation of Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For instances where the conservative approach does not result in a determination that the sum of individual noncarcinogenic hazard quotients is less than 1.0 or that the individual or cumulative carcinogenic risks are less than $1x10^{-6}$ and $1x10^{-5}$, respectively, site-specific risk evaluations may be performed. The noncarcinogenic hazard quotient calculation may use an occupancy factor in Equations 740-1 and 740-2 from WAC 173-340-740(3) for residential land use and in Equations 745-1 and 745-2 from WAC 173-340-745(5) for industrial land use to account for the amount of time individuals may actually spend on a waste site. For small waste sites (less than 1,000 m^2) a site-specific calculation may be performed utilizing an area factor to account for the size of the waste site and, hence, the daily intake.

B4.8.3 Groundwater Cleanup Levels Attained

The groundwater CULs are applicable to all decision units (e.g., shallow zone, deep zone, and overburden). Soil CULs for radionuclides and nonradionuclides for the protection of groundwater and the river are summarized in Table D-1 of Appendix D. These were calculated during development of the 300 Area ROD (EPA 2013) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code. Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

B4.8.3.1 Radionuclide Groundwater Cleanup Levels Attained

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table D-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table D-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation as described in Section D.5.2 of Appendix D to determine if residual soil concentrations may actually be protective of groundwater. Comparison of peak radionuclide concentrations predicted by a site-specific RESRAD evaluation against the groundwater CULs is presented in a table similar to Table B-6.

Table B-6. RESRAD Predicted Peak Radionuclide Groundwater Concentrations Compared to Cleanup Levels

Radionuclide	Peak Concentration (pCi/L)	CUL (pCi/L)	CULs Attained? (Yes/No)
Example Language:			
Tritium	*18,500*	*20,000*	*Yes*

Example Footnotes:

BCL = below cleanup level

CUL = cleanup level

B4.8.3.2 Nonradionuclide Groundwater Cleanup Levels Attained

Comparison table(s), such as Table B-4b, provide a tool for evaluation of the nonradionuclide cleanup verification data against the groundwater and river protection CULs. Residential and industrial soil CULs, protective of groundwater and the river, were calculated based on federal drinking water standards as described in Section 8.2 of the 300 Area ROD (EPA 2013). Parameters specific to a residential or industrial scenario were used in the STOMP model to perform these calculations. Under the Final ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection would trigger additional evaluation based on risk to human health that could induce additional cleanup, a site-specific risk analysis, or other actions.

B4.9 Data Quality Assessment Process

The data quality assessment (DQA) has been integrated into the CVP and is presented here as a subsection. The DQA is very briefly summarized in the body of the CVP, with the detailed DQA (as represented in the following sections) placed in an appendix to the CVP. The DQA process involves evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use (EPA 2000). The DQA process completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the DQO process.

The DQA process is not intended to be a definitive analysis of a project or problem, but instead provides an assessment of the reasonableness of the data that have been generated (EPA 2000).

The DQA focuses on the laboratory data, statistical error tolerances, and the overall DQO, specifically by addressing the question, "Are the data of the right type, quality, and quantity to support their intended use?" The intended use of the data is to make the appropriate decision regarding whether the site meets the RAOs as defined by the CULs. The site closeout or cleanup decision rules are the CULs. Completion of a CVP following this guidance inherently is the functional equivalent of performing a DQA for a waste site.

The DQA may not be performed on field screening data, if the field screening data are not used in decisions regarding the rejection of the null hypothesis (a decision that the site is "clean"). Therefore, field decisions that the site is "dirty" will be made based on the field screening data with the understanding that the decision to remediate a site determined to be contaminated based on field readings may not be within error tolerances. This is a project risk management decision and is deemed as an acceptable risk by project decision makers.

After sampling is completed, sample data packages are validated, including review of the following items, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- Matrix spike recovery
- Surrogate recovery
- Matrix spike/matrix spike duplicate results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness.

For CVPs and related documents (e.g., leachability study reports, data summary reports), all laboratory-applied "J" flags on radionuclide results will be deleted. A footnote will be included in the radionuclide data summary tables indicating that, because of laboratory reporting conventions, these results may have a nonrelevant "J" qualifier in the HEIS database and/or in the analytical report.

Where the "J" qualifier is applied through the validation process, the qualifier will not be deleted and the traditional "estimated" footnote will be presented. The footnote will also direct the reader to the DQA section of the document. The DQA section provides additional discussion regarding the reasons why the "J" qualifier was applied during validation and also discusses the usability of the data.

Data qualified as not detected (i.e., "U") indicate that the appropriate analysis was performed but that the analyte was not detected. The concentration associated with "U" qualified data represents the practical quantitation limit (PQL). The analyte may or may not exist in the sample at concentrations below the PQL.

Data qualified as rejected (i.e., "R") indicate that the data are not useable due to a major quality assurance/quality control deficiency. All other qualified results are considered accurate within the standard errors associated with environmental samples and the individual analytical methods performed.

The adequacy of laboratory quality assurance/quality control is evaluated as a subset of the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) in DOE/RL-2001-48, *300 Area Remedial Action Sampling and Analysis Plan* (300 Area SAP). This evaluation is presented in a validation report that is prepared by a third-party contractor, who determines whether the laboratory met the required target detection limits of precision, accuracy, and completeness.

Reported analytical detection levels are compared to the specified detection limits in the 300 Area SAP (DOE/RL-2001-48). The data validation notes any analyses in which the PQL or minimal detectable activity was above the 300 Area SAP-specified required quantitation limits (RQLs). The RQLs are based on optimal conditions. Interferences and different matrices may significantly affect the PQLs. PQLs that exceed the specified RQLs do not necessarily invalidate the data for decision-making purposes; however, the exceedances need to be evaluated on a case-by-case basis within the DQA.

An evaluation of the matrix spike/matrix spike duplicate samples and the associated percent recoveries and relative percent differences is also performed. Acceptable limits are presented in the 300 Area SAP (DOE/RL-2001-48). However, it should be noted that the matrices of environmental samples are not homogenous. The natural heterogeneities in the matrices can cause significant variability in the percent recovery and relative percent difference calculations which can exceed the limits presented in the

300 Area SAP. Exceedances observed in the data set need to be evaluated on a case-by-case basis, to determine if there is any indication that the analytical system or methodology is at fault.

B4.10 Summary for Waste Site Reclassification

The purpose of this section is to provide a statement that the given waste site has been evaluated in accordance with the 300 Area ROD and that the results of the verification sampling support a reclassification (in accordance with the TPA-MP-14 process [RL-TPA-90-0001]) of the given waste site to "final closed out" or "final no action."

When field screening or sampling results indicate that residual concentrations of contaminants at the site meet the CULs for direct exposure, groundwater protection, and river protection without remediation, "final no action" is the appropriate reclassification status. Per the conceptual site model stated in the 300 Area decision documents, waste site contamination does not extend into deep zone soils if it is not found in the shallow zone. Hence, sampling activities are normally not required for deep zone soils and institutional controls to prevent uncontrolled drilling or excavation into the deep zone are generally not required.

When the waste site has been remediated in accordance with the 300 Area ROD or other decision documents, this is stated and the applicable version of the RDR/RAWP is cited. The amount of material for disposal at the Environmental Restoration Disposal Facility is noted for a general sense of magnitude. Sampling conducted to verify the completeness of remediation is briefly discussed and analytical results for the waste site shown to meet the cleanup objectives for direct exposure and groundwater and river protection are noted. Accordingly, it is stated that waste site reclassification to "final closed out" is supported for the waste site. The maximum depth of the waste site excavation area is identified as necessary to describe potential deep zone considerations and the possible need for institutional controls to prevent future intrusion into deep zone contamination. However, if the entire excavation area may be considered one decision unit and closed out using the more restrictive shallow zone cleanup criteria, then institutional controls to prevent uncontrolled drilling or excavation into the deep zone may not be required.

B5. References

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, as amended.

ANL, 2009, *RESRAD for Windows*, Version 6.5, October 30, 2009, Argonne National Laboratory, Environmental Assessment Division, Argonne, Illinois.

DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes,* Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-12, 1996, *Hanford Site Background: Part 2, Soil Background for Radioactive Analyte*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-48, 2011, *300 Area Remedial Action Sampling and Analysis Plan,* Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Ecology, 1995, *Guidance on Sampling and Data Analysis Methods*, Publication No. 94-49, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2007, WAC 173-340, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, November 2007 Revision.

EPA, 1976, *National Primary Drinking Water Regulations*, EPA-570-76-003, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2000, *Guidance for Data Quality Assessment: Practical Methods for Data Analysis*, EPA/600/R-96/084, QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, WPa/240/B-06/001 U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, , U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, DOD, DOE, and NRC, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, EPA 402-R-97-016, DOE/EH-0624, NUREG-1575, Rev. 1, U.S. Environmental Protection Agency, U.S. Department of Defense, U.S. Department of Energy, and U.S. Nuclear Regulatory Commission, Washington, D.C. Available online at: http://www.epa.gov/radiation/marssim.

RL-TPA-90-0001, 2011, *Tri-Party Agreement Handbook Management Procedures,* Rev. 2, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC 173-340, 2007, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, November 2007 Revision.

This page intentionally left blank.

Appendix C

Revegetation Plan for the 300 Area

This page intentionally left blank.

C1. Introduction

This revegetation plan addresses waste sites covered in this 300 Area remedial design report/remedial action work plan (RDR/RAWP) that will be remediated as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* remedial action project. This appendix addresses sites in the 300-FF-2 Operable Unit (OU). Each site requiring remediation and the associated support facilities (roads, spoils piles, etc.) that are disturbed during remediation will be revegetated under this plan. Sites in the 300-FF-2 OU previously remediated under interim actions, but for which revegetation had not yet been performed, will also be performed under this plan.

This plan is generic; site-specific conditions will be evaluated and adjustments made when necessary. Land-use considerations will also affect the intensity of revegetation of the 300 Area waste sites. Some sites within the 300 Area have been designated for continued or future industrial land use. Other portions of the 300-FF-2 OU have been proposed as resources of concern by DOE/RL-96-32, *Hanford Site Biological Resources Management Plan* (BRMaP), because they contain high-quality shrub-steppe habitat, which is classified as a priority habitat by the Washington Department of Natural Resources (WDNR 1995). Consultations with Tribes and the Natural Resource Trustee Council will also occur, as appropriate, for additional input.

This revegetation plan is based on the information provided in the BRMaP (DOE-RL-96-32) and results of other revegetation efforts that have occurred across the Hanford Site.

C2. Mitigation Action Plan

DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, addresses mitigation actions for waste sites in the 300-FF-2 OU. The mitigation action plan (MAP) provides guidance to the design and field staff to ensure that natural and cultural resources are protected during field activities. The plan includes avoidance and minimization steps in mitigation. Special consideration is also given to the local Native American Tribes and nations for cultural resource concerns.

Much of the nonindustrial and less-disturbed 300 Area contains recovering mid-seral communities of shrub (bitterbrush [*Purshia tridentata*] and snow buckwheat [*Eriogonum niveum*]), perennial grass (e.g., Sandberg's bluegrass [*Poa sandbergii*]), and annual grass (e.g., cheatgrass [*Bromus tectorum*]) species on sandy soils. Portions of the habitat in this area have been proposed as a Level III resource of concern in the BRMaP (DOE/RL-96-32). Level III biological resources are of concern because of their state listing; potential for federal or state listing; unique or significant value for plant, fish, or wildlife species; special administrative designation; or environmental sensitivity. The BRMaP does not identify a resource level of concern for the southern portion of the 300-FF-2 OU adjacent to the industrialized 300 Area due to extensive disturbance and lack of vegetation.

Remediation of the 300 Area waste sites is anticipated to involve extensive excavation, which has the potential to impact natural resources. These sites will be identified in field surveys prior to initiation of remediation. If remedial actions demonstrate the potential for disturbing species of concern or removing high-quality habitat, supplemental mitigation (in addition to actions listed in the MAP [DOE/RL-2002-19]) may be needed.

C3. Site Descriptions

The vegetative status for waste sites that were remediated and the nearby areas for support facilities during remediation have been assessed in various ecological and cultural resources reviews.
The remaining sites will be evaluated for cultural and ecological resources prior to the commencement of

remedial actions at those sites. The vegetative status of the 300 Area varies, but ranges from nonvegetated/industrial (e.g., the parking lot above the 618-8 Burial Ground) to a mixture of nonvegetated and vegetated with low-quality communities, such as cheatgrass/Russian thistle (*Bromus tectorum/Salsola kali*) and rabbitbrush/cheatgrass (*Chrysothamnus nauseosus/Bromus tectorum*), and high-quality mature shrub-steppe habitat containing sagebrush (*Artemisia tridentata*), bitterbrush, rabbitbrush (*Chrysothamnus nauseosus*), and snow buckwheat. The soils in the 300-FF-2 OU are predominantly sandy soils, although remediated sites will consist of backfill from site stabilization. Wildlife that uses the 300 Area includes mule deer, coyotes, geese, badgers, birds, and small mammals such as Great Basin pocket mice and deer mice. Detailed descriptions of the habitat present at the 300-FF-2 OU sites were recorded in *Ecological Resources Review of Remedial Design Package for Nine 300-FF-2 Waste Sites* (00-ER-039) (BHI 2000) and other 300 Area ecological reports (e.g., DOE/RL-2002-19; BHI-00170, *Ecological Investigation Report for the 300-FF-2 Operable Unit*; Rickard et al. 1990).

C4. Purpose of Revegetation

The goal of revegetation in the 300 Area is to restore the remediated waste sites and support areas not identified for future land use to communities dominated by native plant species, as appropriate. Revegetation is valuable for the prevention of runoff, erosion, and infiltration. In some areas, shrubs such as sagebrush and bitterbrush may be planted to provide habitat and structure for nesting birds. Native grasses and forbs that are adapted to the site conditions will be planted to provide an understory. The methods used for revegetation will reflect what is feasible on a site-by-site basis. Future land use and the duration of project activities are factored into mitigation and revegetation planning.

C5. Topsoil and Backfill Material

Fine-grained topsoil, such as sandy loam, is of low availability on the Hanford Site. In the few places where it exists, such as McGee Ranch and the Fitzner Eberhardt Arid Lands Ecology Reserve, removal may cause unacceptable ecological effects at the borrow sites. The "Hanford Comprehensive Land-Use Plan Environmental Impact Statement" (64 *Federal Register* 61615) precludes the use of borrow materials from McGee Ranch; therefore, backfill from nearby borrow pits will be used. The backfill material from the borrow pits was originally deposited by the Columbia River, and a slow, natural revegetation of this backfill can be seen at the borrow sites that have been abandoned. Native species, including sagebrush and Sandberg's bluegrass, have become established in inactive borrow pits. The density of the vegetative cover at the abandoned borrow pits, however, is less than at other sites such as the abandoned pre-Hanford farmland, which is usually dominated by cheatgrass and tumblemustard (*Sisymbrium altissimum*). The soils at the abandoned fields consist of much finer grained materials, with greater moisture-holding capacity and nutrient properties than at the borrow sites. These fine-grained soils tend to favor cheatgrass, which often excludes establishment of shrubs.

Other sources of backfill that may be considered for use include uncontaminated concrete rubble from nearby demolished buildings. If revegetation will occur at the site and secondary material (i.e., inert crushed concrete or other course material) is used as backfill, it will be placed at least 2 to 3 m (6 to 10 ft) below final grade to the extent practicable. The smaller grained material (i.e., cobble, sand, soil), which is necessary for sufficient plant rooting, will be used near the surface.

C6. Site Preparation

On a case-by-case basis, clean overburden may be used as backfill for an entire excavation when conditions warrant. Conditions may include excavations that are long and shallow in nature, making use of new material on top impractical. Overburden may only be used if it has undergone sampling and analytical results demonstrate that cleanup levels have been met. For those sites that are currently vegetated, the top 15 to 46 cm (6 to 18 in.) of clean overburden will be stripped, saved, and used as the topsoil for the excavation. If needed, this material may be spread into a thinner layer (about 5 to 10 cm [2 to 4 in.]) and used as topsoil for several adjacent sites.

The Tri-Parties have determined that waste sites within the 300 Area "industrialized core zone and contiguous areas" will be regraded in a manner that will provide positive drainage away from areas where residual subsurface contamination could result in adverse groundwater impacts. The grading, to the extent practicable, will maximize the amount of large flat areas and minimize rolling contours or depressions where water may accumulate. For waste sites outside of the industrial zone, the final surface contour will be graded to match the surrounding terrain by creating gentle slopes instead of a flat surface. Any large boulders remaining on the sites that are to be revegetated should be buried deep in the excavation or randomly grouped on the surface to create additional wildlife habitat. Based on site-specific considerations, the lead regulatory agency may approve backfill to less than surrounding grade, in which case depressions may remain.

C7. Species to be Planted

The plant species seeded will be selected based on seed availability and species appropriateness for the structure of the soils to be revegetated. Native species found to be growing on the Hanford Site will be used for a majority of revegetation efforts. Seeds manually collected from native plants, such as sagebrush, yarrow (*Achillea millefolium*), Carey's balsamroot (*Balsamorhiza careyana*), pine bluegrass (*Poa scabrella*), and snow buckwheat, may be collected and will be added to the planting mixture as available and as appropriate to each site. Additional seeds of other species may be provided by the Tribes and Trustees and combined with the species described above.

The methods used for seeding will vary, depending on soil type and conditions. For example, drill-seeding works best on soils with minimal amounts of rock, while broadcast seeding may be preferable on rocky soils. Seeds that are uncleaned or of an unsuitable shape or size may be broadcast over the site before the other seeds are planted. The action of the planting and mulching equipment will help set the broadcast seeds. Areas that have been used for support facilities and haul roads may have excessively compacted ground, making the area unsuitable for planting. If necessary, the soils in these areas will be loosened by ripping the soil with heavy equipment. If a seed drill is not appropriate at these areas, broadcast seeding with subsequent mulching may be used to plant seeds. Seeding each year will generally occur between November and mid-January.

On sites where more intensive revegetation is required, sagebrush and bitterbrush tublings are normally planted between November and January in the backfilled areas at a density ranging between 500 to 1,000 plants/ha (200 to 400 plants/acre), depending on the site.

C8. Fertilizer and Straw Mulch

While the usefulness of fertilizers is sometimes in question when seeding native species, the backfill material excavated from borrow pits is often deficient of nutrients. The cobble composition of excavated backfill material does not promote the establishment of cheatgrass as does finer grained topsoil. Therefore, the addition of some fertilizers may help the native planted species become established. To help clarify the role of fertilizer on native plant establishment, different types of fertilizer and rates may be applied to parts of revegetation sites. The success of each fertilized area will be monitored and compared after the first and second years for plant establishment and cost effectiveness. The fertilizer will be applied at the same time as the seeds, and the type and rate will be determined on a site-specific basis. Straw mulch will be spread on the surface at a rate of 4.5 metric ton/ha (2 tons/acre) and crimped into the seedbed.

C9. Irrigation

Any form of applied irrigation within the 300 Area industrial zone is prohibited.

When irrigation is feasible for sites outside the industrial zone, it will generally occur only at the time of initial seeding. No additional irrigation is planned at this time. The presence of cobble and larger gravels used as backfill on the sites act as a mulch, helping to conserve moisture. The effects of supplemental irrigation on restoration success were tested at a restoration site in the 100-B/C Area during 1999 and 2000. The results at this test site indicated that supplemental irrigation in the spring did little to improve the survival of planted sagebrush (BHI-01406, *2000 Environmental Restoration Contractor Revegetation Monitoring Report*). Vegetation analysis from other similar revegetation sites indicate that it is more beneficial to add supplemental water during the planting process to increase germination, with little observed benefit of irrigation after planting.

C10. Monitoring and Success Criteria

The revegetated areas will be monitored for 5 years following planting. Monitoring will be conducted using methods from Daubenmire (1970) to estimate percent canopy cover and frequency of occurrence for each species. All species observed on the sites, including those not captured in the sampling plot frames, will be recorded. If the canopy cover of seeded plants is less than 1% in the spring of the second year, reseeding may occur the following fall, if the cause of the reduced success can be identified and rectified. After 5 years, the criteria for success will be a total canopy cover of greater than 25% for native plants. If this is not achieved, the cause should be identified and rectified with additional plantings, fertilization, irrigation, or soil amendments, as applicable.

The vegetative cover and composition at each site following a revegetation effort will be site specific. Several factors, including seedbed, moisture regime, and topographic features, influence a native plant community establishment and success. Caution should be exercised when comparing success between different locations.

C11. References

64 FR 61615, "Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS), Hanford Site, Richland, Washington; Record of Decision (ROD)," *Federal Register*, Vol. 64, No. 218, pp. 61615, November 12, 1999.

BHI-00170, 1995, *Ecological Investigation Technical Report for the 300-FF-2 Operable Unit*, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

BHI-01406, 2000, *2000 Environmental Restoration Contractor Revegetation Monitoring Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000, "Ecological Resources Review of Remedial Design Package for Nine 300-FF-2 Waste Sites (00 ER-039)," CCN 083958, interoffice memorandum to S. Parnell, Bechtel Hanford, Inc., Richland, Washington, November 13.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

Daubenmire, R., 1970, *Steppe Vegetation of Washington*, Technical Bulletin 62, Washington Agricultural Experiment Station, Pullman, Washington.

DOE/RL-96-32, 2013, *Hanford Site Biological Resources Management Plan*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-19, 2002, *Mitigation Action Plan for the 300 Area of the Hanford Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Rickard, W. H. Jr, R. E. Fitzner, and C. A. Brandt, 1990, *Biota of the 300-FF-1 Operable Unit*, EMO 1016, Environmental Management Operations, Richland, Washington.

WDNR, 1995, State *of Washington Natural Heritage Plan: 1993/1995 Update*, Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

This page intentionally left blank.

Appendix D

Development of Cleanup Levels and Summary of RESRAD Methodology

This page intentionally left blank.

D1. Introduction

As described in the *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (300 Area ROD) (EPA 2013), cleanup levels (CULs) have been developed for each media and/or exposure pathway to provide protection of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs).

Soil CULs for 300 Area contaminants of concern (COCs) were developed based on direct human contact as well as groundwater and surface water protection and are summarized in Table 4 of the 300 Area ROD (EPA 2013). Cleanup levels from this ROD are summarized in Table D-1 of this appendix. These CULs apply to soil and engineered structures that include pipelines and debris. The CULs do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying CULs to sediment/scales within pipelines or other structures. The need for remedial action is based on the existence of soil contamination. Direct contact CULs for nonradionuclides are based on current Washington State Department of Ecology 2007 standards at *Washington Administrative Code* (WAC) 173-340. The direct contact soil CULs for radionuclides were set at either the risk-based level of $1x10^{-4}$ cancer risk or the radiation dose limit of 15 mrem/yr that was used in the 300-FF-2 interim action ROD (EPA 2001), whichever is lower.

The objective of this appendix is to document the development of CULs for nonradionuclide and radionuclide COCs at the 300 Area that are protective of human health and the environment. Impacts to human health are addressed by evaluation of direct contact/exposure and groundwater/Columbia River pathways. The CULs for comparison against residual soil contamination concentrations and evaluation of site risk are contained in the 300 Area ROD (EPA 2013) based on development during the 300 Area remedial investigation/feasibility study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*); DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*) and are summarized in the following sections.

Cleanup levels are developed for waste site COCs to attain acceptable levels of human health risk and to protect groundwater and the Columbia River. Because of uncertainty with the nature and extent of contamination, the CULs are evaluated as if exposure comes from individual constituents and CULs are set at acceptable risk levels for exposure to individual constituents. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated to ensure that the waste site meets total risk limits as specified in the 300 Area ROD (EPA 2013). When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the remedial action objectives of the 300 Area ROD.

D2. Nonradionuclide Cleanup Levels

Numeric CULs, expressed in terms of concentration (mg/kg), were developed for 300 Area nonradionuclide COCs using the version of WAC 173-340 (Ecology 2007) that was in effect at the time the 300 Area ROD (EPA 2013) was approved. Soil residential CULs for nonradionuclides were calculated using the WAC 173-340-740 chemical standards for unrestricted use for all COCs using a hazard index of one and a cancer risk of $1x10^{-6}$. Soil industrial CULs for nonradionuclides were calculated using the WAC 173-340-745 chemical standards for industrial use for all COCs using a hazard index of one and a cancer risk of $1x10^{-5}$.

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Radionuclides	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	
Americium-241	32	--	210	--	ROD
Cesium-137	4.4	--	18	--	ROD
Cobalt-60	1.4	--	5.2	--	ROD
Europium-152	3.3	--	12	--	ROD
Europium-154	3.0	--	11	--	ROD
Europium-155	125	--	518	--	ROD
Iodine-129	0.076	12.8	1,940	37.1	ROD
Plutonium-238	39	--	155	--	ROD
Plutonium-239/240	35	--	245	--	ROD
Plutonium-241	854	--	12,900	--	ROD
Strontium-90	2.3	227,000	1,970	--	ROD
Technetium-99	1.5	272	166,000	420	ROD
Tritium (H-3)	459	9,180	1,980	12,200	ROD
Uranium-233/234	27.2	--	167	--	ROD
Uranium-235	2.7	--	16	--	ROD
Uranium-238	26.2	--	167	--	ROD
Total uranium	56.1	--	350	--	ROD
Metals	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Antimony	32	252	1,400	760	ROD
Arsenic	20	20	20	--	ROD
Barium	16,000	--	700,000	--	ROD
Beryllium	160	--	7,000	--	ROD
Cadmium	80	176	3,500	--	ROD
Chromium, total	120,000	--	>1,000,000	--	ROD
Chromium VI	2.1	2.0	10,500	2.0	ROD
Cobalt	24	--	1,050	--	ROD
Copper	3,200	3,400	140,000	--	ROD
Lead	250	1,480	1,000	--	ROD
Lithium	160	--	7,000	--	ROD

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Manganese	11,200	--	490,000	--	ROD
Mercury	24	8.5	1,050	--	ROD
Nickel	1,600	--	70,000	--	ROD
Selenium	400	302	17,500	912	ROD
Silver	400	--	17,500	--	ROD
Strontium	48,000	--	>1,000,000	--	ROD
Tin	48,000	--	>1,000,000	--	ROD
Uranium	81	102	505	157	ROD
Vanadium	400	--	17,500	--	ROD
Zinc	24,000	64,100	>1,000,000	--	ROD
Inorganics and TPH	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Cyanide	48	636	42	1,960	ROD
Fluoride	4,800	--	210,000	--	ROD
Nitrate	568,000	13,600	>1,000,000	21,000	ROD
TPH, Normal paraffin (kerosene)	2,000	2,000	2,000	2,000	ROD
TPH, Diesel	2,000	2,000	2,000	2,000	ROD
TPH, Motor oil	2,000	2,000	2,000	2,000	ROD
Volatile Organic Analytes	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Benzene	0.57	0.82	5.7	1.4	ROD
Carbon tetrachloride	0.61	0.44	6.1	0.86	ROD
Chloroform	0.24	1.3	2.4	2.1	ROD
Dichloroethylene;1,2-, total	720	55	31,500	89	ROD
Dichloroethylene;1,2-,cis	160	11	7,000	18	ROD
Ethyl Acetate	72,000	--	>1,000,000	--	ROD
Hexachlorobutadiene	13	--	1,680	--	ROD
Hexachloroethane	2.5	23	25	72	ROD
Methyl ethyl ketone (2-butanone)	28,400	1,670	62,200	2,590	ROD
Methyl isobutyl ketone (4-M,2-P)	6,400	285	28,700	445	ROD

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Tetrachloroethene	20	2.4	82	6.0	ROD
Toluene	4,770	1,150	10,400	2,190	ROD
Trichloroethane;1,1,1-	3,660	361	8,000	686	ROD
Trichloroethylene (trichloroethene; TCE)	1.1	1.3	3.5	2.4	ROD
Vinyl chloride	0.53	0.013	5.2	0.021	ROD
Xylene	103	4,700	227	11,090	ROD
Semivolatile Organic Analytes	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Benzo(a)pyrene	0.14	--	18	--	ROD
Chrysene	14	--	1,800	--	ROD
Ethylene glycol	160,000	5,030	>1,000,000	7,770	ROD
Hexachlorobutadiene	13	--	1,680	--	ROD
Hexachloroethane	2.5	23	25	72	ROD
Tributyl phosphate	111	217	14,600	658	ROD
Pesticides and PCBs	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
PCB Aroclor-1016	5.6	--	245	--	ROD
PCB Aroclor-1221	0.5	0.017	66	0.026	ROD
PCB Aroclor-1232	0.5	0.017	66	0.026	ROD
PCB Aroclor-1242	0.5	0.14	66	--	ROD
PCB Aroclor-1248	0.5	0.13	66	--	ROD
PCB Aroclor-1254	0.5	--	66	--	ROD
PCB Aroclor-1260	0.5	--	66	--	ROD

Footnotes from the 300 Area ROD, Table 4:

-- = Not available; no CUL calculated (contaminant is not predicted to reach groundwater).

CUL basis for radionuclides is a cancer risk of 1×10^{-4} or 15 mrem/yr dose, whichever is more conservative. For uranium, 15 mrem/yr is more conservative, so that is the basis for the uranium isotopes total CUL. That total is divided among the individual uranium isotopes using the natural ratio of isotopes.

No uranium isotope CUL is selected for groundwater and river protection because the maximum contaminant level is used, which is based on uranium metal.

CUL basis for chemicals is the more conservative of a hazard index of one or the cancer risk. The cancer risk is 1×10^{-6} for residential cleanup and 1×10^{-5} for industrial cleanup based on MTCA.

Basis for soil CUL for groundwater and river protection is the STOMP soil leach model.

For pipelines too small for people to enter, CULs apply to the contaminated pipelines including the mass of the pipes. CULs for structures and debris also account for the mass of the object.

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	

a Cleanup levels in this table are obtained from the 300 Area ROD. Residential and industrial cleanup levels protective of groundwater and the river are described in Section 8.2 of the ROD. Parameters specific to a residential or industrial scenario were used in STOMP modeling calculations. Under the 300 Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

ROD = EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

CUL = cleanup level
MTCA = Model Toxics Control Act
PCB = polychlorinated biphenyl
ROD = Record of Decision
STOMP = Subsurface Transport Over Multiple Phases
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis

The direct exposure cleanup levels tabulated in Table D-1 apply to the upper 4.6 m (15 ft) of the soil column per WAC 173-340-740(6)(d) and represent concentrations for individual COCs that will be protective of human health from direct contact with contaminated waste for a residential land-use scenario. WAC 173-340 also specifies the evaluation of hazard quotients and excess carcinogenic risk. These parameters can be derived by rearranging Equations 740-1, 740-2, 745-1, and 745-2 of WAC 173-340, as shown in Tables D-2a, D-2b, D-2c, and D-2d, respectively. Values for the reference doses (RfDs) and cancer potency factors (CPFs) are provided in Table D-3. Institutional controls to prevent deep excavation or well drilling will be required if the applicable direct exposure CULs are not attained in the soil below 4.6 m (15 ft) in depth.

D3. Groundwater and River Protection Cleanup Levels for Radionuclide and Nonradionuclide Contaminants In Soil

Soil CULs for radionuclide and nonradionuclide COCs for the protection of groundwater and surface water are summarized in Table D-1. These were calculated as described in the 300 Area ROD (EPA 2013) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code with a one-dimensional model for all contaminants except uranium. For uranium, the STOMP code was used with a two-dimensional model that includes the effects of uranium's more complex sorption behavior. For highly mobile contaminants (retardation coefficient <2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. For the 300 Area industrial complex and 618-11 Burial Ground, a groundwater recharge rate of 25 mm/yr was used for the long term, representing a permanently disturbed soil with cheatgrass vegetative cover. For areas outside the 300 Area industrial complex and 618-11 Burial Ground where CULs are based on a residential scenario, a groundwater recharge rate of approximately 72 mm/yr was used representing an irrigated condition. Based on this model, no soil CUL for groundwater or river protection is calculated for some contaminants because the contaminant is calculated to not reach the groundwater within 1,000 years.

Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions. Site-specific evaluation of the attainment of National Primary Drinking Water Standards for radionuclides is described in Section D.5.2 of this appendix.

D4. Radionuclide Cleanup Levels

Cleanup levels for radionuclide COCs are summarized in Table D-1 of this appendix. Soil radionuclide cleanup levels for the 300 Area of the Hanford Site are based upon determinations of individual radionuclide activities that will be protective of a direct exposure carcinogenic risk limit of $1x10^{-4}$, or a 15 mrem/yr radiological dose limit for isotopes where that is more conservative. The RESidual RADioactivity (RESRAD) model was selected by the Tri-Parties as the radionuclide risk and dose assessment model for generating CULs for radionuclide contaminants in soil and for verifying that concentrations remaining after remedial action achieve cleanup levels to meet the cumulative carcinogenic risk limit of $1x10^{-4}$. The RESRAD model was developed by Argonne National Laboratory (ANL 2001, 2009) to implement U.S. Department of Energy (DOE) guidelines for residual radioactive material in soil. The most current version of RESRAD will be used for conducting radionuclide risk assessments.

Table D-2a. Parameters for Hazard Quotient for Residential Land Use

Rearrange Equation 740-1 of WAC 173-340 (2007)		
Hazard Quotient = (Concentration)*(SIR*AB1*EF*ED)/(RfD*ABW*UCF*AT)		
Hazard Quotient = (Concentration)*(Daily Intake Factor)/(RfD)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	6	years, Averaging Time
RfD	(Variable)	Chemical Specific Reference Dose
Daily Intake Factor =	**1.25E-05**	**per day**

Table D-2b. Parameters for Excess Cancer Risk for Residential Land Use

Rearrange Equation 740-2 of WAC 173-340 (2007)		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*EF*ED)/(ABW*UCF*AT)		
Cancer Risk = (Concentration)*(Daily Intake Factor)*(CPF)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	75	years, Averaging Time
CPF	(Variable)	Chemical Specific Cancer Potency Factor
Daily Intake Factor =	**1.00E-06**	**per day**

Table D-2c. Parameters for Hazard Quotient for Industrial Land Use

Rearrange Equation 745-1 of WAC 173-340 (2007)		
Hazard Quotient = (Concentration)*(SIR*AB1*EF*ED)/(RfD*ABW*UCF*AT)		
Hazard Quotient = (Concentration)*(Daily Intake Factor)/(RfD)		
Variable	Value	Description
SIR	50	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	0.4	unitless, Exposure Frequency
ED	20	years, Exposure Duration
ABW	70	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	20	years, Averaging Time
RfD	(Variable)	Chemical Specific Reference Dose
Daily Intake Factor =	**2.86E-07**	**per day**

Table D-2d. Parameters for Excess Cancer Risk for Industrial Land Use

Rearrange Equation 745-2 of WAC 173-340 (2007)		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*EF*ED)/(ABW*UCF*AT)		
Cancer Risk = (Concentration)*(Daily Intake Factor)*(CPF)		
Variable	Value	Description
SIR	50	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	0.4	unitless, Exposure Frequency
ED	20	years, Exposure Duration
ABW	70	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	75	years, Averaging Time
CPF	(Variable)	Chemical Specific Cancer Potency Factor
Daily Intake Factor =	**7.62E-08**	**per day**

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Metals			
Antimony	0.13	4.00E-04	--
Arsenic	6.5	3.00E-04	1.50E+00
Barium	132	2.00E-01	--
Beryllium	1.51	2.00E-03	--
Boron	3.9	2.00E-01	--
Cadmium	0.563	1.00E-01	--
Chromium, total	19	1.50E+00	--
Chromium VI	--	3.00E-03	--
Cobalt	16	3.00E-04	--
Copper	22	4.00E-02	--
Lead	10	NA	NA
Lithium	13.3	2.00E-03	--
Manganese	512	1.40E-01	--
Mercury	0.013	3.00E-04	--
Molybdenum	0.47	5.00E-03	--
Nickel	19.1	2.00E-02	--
Selenium	0.78	5.00E-03	--
Silver	0.17	5.00E-03	--
Strontium	--	6.00E-01	--
Tin	--	6.00E-01	--
Uranium	3.2	3.00E-03	--
Vanadium	85	5.00E-03	--
Zinc	68	3.00E-01	--
Inorganics			
Chloride	--	NA	NA
Cyanide	--	6.00E-04	--
Fluoride	2.8	6.00E-02	--
Nitrate	52	7.10E+00	--
Nitrite	--	1.00E-01	--

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg-day)^{-1}$
Nitrogen in Nitrite and Nitrate	--	1.60E+00	--
Sulfate	--	NA	NA
Volatile Organic Compounds			
Acetone	--	9.00E-01	--
Benzene	--	4.00E-03	5.50E-02
Carbon tetrachloride	--	4.00E-03	7.00E-02
Chloroform	--	1.00E-02	3.10E-02
Dichloroethylene; 1,1- (dichloroethene)	--	5.00E-02	--
Dichloroethylene;1,2-, total	--	9.00E-03	--
Dichloroethylene;1,2-,cis	--	1.00E-02	--
Ethyl Acetate	--	9.00E-01	--
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachloroethane	--	1.00E-03	1.40E-02
Methyl Ethyl Ketone (2-butanone)	--	6.00E-01	--
Methyl Isobutyl Ketone (4-M,2-P)	--	8.00E-02	--
Methylene chloride	--	6.00E-02	7.50E-03
Tetrachloroethene	--	1.00E-02	5.40E-01
Toluene	--	8.00E-02	--
Trichloroethane;1,1,1-	--	2.00E+00	--
Trichloroethylene (Trichloroethene; TCE)	--	--	8.90E-02
Vinyl Chloride	--	3.00E-03	7.20E-01
Xylene	--	2.00E-01	--
Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons			
Acenaphthene	--	6.00E-02	--
Anthracene	--	3.00E-01	--
Benzo(a)anthracene	--	--	7.30E-01
Benzo(a)pyrene	--	--	7.30E+00
Benzo(b)fluoranthene	--	--	7.30E-01
Benzo(k)fluoranthene	--	--	7.30E-01

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Benzo(g,h,i)perylene	--	NA	NA
Bis(2-chloro-1-methylethyl) ether	--	4.00E-02	7.00E-02
Bis(2-chloroethoxy)methane	--	3.00E-03	--
Bis(2-chloroethyl) ether	--	NA	NA
Bis(2-ethylhexyl) phthalate	--	2.00E-02	1.40E-02
Bromophenylphenyl ether; 4-	--	NA	NA
Butylbenzylphthalate	--	2.00E-01	1.90E-03
Carbazole	--	--	2.00E-02
Chloro-3-methylphenol, 4-	--	1.00E-01	--
Chloroanilene; 4-	--	4.00E-03	2.00E-01
Chloronaphthalene; 2-	--	8.00E-02	--
Chlorophenol, 2-	--	5.00E-03	--
Chrysene	--	--	7.30E-02
Dibenz[a,h]anthracene	--	--	7.30E-01
Dibenzofuran	--	1.00E-03	--
Dichlorobenzene; 1,2-	--	9.00E-02	--
Dichlorobenzene; 1,3-	--	3.00E-02	--
Dichlorobenzene, 1,4-	--	7.00E-02	5.40E-03
Dichlorobenzidine; 3,3-	--	--	4.50E-01
Dichlorophenol; 2,4-	--	3.00E-03	--
Diethylphthalate	--	8.00E-01	--
Dimethylphthalate	--	1.00E+00	--
Dimethylphenol; 2,4-	--	2.00E-03	--
Di-n-butylphthalate	--	1.00E-01	--
Dinitro-2-methylphenol; 4,6-	--	1.00E-04	--
Dinitrophenol; 2,4-	--	2.00E-03	--
Dinitrotoluene, 2,4-	--	2.00E-03	3.10E-01
Dinitrotoluene; 2,6-	--	1.00E-03	--
Ethylene glycol	--	2.00E+00	--
Fluoranthene	--	4.00E-02	--

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Fluorene	--	4.00E-02	--
Hexachlorobenzene	--	8.00E-04	1.60E+00
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachlorocyclopentadiene	--	6.00E-03	--
Hexachloroethane	--	7.00E-04	4.00E-02
Indeno(1,2,3-cd)pyrene	--	--	7.30E-01
Isophorone	--	2.00E-01	0.00095
Methylnaphthalene, 2-	--	4.00E-03	--
Methylphenol; 2- (cresol;o-)	--	5.00E-02	--
Methylphenol; 4- (cresol;p-)	--	1.00E-01	--
Naphthalene	--	2.00E-02	--
Nitroaniline; 2-	--	1.00E-02	--
Nitroaniline; 3-	--	3.00E-04	2.10E-02
Nitroaniline; 4-	--	4.00E-03	2.00E-02
Nitrobenzene	--	2.00E-03	--
Nitrophenol; 4-	--	8.00E-03	--
Nitrosodi-n-dipropylamine, n-	--	--	7.00E+00
Nitrosodiphenylamine;N-	--	--	4.90E-03
Pentachlorophenol	--	3.00E-02	1.20E-01
Phenol	--	3.00E-01	--
Pyrene	--	3.00E-02	--
Tributyl Phosphate	--	1.00E-02	9.00E-03
Trichlorobenzene, 1,2,4-	--	1.00E-02	2.90E-02
Trichlorophenol; 2,4,5-	--	1.00E-01	--
Trichlorophenol; 2,4,6-	--	1.00E-03	1.10E-02
Pesticides and Polychlorinated Biphenyls			
Aldrin	--	3.00E-05	1.70E+01
BHC, Alpha-	--	8.00E-03	6.30E+00
BHC, beta	--	--	1.80E+00
BHC, gamma (Lindane)	--	3.00E-04	1.10E+00

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Chlordane	--	5.00E-04	3.50E-01
Dalapon	--	3.00E-02	--
Db; 2,4- [4-(2,4-dichlorophenoxy) butanoic acid]	--	8.0E-03	--
DDD, 4,4'-	--	--	2.40E-01
DDE, 4,4'-	--	--	3.40E-01
DDT, 4,4'-	--	--	3.40E-01
Dicambra	--	3.00E-02	--
Dichlorophenoxyacetic acid; 2,4-	--	1.00E-02	--
Dieldrin	--	5.00E-05	1.60E+01
Dinoseb (DNBP)	--	1.00E-03	--
Endosulfan (I, II, sulfate)	--	6.00E-03	--
Endrin (and ketone, aldehyde)	--	3.00E-04	--
Heptachlor	--	5.00E-04	4.50E+01
Heptachlor epoxide	--	1.30E-05	9.10E+00
Methoxychlor	--	5.00E-03	--
Polychlorinated biphenyls	--	--	2.00E+01
PCB Aroclor 1016	--	7.00E-05	7.00E-02
PCB Aroclor 1221	--	--	2.00E+00
PCB Aroclor 1232	--	--	2.00E+00
PCB Aroclor 1242	--	--	2.00E+00
PCB Aroclor 1248	--	--	2.00E+00
PCB Aroclor 1254	--	2.00E-05	2.00E+00
PCB Aroclor 1260	--	--	2.00E+00
Silvex (tp;2,4,5-)	--	8.00E-03	--
Toxaphene	--	--	1.10E+01
Trichlorophenoxyacetic acid;2,4,5-	--	1.00E-02	--

a Background from ECF-HANFORD-11-0038,2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

b Oral reference dose and cancer potency factor values from Table G-17 of DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*.

Single radionuclide soil concentrations corresponding to a carcinogenic risk limit of 1×10^{-4} in a rural-residential scenario were calculated using RESRAD version 6.5 (ANL 2009) and the appropriate parameters from the 300 Area RI/FS report (DOE/RL-2010-99), Appendix G, Table G 6, for an unrestricted land-use scenario and from Table G-7 for an industrial land-use scenario. Determinations of radionuclide cleanup levels to be protective of human health direct exposure carcinogenic risk are reported in a calculation brief (ECF-HANFORD-10-0429, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FA) Report*) and summarized in Table 4 of the 300 Area ROD (EPA 2013). The tables of RESRAD input parameters are reproduced in this appendix as Tables D-4 and D-5.

D5. Using RESRAD for Waste Site Radionuclide Cleanup Verification

Where more than one radionuclide is detected and radionuclide cleanup levels in Table D-1 are not exceeded, a sum-of-fractions evaluation or a RESRAD evaluation must be performed to determine that the cumulative carcinogenic risk limit of 1×10^{-4} is not exceeded. The input parameters and assumptions used in RESRAD to generate the radionuclide direct exposure cleanup levels presented in this remedial design report/remedial action work plan are summarized in Tables D-4 and D-5. For the purpose of site cleanup verification, the RESRAD input values (e.g., the thickness of the contaminated zone, the thickness of the uncontaminated zone, and the size of the waste site) will be determined on a site-specific basis. RESRAD calculates all radionuclides in the decay chain (daughters) in calculating ingrowth and decay. It has not been determined if any daughters were present at the time of waste emplacement, but they would be insignificant dose contributors; therefore, estimated daughters are not included as input.

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
Exposure pathways	External Gamma: Inhalation: Plant Ingestion: Meat Ingestion: Milk Ingestion: Aquatic Foods: Drinking Water: Soil Ingestion: Radon:	NA	Active Active Active Active Active Active Active Active Suppressed	DOE/RL-96-17, Rev. 4
R011 – Contaminated Zone (CZ)	Area of CZ [a]	m^2	10,000 [a]	RESRAD default
	Thickness of CZ [a]	m	4.6 [a]	Shallow zone
	Length parallel to aquifer flow [a]	m	100 [a]	Square root of contaminated site area
	Radiation dose limit	mrem/yr	15	DOE/RL-99-40
	Elapsed time since waste placement	yr	0	RESRAD default
R012 – Principal Radionuclide Concentrations	All radionuclide contaminants of concern	pCi/g	Contaminant-specific	

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R013 – Cover and CZ Hydrological Data	Cover depth [a]	m	0	RESRAD default
	Cover material density	g/cm^3	1.6	DOE/RL-99-40
	Cover erosion rate	m/yr	Not Used	No cover
	Density OF CZ	g/cm^3	1.6	DOE/RL-99-40
	CZ erosion rate	m/yr	Not Used	Only used when rate is known
	CZ total porosity	Unitless	0.3	DOE/RL-99-40
	CZ field capacity	Unitless	0.25	DOE/RL-99-40
	CZ hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
	CZ b parameter	Unitless	15	DOE/RL-99-40
	Humidity in air	g/cm^3	8	RESRAD default
	Evapotranspiration coefficient	Unitless	0.91	WDOH/320-015
	Wind speed	m/sec	3.4	PNNL-12087
	Precipitation	m/yr	0.16	DOE/RL-96-17, Rev. 6
	Irrigation rate	m/yr	0.76	DOE/RL-96-17, Rev. 4
	Irrigation mode	NA	Overhead	RESRAD default
	Runoff coefficient	Unitless	0.2	RESRAD default
	Watershed area for nearby stream or pond	m^2	10,000,000	DOE/RL-99-40
	Accuracy for water/soil computations	NA	0.001	RESRAD default
R014 – Saturated Zone (SZ) Hydrological Data	Density of SZ	g/cm^3	1.6	DOE/RL-99-40
	SZ total porosity	Unitless	0.3	DOE/RL-99-40
	SZ effective porosity	Unitless	0.3	DOE/RL-99-40
	SZ hydraulic conductivity	m/yr	673,846	DOE/RL-99-40
	SZ hydraulic gradient	Unitless	0.0005	DOE/RL-99-40
	SZ b parameter	Unitless	3.5	DOE/RL-99-40
	Water table drop rate	m/yr	Not Used	Only used when rate is known
	Well pump intake depth below water table	m	4.6 (15 ft), typical RCRA well screen length	
	Nondispersion (ND) or mass balance (MB)	NA	ND	RESRAD default
	Well pumping rate	m^3/yr	250	RESRAD default
R015 – Uncontaminated and Unsaturated Strata Hydrological Data	Number of unsaturated strata [a]	Unitless	1 [a]	Site-specific
	Thickness [a]	m	5 [a]	Site-specific
	Soil density	g/cm^3	1.6	DOE/RL-99-40
	Total porosity	Unitless	0.3	DOE/RL-99-40
	Effective porosity	Unitless	0.3	DOE/RL-99-40
	Field capacity	Unitless	0.2	RESRAD default
	Soil-specific b parameter	Unitless	15	DOE/RL-99-40
	Hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
R016 – K_d for Individual Radionuclides	K_d for contaminated zone, uncontaminated zone, and saturated zone	mL/g	Contaminant-specific	DOE/RL-96-17, Rev. 6
	Saturated leach rate	yr^{-1}	Not used	Use Kd values
	Saturated solubility	g/mL	Not used	Use Kd values

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R017 – Inhalation and External Gamma	Inhalation rate	m^3/yr	7,300	WDOH/320-015
	Mass loading for inhalation	g/m^3	0.0001	WDOH/320-015
	Exposure duration	yr	30	RESRAD Default
	Indoor dust filtration factor	Unitless	0.4	RESRAD Default
	External gamma shielding factor	Unitless	0.4	DOE/RL-2010-99
	Indoor time fraction	Unitless	0.6	WDOH/320-015 15 hr/day, 350 days/yr
	Outdoor time fraction	Unitless	0.12	DOE/RL-2010-99 3 hr/day, 350 days/yr
	Shape factor	NA	Circular unless otherwise specified	
R018 – Ingestion Pathway Data, Dietary Parameters	Fruits, vegetables, and grain consumption	kg/yr	110	WDOH/320-015
	Leafy vegetable consumption	kg/yr	2.7	WDOH/320-015
	Milk consumption	L/yr	100	WDOH/320-015
	Meat and poultry consumption	kg/yr	36	WDOH/320-015
	Fish consumption	kg/yr	19.7	WDOH/320-015
	Other seafood consumption	kg/yr	0.9	RESRAD Default
	Soil ingestion	g/yr	73	WDOH/320-015
	Drinking water intake	L/yr	730	WDOH/320-015
	Drinking water contamination fraction	Unitless	1	RESRAD Default
	Household water contamination fraction	Unitless	1	RESRAD Default
	Livestock water contamination fraction	Unitless	1	RESRAD Default
	Irrigation water contamination fraction	Unitless	1	RESRAD Default
	Aquatic food contamination fraction	Unitless	0.5	RESRAD Default
	Plant food contamination fraction	Unitless	-1 [b]	RESRAD Default
	Meat contamination fraction	Unitless	-1 [b]	RESRAD Default
	Milk contamination fraction	Unitless	-1 [b]	RESRAD Default
R019 – Ingestion Pathway Data, Nondietary	Livestock fodder intake for meat	kg/d	68	RESRAD Default
	Livestock fodder intake for milk	kg/d	55	RESRAD Default
	Livestock water intake for meat	L/d	50	RESRAD Default
	Livestock water intake for milk	L/d	160	RESRAD Default
	Livestock intake of soil	kg/d	0.5	RESRAD Default
	Mass loading for foliar deposition	g/m^3	0.0001	RESRAD Default
	Depth of soil mixing layer	m	0.15	RESRAD Default
	Depth of roots	m	0.9	RESRAD Default
	Groundwater fractional usage – drinking water	Unitless	1	RESRAD Default
	Groundwater fractional usage – household	Unitless	1	RESRAD Default
	Groundwater fractional usage – livestock water	Unitless	1	RESRAD Default
	Groundwater usage – irrigation	Unitless	1	RESRAD Default

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R021 – Radon		NA	Not used	Radon is not a COPC

a The stated numeric values are only used when RESRAD is used to determine generic cleanup levels. Otherwise, site-specific input values for these parameters are determined on a site-by-site basis. All other values are fixed at the values shown unless modified with regulator approval.

b The default value of -1 specifies that the contaminated fraction of this input will be calculated from the appropriate area factor in RESRAD (for a waste site of less than the default of 10,000 m^2 RESRAD calculates and applies an area factor based on the actual waste site area). Setting the default value in this column to zero will turn off the pathways entirely.

COPC = contaminant of potential concern
CZ = contaminated zone
GW = groundwater
ND = nondetect
RCRA = *Resource Conservation and Recovery Act of 1976*
RESRAD = RESidual RADioactivity

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
Exposure Pathways	Pathway External Gamma: Inhalation: Plant Ingestion: Meat Ingestion: Milk Ingestion: Aquatic Foods: Drinking Water: Soil Ingestion: Radon:	NA	Soil Status Active Active Suppressed Suppressed Suppressed Suppressed Suppressed Active Suppressed	DOE/RL-99-40
R011 – Contaminated Zone (CZ)	Area of CZ [a]	m^2	10,000 [a]	RESRAD default
	Thickness of CZ [a]	m	4.6 [a]	Shallow Zone
	Length parallel to aquifer flow [a]	m	100 [a]	Square root of contaminated site area
	Radiation dose limit	mrem/yr	15	DOE/RL-99-40
	Elapsed time since waste placement	yr	0	RESRAD default
R012 – Principal Radionuclide Concentrations	All radionuclide contaminants of concern	pCi/g	Contaminant-specific	
R013 – Cover and CZ Hydrological Data	Cover depth [a]	m	0	RESRAD default
	Cover material density	g/cm^3	1.6	DOE/RL-99-40
	Cover erosion rate	m/yr	Not used	No cover
	Density of CZ	g/cm^3	1.6	DOE/RL-99-40
	CZ erosion rate	m/yr	Not used	Only used when rate is known
	CZ total porosity	Unitless	0.3	DOE/RL-99-40
	CZ field capacity	Unitless	0.25	DOE/RL-99-40
	CZ hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
	CZ b parameter	Unitless	15	DOE/RL-99-40

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
R013 – Cover and CZ Hydrological Data (continued)	Humidity in air	g/cm^3	8	RESRAD default
	Evapotranspiration coefficient	Unitless	0.91	WDOH/320-015
	Wind speed	m/sec	3.4	PNNL-12087
	Precipitation	m/yr	0.16	DOE/RL-96-17, Rev. 6
	Irrigation rate	m/yr	0	DOE/RL-99-40
	Irrigation mode	NA	Overhead	RESRAD default
	Runoff coefficient	Unitless	0.2	RESRAD default
	Watershed area for nearby stream or pond	m^2	10,000,000	DOE/RL-99-40
	Accuracy for water/soil computations	Unitless	0.001	RESRAD default
R014 – Saturated Zone (SZ) Hydrological Data	Density of SZ	g/cm^3	1.6	DOE/RL-99-40
	SZ total porosity	Unitless	0.3	DOE/RL-99-40
	SZ effective porosity	Unitless	0.3	DOE/RL-99-40
	SZ hydraulic conductivity	m/yr	673,846	DOE/RL-99-40
	SZ hydraulic gradient	Unitless	0.0005	DOE/RL-99-40
	SZ b parameter	Unitless	3.5	DOE/RL-99-40
	Water table drop rate	m/yr	Not Used	Only used when rate is known
	Well pump intake depth below water table	m	4.6 m (15 ft), typical RCRA well screen length	
	Nondispersion (ND) or mass balance (MB)	NA	ND	RESRAD default
	Well pumping rate	m^3/yr	250	RESRAD default
R015 – Uncontaminated and Unsaturated Strata Hydrological Data	Number of unsaturated strata [a]	Unitless	1 [a]	Site-specific
	Thickness [a]	m	5 [a]	Site-specific
	Soil density	g/cm^3	1.6	DOE/RL-99-40
	Total porosity	Unitless	0.3	DOE/RL-99-40
	Effective porosity	Unitless	0.3	DOE/RL-99-40
	Field capacity	Unitless	0.2	RESRAD default
	Soil-specific b parameter	Unitless	15	DOE/RL-99-40
	Hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
R016 – K_d for Individual Radionuclides	K_d for contaminated zone, uncontaminated zone, and saturated zone	mL/g	Contaminant-specific	DOE/RL-96-17, Rev. 6
	Saturated leach rate	yr^{-1}	Not used	Use Kd values
	Saturated solubility	g/mL	Not used	Use Kd values
R017 – Inhalation and External Gamma	Inhalation rate	m^3/yr	8,400	DOE/RL-99-40
	Mass loading for inhalation	g/m^3	0.0002	DOE/RL-99-40
	Exposure duration	yr	30	RESRAD default
	Indoor dust filtration factor	Unitless	0.4	RESRAD default
	External gamma shielding factor	Unitless	0.4	DOE/RL-2010-99
	Indoor time fraction	Unitless	0.17	DOE/RL-2010-99 6 hr/day, 250 days/yr
	Outdoor time fraction	Unitless	0.057	DOE/RL-2010-99 2 hr/day, 250 days/yr
	Shape factor	NA	Circular	RESRAD default

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
R018 – Ingestion Pathway Data, Dietary Parameters	Fruits, vegetables, and grain consumption	kg/yr	Not used in industrial scenario	
	Leafy vegetable consumption	kg/yr		
	Milk consumption	L/yr		
	Meat and poultry consumption	kg/yr		
	Fish consumption	kg/yr		
	Other seafood consumption	kg/yr		
	Soil ingestion	g/yr	25	DOE/RL-99-40
	Drinking water intake	L/yr	0	DOE/RL-99-40
	Drinking water contamination fraction	Unitless	0	DOE/RL-99-40
	Household water contamination fraction	Unitless	Not used in industrial scenario	
	Livestock water contamination fraction	Unitless		
	Irrigation water contamination fraction	Unitless		
	Aquatic food contamination fraction	Unitless		
	Plant food contamination fraction	Unitless		
	Meat contamination fraction	Unitless		
	Milk contamination fraction	Unitless		
R019 – Ingestion Pathway Data, Nondietary	Livestock fodder intake for meat	kg/d	Not used in industrial scenario	
	Livestock fodder intake for milk	kg/d		
	Livestock water intake for meat	L/d		
	Livestock water intake for milk	L/d		
	Livestock intake of soil	kg/d		
	Mass loading for foliar deposition	g/m^3		
	Depth of soil mixing layer	m		
	Depth of roots	m		
	Groundwater fractional usage – drinking water	Unitless	0	DOE/RL-99-40
	Groundwater fractional usage – household	Unitless	0	DOE/RL-99-40
	Groundwater fractional usage – livestock water	Unitless	0	DOE/RL-99-40
	Groundwater usage – irrigation	Unitless	0	DOE/RL-99-40
R021 – Radon		NA	Not used	Radon is not a COPC

a The stated numeric values are only used when RESRAD is used to determine generic cleanup levels. Otherwise, site-specific input values for these parameters are determined on a site-by-site basis. All other values are fixed at the values shown unless modified with regulator approval.

COPC = contaminant of potential concern
CZ = contaminated zone
GW = groundwater
ND = nondetect
RCRA = *Resource Conservation and Recovery Act of 1976*
RESRAD = RESidual RADioactivity
SZ = saturated zone

D5.1 Radionuclide Evaluation of Direct Exposure Risk

For waste sites with few radionuclide COCs at concentrations all below the individual radionuclide CULs, Table B-5a of Appendix B provides an example comparison of the shallow zone radionuclide cleanup verification data to direct exposure single radionuclide cancer risk values and the cumulative carcinogenic risk limit of $1x10^{-4}$ using a sum-of-fractions evaluation. Typically, this will be sufficient to demonstrate that direct exposure cumulative risk limitations are met. It is not necessary to perform a sum-of-fractions or RESRAD evaluation for a waste site or decision unit if there is only one detected radionuclide or if the residual concentrations of multiple radionuclide COCs are all below background or are less than one-tenth of the single radionuclide soil concentration equivalent to a $1x10^{-4}$ carcinogenic risk calculated by RESRAD. This is because no remediated waste site has been found with as many as 10 radionuclide COCs and the background values for Hanford Site radionuclides are much less than the 300 Area radionuclide direct exposure cleanup levels.

If the sum-of-fractions evaluation indicates the cumulative carcinogenic risk limit of $1x10^{-4}$ is exceeded, a site-specific RESRAD evaluation should be performed. The general process is to first determine the nature and extent of site-specific residual contamination (concentrations, thickness, and area of actual radionuclide contamination). This information is input to the RESRAD model with the general parameters from Table D-4 or D-5 for the residential or industrial scenario (as appropriate) to evaluate the direct exposure carcinogenic risk. No cover material is assumed to exist on top of the contaminated shallow zone unless existence of cover is explicitly stated. To perform the calculations, the parameters are entered into the RESRAD data menu, the residential or industrial exposure pathways are selected (as appropriate), and appropriate times for calculations are selected. Default times of 1, 3, 10, 30, 100, 300, and 1,000 years are used in a preliminary run to determine the year when the peak risk occurs from each radionuclide COC, pathway, and layer (e.g., shallow zone or deep zone).

The RESRAD software is run and the summary report and graphical output for radionuclide risk are accessed to determine the peak year(s) in 1,000 years. The summary report is accessed by viewing the file “summary.rep” in the RESRAD output. The graphical output for excess cancer risk of radionuclides is accessed by selecting:

Results: Standard Graphics

Type: Risk

Radionuclide: Individual

Pathways: Summed/External

If the peak year of the maximum risk for individual radionuclides indicated in the graphical output is not the same as the year of maximum dose/risk in the “Contaminated Zone and Total Dose Summary” of the summary report, then individual RESRAD runs should be performed for the individual radionuclides to find the individual years of peak dose/risk. The years of peak dose/risk are entered as calculation times in the RESRAD calculation, and the RESRAD software is rerun.

The health risk report (“intrisk/rep”) is accessed and the “All Pathways” total risk for each year of the RESRAD evaluation is recorded in an appropriate table. The table is included with other site-specific detailed information in a calculation brief presented in the calculations appendix to the cleanup verification package (CVP). A figure or figures may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

D5.2 Radionuclide Evaluation for Groundwater Protection

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table D-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table D-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation to determine if residual soil concentrations may actually be protective of groundwater. After remediation, residual radioactive and nonradioactive contaminants remaining in soil must be at such levels that concentrations of contaminants that could migrate through the soil column to groundwater do not exceed cleanup levels considered protective of groundwater in Table D-1. Protection of groundwater is intended to achieve CULs derived from MCLs promulgated under the federal National Primary Drinking Water Regulations (40 CFR 141).

D5.2.1 Attainment of Radionuclide MCLs

Separate maximum contaminant levels (MCLs) exist for strontium-90, tritium (H-3), radium-226, and radium-228. The MCLs for strontium-90 and tritium are 8 pCi/L and 20,000 pCi/L, respectively (40 CFR 141.66). The MCL for combined radium-226 and radium-228 is 5 pCi/L (40 CFR 141.66). The MCL for technetium-99 is 900 pCi/L as obtained from the *Soil Screening Guidance for Radionuclides: User's Guide* (EPA 2000). The MCL for total uranium (as uranium metal) is established at 30 µg/L (40 CFR 141.66). The MCL for individual alpha-emitting radionuclides (excluding radon and uranium) is 15 pCi/L (40 CFR 141.66). However, per the STOMP model evaluation of transport to groundwater summarized in Table D-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years, so residual soil concentrations of all alpha-emitting radionuclides are protective of groundwater and surface water.

To predict site-specific groundwater radionuclide activities, risk, and dose based on activities in soil, exposure pathways in the RESRAD input file for external gamma exposure, inhalation, soil ingestion, and radon are suppressed. Pathways for ingestion of plants, meat, milk, aquatic foods, and drinking water are active in the residential scenario. Only the drinking water pathway is active in the industrial scenario. Appropriate site-specific input parameters including contaminated site dimensions and radionuclide activities in soil and their distribution coefficients (K_d values) are entered into the RESRAD data menu and default calculation times of 1, 3, 10, 30, 100, 300, and 1,000 years are used for the initial calculation. The concentration of uranium metal in mg/kg is entered for uranium-238 as pCi/g, and the predicted uranium-238 groundwater concentration (as pCi/L in the RESRAD output) is the uranium metal concentration in µg/L. The basic radiation dose limit of 4 mrem/yr is input for groundwater protection.

The RESRAD software is run and the concentration report and graphical output for radionuclides in drinking water are accessed to determine which radionuclides do or do not reach groundwater in 1,000 years. The concentration report is accessed by viewing the file "concent.rep" in the RESRAD output. The graphical output for concentration of radionuclides in drinking water is accessed in the RESRAD version 6.5 Graphics Display (ANL 2009) by selecting:

Type: Concentration

Radionuclide: Individual

Media (Pathways): Drinking Water

If the drinking water concentrations predicted in the concentration report and the graphical output displays zero for the full 1,000 years, the contaminants do not impact groundwater within 1,000 years. Typically, the graphical output may show that strontium-90, technetium-99, and tritium (H-3) are predicted to reach groundwater within 1,000 years. The years of the maximum groundwater concentrations for these radionuclides are obtained from the RESRAD summary report for radiological dose in the RESRAD output table headed "Summed Dose/Source Ratios and Single Radionuclide Soil

Guidelines." The year of maximum groundwater concentration for each radionuclide is in the column headed by "tmin, years."

The year of maximum groundwater concentration for each radionuclide from the column headed by "tmin, years" is entered in the calculation times of the RESRAD inputs and the software is rerun. The concentration report and graphical output for radionuclides in drinking water are accessed to determine that the predicted years of maximum groundwater concentration are correct. If the predicted maximum groundwater (well water) concentrations in the concentration report, "concent.rep," for strontium-90, technetium-99, and tritium are less than their respective MCLs of 8 pCi/L, 900 pCi/L, and 20,000 pCi/L (and the predicted uranium-238 groundwater concentration [shown as pCi/L in the RESRAD output but read as μg/L] is less than the uranium metal MCL of 30 μg/L), residual soil concentrations of these constituents are predicted to be protective of groundwater and the river. The findings of the RESRAD evaluation are typically reported in a calculation brief included in the calculations appendix to the waste site CVP. If the groundwater concentrations predicted by RESRAD indicate that COCs impact groundwater, a table is provided in the calculation brief that shows the predicted peak concentration for each detected radionuclide COC and provides the individual MCLs for comparison, as shown in Table D-6 example.

Table D-6. Example Peak Radionuclide Groundwater Concentrations Compared to Maximum Contaminant Levels

Radionuclide	Groundwater Peak Concentration (pCi/L)	Year of Peak Concentration (years)	Groundwater MCL (pCi/L)
Americium-241	0 [a]	NA	15
Carbon-14	(Site-specific)	(Site-specific)	2,000
Cobalt-60	(Site-specific)	(Site-specific)	100
Cesium-137	(Site-specific)	(Site-specific)	60
Europium-152	0 [a]	NA	200
Europium-154	0 [a]	NA	60
Europium-155	0 [a]	NA	600
Nickel-63	(Site-specific)	(Site-specific)	50
Plutonium-238	0 [a]	NA	15
Plutonium-239/240	0 [a]	NA	15
Strontium-90	(Site-specific)	(Site-specific)	8
Technetium-99	(Site-specific)	(Site-specific)	900
Tritium (H-3)	(Site-specific)	(Site-specific)	20,000

a Per the STOMP model evaluation of transport to groundwater summarized in Table D-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years.

MCL = maximum contaminant level

D5.2.2 Attainment of 4 mrem/yr Drinking Water Radionuclide Dose Rate

The average annual activity of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr, per 40 CFR 141.66. To determine if any organ receives a dose of more than 4 mrem/yr, the dose to each organ is calculated for the radionuclide COCs that are predicted to migrate to groundwater. However, if only one radionuclide is predicted to reach groundwater and this radionuclide attains its MCL as discussed in Section D.5.2.1, it is not necessary to evaluate the attainment of the 4 mrem/yr drinking water dose rate.

An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087. The 4 mrem/yr equivalent concentration for each organ for each radionuclide is determined from the maximum permissible concentrations listed in Table 1 of NBS Handbook 69 (NBS 1963). The factor C4 (i.e., the concentration that will produce a dose of 4 mrem/yr to that organ) is calculated for each organ and radionuclide.

The C4 factors for the COCs are summarized in Table D-7.

Table D-7. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters

Radionuclide	Organ	C_4 [a], 4 mrem/yr Equivalent Concentration (pCi/L)
Carbon-14	Total Body	9,000
	Bone	2,000
	Fat	2,000
Cobalt-60	GI(LLI)	100
	Total Body	900
	Liver	3,000
Cesium-137	Bone	80
	GI(LLI)	2,000
	Total Body	200
	Liver	60
Europium-152	Bone	30,000
	GI(LLI)	200
	Total Body	2E+05
	Liver	1E+05
Europium-154	Bone	5,000
	GI(LLI)	60
	Total Body	7E+04
	Liver	6E+04
Europium-155	Bone	1E+05
	GI(LLI)	600
	Total Body	9E+05
	Liver	6E+05
H-3 (Tritium)	Total Body	20,000

Table D-7. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters

Radionuclide	Organ	C_4 [a], 4 mrem/yr Equivalent Concentration (pCi/L)
Nickel-63	Bone	50
	GI(LLI)	3,000
	Total Body	2,000
	Liver	600
Strontium-90	Bone	8
	GI(LLI)	100
	Total Body	8

a Calculated by methodology given in *National Interim Primary Drinking Water Regulations*, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity" (EPA 1997).

GI(LLI) = gastrointestinal tract-lower large intestine

The cumulative dose for each organ at time "t" needs to be calculated separately and using a sum-of-fractions equation, as shown in the formula below. If a radionuclide does not have a maximum permissible concentration for the organ of interest, the C4 factor for total body dose is used in the calculation. The calculations performed are documented in the comparison to drinking water standards calculation brief. The organs for which doses need to be computed are total body, bone, gastrointestinal tract-lower large intestine, and liver. The individual organ doses are summed and compared to 4 mrem/yr.

$$\text{Doseorgan x (t)} = [\text{ConcA(t)/C4A(x)} + \text{ConcB(t)/C4B(x)} + \ldots] \text{ x (4 mrem/yr)}$$

If the total dose for organ "x" is less than 4 mrem/yr, then the standard is met.

A figure may be provided in the CVP that shows the calculated dose to each organ from groundwater. An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087.

D6. REFERENCES

40 CFR 131, "Water Quality Standards," Code of Federal Regulations, as amended.

40 CFR 141, "Federal Safe Drinking Water Act," Code of Federal Regulations, as amended.

40 CFR 143, "National Secondary Drinking Water Regulations," Code of Federal Regulations, as amended.

ANL, 2001, *Users' Manual for RESRAD 6.0*, ANL/EAD-4, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

ANL, 2009, RESRAD Version 6.5, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

Calc. No. 0100H -CA-V0087, 2006, *105-H Reactor Building (118-H-6) Fuels Storage Basin Comparison to Drinking Water Standards (MCL)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE/RL-96-17, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-99-40, 2000, *Focused Feasibility Study for the 300-FF-2 Operable Unit,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECF-HANFORD-10-0429, 2013, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FA) Report*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Ecology, 2007, *Model Toxics Control Act Regulation and Statute: MTCA Cleanup Regulation, Chapter 173-340 WAC; Model Toxics Control Act, Chapter 70.105D RCW; Uniform Environmental Covenants Act, Chapter 64.70 RCW*, Publication No. 94-06, Revised November 2007, Washington State Department of Ecology, Toxics Cleanup Program, Olympia, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1997, National Interim Primary Drinking Water Regulations, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity," EPA-570/9-76-003, U.S. Environmental Protection Agency, Office of Water Supply, Washington D.C.

EPA, 2000, "Radionuclide Drinking Water MCLs," Table D.2 of *Soil Screening Guidance for Radionuclides: User's Guide*, EPA/540 R 00 007, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

NBS, 1963, *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure*, NBS Handbook 69, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

PNNL-12087, 1999, *Hanford Site Climatological Data Summary 1998 with Historical Data*, Pacific Northwest National Laboratory, Richland, Washington.

WAC 173-340, "Model Toxics Control Act--Cleanup," *Washington Administrative Code*, 1996.

WDOH/320-015, 1997, *Hanford Guidance for Radiological Cleanup*, Rev. 1, Division of Radiation Protection, Washington State Department of Health, Olympia, Washington.

Appendix E

Air Monitoring Plan for the 300 Area Waste Sites Remedial Action

This page intentionally left blank.

E1. Introduction

The remove, treat, and dispose (RTD) remedy for 300-FF-2 Operable Unit waste sites has the potential to emit (PTE) radionuclides. This remedy is being conducted under a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) Record of Decision (ROD) (EPA 2013). This air monitoring plan (AMP) addresses air emissions requirements for remedy implementation at waste sites in the 300 Area as listed in Section E1.1. Requirements for the 618-10 and 618-11 Burial Grounds and surrounding waste sites are addressed separately. This AMP does not address any air emissions requirements associated with the 300-FF-5 groundwater Operable Unit (OU) or enhanced monitored natural attenuation remedy implementation within the 300-FF-2 OU.

Quantification of radioactive emissions, implementation of best available radionuclide control technology (BARCT), and air monitoring have been identified as substantive requirements (i.e., applicable or relevant and appropriate requirements) of the *Clean Air Act of 1970* for the 300-FF-2 waste sites remedial action. These substantive requirements are implemented in accordance with *Washington Administrative Code* (WAC) 246-247-040.

E1.1 Planned Activities

Work scope includes completing ongoing remediation, or initiating new remediation of waste sites consisting of unplanned releases, contaminated soil, pipes, below-grade structures, etc., in the 300-FF-2 Operable Unit. Waste sites addressed by this AMP are identified in Table E-1. Any waste site additions to this AMP must be approved to the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office.

General remedial action operations include characterizing, excavating, sampling, sorting, size reducing, stockpiling, treating (if necessary), decontaminating, staging, containerizing, loading, backfilling, and transport of materials from the waste sites. Materials may include a wide range of chemically and/or radiologically contaminated soil, miscellaneous debris, and structural materials. Also included is test-pitting, trenching, and other activities that may be performed before or during remediation to further characterize and/or determine the limits of the waste sites.

Scattered debris within some of the waste sites will be picked up by hand; however, standard construction equipment will be used for excavation, loading, and hauling. The loading of contaminated material into waste containers may result in soil spilled on the waste containers and/or haul trucks. Haul trucks with loaded containers will enter a survey area where they will be screened to detect exterior contamination. A decontamination station will be established to decontaminate containers and haul trucks, as required. Waste containers and/or haul trucks will be decontaminated by conventional means such as brushing or wiping, or with high-efficiency particulate air (HEPA)-filtered vacuum cleaners. More aggressive decontamination methods (e.g., grinding or wet-grit blasting) may be used for decontamination if the other methods fail. Decontaminated trucks and containers will then proceed to the container transfer area from which the containers will be transported to the ERDF. A combination of HEPA-filtered vacuums, exhausters, and blowers may be used to support personnel and equipment decontamination activities, in egress tents, or glovebox type applications during the execution of the remedial action work scope. HEPA-filtered vacuum cleaners, HEPA-filtered enclosures, and gloveboxes may also be used for other applications during remediation as needed.

Table E-1. Summary of 300 Area Waste Sites Included

Waste Site	General Description
300-4	351 Substation Soil Contamination
300-7	Undocumented Solid Waste Burial Ground, North 300 Area
300-9	Early Solid Waste Burial Ground, North 300 Area
300-11	Gasoline release from 382 Underground Storage Tank
300-15	300 Area Process Sewer System
300-22	309 Building B-Cell Cleanout Leak
300-34	300 Area Process Sewer Leak
300-121	Contaminated French Drain
300-214	300 Area Retention Process Sewer
300-255	309 Tank Farm Contaminated Soil
300-263	324 Building Diversion Tank
300-265	Pipe Trench Between 324 and 325 Buildings
300-277	300 Area North Queue
300-280	Construction Debris, West of G-Way
300-284	Sand Blasting Site Near 3221
300-287	Transite Debris West of Route 4
300-288	Garnet Sands, Pit 6
300-289	Stained Soil North of 300 Area
300-290	Radiological Debris East of Horn Rapids Landfill
300-291	Garnet Sands West of 350A Paint Shop
300-294	Garnet Sands East of 350 Building
300-296	Soil Contamination Under 324 Building
300-RLWS	300 Area Radioactive Liquid Waste System
300-RRLWS	300 Area Retired Radioactive Liquid Waste System
340 Complex	340 Radioactive Liquid Waste Handling Facility
UPR-300-1	307-340 Waste Line Leak
UPR-300-2	Releases at the 340 Facility
UPR-300-5	Spill at 309 Storage Basin
UPR-300-11	Underground Radioactive Liquid Line Leak at 340

Excavated material will be sent primarily to the Environmental Restoration Disposal Facility (ERDF) for disposal. On a case-by-case basis, other EPA-approved disposal facilities may be used based on the specific waste stream designation.

Characterization sampling at radiological contaminated sites is included in the scope of this plan since the emissions from these activities (e.g., surface sampling, potholing) will generate negligible emissions.

E2. Airborne Source Information

There is a potential for radioactive airborne emissions resulting from remediation of waste sites in the 300-FF-2 Operable Unit. To determine the PTE, the calculated waste site inventories were multiplied by release fractions according to the requirements from WAC 246-247-030. A release fraction of 1×10^{-3} (for particulates) was applied to all soils, contaminated debris, and pipes. A release fraction of 1×10^{-6} was applied to radioactive solids removed whole, such as piping that has been internally stabilized with grout, epoxy, or other suitable material. For calculation purposes, it is conservatively assumed that tritium is present as a gas and a release fraction of 1 is applied. In addition, it is assumed that some of the soil will be collected in HEPA-filtered vacuums. However, HEPA-filtered vacuum use is anticipated to be limited if used at all. A release fraction of 1 is applied to this inventory as well.

The CAP88-PC model (Version 3.0) was used to determine the total effective dose equivalent (TEDE), or annual unabated offsite dose for each waste site. The PTE (curies per year) was the input for the computer model, and the model generated the annual unabated dose. The calculated total annual unabated offsite dose (TEDE) for the remedial actions by waste site are presented in Table E-2. Site-specific inventories, release fractions, and distances to the maximally exposed individual (MEI) are found in Calculation 0300X-CA-V0180, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*.

Table E-2. Summary of Total Effective Dose Equivalents for 300 Area Sites Included [a]

Waste Site	Unabated Total Effective Dose Equivalent to the Maximum Exposed Individual (mrem/yr)
300-4	To be determined prior to remediation
300-7	7.60E-03
300-9	8.39E-03
300-11	No radiological inventory
300-15	6.38E-03
300-22	3.06E-04
300-34	Bounded by 300-15 TEDE
300-121	No radiological inventory
300-214	8.25E-05
300-255	1.28E-05
300-263	0.00E+00
300-265	3.59E-03

Table E-2. Summary of Total Effective Dose Equivalents for 300 Area Sites Included [a]

Waste Site	Unabated Total Effective Dose Equivalent to the Maximum Exposed Individual (mrem/yr)
300-277	1.38E-04
300-280	No radiological inventory
300-284	No radiological inventory
300-287	No radiological inventory
300-288	No radiological inventory
300-289	No radiological inventory
300-290	Very little to no radiological inventory, bounded by Calculation 0300X-CA-V0180
300-291	No radiological inventory.
300-294	No radiological inventory.
300-296	To be determined prior to remediation
300-RLWS	2.75E-03
300-RRLWS	1.66E-03
340 Complex	1.44E-02
UPR-300-1	Included in 340 Complex TEDE
UPR-300-2	Included in 340 Complex TEDE
UPR-300-5	2.94E-05
UPR-300-11	Included in 340 Complex TEDE

Notes:

a Table 2 includes nonradiological sites that are bounded by the air monitoring plan and Calculation 0300X-CA-V0180, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*.

TEDE = total effective dose equivalent

E2.1 Best Available Radionuclide Control Technology

The following is the BARCT to be implemented during the waste site remedial action. This describes the controls to be implemented during the excavation, sorting, size reduction, stockpiling, and bulk material loading:

- Water will be applied during excavation, sorting, size reduction, container loading, stockpiling, and backfilling processes to minimize airborne releases.
- Soil fixatives will be applied to any contaminated soils and debris (inc1uding stockpiles) that will be inactive for more than 24 hours. Periodic monitoring (visual observation) shall be performed, as

determined by the project, of contaminated soils and debris that remain inactive for greater than 1 month. Reapplication of fixative or other control measure shall be performed if warranted by the periodic monitoring.

- Fixatives will be applied to contaminated soils and debris (including stockpiles) that will be inactive less than 24 hours at the end of work operations, if the sustained wind speed is predicted overnight to be greater than 32.2 kph (20 mph) based on the Hanford Meteorological Station morning forecast. This will allow the project enough time, if necessary, to prepare for the application of dust control measures. If a soil fixative has already been applied and the soil will remain undisturbed, further uses of fixatives will not be needed. The fixatives or other controls will not be applied when the contaminated soils are frozen, or if it is raining, snowing, or other freezing precipitation is falling at the end of work operations.
- The haul trucks transporting bulk materials will be covered to contain the materials while in transit to the ERDF.
- HEPA filters (e.g., HEPA-filtered vacuum cleaner) may be used during remediation activities. The use of HEPA filters has been generally accepted as BARCT. HEPA filters shall have efficiency testing performed upon installation and on an annual basis thereafter and must be demonstrated to have 99.95% removal efficiency.
- Additional measures for controlling small debris in waste piles may be prudent based on waste site conditions as determined by project personnel. Some additional measures that may be used are as follows: (1) application of a thin layer of other contaminated soil from the same waste site that is free of debris on the surface followed by normal fixative application, (2) application of a thin layer of uncontaminated soil that is free of debris on the surface followed by normal fixative application, (3) application of a bonded fiber fixative, and (4) covering the area containing small debris that is easily resuspended with a tarp or other appropriate material.

E3. Monitoring

During remediation of the 300 Area waste sites, monitoring activities will consist of using existing air monitoring stations 300 Area Northeast, 300 Area Southwest #2, 300 Trench, and 300 Water Intake. The operation of these monitors will follow the protocol established for these programs and operate at approximately 2 cfm. Activities such as building demolition and field remediation may somewhat alter air monitor locations. EPA approval will be obtained prior to moving any air monitor.

These air monitors are the means/methods to measure emissions. The operation of these monitors will follow the protocol established for these programs. The data from these monitors will be included in the annual reports prepared for the Hanford Site. Air samples are collected every 2 weeks and analyzed for total alpha and total beta emissions. These samples are also composited semi-annually and analyzed for isotopic uranium, isotopic plutonium, americium-241, strontium-90, and gamma-emitting radionuclides (gamma energy analysis). In addition, monthly tritium samples are collected from these monitors. Isotopic results that exceed 10% of the values in Table 2 of 40 CFR 61, Appendix E will be investigated and the adequacy of controls evaluated as appropriate.

Air monitors are run continuously and air monitor downtime will be minimized. If any one of the air monitor stations is out of operation for more than 48 hours during normal work operations (excluding weekends and holidays), the EPA will be notified. At least two air monitors must be operating for normal work operations, excavation, and loading activities to continue at the site.

Exhaust points from HEPA filters (and any ductwork, seams, or other potential release locations from enclosures) will be monitored on a routine basis for potential radionuclide releases and results recorded (e.g., post-survey results negative). Any positive survey results will require appropriate maintenance on the facility, exhauster, or vacuum to ensure that continued releases do not occur. Records of routine monitoring and necessary maintenance will be provided to EPA staff upon request.

There are other existing air monitors for other 300 area activities and thermoluminescent dosimeters (TLDs) in and near the perimeter of the 300 Area that provide information concerning air emissions and radiation fields. The location and data from these monitors and TLDs are reported each year in the Hanford Site Environmental Report and associated appendices.

E4. References

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

Calculation 0300X-CA-V0180, 2014, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*, Rev. 0, Washington Closure Hanford, Richland, Washington.

Clean Air Act of 1970, 42 U.S.C. 7401, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code,* as amended.

DOE/RL-2014-13-ADD1
Draft A

Remedial Design Report/ Remedial Action Work Plan for 300-FF-2 Soils

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

For External Review

DOE/RL-2014-13-ADD1
Draft A

STANDARD APPROVAL PAGE

Title: Remedial Design Report/Remedial Action Work Plan for 300-FF-2 Soils

Author Name: J. M. Capron

Approval: J. A. Lerch, Mission Completion & Environmental Compliance Manager

Signature [signature] Date 5/7/14

The approval signature on this page indicates that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

DOE/RL-2014-13-ADD1
Draft A

Remedial Design Report/ Remedial Action Work Plan for 300-FF-2 Soils

Date Published
May 2014

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

For External Review

Contents

Appendices

Figures

Tables

This page intentionally left blank.

Terms

ACM	asbestos-containing material
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CTA	container transfer area
CVP	cleanup verification package
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FS	feasibility study
LDR	land disposal restricted
MAP	mitigation action plan
MTCA	"Model Toxics Control Act – Cleanup"
NCP	"National Oil and Hazardous Substances Contingency Plan"
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RAO	remedial action objective
RAWP	remedial action work plan
RCBRA	river corridor baseline risk assessment
RCC	River Corridor Closure (Project)

RCRA	*Resource Conservation and Recovery Act*
RDR	remedial design report
RESRAD	RESidual RADioactivity
RI	remedial investigation
ROD	record of decision
RTD	remove, treat, and dispose
SAP	sampling and analysis plan
SNF	spent nuclear fuel
SPA	staging pile area
STOMP	Subsurface Transport Over Multiple Phases
TBC	to be considered
TRU	transuranic
TSD	treatment, storage, and disposal
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VPU	vertical pipe unit
WAC	*Washington Administrative Code*

1 Introduction

The *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (hereafter referred to as the 300 Area ROD) (EPA 2013) defines selected remedies for the 300 Area of the Hanford Site. In general, these selected remedies can be grouped into three categories:

- Remove, treat, and dispose (RTD) for waste sites in the 300-FF-2 Operable Unit (OU), with interim pipeline void filling and surface barriers for waste sites associated with long-term retained facilities
- Uranium sequestration for the vadose zone and periodically rewetted zone for soils and sediments greater than 4.6 m (15 ft) below ground surface (bgs) in the 300-FF-1 and 300-FF-2 OUs
- Monitored natural attenuation for groundwater in the 300-FF-5 OU.

The *Integrated Remedial Design/Remedial Action Work Plan for the 300 Area (300-FF-1, 300-FF-2, & 300-FF-5 Operable Units)* (hereafter referred to as the Integrated RDR/RAWP) (DOE/RL-2014-13) addresses overarching common elements and integration considerations for these three categories. This addendum supplements the Integrated RDR/RAWP in addressing implementation requirements specific to the first category: temporary stabilization and remediation by RTD of 300-FF-2 waste sites.

The 300-FF-2 OU (Figure 1-1) is composed of waste sites that fall into four general categories: waste sites in the 300 Area industrial complex; outlying waste sites north and west of the industrial complex; general content burial grounds within and around the industrial complex; and transuranic (TRU)-contaminated burial grounds. The selected remedy is protective of future industrial uses of the 300 Area industrial complex and the 618-11 Burial Ground, and residential use for the remaining areas.

Remedial actions have been ongoing at the 300-FF-2 OU since 2001 under the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (EPA 2001). Approximately thirty 300-FF-2 waste sites were also remediated earlier due to their proximity to 300-FF-1 waste sites remediated under the *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington* (EPA 1996). These previous and ongoing remediation activities have been performed in accordance with the applicable revision of DOE/RL-2001-47, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (hereafter referred to as the interim action RDR/RAWP). The interim actions have established much of the document and process framework needed to successfully implement the scope of the 300 Area ROD. Upon approval, this addendum and the Integrated RDR/RAWP replace the interim action RDR/RAWP, but remedial designs, plans, and other regulatory agreements approved under interim actions shall remain in effect except where this addendum explicitly describes otherwise. Existing lower tier documents that reference the interim action RDR/RAWP may continue to be used with the understanding that these references are superseded by this approved addendum and the associated Integrated RDR/RAWP (DOE/RL-2014-13).

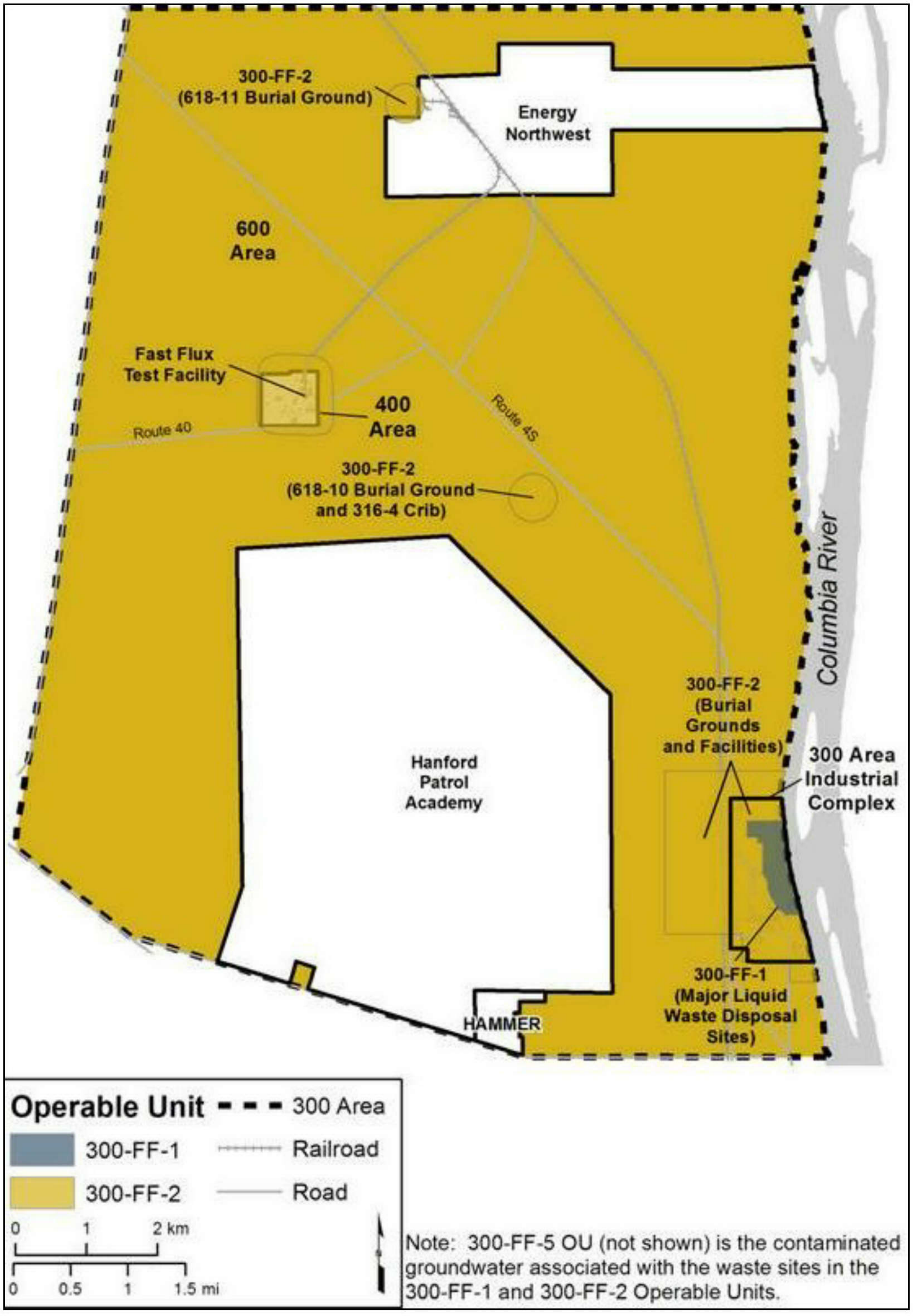


Figure 1-1. 300-FF-1 and 300-FF-2 Operable Units

1.1 Purpose

The primary purpose of this addendum is to provide the RDR/RAWP to describe the design and implementation of the remedial action process required for RTD and interim stabilization of 300-FF-2 waste sites by the 300 Area ROD. In addition, this document addresses the requirements for completion of the remedial action process and the closeout/verification process for the 300-FF-2 waste sites in accordance with the 300 Area ROD. The contents of this document will be reviewed and revised as appropriate to reflect changes to the design and work plans for remedial action. In the meantime, any adjustments will be documented in the unit manager's meeting minutes and/or via change notices, as necessary.

1.2 Scope

This addendum supplements the Integrated RDR/RAWP to provide the RDR and RAWP for RTD and interim stabilization of 300-FF-2 waste sites. The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) lists the RDR and the RAWP as two separate documents. However, this document streamlines the requirements; the RDR and RAWP are combined to cover both the remedial designs and remedial actions.

1.2.1 Remedy Components and Waste Sites

This addendum addresses the following components of the 300 Area ROD:

- Removal of contaminated soil and associated debris from waste sites
- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility
- Disposal of contaminated materials at the Hanford Site's Environmental Restoration Disposal Facility (ERDF); the Waste Isolation Pilot Plant in Carlsbad, New Mexico; or other disposal facilities approved in advance by the U.S. Environmental Protection Agency (EPA)
- Backfilling and recontouring of excavated areas followed by appropriate infiltration control measures
- Installation of temporary surface barriers above specific portions of waste sites associated with long-term retained facilities
- Void-fill grouting of specific portions of pipeline waste sites associated with long-term retained facilities
- Institutional controls associated with access for active remediation areas.

The 300-FF-2 waste sites with a selected RTD remedy in the 300 Area ROD are identified in Table 1-1. If additional waste sites that may require remediation are identified beyond those listed in the table, they will be discussed with the U.S. Department of Energy, Richland Operations Office (DOE-RL) and EPA for appropriate disposition. Summary information for all 300-FF-1 and 300-FF-2 waste sites is provided in Appendix A. Forty of the waste sites identified in Table 1-1 have already been addressed and reclassified under interim actions. Activities for these waste sites may be limited to verification that the interim actions taken remain protective under the 300 Area ROD requirements without further action.

Table 1-1. 300-FF-2 Waste Sites Addressed by this Remedial Design Report/ Remedial Action Work Plan

Selected Remedy	Waste Site
RTD to industrial cleanup levels	300 RLWS, 300 RRLWS, 300-11, 300-121, 300-123[a], 300-15, 300-16[a], 300-175, 300-2[a], 300-214, 300-218[a], 300-219[a], 300-22, 300-224[a], 300-24[a], 300-249[a], 300-251[a], 300-255, 300-257[a], 300-258[a], 300-263, 300-265, 300-268[a], 300-269, 300-270[a], 300-273[a], 300-274[a], 300-276[a], 300-277, 300-279[a], 300-28[a], 300-280, 300-281[a], 300-283[a], 300-284, 300-286[a], 300-289, 300-291, 300-293[a], 300-294, 300-296, 300-32[a], 300-34, 300-4, 300-40[a], 300-43[a], 300-46[a], 300-48[a], 300-5, 300-6[a], 300-7, 300-80[a], 300-9, 313 ESSP[a], 316-3[b], 331 LSLT1, 331 LSLT2, 333 WSTF[a], 340 COMPLEX, 3712 USSA[a], 618-11, UPR-300-1, UPR-300-10, UPR-300-11, UPR-300-12, UPR-300-2, UPR-300-38[a], UPR-300-39[a], UPR-300-4[a], UPR-300-40[a], UPR-300-42[a], UPR-300-45[a], UPR-300-48, UPR-300-5
RTD to residential cleanup levels	300-287, 300-288, 300-290, 316-4, 400 PPSS, 400-37, 400-38, 600-290[a], 600-367, 600-63, 618-10, UPR-600-22

Notes:

a Waste site has been remediated and reclassified under the interim action ROD. Further activities may be limited to verification that the interim action remediation attains the protectiveness criteria of the 300 Area ROD.

b The 300 Area ROD also associates the 316-3 waste site with the enhanced monitored natural attenuation remedy, and final site reclassification should consider implementation of both remedy components. Under the interim action ROD, this site was determined to require no action based on site-specific evaluation. Further activities for this site under this remedial design report/remedial action work plan addendum may be limited to verification that the interim action evaluation also attains the protectiveness criteria of the 300 Area ROD.

ROD = Record of Decision

RTD = remove, treat, dispose

The following are not within the scope of this document:

- Contaminated buildings are being demolished and removed in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act of* 1980 (CERCLA) action memoranda (DOE-RL 2005, 2006a, 2006b) and an associated removal action work plan (DOE/RL-2004-77, *Removal Action Work Plan for the 300 Area Facilities*). Potential releases from those buildings may have resulted in waste sites that have been previously addressed or are within the scope of this document.

- Operation and closure of *Resource Conservation and Recovery Act* (RCRA) treatment, storage, and disposal (TSD) units will be performed in accordance with the Hanford Facility Dangerous Waste Permit. There are currently two permitted RCRA TSD units within the general 300 Area: the 325 Hazardous Waste Treatment Units (325 HWTU) and the 400 Area Waste Management Unit (400-40).

- The 324 Building is planned to be closed under a site-specific closure plan (DOE/RL-96-73, *324 Building Radiochemical Engineering Cells, High-Level Vault, Low-Level Vault, and Associated Area Closure Plan*) in coordination with the applicable action memorandum (DOE-RL 2006a). (The associated 300-296 waste site is within the scope of this RDR/RAWP.)

1.2.2 Retained Facilities and Associated Waste Sites

The U.S. Department of Energy (DOE) has determined that certain buildings and utilities within the 300 Area need to be retained to support the ongoing mission of the Pacific Northwest National Laboratory and the Hanford Site. These facilities, shown in Figure 1-2, are expected to be retained through at least 2027. In addition, the 324 Complex must be retained temporarily (interim retained) in order to safely remediate highly contaminated portions of the underlying 300-296 waste site. Other waste sites, listed in Table 1-2, are located partly or wholly under or immediately adjacent to facilities and utility corridors that will be retained, restricting the capability to complete RTD at these sites until the retained facilities are removed. Accordingly, the selected remedy for 300-FF-2 waste sites includes a component for interim stabilization using temporary surface barriers (e.g., asphalt or other suitable impermeable material) and pipeline void filling (e.g., by grouting or use of other suitable stabilizing agent).

1.2.3 Waste Sites Containing Principal Threat Waste

Principal threat wastes are those source materials considered to be highly toxic and/or highly mobile that generally cannot be reliably contained and/or would present a significant risk to human health and/or the environment should exposure occur. Three waste sites in the 300-FF-2 OU are anticipated to contain principal threat waste that will be addressed under this RDR/RAWP. The "National Oil and Hazardous Substances Contingency Plan" (NCP) (40 *Code of Federal Regulations* [CFR] 300) establishes an expectation that treatment will be used to address principal threats, and considerations specific to these sites are included within this RDR/RAWP. The waste sites that may contain principal threat wastes are as follows:

- The 618-10 and 618-11 Burial Grounds contain vertical pipe units (VPUs), consisting of approximately 4.6-m (15-ft)-long pipes up to 0.6 m (22 in.) diameter with open ends. Highly radioactive containers of waste were disposed in many of these VPUs and covered with fill material. The 618-11 Burial Ground also includes caissons that were used for similar disposal, but differ in construction. The caissons are approximately 3-m (10-ft)-long pipes up to 2.4 m (8 ft) in diameter installed vertically in the subsurface with open bottoms. An angled chute extended from each caisson towards the surface for disposal access. Waste forms within some of these VPUs and caissons may be considered principal threat waste.

- The 300-296 waste site consists of highly radioactive contaminated soil beneath the 324 Building B Hot Cell. Cesium-137 and strontium-90 are the primary isotopes present, and the most highly contaminated soils are considered principal threat waste.

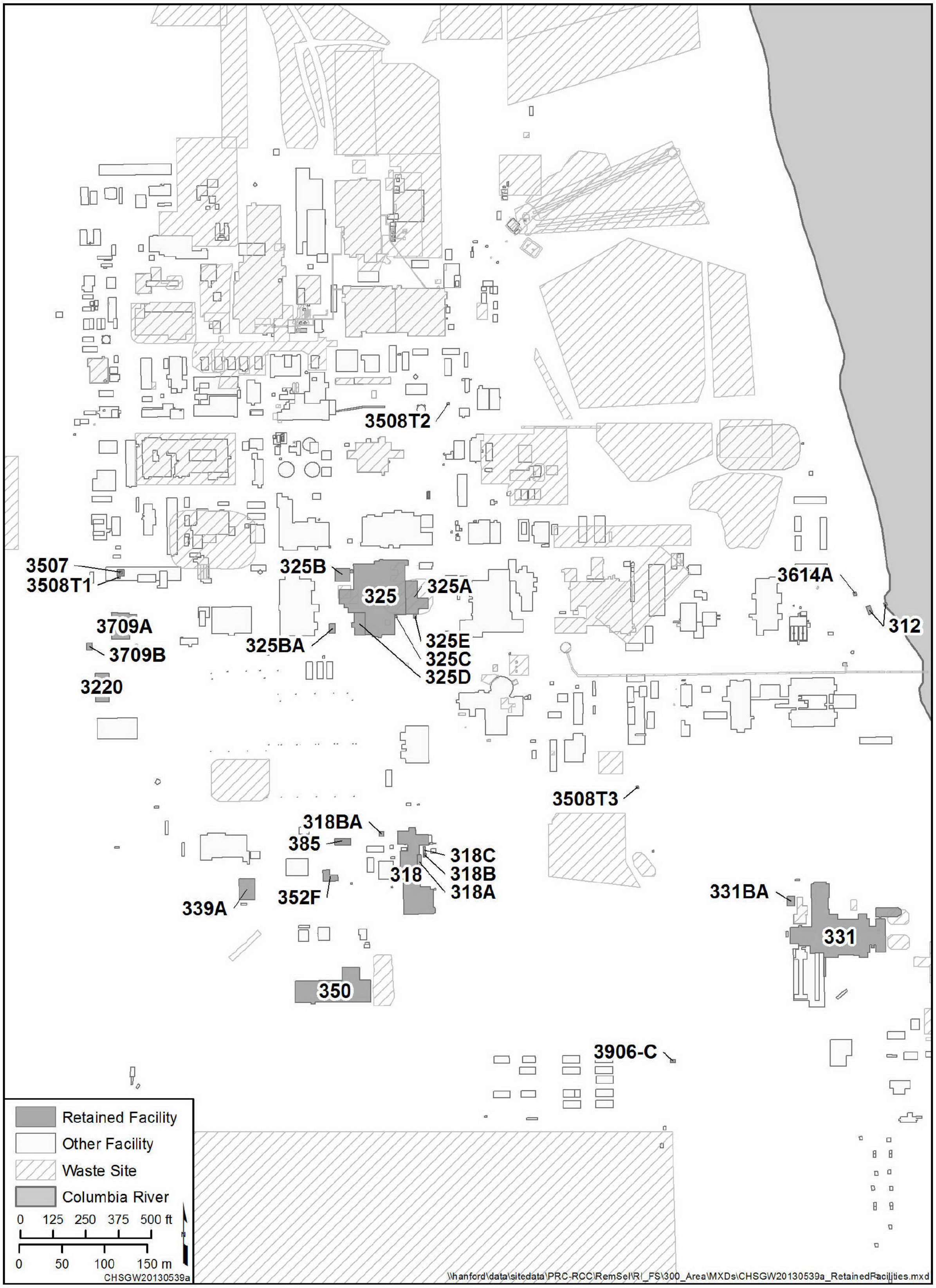


Figure 1-2. Long-Term Retained Facilities in the 300 Area Industrial Complex

Table 1-2. 300 Area Waste Sites Affected by Retained Facilities

Waste Site	Facility Interference
300-5, Fire Station Fuel Tanks	3709-A and 3709-B
300-15, Process Sewer System	Multiple facilities and utility corridors
300-121, 3621D Stormwater Runoff Drain	Overhead electrical lines
300-214, Retention Process Sewer	Multiple facilities and utility corridors
300-265, Pipe Trench between 324 and 325	324 Complex & 325 Complex
300-269, 331A Building Foundation	331A Building foundation
300-296, Soil Contamination Below the 324 Building	324 Complex[a]
300-RLWS, Radioactive Liquid Waste Sewer	Multiple facilities and utility corridors
300-RRLWS, Retired Radioactive Liquid Waste Sewer	Multiple facilities and utility corridors
331-LSLT-1, Life Sciences Lab Trench 1	331 Complex
331-LSLT-2, Life Sciences Lab Trench 2	331 Complex
UPR-300-10, Unplanned Release	325 Complex
UPR-300-12, Unplanned Release	325 Complex
UPR-300-48, Unplanned Release	325 Complex
325 WTF[b], Waste Storage	325 Complex
400-37, Underground Fuel Oil Tank	4732-B Building
400-38, Underground Fuel Oil Tank	4722-A Building foundation

Notes:

a The 324 Complex will be interim retained to support safe remediation of highly contaminated soil at the 300-296 waste site.

b The 325 WTF site is a *Resource Conservation and Recovery Act* treatment, storage, and disposal unit and is not included in the scope of this addendum.

1.3 Report Organization

The essential elements of this RDR/RAWP are present in Sections 1.0 through 5.0, which comprise the main body of the report. The appendices present additional information and guidance. The contents of each section are briefly described below:

- Section 1.0, "Introduction," presents the purpose, scope, and this overview of the report's organization. Additional introductory and background information can be found in the integrated RDR/RAWP.
- Section 2.0, "Basis for Remedial Action," presents the objectives, cleanup levels, verification of waste, and applicable or relevant and appropriate requirements (ARARs).
- Section 3.0, "Remedial Action Design and Planning," presents the design and remediation planning components and process.

- Section 4.0, "Remedial Action Management and Approach" presents the details for field-implementation of the selected remedy and institutional controls specific to 300-FF-2 remediation.
- Section 5.0, "Waste Management Plan," presents waste storage, transportation, packaging, handling, and labeling as applicable to waste streams for each waste site.
- Section 6.0, "References," contains all reference information used for the main body of the report.
- Appendix A, "Waste Site Information," presents a general description and status of all 300-FF-1 and 300-FF-2 waste sites.
- Appendix B, "Guidance for Cleanup Verification Packages," presents a detailed description of the cleanup verification process to aid in development and review of cleanup verification packages (CVPs).
- Appendix C, "Revegetation Plan for the 300 Area," presents the revegetation plan for the 300 Area.
- Appendix D, "Cleanup Levels," presents a summary of the development of the contaminant-specific numerical cleanup values.
- Appendix E, "Air Monitoring Plan for the 300 Area Waste Sites Remedial Action," presents the air monitoring plan for remediation of wastes sites at the 300 Area industrial core and immediate surrounding area.

2 Basis for Remedial Action

The 300 Area ROD (EPA 2013) selected remedial action for specific 300-FF-2 waste sites based on a determination that remaining unremediated sites present an unacceptable risk to human health and the environment. The Integrated RDR/RAWP (DOE/RL-2014-13) provides the associated remedial action objectives (RAOs), which provide a narrative statement of the extent to which cleanup is necessary under the ROD. This chapter then provides the associated analyte-specific soil cleanup levels and requirements for their application, as well as the ARARs for 300-FF-2 remedial action.

2.1 Cleanup Levels

To achieve RAOs, numerical cleanup levels for industrial and residential land use were calculated during the 300 Area remedial investigation/feasibility study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*) and promulgated by the 300 Area ROD (EPA 2013). The cleanup levels are based on restoring groundwater to drinking water levels, protecting groundwater and the Columbia River, and protecting industrial use in all areas. In addition, DOE and EPA have agreed to residential cleanup levels that must be met outside the 300 Area industrial complex and the 618-11 Burial Ground.

Soil cleanup levels for direct contact human health receptors were developed using standard approaches, consistent with state and federal guidance. Direct contact cleanup levels for nonradionuclides are based on risk calculations provided in the Washington State's "Model Toxics Control Act – Cleanup" (MTCA) procedures. Direct contact cleanup levels for radionuclides are calculated based on an excess lifetime cancer risk of $1x10^{-4}$ or a radiological dose of 15 mrem/yr. For each radionuclide, the lower of the risk or dose-based calculations is used as the cleanup level.

Soil cleanup levels for groundwater and surface water protection were also developed based on current state and federal guidance and, consistent with guidance, incorporate site-specific data from the 300 Area. Soil cleanup levels are described below based on a residential scenario with irrigation and based on an industrial scenario without irrigation. One main difference between the scenarios is the amount of water infiltrating the soil to reach groundwater. The industrial scenario is based on natural precipitation, no irrigation, runoff management from surfaces such as pavement, and marginal vegetation cover. The industrial scenario assumes that a moderate 25 mm/yr of precipitation reaches groundwater. In residential areas, irrigation provides an increased amount of water to the soil, and a relatively high 72 mm/yr of water is assumed to reach groundwater. The irrigated residential scenario is used to identify the potential for groundwater and surface water contamination to occur from waste sites due to higher groundwater recharge rates associated with the irrigation of crops and was used to develop the residential cleanup levels.

Residential cleanup levels for areas outside of the 300 Area industrial complex and the 618-11 Burial Ground, and industrial cleanup levels for waste sites inside the 300 Area industrial complex and the 618-11 Burial Ground, are presented in Appendix D of this RDR/RAWP (Table D-1).

Cleanup levels are calculated for single contaminants. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated (as described in Section 2.2.2) to ensure that the waste site meets total risk limits as specified in CERCLA and the NCP. When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the RAOs.

The river corridor baseline risk assessment (RCBRA) (DOE/RL-2007-21) and the RI/FS report (DOE/RL-2010-99) evaluated ecological risks at 300 Area interim remediated waste sites with upland habitats for potential ecological risks. The RI/FS used information from the RCBRA and from other sources to evaluate the risk to populations and communities of ecological receptors, and determined that interim remedial actions that achieved interim action ROD cleanup levels for protection of human health were also protective of ecological receptors and there was no ecological risk at remediated waste sites within the 300-FF-2 OU. Further, the 300 Area RI/FS report (DOE/RL-2010-99) concluded that there were no contaminants of ecological concern or ecological risk to populations and communities due to the 300-FF-2 and 300-FF-5 OUs in riparian, near-shore, and river environments. These conclusions considered the size of waste sites relative to ecological receptor home ranges. The 300 Area ROD (EPA 2013) then determined that, for 300-FF-2 waste sites that have not been remediated under interim actions, residual contamination will not be sufficient to adversely impact populations and communities of ecological receptors once human health cleanup levels are achieved. As such, no further evaluation of ecological risks will be performed for individual waste sites addressed under this RDR/RAWP.

2.1.1 Cleanup Levels for Industrial Land Use

The 300 Area ROD cleanup levels for an industrial land-use scenario are included in Table D-1 for radiological and nonradiological constituents. The methodology used to arrive at these values for the direct exposure and groundwater and river protection pathways is summarized in Appendix D of this document and in the 300 Area ROD (EPA 2013).

For radionuclides, the 300 Area industrial land-use scenario assumes that the exposure pathways for residual contamination will be (1) direct exposure to radiation, (2) ingestion of soil containing residual contamination, (3) inhalation of particles in the air from residual contamination, and (4) protection of groundwater based on attainment of federal drinking water standards. It is assumed that drinking water is not obtained from groundwater sources and food products are not grown on the site. Groundwater is considered to be a potential future drinking water source that must be restored to drinking water standards in a reasonable time frame, as established in the 300 Area ROD (EPA 2013). The assumptions used for the 300 Area industrial land-use scenario are summarized in Appendix D of this document. Major assumptions include the following:

- **Direct Exposure Route.** The industrial land-use scenario assumes an adult worker is located in the area of residual contamination for approximately 1,500 hr/yr inside a building and 500 hr/yr outdoors for a period of 30 years (these correspond to a typical work year for an adult worker). When the worker is outdoors, it is assumed that clean fill does not provide shielding from residual contamination. Furthermore, it is assumed that indoor exposure to external radiation is 40% of the outdoor levels (based on the shielding provided by the building from direct exposure to radiation from residual contaminants in the soil).
- **Soil Ingestion Route.** The scenario assumes that a worker ingests 25 g of contaminated soil each year.
- **Inhalation Route.** The scenario assumes that the air contamination inside a building is 40% of the outside air particle concentration (which is assumed to be 0.0002 g/m^3 from residual soil contamination).

- **Groundwater Protection.** Based on attainment of federal drinking water standards, soil cleanup levels for groundwater and surface water protection were calculated using the STOMP (Subsurface Transport Over Multiple Phases) code. The consideration of lesser amounts of irrigation in areas with institutional controls for industrial use allows higher soil cleanup levels to be protective of the same federal drinking water standards.

The key modeling parameters that affect the direct exposure cleanup levels for radionuclides are (1) the depth of cover/clean fill over residual contamination (none is assumed for the 300 Area), and (2) the time spent on the former waste site location, both indoors and outdoors (approximately 1,500 hr/yr inside a building and 500 hr/yr outdoors). Other parameters affect the modeling results but are not as significant as these two items.

Cleanup levels for nonradionuclides in the 300 Area industrial land-use scenario are based on *Washington Administrative Code* (WAC) 173-340-745(5), which assumes that the exposure pathway for residual contamination will be from ingestion of contaminated soil. Soil cleanup levels are calculated using the equations provided by WAC 173-340-745(5), Method C for carcinogens and noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a person weighing 70 kg ingests soil at a rate of 50 mg/day, with an exposure frequency of 40% and a gastrointestinal absorption rate of 100%. For carcinogens, the calculation is based on achieving a lifetime cancer risk goal of $1x10^{-5}$ for an exposure duration of 20 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

The key assumptions in the 300 Area industrial land-use scenario that affect the groundwater protection determination are (1) vegetation not requiring irrigation will be grown on the waste site after the cleanup is complete, or the waste site will be resurfaced to reduce water infiltration (thus allowing for a higher, 0.91, evapotranspiration coefficient to be used); and (2) no water will be applied to former waste site locations for irrigation purposes. These assumptions can only be modified if it can be demonstrated that there will be no negative impact on groundwater quality from residual contamination at former waste site locations (which requires EPA approval in advance).

Finally, it is assumed that (1) no sensitive human subpopulations (e.g., children) are permitted to come into contact with residual soil or debris contamination from waste sites (i.e., the cleanup levels are based on exposures to adults); (2) the period of analysis for evaluation of site risks and groundwater protection is 1,000 years; and (3) direct exposure of onsite workers to residual contamination to a depth of 4.6 m (15 ft) may occur (this represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities).

One thousand years was used as a reasonable endpoint for modeling calculations performed to support development of the 300-FF-2 OU preliminary remediation goals. The *Risk Assessment Guidance for Superfund (RAGS)* (EPA 1989) notes that consideration of multigenerational effects is useful when assessing risk posed by long-lived radionuclides. A 1,000-year time period is considered to be a reasonable endpoint for modeling, based on the following considerations:

- A 1,000-year time frame has been recognized by several regulatory programs as being long enough to identify health impacts for residual contaminants. Although some long-lived radioactive materials may remain on these sites as part of the cleanup and disposal process, the peak dose occurs in less than 1,000 years for most.

- When predicting thousands of years into the future, uncertainties become very large because of major potential changes in the geohydrologic regime at the site over long periods of time. The consequences of exposure to residual radioactivity at levels approaching background are small, and considering the large uncertainties, long-term modeling is considered to be of little value.
- Time frames greater than 1,000 years are considered to be more appropriate for evaluating long-term performance of disposal facilities, as opposed to residual contaminants at sites that have undergone a cleanup action.

2.1.2 Cleanup Levels for Unrestricted Land Use

The cleanup levels for a residential land-use scenario are included in Appendix D, Table D-1 for radiological and nonradiological constituents. The methodology used to arrive at these values is summarized in Appendix D of this document and in the 300 Area ROD (EPA 2013). For the purpose of using the RESidual RADioactivity (RESRAD) dose model, unrestricted future use in the 300 Area is represented by an individual resident in a rural-residential setting. This resident is assumed to consume and irrigate crops raised in a backyard garden; consume animal products (e.g., meat and milk) from locally raised livestock or meat from game animals (including fish); and live in a residence on the waste site. The exposure pathways considered in estimating dose from radionuclides in soil are inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. Based on EPA guidance, this individual is conservatively assumed to spend 60% of his/her lifetime (15 hr/day; 350 days/yr) indoors on site and 12% of their time (3 hr/day; 350 days/yr) outdoors on site. The assumptions used for the 300 Area unrestricted land-use scenario are also described in Appendix D of this document.

Soil cleanup levels for nonradionuclides in the 300 Area residential land-use scenario are calculated using the MTCA Method B equations provided by WAC 173-340-740(3) for carcinogens and noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a resident with an average body weight 16 kg (35 lb) over the period of exposure ingests soil at a rate of 200 mg/day (73 g/yr), with a frequency of contact of 100% and a gastrointestinal absorption rate of 100%. For individual nonradionuclide carcinogenic chemicals, the calculation is based on achieving an excess lifetime cancer risk goal of 1×10^{-6} for an exposure duration of 6 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

Soil cleanup levels for the protection of groundwater and surface water are based on site-specific data for the 300 Area and current federal drinking water standards (EPA 2013). Soil cleanup levels for the protection of groundwater and surface water were calculated based on site-specific data and specific parameters using the STOMP code with a one-dimensional model for all contaminants except uranium. For uranium, the STOMP code was used with a two-dimensional model that includes the effects of uranium's more complex sorption behavior. For highly mobile contaminants (retardation coefficient < 2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. For the 300 Area industrial complex and 618-11 Burial Ground, a groundwater recharge rate of 25 mm/yr was used for the long term, representing a permanently disturbed soil with cheatgrass (*Bromus tectorum*) vegetative cover. For areas outside the 300 Area industrial complex and 618-11 Burial Ground where cleanup levels are based on a residential scenario, a groundwater recharge rate of approximately 72 mm/yr was used representing an irrigated condition. Based on this model, no soil cleanup level for groundwater or river protection is calculated for some contaminants because they are calculated to not reach the groundwater within 1,000 years at levels that contaminate groundwater above drinking water standards (or would contaminate the river above surface water standards).

For the residential land-use scenario, it is assumed that the period of analysis for evaluation of site risks and groundwater protection is 1,000 years, and direct exposure of onsite residents to residual contamination to a depth of 4.6 m (15 ft) may occur (this represents a reasonable estimate of the soil depth that could be excavated and distributed at the soil surface as a result of site development activities).

2.2 Application of Cleanup Levels

2.2.1 Cleanup Levels Based on Vadose Zone Depth

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below the ground surface per WAC 173-340-740(6)(d). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) or more below ground surface are referred to as being in the deep zone whereas the materials above 4.6 m (15 ft) bgs are referred to as being in the shallow zone. The direct exposure cleanup levels are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection cleanup levels are applicable to soils in both the shallow and the deep zones. However, if a site 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 regardless of the depth of the excavation. This is advantageous for site closeout because a site that does not require a separate deep zone evaluation will also have no requirement for deep zone institutional controls.

The RAOs call for prevention of human exposure to the upper 4.6 m (15 ft) of soil, structures, or debris with contaminants of concern (COCs) at concentrations above cleanup levels and management of contaminated soils below 4.6 m (15 ft). Generally, this would entail RTD of soils below 4.6 m (15 ft) exceeding cleanup levels in Table D-1 for groundwater and river protection for waste sites in the scope of this addendum. It is anticipated that (under limited circumstances) factors such as nature and form of contaminated material, implementability, cost, volume, and impacts to ecological and cultural resources may be used to evaluate the extent of excavation at depths greater than 4.6 m (15 ft). Appropriate remedy selection change documentation (e.g., a memorandum-to-file, explanation of significant differences, or ROD amendment, based on the nature of the exception) will be prepared and public involvement will be provided for, if necessary. Regardless of these factors, protection of groundwater and the Columbia River must be achieved for any contamination left below 4.6 m (15 ft) (i.e., alternative remedial measures must be evaluated).

The soil cleanup levels apply to soil and structures (including pipelines and debris). Cleanup levels do not apply to constituents that are an integral part of manufactured structures. Application of soil cleanup levels to sediment and scale within pipelines and similar structures may be over-conservative, depending on site-specific conditions. Where there are exceedances of cleanup levels in sediment/scale data, but not in corresponding underlying soil, alternative demonstrations of RAO attainment may be used with EPA approval. For example, the EPA may approve use of a matrix-correction approach to adjust contaminant concentrations to consider a combined scale and pipeline wall matrix. The EPA may also approve qualitative demonstrations of protectiveness based on site-specific considerations.

2.2.2 Multiple Contaminant Concentrations

Cumulative effects associated with the presence of multiple radionuclide or nonradionuclide contaminants at waste sites must be evaluated to ensure that the waste site meets total risk limits as specified in CERCLA, the NCP, and MTCA. The following standards must be met for cumulative effects of multiple contaminants:

- Total excess cancer risk from all nonradionuclide constituents must not exceed 1×10^{-5}.
- Total of all toxicity hazard quotients for nonradionuclide constituents must be a hazard index of less than 1.
- Cumulative risk of all radionuclides must not exceed the CERCLA risk range of 10^{-4} to 10^{-6} or a radiological dose of 15 mrem/yr, where that limitation is more conservative.
- Summation of the predicted groundwater dose from all beta- and photon-emitting radionuclides must be less than 4 mrem/yr.

The 2007 MTCA cleanup regulation, WAC 173-340-708(8)(e), provides a method to determine compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs). Mixtures of carcinogenic PAHs are considered as a single hazardous substance, and the cleanup levels established for benzo(a)pyrene are used as the cleanup levels for mixtures of carcinogenic PAHs. Cleanup verification samples are analyzed to determine the concentration of each carcinogenic PAH listed in Table 2-1 (from Table 708-2 of the 2007 MTCA cleanup regulation). Following the criteria of Appendix B, statistical values representing the PAH COC concentrations for each decision unit are calculated or the maximum detected value is selected when the COC is detected in fewer than 50% of the samples (and for focused samples). The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor in Table 2-1 to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table D-1 to determine compliance. The results of this determination are included in the waste site CVP as described in Appendix B.

2.2.3 Discovery of Additional Contaminants

Contaminants of concern were selected in the 300 Area ROD (EPA 2013), which included a risk assessment. In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the DOE and EPA project managers for determination of a path forward.

Table 2-1. Toxic Equivalency Factors for Carcinogenic Polyaromatic Hydrocarbons [a]

CAS Number	Carcinogenic Polyaromatic Hydrocarbons	Toxic Equivalency Factors
50-32-08	Benzo(a)pyrene	1
56-55-3	Benzo(a)anthracene	0.1
205-99-2	Benzo(b)fluoranthene	0.1
207-08-9	Benzo(k)fluoranthene	0.1
218-01-9	Chrysene	0.01
53-70-3	Dibenz(a,h)anthracene	0.1
193-39-5	Indeno(1,2,3-cd)pyrene	0.1

Notes:

a From WAC 173-340-708(8)(e), Table 708-2.

CAS = Chemical Abstract Services

2.3 Verification of Waste Site Cleanup

Appendix B provides guidance for the process by which CVPs are prepared and reviewed. The purpose of the CVP is to document that the relevant waste site has been remediated in accordance with the applicable ROD and that the RAOs under the applicable land-use scenario have been achieved. Site-specific data evaluations are presented in the CVP to demonstrate that the waste site, following remediation, does not pose an unacceptable risk to human health and is protective of groundwater and the river.

The primary determination of the successful completion of remediation is the comparison of quantified residual soil analyses against cleanup levels in appropriate tables. In addition, site-specific factors such as the concentration of the contaminants at depth, the type of waste site (solid or liquid), and calculations of residual site risks are used to verify that remaining concentrations of contaminants are protective of direct exposure and groundwater and the Columbia River (see Appendix B). Development of a site-specific contaminant distribution model may be necessary to more accurately describe actual site conditions and show that contaminant concentrations decrease with soil depth. Use of analogous sites and process knowledge, or a test pit or borehole, may be needed to establish the distribution of contaminants with respect to soil depth. A site-specific contaminant distribution model, using actual field data, will more accurately predict potential impacts of vadose zone soil contaminants on groundwater and the river. The model information will be used to determine if the residual concentrations of contaminants in the unsaturated vadose zone are protective of groundwater and the river, or if further excavation of remaining contamination in the unsaturated vadose zone is required. Results will be documented in the CVP.

2.4 Applicable or Relevant and Appropriate Requirements

The NCP (40 CFR 300) and the 300 Area ROD require that the remedial actions comply with ARARs established in the ROD. The purpose of this section is to summarize how each of the ARARs identified in the ROD will be met during 300-FF-2 remedial action.

Activities associated with the remedial action for the source area waste sites covered under the ROD are expected to occur on site, as that term is defined under the NCP. As a result, the remedial actions described in this document must meet the substantive, but not administrative, requirements of the ARARs established in the RODs. In the event that any portion of the remediation work occurs at an offsite location (e.g., waste treatment at an offsite facility), the work is required to comply with all applicable requirements. The sites addressed by the 300 Area ROD and ERDF are reasonably close to one another, and the wastes meeting the ERDF waste acceptance criteria (WCH-191) are compatible for the selected disposal approach. Therefore, the waste sites and ERDF are considered to be a single site for response purposes.

If any requirement that might be an ARAR for the remedial action is promulgated subsequent to issuance of the 300 Area ROD, the DOE and EPA will review the requirement and determine if compliance with the new requirement is necessary to ensure that the remedy is protective of human health and the environment, in accordance with 40 CFR 300.430(f). If necessary to ensure protection of human health and the environment, the selected remedy will be revised to incorporate the newly promulgated ARAR.

2.4.1 Chemical-Specific ARARs

Chemical-specific ARARs are typically health- or risk-based regulatory values or methodologies that are applied to site-specific media and used to establish cleanup criteria. Chemical-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards":** Establishes methodology for calculating soil cleanup levels based on unrestricted land use (WAC 173-340-740(3)); adjustments to calculated cleanup levels to take into account cumulative effects of multiple contaminants and exposure pathways, adjustments based on state and federal law, and adjustments in consideration of natural background levels and practical quantitation limits (WAC 173-340-740(5)); points of compliance where cleanup levels must be attained (WAC 173-340-740(6)); and monitoring protocols for sampling, analysis, and statistical methods used to determine compliance (WAC 173-340-740(7)). Soil cleanup levels for residential land use have been selected in the ROD. Sampling and analysis requirements and locations will be addressed in accordance with a sampling and analysis plan (SAP) for each waste site undergoing remediation; considerations for cumulative effects of multiple contaminants will be documented in closeout documentation as described in Appendix B.
- **WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties":** Establishes methodology for calculating soil cleanup levels where industrial land use represents the reasonable maximum exposure (WAC 173-340-745(5)), and adjustments to cleanup levels to take into account cumulative effects of multiple contaminants and exposure pathways, adjustments based on state and federal laws, and adjustments in consideration of natural background levels and practical quantitation limits (WAC 173-340-745(6)). Soil cleanup levels for industrial land use have been selected in the ROD. Sampling and analysis requirements and locations will be addressed in accordance with a SAP for each waste site undergoing remediation; considerations for cumulative effects of multiple contaminants will be documented in closeout documentation as described in Appendix B.
- **WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection":** Establishes methodology for determining soil concentrations that will not cause contamination of groundwater at levels that exceed groundwater cleanup levels. Soil cleanup levels to ensure protection of groundwater have been selected in the ROD, using alternative fate and transport modeling as allowed in WAC 173-340-747(8).

- **WAC 173-340-7490, WAC 173-340-7493, WAC 173-340-7494, "Terrestrial Ecological Evaluation Procedures":** Define goals and procedures for evaluating whether a release to soil may pose a threat to the terrestrial environment and establishes methods for determining site-specific cleanup levels for protection of terrestrial plants and animals. Site-specific cleanup levels were developed using the "Site-Specific Ecological Evaluation" procedures (WAC 173-340-7493). Based on the ecological risk assessment, once human health cleanup levels are achieved, residual contamination will be below levels that have the potential to adversely impact populations and communities of ecological receptors.
- **WAC 246-247-035(1)(a)(ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopting by reference 40 CFR 61.92):** Requires that airborne emissions from all combined operations at the Hanford Site not exceed 10 mrem/yr effective dose equivalent to any member of the public. For source waste site remedial actions, standard construction techniques such as use of water spray to control fugitive emissions of radioactively contaminated dust and particles will be used to meet this ARAR.

2.4.2 Action-Specific ARARs

Action-specific ARARs typically are technology- or activity-based requirements or limitations triggered by a particular type of action such as excavation, transport, and/or disposal of hazardous waste. Action-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells":** These regulations are applicable for the location, design, construction, and decommissioning of resource protection wells, which include wells and soil borings that may be created or impacted by remedial actions. The remedial action will comply with substantive requirements of this ARAR by compliance with established site well construction and maintenance procedures. Specific sections of WAC 173-160 that may be applicable to remedial actions involving wells or soil borings are as follows:
  - WAC 173-160-161, "How Shall Each Water Well Be Planned and Constructed?"
  - WAC 173-160-171, "What Are the Requirements for the Location of the Well Site and Access to the Well?"
  - WAC 173-160-181, "What Are the Requirements for Preserving the Natural Barriers to Groundwater Movement Between Aquifers?"
  - WAC 173-160-400, "What Are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?"
  - WAC 173-160-420, "What are the General Construction Requirements for Resource Protection Wells?"
  - WAC 173-160-430, "What Are the Minimum Casing Standards?"
  - WAC 173-160-440, "What Are the Equipment Cleaning Standards?"
  - WAC 173-160-450, "What Are the Well Sealing Requirements?"
  - WAC 173-160-460, "What Is the Decommissioning Process for Resource Protection Wells?"

- **WAC 173-400, "General Regulations for Air Pollution Sources":** Authority to implement the national air quality standards has been delegated to the State of Washington and is implemented via WAC 173-400. These regulations define methods of control to be used to minimize the release of air contaminants associated with fugitive emissions resulting from materials handling, construction, demolition, or other operations. Emissions are to be minimized through application of best available control technology. Specific sections of WAC 173-400 that may be applicable to source waste site remedial action are as follows:
  - **WAC 173-400-040, "General Standards for Maximum Emissions":** Subsections (2) "Visible emissions," (4) "Fugitive emissions," and (9) "Fugitive dust" include substantive requirements applicable to source waste site remedial action. Compliance with these requirements will be achieved by the use of fixatives and water sprays to control emissions of contaminated dust and particulates.
  - **WAC 173-400-075, "Emission Standards for Sources Emitting Hazardous Air Pollutants":** This section identifies emission standards for hazardous air pollutants from various sources and adopts, by reference, "National Emission Standards for Hazardous Air Pollutants," 40 CFR 61. These sources are, for the most part, industry specific and not expected to be encountered or implemented as part of 300 Area source waste site remediation, with the exception of standards for asbestos emissions (discussed under the ARAR entry for 40 CFR 61 Subpart M) and radionuclide emissions (discussed under the ARAR entry for WAC 246-247).
- **WAC 173-460, "Controls for New Sources of Toxic Air Pollutants":** These requirements are considered applicable if a treatment technology that involves air emissions is necessary during implementation of the source waste site remedial action. No treatment requirements have been identified at this time that would be required to meet the substantive requirements of WAC 173-460. Treatment of some waste encountered during the remedial action may be required to meet the ERDF waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques, and the provisions of WAC 173-460 would not be an ARAR. If the need for any treatment technology with air emissions potentially subject to WAC 173-460 is identified, DOE will notify the EPA and an evaluation of WAC 173-460 requirements will be conducted.
- **WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"; WAC 246-247, "Radiation Protection – Air Emissions":** These standards specify that airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/yr effective dose equivalent to any member of the public or hypothetically maximally exposed individual. (WAC 173-480-040/WAC 246-247-035) The radionuclide emission standard applies to fugitive, diffuse, and point-source air emissions generated during excavation or treatment of source waste site contaminated soil. Compliance with the standard is determined on a Hanford Site-wide basis and is documented in the annual radionuclide air emissions report for the Hanford Site. WAC 246-247-075 and WAC 173-480-070 require monitoring for emissions of radioactive material. WAC 173-480-060 and WAC 246-247-040(3) requires the application of best available radionuclide control technology to control radioactive air emissions for new emission units; WAC 246-247-040(4) requires use of as low as reasonably achievable--based control technology for existing emission units. WAC 173-480-050 requires that all emission units make every reasonable effort to maintain radioactive materials in effluents to residential areas to levels that are as low as reasonably achievable. Standard construction techniques such as using water spray to control fugitive emissions of contaminated dust and particulates will be used to meet emission standards of WAC 173-480 and WAC 246-247 when excavating source waste sites.

- **40 CFR 61 Subpart M, "National Emission Standard for Asbestos":** 40 CFR 61.140 and 40 CFR 61.145 define regulated asbestos-containing material (ACM) and regulated removal and handling requirements, and specify sampling, inspection, handling, and disposal requirements for regulated sources having the potential to emit asbestos. No visible emissions are allowing during handling, packaging, and transport of ACM. 40 CFR 61.150 identifies requirements for the removal and disposal of asbestos from demolition and renovation activities, and also specifies no visible emissions. Buried ACM may be encountered during excavation of source waste sites and on pipelines or other structures excavated as part of remedial action. Asbestos-containing material associated with remedial actions will be handled consistent with the applicable or relevant requirements of 40 CFR 61.140, 40 CFR 61.145, and 40 CFR 61.150.

- **40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions":** 40 CFR 761.50(b)1, 2, 3, 4, and 7 and (c) establish general requirements for the storage and disposal of polychlorinated biphenyl (PCB) wastes including liquid PCB wastes, PCB items, PCB remediation waste, PCB bulk product wastes, and PCB/radioactive wastes at concentrations exceeding 50 ppm PCBs. Specific handling and disposal requirements are established for PCB liquids, articles, and PCB containers in 40 CFR 761.60(a), (b), and (c), respectively. PCB remediation waste requirements are established in 40 CFR 761.61. Substantive requirements of these provisions would generally be applicable to PCB wastes encountered during remedial action for source waste sites. Remedial action will comply with these requirements through adherence to waste management procedures (see Chapter 5) and receiving facility waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*.)

- **WAC 173-303, "Dangerous Waste Regulations":** WAC 173-303 establishes a variety of substantive requirements applicable to generation, storage, treatment, and disposal of materials designated as dangerous waste. Dangerous waste will comply with the identified requirements through adherence to waste management procedures (see Chapter 5) and, for disposal, the receiving facility's waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*) . Specific provisions of WAC 173-303 identified in the ROD as ARARs are as follows:

  - **WAC 173-303-016, "Identifying Solid Waste," and WAC 173-303–017, "Recycling Processes Involving Solid Waste":** These sections establish criteria for identifying materials that are and are not solid wastes, including materials that are or are not solid wastes when recycled in certain ways.

  - **WAC 173-303-070, "Designation of Dangerous Waste":** Establishes the method for determining if a solid waste is regulated as a dangerous waste.

  - **WAC 173-303-073, "Conditional Exclusion of Special Wastes":** Excludes certain relatively low-hazard wastes from many of the requirements of WAC 173-303 and establishes alternative management provisions for such wastes.

  - **WAC 173-303-077, "Requirements for Universal Waste":** This section exempts universal waste (i.e., certain batteries, mercury-containing equipment, and lamps) from most of the requirements of WAC 173-303 in lieu of alternative, less stringent management requirements.

- **WAC 173-303-120, "Recycled, Reclaimed, and Recovered Wastes":** Describes requirements for persons who recycle materials that are solid and dangerous wastes. Certain recyclable materials, including scrap metal, spent refrigerants, spent antifreeze, and lead acid batteries, are subject to less stringent standards under WAC 173-303-120 when being recycled.

- **WAC 173-303-140, "Land Disposal Restrictions":** Establishes treatment requirements and prohibitions for land disposal of dangerous waste. Provisions incorporate treatment standards for federal RCRA hazardous or mixed (hazardous and radioactive) wastes, in addition to establishing requirements for land disposal of certain state-only (nonfederally regulated) dangerous waste.

- **WAC 173-303-170, "Requirements for Generators of Dangerous Waste":** Establishes requirements for generators of solid waste, including requirement to determine if the waste is regulated as a dangerous waste; requirements for generators who accumulate dangerous waste on site in tanks, containers, or containment buildings for a period of 90 days or less; and requirements for generators who treat waste in on-site containers, tanks, or containment buildings within 90 days of waste generation.

- **WAC 173-303-200, "Accumulating Dangerous Waste On-Site":** Establishes requirements for accumulating dangerous waste on site in containers, tank systems, or containment buildings. Invokes various substantive standards for management of dangerous waste in containers and tanks. Container waste storage exceeding 90 days would be subject to the substantive requirements of WAC 173-303-630.

- **WAC 173-303-630, "Use and Management of Containers":** Establishes requirements for storing dangerous waste in containers. Invokes various substantive standards, including provision of secondary containment for containers holding liquids or ignitable or reactive wastes.

- **WAC 173-303-64620(4), "Requirements" (corrective action):** Requires corrective action for releases of dangerous waste and dangerous constituents, and establishes minimum standards for implementing actions. Corrective action performed under CERCLA authority must be consistent with these standards. The process, selected action, and implementation of the remedial action for the 300 Area remedial action satisfies this requirement.

- **WAC 173-350, "Solid Waste Handling Standards":** These regulations establish minimum standards for the proper handling and disposal of nondangerous, nonradioactive solid waste. Performance standards of WAC 173-350-040 require that solid waste facilities be designed, constructed, operated, and closed in a manner that does not pose a threat to human health or the environment, and that comply with other applicable environmental laws. WAC 173-350-300 establishes requirements for on-site storage of solid waste in containers, and for collection and transportation in a manner that avoids littering or releases. Remedial action will comply with these requirements through adherence to the waste management procedures in Chapter 5.

2.4.3 Location-Specific ARARs

Location-specific ARARs are restrictions or requirements placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the ROD are discussed below.

- **36 CFR 800, "Protection of Historic Properties," 36 CFR 60, "National Register of Historic Places":** These provisions require that federal agencies consider the impacts of their actions on properties that are on or are eligible for the National Register of Historic Places. The remedial action will comply with these requirements through an assessment and mitigation of impacts to properties listed on or eligible for inclusion on the National Register of Historic Places.

- **43 CFR 10, "Native American Graves Protection and Repatriation Regulations":** These provisions are applicable to any sites should Native American remains be found, and provide requirements for federal agency responsibilities with regard to any such discoveries. The remedial action will comply with these requirements through an assessment and mitigation of any Native American remains within the 300 Area prior to remedial action or discovered during remedial action, as prescribed in this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- ***Archeological and Historic Preservation Act of 1974*; 36 CFR 65, "National Landmarks Program":** These requirements are applicable to the recovery and preservation of artifacts in areas where an action may cause irreparable harm, loss, or destruction of significant artifacts. The remedial action will comply with these requirements through an assessment and mitigation of archeological and historic sites within the 300 Area prior to undertaking remedial action, as prescribed within this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- **50 CFR 402, "Interagency Cooperation – Endangered Species Act of 1973":** These requirements pertain to the conservation of critical habitat upon which endangered or threatened species depend. Consultation with the U.S. Department of Interior is required or, in the case of anadromous fish species, consultation with the National Marine Fisheries Service. The remedial action will comply with these requirements through an assessment and mitigation of endangered species or their habitat within the 300 Area prior to remedial action, as prescribed in this RDR/RAWP. (See Section 3.5, "Mitigation Action Plan.")

- ***Migratory Bird Treaty Act of 1918*:** These requirements are applicable to the protection of migratory bird species associated with the 300 Area, including upland species and waterfowl. The remedial action will comply with these requirements by following guidance prescribed in DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, and through performance of site-specific ecological resource reviews prior to remedial action. (See Section 3.5, "Mitigation Action Plan.")

- **WAC 232-12-292, "Habitat Buffer Zone for Bald Eagles":** This regulation requires protection of eagle habitat to maintain eagle populations. Bald eagles have not been historically present in the 300 Area, but should they be encountered, any disruptive work performed near or within an area of potential roosting or nesting must be performed to the specifications described in DOE/RL-94-150, *Bald Eagle Management Plan for the Hanford Site, South Central Washington*.

- **50 CFR 83, "Rules Implementing the Fish and Wildlife Conservation Act of 1980":** This regulation requires preservation and conservation of nongame fish and wildlife and their habitats. The remedial action will comply with these requirements by following guidance prescribed in DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, and through performance of site-specific ecological resource reviews prior to remedial action. (See Section 3.5, "Mitigation Action Plan.")

2.4.4 Other Criteria, Advisories, or Guidance to be Considered for this Remedial Action

In addition to ARARs, "to-be-considered" (TBC) provisions consisting of nonpromulgated criteria, advisories, and guidance may be identified in the selected remedy to help guide cleanup in situations where promulgated ARARs are unavailable for particular contaminants or situations. TBCs are evaluated along with ARARs, and identified in the ROD. TBC guidance identified in the 300 Area ROD consists of the following two items:

- **OSWER Directive 9285.7-55, *Guidance for Developing Ecological Soil Screening Levels*:** To-be-considered guidance that provides a set of risk-based soil screening levels for several soil contaminants for protection of terrestrial plants and animals. Based on the ecological risk assessment, once human health cleanup levels are achieved, residual contamination will be below levels that have the potential to adversely impact populations and communities of ecological receptors.
- **DOE/EIS-0222F , *Final Hanford Comprehensive Land Use Plan Environmental Impact Statement*:** The DOE-selected land use for the 300 Area involves industrial land use for associated waste sites. The selected remedial action considers this guidance through the establishment of RAOs and cleanup standards for industrial land use within the 300 Area industrial complex and the 618-11 Burial Ground.

3 Remedial Action Design and Planning

This chapter describes the framework for remedial action designs and other associated planning documents. Due to interim actions in the 300 Area, many of the components described in this chapter have already been completed and implemented in ongoing waste site remediation.

3.1 Remedial Action Planning

The remedial action schedules for cleanup of the Hanford Site are driven by a set of milestones that have been established as part of the Tri-Party Agreement (Ecology et al. 1989), and which may be renegotiated as remediation proceeds. Schedule milestones associated with cleanup of the 300-FF-2 OU under the 300 Area ROD are summarized in Table 3-1. These milestones are shown in Figure 3-1 along with selected other 300 Area milestones to show integration points. Milestones presented in Draft A are based on a draft milestone change notice.

Cost estimates for remediation of remaining 300-FF-2 OU waste sites were prepared as part of the 300 Area RI/FS (DOE/RL-2010-99) and subsequently carried forward into the 300 Area ROD (EPA 2013). The estimates were prepared with an accuracy of -30% to +50% to support evaluation of remedial alternatives and selection of a remedy. Cost estimates are updated based on design work. In accordance with CERCLA requirements, an explanation of significant differences will be pursued by the Tri-Parties if remediation costs change significantly from those identified in the ROD.

3.1.1 Detailed Remediation Planning

Project schedules are developed in accordance with the procedures of the performing contractor at several different levels consistent with the project work breakdown structure. The work breakdown structure-based schedules promote complete and consistent compliance with DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets,* and cost and schedule control systems criteria. Large-scale (multi-year) projects encompassing multiple smaller projects (e.g., each waste site remediation can be considered a single project, while the entire project is to remediate all waste sites) are generally planned and scheduled using a phased approach. Near-term (less than 1 year) work is usually planned and scheduled at a detail activity level using logic ties to establish and maintain a true critical-path schedule. Logic-driven, critical-path schedules, commonly referred to as the critical-path method, are used to manage and control the daily progress of the work and provide early warning of problem areas. Forecast planning and scheduling (1 to 2 years) can be performed at the task-package level, and long-range planning and scheduling (greater than 2 years) is performed at the work package or cost account levels. Planning elements at the work package level include, but are not limited to or bound by, remedial design, procurement, remedial actions, and site closures.

Some of the tiered planning documentation (e.g., remedial designs) may require approval by the lead regulatory agency, if requested. When reviews are required, DOE shall provide the documentation to the lead regulatory agency for review and approval. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules, including those for procurement. Specific processes for remedial design reviews and approvals are provided in Section 3.2.

Table 3-1. Summary of Tri-Party Agreement Milestones for 300-FF-2 Waste Site Remediation

Milestone	Description	Due Date/ Complete Date
M-16-XX-1	Complete remedial actions for the following waste sites: 300-2, 300-4, 300-6, 300-7, 300-9, 300-11, 300-16, 300-22, 300-24, 300-28, 300-32, 300-34, 300-40, 300-43, 300-46, 300-48, 300-80, 300-123, 300-218, 300-219, 300-224, 300-249, 300-251, 300-255, 300-257, 300-258, 300-268, 300-270, 300-273, 300-274, 300-276, 300-279, 300-281, 300-283, 300-284, 300-286, 300-293, UPR-300-1, UPR-300-2, UPR-300-4, UPR-300-5, UPR-300-11, UPR-300-38, UPR-300-39, UPR-300-40, UPR-300-42, UPR-300-45, 313 ESSP, 333 WSTF, 3712 USSA, 340 Complex, and 600-290. Complete remedial actions through backfill, but excluding revegetation for the 316-3 waste site. Enhanced monitored natural attenuation and final site reclassification are outside the scope of this milestone. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2016
M-16-XX-2	Complete remedial actions for the following waste sites: 300-263, 316-4, 600-367, and 618-10. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2020
M-16-XX-3	Complete remedial actions through revegetation for accessible portions (not impacted by interim and long-term retained facilities and their associated utilities) for the following waste sites: 300 RLWS, 300 RRLWS, 300-15, 300-214. Complete required interim stabilization for the following waste sites: 300 RLWS, 300 RRLWS, 300-5, 300-15, 300-121, 300-175, 300-214, 300-269, 331 LSLT1, 331 LSLT2, 400-37, 400-38, UPR-300-10, UPR-300-12, and UPR-300-48. Complete remedial actions for the following waste sites: 300-280, 300-287, 300-288, 300-289, 300-290, 300-291, and 300-294. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2017

Table 3-1. Summary of Tri-Party Agreement Milestones for 300-FF-2 Waste Site Remediation

Milestone	Description	Due Date/ Complete Date
M-16-XX-4	Complete remedial actions for waste sites 300-277, 300-296, and 600-63, which are associated with interim retained facilities. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	TBE
M-16-XX-5	Complete remedial actions for waste sites listed in M-16-XX-3 including: 300 RLWS, 300 RRLWS, 300-5, 300-15, 300-121, 300-175, 300-214, 300-269, 331 LSLT1, 331 LSLT2, 400-37, 400-38, UPR-300-10, UPR-300-12, and UPR-300-48. Complete remedial actions for the 300-265 waste site. Complete remedial actions for the 400-PPSS waste site. Complete revegetation of the 300 VTS waste site. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	TBE
M-16-XX-6	Complete remedial actions for the 618-11 Burial Ground, including remediation, backfill, revegetation, and closeout of the trenches, vertical pipe units, and caissons. Complete remedial actions for the UPR-600-22 waste site. Completion of remedial actions is defined as completion of ROD requirements of removal of contaminated soil, structures, and debris; treatment as necessary; disposal of contaminated materials; recontouring and backfilling of the excavated areas; revegetation; and obtaining regulatory approval of appropriate project closeout documents in accordance with this approved RDR/RAWP. Alternate remedies such as uranium sequestration are outside the scope of this milestone.	March 31, 2024

Notes:

RDR/RAWP = remedial design report/remedial action work plan

ROD = Record of Decision

TBE = to be established

UPR = unplanned release

VTS = vitrification test site

This page intentionally left blank.

MILESTONES	FISCAL YEAR 2014	FISCAL YEAR 2015	FISCAL YEAR 2016	FISCAL YEAR 2017	FISCAL YEAR 2018	FISCAL YEAR 2019	FISCAL YEAR 2020	FISCAL YEAR 2021	FISCAL YEAR 2022	FISCAL YEAR 2023	FISCAL YEAR 2024	FISCAL YEAR BEYOND 2024
M-089-06-T1	▲	30% Design of Mixed Waste Units in 324, including schedule to complete design (9/30/14)										
M-094-10		▲	Complete 300 Area facilities included in the RAWP excluding 324 (9/30/15)									
M-016-XX-1			▲	Complete remedial actions for 53 waste sites (3/31/16)								
M-089-06			▲	Request for Class 2 permit Mod for 324, including schedule of closure activities (6/30/16)								
M-089-00			▲	Complete closure of mixed waste units in 324 (TBE with M-89-06)								
M-016-XX-3				▲	Complete remedial actions for accessible portions of 4 waste sites, interim stabilization for 15 waste sites, and remedial actions for 7 waste sites (3/30/17)							
M-94-00					▲	Complete 300 Area facilities including 324 (9/30/18)						
M-016-XX-2							▲	Complete remedial actions for 300-263, 316-4, 600-367, 618-10 (3/30/20)				
M-016-XX-6											▲	Complete remedial actions for 618-11 and UPR-600-22 (3/31/24)
M-016-XX-4											▲	Complete remedial actions for 300-277, 300-296, and 600-63, associated with interim retained facilities (TBE)
M-016-XX-5											▲	Complete remedial actions for 17 waste sites including those in M-16-XX-3 (TBE)

Figure 3-1. Tri-Party Agreement Milestones for 300 Area CERCLA Cleanup

This page intentionally left blank.

3.1.1.1 Remedial Action Design

Remedial designs are prepared by the remediation contractor and include all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to perform the remediation. Project plans, procedures, and work packages will define the data-gathering requirements to ensure worker health and safety and to eventually prove the waste sites meet remediation goals and standards. Project procedures will define the "how to" of obtaining data and controlling the site activities. Planning documentation is discussed further in Section 3.3. Scope of work, design drawings, and specifications will also provide the necessary technical tools to procure subcontractors, as needed.

3.1.1.2 Remedial Actions

Remedial action includes implementing the remedial design and project plans. The implementation will include, but will not be limited to, subcontractor oversight, excavation, material handling, waste treatment, analytical system operations, worker health and safety, radiological controls, data gathering, and overall daily conduct of operations. Subcontractor oversight occurs through administration of subcontract documents. Project specifications and procedures define the "how to" of excavation, material handling, analytical system operation, data gathering, and overall daily conduct of operations. Appropriate worker health and safety and radiological control requirements are included in site health and safety plans, permits, and job hazard analyses included in work packages.

3.1.1.3 Site Verification and Closeout

Site verification and closeout includes, but is not limited to, data collection (including samples and photographs), data evaluation, data interpretation, preparation of documentation, and EPA approval that the RAOs have been met via waste site reclassification or other documentation.

3.2 Remedial Action Design

Remedial action design includes all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to perform the remedial action. Project plans will define the data-gathering requirements to ensure worker health and safety and to eventually prove that the waste sites meet remediation goals and standards. Project procedures and work packages define the "how to" of obtaining data and controlling the site activities. DOE shall provide the remedial action designs to the lead regulatory agency for review and approval, if requested. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules for issuing requests for proposals. Remedial action designs that were prepared and initiated or approved under the interim action ROD, and where the remedy has not significantly changed the designed work, will not require new review and approval.

The following process will be followed to implement the remedial action design review and approval process and may be modified at the 300 Area unit manager's meeting or via other documentation (e.g., Tri-Party Agreement change notice):

- When requested, DOE shall provide the draft remedial design package and design schedule to the lead regulatory agency at the unit manager's meetings, or deliver to the local field office.
- The lead regulatory agency shall provide notice to DOE in a timely manner, if approval is warranted, usually within 3 to 5 days.
- The lead regulatory agency review period is generally 2 weeks. If additional review time is necessary, the review period can be increased up to 4 weeks. If more than 4 weeks is required due to

the complexity of the project, DOE and the lead regulatory agency shall agree to the review period, as necessary. To minimize impacts to the schedule, additional review time should be communicated early in the process.

- Review comments and issues shall be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, shall be documented in the unit manager's meetings, letters, or other forums, as agreed.
- DOE shall provide a copy of the final remedial design package, with comments incorporated, to the lead regulatory agency at the unit manager's meetings, deliver to the local field office, or otherwise transmit.
- A documented approval should be communicated to DOE by the lead regulatory agency within a reasonable time frame. The approval should reference the specific design and indicate that approval by the lead regulatory agency is warranted.

3.3 Other Remedial Action Planning Documents

Additional planning documentation for remedial action includes work packages and procedures, the SAP, health and safety plan(s), the mitigation action plan (MAP), air monitoring plans, technical performance specifications, and safety analysis/hazard classifications. Many of these planning documents have previously been prepared and issued under the interim action RDR/RAWP. As described in the following subsections, the existing documents may continue to be used under this RDR/RAWP, with the understanding that references to the interim action RDR/RAWP are superseded by this approved addendum and the associated Integrated RDR/RAWP (DOE/RL-2014-13).

3.3.1 Work Packages and Procedures

Work packages and procedures are used to provide guidance to site workers during field work execution. They define the scope, operations, progression of field work, personnel control requirements, radiological posting requirements, and analytical system guidance. Work packages and procedures are developed by multi-disciplinary involvement following a graded approach. The personnel responsible for compliance with this RDR/RAWP are included in the development process for work packages to ensure that applicable requirements are incorporated or addressed. The site superintendent must then execute field operations in compliance with these work packages.

3.3.2 Sampling and Analysis Plan

DOE/RL-2001-48, *300 Area Remedial Action Sampling and Analysis Plan*, will be revised to reflect appropriate changes under the new 300 Area ROD (EPA 2013). Until approval of that revision, the current SAP revision will continue to be used. This SAP provides direction for sampling efforts to support excavation guidance, waste characterization, worker health and safety, and site closure for 300-FF-2 remediation. The SAP includes quality assurance project plans that define the strategy to control the quality and reliability of the analytical data and establish associated protocols for data management. The field analytical team must perform all sampling and analysis efforts in compliance with the applicable SAP and any site-specific sampling instructions or agreements developed in accordance with that SAP. New or revised SAPs are provided by DOE to the EPA for review and approval.

3.4 Health and Safety Plan

Health and safety plans for waste site remediation within the 300 Area have been developed to provide direction for general site health and safety measures associated with the remedial action scope. All remedial action contractor project personnel will be trained on the applicable health and safety plan. Job hazard analyses are developed for task-specific controls and are included in work packages.

3.5 Mitigation Action Plan

A MAP was prepared for the 300 Area in 2002 (DOE/RL-2002-19). The document was developed to fulfill the requirement for a "natural resource mitigation plan," as specified in the 300-FF-1 ROD (EPA 1996). Consistent with the selected remedy in the ROD, the MAP was developed with input from affected stakeholders. The MAP states the methods for mitigation and restoration, as well as the species inhabiting the 300 Area.

The MAP presents a framework for limiting disturbances to natural and cultural resources during remedial action projects and identifies opportunities for site restoration and revegetation, as appropriate. The MAP is intended to be used as a guidance document where mitigation and restoration are required.

Key objectives of the 300 Area MAP (DOE/RL-2002-19) are to avoid, minimize, rectify, reduce/eliminate, or compensate for impacts to natural resources incurred as the result of remedial action and construction. Prior to remedial action or the construction of support areas, cultural and ecological resource reviews are conducted to determine if the proposed activities in these areas will impact natural or cultural resources. The first line of action is to avoid or minimize impacts by siting activities in areas with the least potential for impact. When impacts to natural or cultural resources are unavoidable, the project is given recommendations to minimize impacts. Additional mitigation may be required if criterion for a threshold area of disturbance or habitat quality is met. Habitat quality thresholds are described in the biological resource management plan (DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*).

Not all biological resources are considered mitigable resources at the Hanford Site. For projects that do not exceed the thresholds for rectification or compensation as defined by DOE/RL-96-32, mitigation actions are discussed in the project planning documents or site-specific ecological resource reviews. Avoidance and minimization mitigation for low-quality invasive plant species on highly disturbed sites or nonvegetated areas is employed only as necessary to reduce impacts to site-specific resources such as nesting birds. The duration of activities and foreseeable land use are also accounted for in mitigation planning.

Where site revegetation is appropriate for compensatory mitigation purposes (i.e., active revegetation as compensation for the destruction of high-quality habitat for the construction of layback and staging areas) or for site stabilization, the 300 Area MAP outlines methods of site preparation to facilitate successful revegetation by native species (DOE/RL-2002-19). Waste sites will be revegetated with native species that will survive without irrigation. The purpose of this sustainable revegetation is to provide dust control and reduce infiltration from precipitation. Subsequent land development design, although outside the scope of this RDR/RAWP, will include engineered runoff controls for parking lots and roof runoff to prevent residual contaminants from migrating to groundwater. Graveled areas will generally not be appropriate for areas that are over residual subsurface contamination but may be used on a case-by-case basis with EPA approval.

3.6 Air Monitoring Plan

The substantive requirements applicable to radioactive air emissions resulting from remediation activities are to quantify potential emissions, monitor the emissions, and identify and employ best available radionuclide control technology. Exemption from these requirements may be requested if the potential-to-emit for the activity or emission unit would result in a total effective dose equivalent of less than 0.1 mrem/yr. Implementation of these elements fulfills the ARARs identified in Section 2.4. The use of best available radionuclide control technology includes, but is not limited to, dust suppression (e.g., water, water sprays, fixatives) and the use of other standard engineering controls (e.g., high-efficiency particulate air filter vacuum cleaners). The project-specific air monitoring plan for remediation of waste sites at the 300 Area industrial core and immediate surrounding area is provided in Appendix E. Air monitoring plans for other waste site remediation project areas are approved by the lead agencies and maintained separately from this RDR/RAWP. Additional air monitoring plans may be developed and approved as changes to this document, or as stand-alone documents.

3.7 Technical Performance Specifications

Technical performance specifications are prepared as needed to support remedial actions. Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. Technical performance specifications may include the following areas:

- Earthwork and excavated material handling
- Survey and decontamination station
- Waste profiles
- Basic electrical materials and methods
- Lighting.

Each technical specification establishes quality and workmanship requirements and defines how quality is measured.

3.8 Safety Analysis/Emergency Preparedness

Hazards associated with the proposed remedial actions addressed in this document are examined based on anticipated inventories of radioactive and/or hazardous materials and appropriate controls identified, and the hazard categorization is documented as warranted. Hazard categorization documentation, as well as analysis of radioisotopes and hazardous material for emergency response planning for the 300-FF-2 OU waste sites, will be prepared before initiating excavation operations.

4 Remedial Action Management and Approach

The Integrated RDR/RAWP (DOE/RL-2014-13) identifies the overall remedial action management and approach for implementation of all aspects of the 300 Area ROD (EPA 2013). This chapter describes the components of the project team, change management approach, remedial action operations, and waste site closure processes specific to RTD and interim stabilization by void-fill grouting and surface capping at 300-FF-2 waste sites.

4.1 Project Team

The project team for 300-FF-2 soil remediation consists of the lead and regulatory agencies identified in the Integrated RDR/RAWP (DOE/RL-2014-13), as well as DOE-RL's selected contractor(s). The contractor project managers are responsible for leading project teams in remedial action implementation. The project teams contain the personnel necessary to perform the remedial actions in a safe, efficient, and compliant manner.

4.2 Remedial Action Change Management

Change management will be performed as described in the Integrated RDR/RAWP (DOE/RL-2014-13). The contractor project manager is responsible for tracking all changes and obtaining appropriate reviews by staff for changes affecting 300-FF-2 waste site remediation. The project manager will discuss the proposed change with DOE-RL, and DOE-RL will then discuss the type of change that is necessary with the EPA. As the lead regulatory agency, the EPA is responsible to determine the significance of the change.

4.3 Remedial Action Operations

The components of the selected remedy addressed by this addendum are identified in Section 1.2.1. This section describes general mobilization and RTD operations for waste sites. For waste sites or portions of waste sites that cannot be remediated due to interference from retained facilities and associated utilities, the 300 Area ROD (EPA 2013) specifies consideration of interim stabilization measures, which are described below. Lastly, this section identifies institutional controls associated with remedial action operations.

4.3.1 Mobilization and Site Preparation

Mobilization and site preparation include the following activities that are necessary to prepare the site for excavation:

- Establishing site utility services as required.
- Constructing roads, field support facilities, container survey stations, and decontamination stations. Hanford Site roadways are constructed of existing site materials, except the surface course, which is imported. Field support facilities provide a changing area, lunchroom, and construction offices at individual sites. The changing area includes lockers, benches, and storage for both clean and contaminated personal protective equipment (PPE).

- Stripping the existing vegetation and debris. Stripping removes surface and near-surface materials (including vegetation and roots, cobbles, and boulders) that may be stockpiled (where practicable) and used later as a top dressing and planting medium for revegetation. For sites where topsoils contain hazardous debris material or do not meet cleanup levels, the material is not stockpiled for reuse. In these cases, stripping may still be performed, with resulting material managed for disposal as waste, or surface material may be removed as part of general excavation activities without a discrete surface-stripping effort.

- Removing overburden material. Clean overburden may be segregated and stockpiled on site for later use as backfill material.

- Removing slabs and foundations of demolished buildings.

4.3.2 Remove, Treat, and Dispose

This subsection address activities specific to RTD remediation of waste sites. During all aspects of RTD, dust control will be maintained on the haul roads, at the excavation site, and in the staging areas. Use of water for dust control at the excavation site will be minimized. Soil fixatives (e.g., soil cement) will be applied to open excavation sites during periods of extended inactivity and/or when potential concerns arise about health issues or the spread of contamination.

Under the RTD process, contaminated soils and engineered structures containing contamination (e.g., pipelines, drums, caissons, and VPUs) with COCs exceeding cleanup levels will be remediated up to 4.6 m (15 ft) bgs to meet cleanup levels for direct exposure, groundwater, and surface water protection as identified in Chapter 2. Remediation will continue below 4.6 m (15 ft) bgs where site nonuranium COC concentrations exceed cleanup levels for groundwater and surface water protection. Where site COC exceedances of groundwater and surface water protection cleanup levels below 4.6 m (15 ft) bgs are limited to uranium in soil, RTD or phosphate sequestration may be performed for those soils, as approved by the EPA. Considerations and implementation for potential phosphate sequestration will be determined on a site-by-site basis.

Engineered structures at waste sites identified for RTD, including pipelines, may be left in place if it can be demonstrated that residual contamination is not present or is present at residual concentrations that achieve RAOs. The cleanup levels do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying cleanup levels to sediment/scales within pipelines or other structures. When asbestos in nonfriable form (e.g., asbestos in the pipe matrix, asbestos impregnated in tar paper-wrapped water pipes) is encountered in the shallow zone, as in pipelines, and no other CERCLA hazardous waste is associated with the pipelines other than asbestos in nonfriable form, remediation of such pipelines is not required (DOE-RL et al. 2005c).

4.3.2.1 Excavation

Excavation involves removing clean and contaminated soil, debris, and anomalous waste present within the site boundaries. For all burial grounds and dump sites, materials will be excavated with standard construction equipment using one or more of the following techniques to sort and disposition waste:

- **0.3-m (1-ft) Horizontal Lifts.** The exposed surface of each lift will be visually observed, radiologically screened, sorted as necessary to remove anomalous material and large debris, and then excavated using heavy equipment and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.

- **0.3-m (1-ft) Diagonal (Sloping) Lifts.** The exposed surface of each lift will be visually observed as it is raked down the face of an excavation slope using heavy equipment. Material will be radiologically surveyed at the bottom of the slope, sorted as necessary, and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.
- **Bulk Excavate and Spread.** Material will be bulk excavated using heavy equipment, and then spread onto the ground in approximately 0.3-m (1-ft) layers. The shallow layer of material will then be radiologically screened and sorted.
- **Direct-Load Lifts.** The surface of each lift will be visually observed, radiologically screened, sorted (if necessary), and then excavated and loaded into containers using heavy equipment. This technique is best suited for areas with little visible debris.

In excavation areas where there are large quantities of observed lead-containing materials (e.g., lead bricks, lead slag) intermixed with the soil, a variation of these excavation/sorting methods may be used. Observation, sorting, and radiological surveys for removal of the large materials and nonlead anomalous materials will be performed using one or more of the above-described methods. The remaining materials may then be identified as meeting the RCRA definition of "soil" per 40 CFR 268.2 and considered hazardous/dangerous due to lead contamination. In such cases, the soil will be sampled in accordance with the 300 Area SAP and transported to the ERDF or other approved facility for treatment (stabilization) and subsequent disposal. Treatment of debris may be conducted on site on a case-by-case basis in accordance with WCH-539, *Treatment Plan for Macroencapsulation of 300-FF-2 Debris*.

Additional excavation/waste retrieval methods in support of remediation of the 618-10 and 618-11 Burial Grounds may be used and are discussed in WCH-127, *600 Area Remediation Design Solution Technology Assessment and Deselection Report*. These methods include technologies such as overcasing, in situ vitrification, and manually or remote-operated excavation.

Sluicing (use of water) is not an acceptable excavation method. Selection of the excavation/sorting method will be made by remedial action project management, and the method may be changed to another approved method based on the type of material being excavated. Alternate excavation/sorting methods (e.g., vacuum systems, metal detectors) may be proposed by the project on a case-by-case basis and implemented with concurrence from the DOE and EPA project representatives. During the excavation process, care will be taken to prevent the breakage or puncture of unopened or sealed cans, jars, and containers.

Material from waste sites that are not burial grounds (e.g., acid neutralization pit) or the periphery of burial grounds (e.g., plumes) where anomalous material is not encountered does not require mechanical sorting. This material may be directly loaded into containers after enough information is gathered to characterize the waste. Material that has been excavated using one of the approved sorting techniques will be directed in one of the following ways.

- Material that is above cleanup levels and within the ERDF waste acceptance criteria (WCH-191) will be loaded into plastic-lined roll-off containers on project haul trucks at the excavation site. The loaded containers will be covered (i.e., by folding and securing the liner over the load) and surveyed prior to being transported to a container transfer area (CTA) using the project haul trucks. If contamination is found on a container exterior, the container will be decontaminated using standard equipment and techniques. In the unlikely event that a container cannot be decontaminated using standard methods, advanced techniques will be implemented as necessary. Released containers will be offloaded and staged in the CTA until applicable shipping papers are completed. When the shipping papers have been completed, ERDF transport vehicles will enter the CTA, pick up the full containers, and haul them to the ERDF.

- Anomalous waste (e.g., drums, intact containers, elemental lead, unknown materials) and/or above-cleanup-level material that is not within ERDF waste acceptance criteria (WCH-191) will be set aside within the area of contamination (AOC) or within designated staging piles for further characterization and final disposition. Waste that is subsequently identified for ERDF disposal or staging will be directed as described previously, with the exception that drummed waste may be transported in standard ERDF containers or by other means such as flatbed trailers or cargo vans. Concreted drums at the 618-10 and 618-11 Burial Grounds will be processed differently as described later in this section. Excavated material that must be sent to facilities other than ERDF for treatment and/or disposal will be stockpiled or drummed and staged within the AOC or within designated staging pile areas (SPAs) until loaded for offsite shipment. Identification of an appropriate treatment and/or disposal facility and arrangements for loading and transporting excavated material to facilities other than ERDF will be made on a case-by-case basis by the project in coordination with the River Corridor Closure (RCC) Project waste management representatives. Prior to shipment, an offsite acceptability determination in accordance with 40 CFR 300.440 must be obtained from the EPA for receipt, storage, treatment, and disposal of CERCLA waste at the identified treatment/disposal facility.

- Land disposal restricted (LDR) waste or containers of LDR waste that are not within the ERDF waste acceptance criteria may need repackaging or treatment to comply with the ERDF waste acceptance criteria (WCH-191). Land disposal restricted waste that has been placed into a container will not be placed back into the AOC (i.e., on the land). Land disposal restricted waste may be removed from a container and placed directly into another container, even within the designated AOC boundary, as long as no land placement occurs. Containerized LDR waste that needs to be placed on the ground for treatment or repackaging will be done within a SPA.

- Material that is free of anomalous waste and below cleanup levels may be stockpiled on site for use as backfill material. In certain situations, soil may be placed over material excavated within a waste site or discovered within a staging pile as a temporary measure. Such action may be undertaken to minimize an imminent threat to the worker (e.g., a high-dose item is uncovered, and a temporary soil cover is appropriate to control worker exposure). Temporary covering with soil may also be undertaken to prevent windborne dispersal of excavated material or highly contaminated soil and to maintain segregation from other waste site materials. These temporary measures may be undertaken while plans are developed for safe re-excavation and removal of waste site materials. In these instances lead regulator notification will be made.

- Non-LDR material that has been packaged may be returned to an excavation area or SPA in situations where the dose rates, contamination levels, free liquids, or other abnormalities have subsequently been determined to exceed normal transport requirements. In these situations, when repackaging is necessary, the previously excavated material will be reloaded into the transportation container. Notification to the lead regulatory agency is generally not required for these actions. The exception is LDR waste, which shall be managed in accordance with the third bullet above.

- An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b).

- If suspect spent nuclear fuel (SNF) is discovered, it must be managed as SNF and is not eligible for disposal in ERDF. Shielded bunkers will be used for interim storage of the SNF with minimum specifications of (1) a 1.8-m (6-ft)-tall security fence, and (2) a bunker constructed of concrete shielding blocks including a heavy metal lid or concrete shielding block cover. Spent nuclear fuel will be characterized for shipment to the Canister Storage Building facility until an offsite storage or disposal facility authorized to manage SNF becomes available (DOE-RL et al. 2005b).
- If TRU material is discovered, it must be identified as either contact-handled TRU waste or remote-handled TRU waste and managed in accordance with the waste acceptance criteria of the receiving facility (WCH-126, *600 Area Remediation Design Solution Waste Packaging, Transportation, and Disposal Requirements*).
- At the 618-10 and 618-11 Burial Grounds, some high-activity waste and possibly small amounts of plutonium-contaminated liquid waste were sealed in concreted 208-L (55-gal) drums. Some concreted drums also contained an additional 2.5 or 5 cm (1 or 2 in.) of lead shielding. One type of drum had a 20-cm (8-in.)-diameter galvanized metal culvert centered in the 208-L (55-gal) drum, surrounded by concrete on the bottom and sides. The culvert may also have lead wrapped around it, depending on shielding requirements. High-activity liquid or solid waste was placed in the culvert. The culvert was capped with a lead plate and concrete poured in to fill the void space. Another type of drum had the waste placed inside the container and then concrete poured around the containers to provide shielding and to prevent shifting of contents. Opening these concrete drums for examination and processing would present a very high risk due to the radiological contents. Excavation techniques allow for examination of the drum condition and the condition of the concrete cap. If the outer drum is intact and the concrete cap is seen to be intact, the concrete is reasonably expected to be intact. When the concrete in these drums is intact, it meets the macroencapsulation standard of 40 CFR 268.42 for radioactive lead solids. When the outer drum is not intact, but the concrete within the outer drum can be seen as intact on the sides and the top, the concrete can reasonably be expected to be intact. Intact concrete waste will be overpacked with an absorbent filling the annulus between the concreted drum and the overpack drum to preclude migration of potential liquids. In this form, the overpacked drum can be disposed in the ERDF. If the concrete in these drums is not intact, the drums will be overpacked and an absorbent will be added. Macroencapsulation will be performed either at the waste site and then disposed at ERDF, or the macroencapsulation treatment will be performed at ERDF prior to disposal. If macroencapsulation treatment is performed at the waste site, a treatment plan will be developed and approved by the lead regulatory agency.
- For the 618-10 and 618-11 Burial Ground trenches, treatment of liquid waste in bottles, up to 3.8 L (1 gal) per bottle, will occur in a tray or box within the excavation. Bottles will be placed in a spaced pattern into a containment structure within an excavated trench. Bottles will be covered with Portland cement-based grout and then crushed and mixed into the grout. Crushing may be performed individually or in a batch process. The treatment requirements are met by mixing the liquid into grout which immobilizes metals and radioactive metals expected in the waste and neutralizes acids. A grab sample from each treatment batch will be subjected to laboratory analysis to confirm that the treated waste falls below the LDR limits for COCs in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised). Liquid waste treated in this manner will be subsequently handled as bulk waste as described below or may be transported for disposal as a monolith within an acceptable container.

Excavated material will be surveyed and characterized for appropriate disposition prior to undertaking disposal of materials. When excavation of a waste site is complete, exposed dig faces will be evaluated to verify that remedial action goals have been met. When cleanup levels have been met and backfill concurrence is obtained from the lead regulatory agency, site backfill will be authorized. (Note: Unless specified otherwise, the term "backfill" as used in this document refers to filling in the excavation once post-waste site remediation sampling has demonstrated that cleanup levels have been met.) Clean backfill material is obtained from clean material storage areas, approved/clean rubble, and local borrow sites. Excavations are backfilled as described in Section 4.4.4.

4.3.2.2 Material Handling and Transportation

All contaminated materials (including excavated soils, debris, disposable protective clothing, air filters, and trash) require proper packaging, handling, and transportation in accordance with the waste management plan prescribed in Chapter 5. Contaminated bulk materials will be hauled in the standard ERDF open-top, hinged-gate roll-off boxes that are designed for a maximum capacity of either approximately 18.1 metric tons (20 tons) or 22.7 metric tons (25 tons). The bulk containers will be transported on roll-on/roll-off trailers with hydraulic dumping capabilities that are towed by conventional tractor units. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans.

Weighed containers will be transported from the remediation site to the ERDF over existing Hanford Site roadways. Each shipment of soil/debris transported to the ERDF will be referenced to a waste profile that is intended to provide an upper bound on the concentrations of contaminant materials found at the site. The waste profile is in effect until the characteristics of the excavation site have changed significantly. Empty containers returning from the ERDF will be removed from the ERDF tractor trailers in the CTA and rolled on to project haul trucks for refilling. The CTA helps to maintain a continuous flow of materials through the transportation system by allowing excavation to continue for a limited time if the trucks running to the ERDF are not operating, or it allows ERDF trucks to continue to run for a limited time if the excavators are not operating.

The containers are inspected for the presence of water prior to placing a liner or waste into the container. When water is found in a container with an estimated volume of 151 L (40 gal) or less (less than a depth of 1.27 cm [0.5 in.] in the bottom of the container), the water will typically be used as an aid for dust suppression in the adjacent radiological excavation, staging pile, or radiological debris piles in a manner that is consistent with regulator-approved work plans. When water is found in the container with an estimated volume greater than 151 L (40 gal), lead regulatory agency approval will be sought to use the water as an aid for dust suppression in the adjacent radiological excavation, staging pile, or radiological debris pile, or direction from the agency to process the water through other means.

Transportation and handling for offsite treatment and/or disposal of contaminated material will be coordinated on a case-by-case basis. All offsite shipments will be conducted using equipment and methods that are compliant with applicable U.S. Department of Transportation (DOT) regulations and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*.

4.3.2.3 Vertical Pipe Unit Remedial Action Operations

Remediation of the 618-10 and 618-11 Burial Grounds requires the removal, treatment, and disposal of approximately 144 VPUs located within the burial grounds that were used for disposal of 300 Area low- to high-activity waste, including TRU waste. Vertical pipe units that are determined to be low-level waste or mixed low-level waste will be treated, as necessary, and disposed at the ERDF. Suspect TRU waste will be packaged for shipment and storage at the Central Waste Complex, pending shipment to the Waste Isolation Pilot Plant for disposal. Additional nondestructive analysis and repackaging may be performed at the Central Waste Complex.

An in situ treatment process will be used during VPU remediation due to the presence of highly dispersible alpha radiological materials and potential reactive materials. Treatment processes may involve placing a structure around exposed VPUs and then stabilizing contents under a Portland cement grout. Other methods may include installation of an over-casing around VPUs and then augering contents followed by Portland cement stabilization. After stabilization, waste will be removed by conventional excavation methods, as a monolith, or by a remote retrieval system and packaged for disposal or storage, as appropriate.

4.3.2.4 300-296 Waste Site Remediation

Highly contaminated soils within the 300-296 waste site will be excavated using remote excavation methods. These soils will be retrieved through the 324 Building B Cell floor and placed in other hot cells within the facility. These cells provide additional shielding to workers. Removal of the 324 Building and the soil in the hot cells will then be performed under the applicable action memorandum (DOE-RL 2006a) and a facility-specific closure plan. Following removal of the 324 Facility, RTD will be performed for remaining, less highly contaminated 300-296 soils exceeding cleanup levels.

4.3.2.5 Soil and Debris Characterization

Soil and debris characterization will be based on the observational approach and performed in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised). This approach relies on available historical information and limited field investigations combined with a "characterize-and-remediate-in-one-step" methodology. The latter methodology consists of site excavation and monitoring at sites where remedial action and cleanup goals have been selected. Remediation will continue until a combination of field screening results, sampling results, and/or observed absence of waste debris indicates that cleanup goals have been achieved.

4.3.2.6 Decontamination

Decontamination to support excavation activities will generally be performed using dry methods (e.g., wiping and high-efficiency particulate air-filtered vacuum cleaners) to the extent possible. When the use of wet methods (e.g., pressure washers and steam cleaners) is required to achieve decontamination objectives and the associated water or cleaning solutions are not collected, work will be conducted by trained site workers in accordance with the following best management practices.

4.3.2.7 General Best Management Practice

This applies to all equipment cleaning/decontamination activities within a waste site.

- Decontamination activities are typically performed within active excavation areas of the AOC.
- The amount of water used to clean equipment will be minimized.
- Only raw or potable water will be used.
- Soaps, detergents, or other cleaning agents that would be regulated as a hazardous waste will not be added to wash water.
- Pressure washing will normally use cold water (hot water may be used to avoid icing).
- Steam cleaning will be used only after other methods prove to be ineffective.

- Decontamination practices will be documented in the daily log.
- Personnel responsible for equipment decontamination will be trained to this best management practice.

4.3.2.8 Ongoing Remediation Site Best Management Practice

This applies to equipment being washed and/or decontaminated within sites that have ongoing remediation, or at a decontamination area established outside of the waste sites.

- Equipment washing/decontamination will be located in areas with ongoing waste removal or in a centralized area that supports multiple remedial actions.
- Spent wash water and associated contamination will be kept within active areas of the AOC or within the decontamination area if located outside of the AOC.
- Pre- and post-washing/decontamination contaminant surveys are not required.
- The project may opt to collect wash water for reuse in the excavation or to be sent for treatment.

4.3.2.9 Completed Remediation Site Best Management Practice

This applies to equipment being washed and/or decontaminated within sites that have achieved preliminary remediation goals.

- At the "completion" of excavation activities at a site, the project may opt to transport the equipment to a nearby site that is being remediated (by excavation) to perform equipment washing/decontamination (as described above), or to utilize a defined decontamination area.
- A pre- and post-survey will be performed on the washing/decontamination area to assess and remediate (if required) areas affected by the activity. When the washing/decontamination is set up in an area of a site that has apparently attained the preliminary remediation goals, sampling of the area will be performed in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised), including site-specific work instructions, as applicable.
- The project may also opt to perform other methods of equipment washing and/or decontamination for a completed site (e.g., wrap the equipment for transfer to a decontamination pad, provide for a temporary facility at the site to collect wash water, fix the contamination to the equipment).

4.3.3 Pipeline Void Filling and Temporary Surface Barriers

Due to ongoing use of some buildings and supporting in-ground infrastructure (e.g., utility lines), some of the waste sites identified in Table 1-1 will not be available for RTD for an extended period. Temporary surface barriers and void-filling in pipelines will be used to reduce the mobility of contaminants until the RTD activity can be performed.

For waste sites in Table 4-1 that exceed applicable cleanup levels and that are adjacent to the long-term retained facilities, temporary surface barriers will be installed and maintained. Details associated with installation of surface barriers will be documented in project drawings and will be included in the administrative record. Surface barriers are intended to reduce infiltration and contaminant flux to groundwater. Design of the barriers will be established on a site-by-site basis as approved by the EPA.

Table 4-1. Waste Site Surface Barrier Locations and Construction

Waste Site	Surface Barrier Type	Location
300 RLWS	Asphalt	Primarily east to west under Spruce Street
300 RRLWS	Asphalt	Primarily east to west under Spruce Street
300-5	Asphalt	South side of the 300 Area Fire Station (3790A Building)
300-121	Concrete	Immediately southwest of the former 3621D Building
300-214	Asphalt	Primarily east west under Spruce Street
300-265[a]	Asphalt and concrete	East to west under Spruce Street
331-LSLT1	Geomembrane	East side of the 331 Building
331-LSLT2	Geomembrane	East side of the 331 Building
400-37	Asphalt	Southeast side of the 4732B Building
400-38	Asphalt	East side of the 4722A Building foundation

Notes:

a Partial remediation and interim stabilization of the 300-265 site will be delayed until after demolition of the 324 Facility.

Surface barriers will typically be constructed of asphalt, but similarly impermeable materials (e.g., concrete, water-resistant synthetic membranes) that decrease water infiltration into contaminated soils may also be used. Surface barriers also will be designed to direct surface runoff away from waste sites to the extent practical. Surface barriers are not required for waste sites with interim interferences (i.e., those associated with the 324 Building). Surface barriers are also not required for portions of waste sites abandoned-in-place in areas that have otherwise undergone remediation and revegetation. These portions typically consist of small process sewer segments that remain in place because of active utility interferences or remain in the ground within the operational boundary of an active facility. Surface barriers are also not required if the waste site lies beneath an active facility that already meets the intention of a surface barrier, as listed in Table 4-2. The surface barrier types and locations described in this section are approved by the EPA. Any exception to the installation and maintenance of surface barriers must be approved by the EPA.

Table 4-2. Waste Sites Considered as Interim Stabilized

Waste Site	Existing Barrier	Location
300-175	Grouted french drain	South-central 300 Area
300-269	331A Building foundation	Southeast 300 Area
UPR-300-10	325 Building	South-central 300 Area
UPR-300-12	325 Building	South-central 300 Area
UPR-300-48	325 Building	South-central 300 Area

Pipelines with uranium and/or mercury contamination that exceeds cleanup levels for groundwater and river protection that are inaccessible for the RTD remedy because of their close proximity to long-term facilities will be void filled to the maximum extent practicable as defined in the RD/RAWP to immobilize radionuclides (and elemental mercury in waste site 300 RRLWS) in the pipelines for groundwater protection.

Pipeline void filling will be performed by installing fill and vent ports to a selected segment of piping. Grout, epoxy, or other suitable stabilizing material will be introduced to the piping segment using industry-standard techniques. Void-filling material can either be pumped or gravity fed into a piping segment. Void-filling material will be allowed to cure prior to initiating remedial actions on piping segments, if applicable. When only a portion of void-filled piping is remediated, the end location of piping to remain in place will be recorded with global positioning system coordinates, documented on project drawings, and included in the administrative record. In addition, a monument will be installed at ground surface to document the location of the pipe end. Both the monument and project drawings will facilitate future remedial actions after interferences associated with the long-term retained facilities are removed. Void filling may not be required on intact pipelines that pose elevated hazards to workers (e.g., 300-265). Also, pipeline void filling may not be required for piping segments associated with interim retained facilities (e.g., the 324 Building) or piping segments abandoned-in-place in areas that have otherwise undergone remediation and revegetation. Piping segments abandoned in place are primarily process sewer segments that remain in the ground north of Apple Street or remain within the operational boundary of an active facility.

When the long-term facilities are no longer in use and are removed, waste sites and pipelines will be remediated as described in this RDR/RAWP. The long-term retained facilities are described further in Section 1.2.2.

4.3.4 Implementation of Institutional Controls for Waste Site Remediation

Institutional controls are required before, during, and after the active phase of remedial action implementation where institutional controls are necessary to protect human health and the environment. Institutional controls are used to control access to residual contamination in soil above standards for unlimited use and unrestricted exposure. Institutional controls are required during remedial action and after cleanup is complete, or until the site meets the requirements for unrestricted land use as defined in Section 2.0. Cleanup to industrial levels in the 300 Area industrial core is based on the mandate of restricted land and groundwater use, until such time that contaminant concentrations are conducive to unrestricted use. Accordingly, DOE may choose to demonstrate that unrestricted use cleanup levels have been attained in areas designated for industrial use.

The Integrated RDR/RAWP (DOE/RL-2014-13) provides additional description of the institutional controls specified under the 300 Area ROD (EPA 2013). Details for implementation are described in DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Action Sites* (as revised). Remedial action planning, including siting of haul roads, SPAs, and support areas, shall consider the ROD requirement to prevent enhanced recharge at sites with soil concentrations exceeding residential (irrigation-based) groundwater and surface water protection cleanup levels. Dust-suppression water used during remediation will be limited to that necessary to prevent airborne emissions. Irrigation (including landscape watering) is prohibited at waste sites within the industrial zone. Active irrigation systems that may impact waste sites will be deactivated, and the installation of new systems is prohibited. Existing landscapes may be converted to dryscapes utilizing xeriscaping techniques, should operational facilities choose to do so. Drainage control and construction/maintenance of surface barriers, as described in Section 4.3.3, will also be used to restrict enhanced recharge at waste sites.

Implementation of the ROD requirement to provide signage and access control for waste sites with contamination above cleanup levels is described below.

- Along the Columbia River, a sign set has been placed at or above the high water line (at approximately the same line as the no trespassing signs). The sign set consists of one each in English and Spanish. The signs are located so that the distance for viewing from the river is approximately 152 m (500 ft). The English language sign reads as follows:

  WARNING: HAZARDOUS AREA
  DO NOT ENTER
  Area May Contain Hazardous Soil and Water
  For Information Call: 509-376-7501

  The Spanish language sign reads as follows:

  ADVERTENCIA: AREA DE PELIGRO
  NO ENTRE
  Esta area puede contener tierra y fuentes de agua que son peligrosas.
  Para Informacion Llame al (509) 376-7501

- One large sign is located north of the 300 Area. Additional smaller signs are located at roads leading to the 618-10 and 618-11 Burial Ground areas. These signs read as follows:

  WARNING: HAZARDOUS AREA
  Area May Contain Hazardous Soil
  Only Authorized Personnel Allowed
  For Information Call: 509-376-7501

- Signs placed at key access roads into the 300 Area industrial zone read as follows:

  WARNING: HAZARDOUS AREA
  Area May Contain Hazardous Soil
  Observe All Signs and Hazard Postings
  Only Authorized Personnel Allowed
  For Information Call: 509-376-7501

- Signs may also be placed in temporary security fence openings when necessary to accommodate special shipments.

Following remediation, institutional controls restricting land use to industrial uses or restricting excavation of deep zone soils with contaminants above shallow zone cleanup levels will be identified in the waste site closeout documentation, as necessary, and in accordance with the requirements of Section 4.4.5.

4.4 Site Verification and Closeout

Site verification and closeout includes sample collection, demonstration of attainment of RAOs, cleanup documentation, site closure, and site release, as summarized in the following subsections.

4.4.1 Verification Sample Collection

Verification samples of the residual soil from the excavated site, any clean soil stockpiles intended for use as backfill material, and residual soil from SPAs (if applicable) will be collected in accordance with the 300 Area SAP (DOE/RL-2001-48, as revised), including site-specific work instructions or other documented agreements for verification sample collection. Results from the verification samples will be used to demonstrate attainment of the RAOs.

4.4.2 Attainment of Remedial Action Objectives

The general approach for verifying attainment of RAOs involves the following steps:

- Calculating summary statistics appropriate to the verification data set
- Evaluating summary statistics against the appropriate cleanup levels
- If needed, modeling exposure and risk to future site inhabitants
- If needed, modeling future impacts to groundwater and the Columbia River.

A detailed description of the process for verifying attainment of the RAOs is provided in Appendix B of this document.

4.4.3 CERCLA Cleanup Documentation

Subsequent to determining that the RAOs have been attained, waste site reclassification documentation will be prepared, typically including a supporting CVP or other closeout documentation. The waste site reclassification documentation will document the remedial action process, verification sampling results (if applicable), and attainment of the RAOs under the appropriate land use at a site; and will support the eventual removal of the OU from the National Priorities List. In some cases, DOE may choose to evaluate compliance with unrestricted use cleanup levels in the industrial zone in order to eliminate unnecessary institutional controls for the site. Waste site reclassification documentation may be prepared for groups of sites or individual sites, as needed, in accordance with the guidance provided in Appendix B. Closeout documentation may also be used to support other CERCLA closeout documentation (e.g., remedial action reports, construction completion reports, and National Priorities List deletion packages).

4.4.4 Backfill, Regrade, and Revegetation

Once attainment of the RAOs under the appropriate land use has been verified, the site will be recontoured and/or backfilled and revegetated following guidance in Appendix C. A general recontour/backfill design will be developed based on the final excavated site and surrounding area topography, as well as the amount of stockpiled overburden/below cleanup level material that has been released for use as backfill material. As needed, additional backfill material may be transported to the excavated site from approved Hanford Site borrow areas. Recontouring and backfilling operations will be performed using standard construction equipment.

Waste sites within the 300 Area "industrial core zone and contiguous areas" (including the 618-11 Burial Ground) will be backfilled and regraded in a manner that will support future industrial reuse of the site. The slope of the regrade topography will provide positive drainage away from areas where residual subsurface contamination could result in adverse groundwater impacts. The grading, to the extent practicable, will maximize the amount of large flat areas and minimize rolling contours or depressions where water may accumulate. Outlying sites should be backfilled and revegetated in a manner that matches the local area contours.

In order to support industrial use, planting of native vegetation will be delayed for portions of the 300 Area until completion of industrial use. Currently, the only remediated and backfilled site requiring delayed revegetation is the 300-VTS waste site. The area around this site is utilized by the U.S. Department of Defense in support of operations to support deactivation of naval vessels. This area will be revegetated when the U.S. Department of Defense activity is completed at this site. Other waste sites that may warrant delayed revegetation will be identified by DOE and will require the concurrence of the EPA Remedial Project Manager.

4.4.5 Site Release

The DOE will continue to manage the land in the 300 Area of the Hanford Site as long as necessary to support remedial actions and other missions. The release of land areas for industrial or unrestricted uses will depend on the following: (1) release of the individual waste sites, and (2) the completion of other work in the OU, such as decontamination and decommissioning of facilities, as well as final cleanup verification under CERCLA.

Where deed notices or other institutional controls are used in accordance with the 300 Area ROD (EPA 2013), DOE will not allow activities that would interfere with the remedial action prior to EPA approval. In addition, DOE will take necessary measures, such as filing deed notices in appropriate county offices and enforcing such land-use limitations through contractual mechanisms, to ensure the continuation of these restrictions prior to any transfer or lease of the property to any private party in accordance with the statutory requirements of Section 120(h) of CERCLA and the regulatory requirements of 40 CFR 373. A copy of any restriction notification will be given to any prospective purchaser/transferee before any transfer or lease by DOE. The DOE will provide the EPA with written verification that these restrictions are in place. In addition, unless and until cleanup levels that would support unlimited use and unrestricted exposure are attained, a reevaluation of the remedial action will occur as part of the CERCLA 5-year review for the 300-FF-2 OU. For more information on requirements applicable to institutional controls, refer to the Integrated RDR/RAWP (DOE/RL-2014-13) and the 300 Area ROD (EPA 2013).

This page intentionally left blank.

5 Waste Management Plan

Waste management activities will be performed in accordance with the applicable ARARs identified in Section 2.4 and RCC Project internal procedures. The requirements specified by the ARARs and other applicable guidance will address waste storage, transportation, packaging, handling, and labeling as they specifically apply to waste streams from each waste site. This process is illustrated in Figure 5-1.

5.1 Waste Designation Methods

Wastes will be designated for disposition based on historical data, process knowledge, engineering calculations, sampling and analysis, or combinations thereof. Each of these methods and their applications is described as follows:

- Historical data (e.g., analytical results) may be used to designate waste forms that have previously been characterized. In addition, previous and current 300 Area remediation projects have designated significant quantities of buried solid waste. The waste forms in this category are readily identified and are known for their hazardous material content.
- Process knowledge will be used to designate waste for which process knowledge provides sufficient information. Waste forms such as asbestos-containing floor tiles and pipe lagging do not require sampling and analysis because these will be designated as ACMs based on visual observation. Elemental lead debris, paint debris, and lead acid batteries are other examples where designation will be based on process knowledge.
- Engineering calculations may be performed to estimate the weight or volume of a hazardous waste in a certain matrix (e.g., calculating lead-based paint content on pump housings).
- Sampling and analysis will be used for designation of wastes when the above-mentioned methods are not appropriate or available. Sampling and analysis is required for liquids and most of the anomalous waste forms. Where sampling is needed, historical data, process knowledge, and/or engineering calculations may be used to reduce the suite of analyses required. All sampling activities supporting waste designation will be performed in accordance with the appropriate 300 Area SAP.

Specific types of waste that are initially designated based on sampling results may be designated using one of the other methods (e.g., historical data) as the waste is unearthed during the excavation. All excavation operations will be observed by personnel assigned to assist with the designation process.

5.2 Waste Stream-Specific Management

Various waste streams will be encountered during the course of remedial actions. Each waste stream will require specific processing and disposal. Similar types of waste will be managed uniformly. Management of waste streams that are projected to be encountered during the course of remedial actions are summarized in the following subsections.

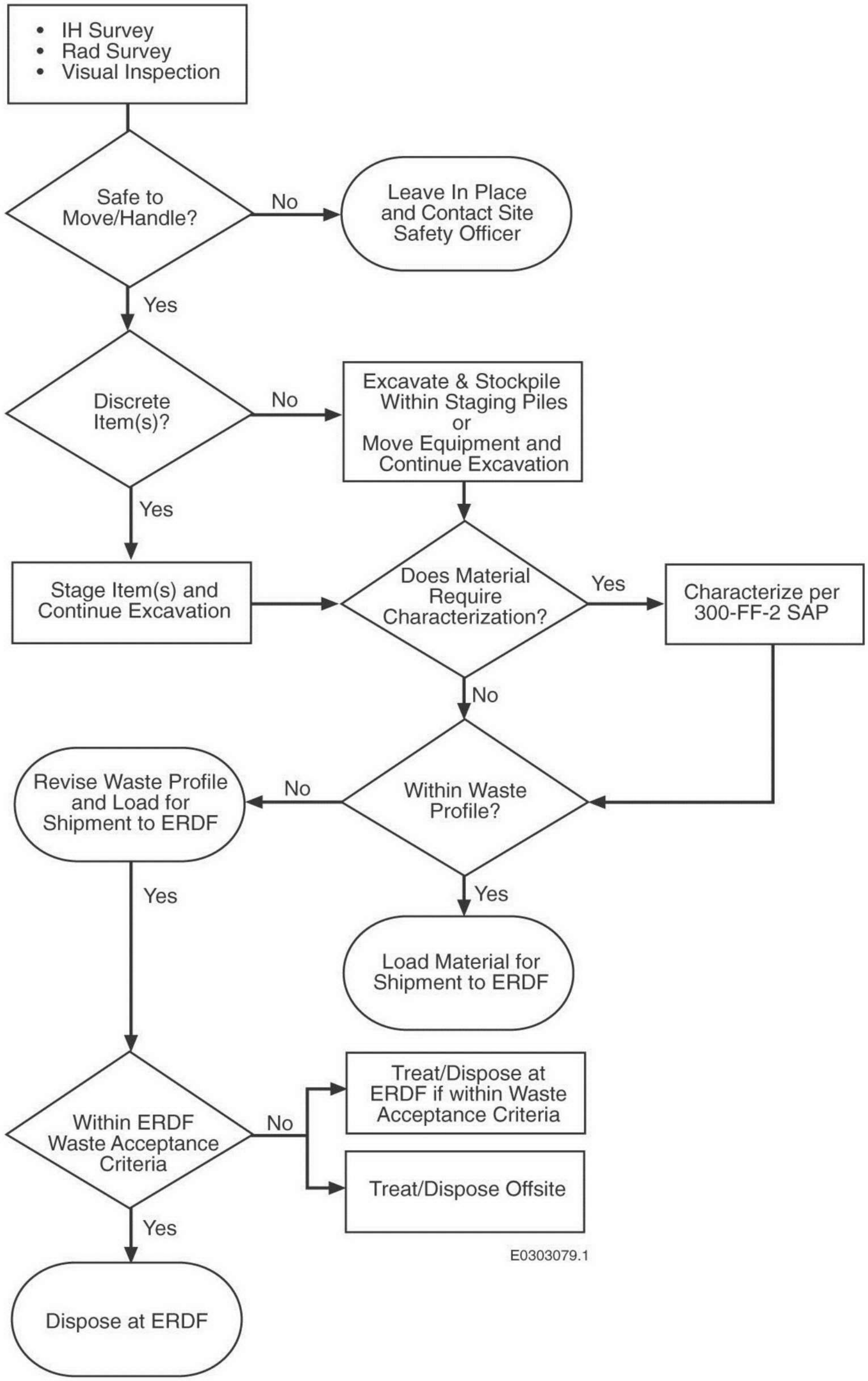


Figure 5-1. Logic Flow Diagram for Disposition of Buried Waste and Co-Mingled Soil

5.2.1 Miscellaneous Solid Wastes

Miscellaneous solid waste that has contacted potentially contaminated materials will be segregated from other materials and will generally be transported to the ERDF for disposal. Miscellaneous solid waste that has not contacted contaminated media and that has been radiologically released may be disposed offsite at a permitted disposal facility, disposed in an onsite limited purpose or inert landfill, or recycled, as appropriate. Examples of miscellaneous solid waste include (but are not limited to) filter paper, wipes, PPE, cloth, plastic, equipment, tools, pumps, wire, metal and plastic piping, and materials from cleanup of unplanned releases.

At the 618-10 and 618-11 Burial Grounds, some nonhazardous miscellaneous solid waste destined for disposal at ERDF is generated in support areas adjacent to the burial ground. For compliance with the nuclear facility fire hazard analyses, this nonhazardous waste may be taken into the burial ground trenches and mixed with soil prior to loading into an ERDF disposal container.

5.2.2 Low-Level Radioactive Waste

Low-level radioactive waste, including soil, concrete, debris, and structures, will be removed during excavation. Plastic, paper, and other compactible waste will also be generated as part of the remediation activities. Debris that has contacted contaminated media may be disposed at the ERDF if the waste acceptance criteria can be met. If the waste acceptance criteria cannot be met, the waste will be shipped to an appropriate offsite facility, depending on the waste designation. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440.

At the 618-10 and 618-11 Burial Grounds, some nonhazardous miscellaneous solid waste destined for disposal at ERDF is generated in support areas adjacent to the burial ground. For compliance with the nuclear facility fire hazard analyses, this nonhazardous waste may be taken into the burial ground trenches and mixed with soil prior to loading into an ERDF disposal container.

At the 618-10 and 618-11 Burial Grounds, nonhazardous radioactive waste may be processed similarly to mixed waste. For example, radiological conditions may warrant that nonhazardous radioactive waste be mixed with grout prior to disposal to mitigate potential personnel exposure and potential for an airborne radioactive material release. In these cases, an approved treatment plan will not be required.

5.2.3 Hazardous and/or Mixed Waste (Both Radioactive and Hazardous)

Hazardous and/or mixed waste that meets the LDR treatment standards and the most current ERDF waste acceptance criteria may be disposed in the ERDF. Wastes that do not meet the ERDF acceptance criteria may be staged until treated to meet the criteria and will be handled on a case-by-case basis. Depending on the waste designation, the waste may be shipped to an appropriate offsite facility deemed acceptable by the EPA in accordance with 40 CFR 300.440.

5.2.4 Spent Nuclear Fuel

Waste identified as suspect SNF will be evaluated against the criteria in applicable DOE orders and guides to determine if the material is, in fact, subject to management as SNF. Waste categorized as SNF is not eligible for disposal at the Hanford Site. Spent nuclear fuel will be transported to the Canister Storage Building facilities in the 200 Area for storage until an offsite facility capable of managing high-level waste becomes available. Any SNF will be packaged directly at the remediation site as necessary for transport to the 212H Canister Storage Building, where additional packaging may be performed for interim storage. In accordance with 40 CFR 300.440, the EPA will approve the receiving facilities for

SNF prior to shipment. Should the Canister Storage Building facilities not be available, other locations may be approved by the EPA on a case-by-case basis (DOE-RL et al. 2005b).

5.2.5 Transuranic Waste

Appropriate characterization, packaging, and processing will be performed to meet the receiving facility waste acceptance criteria and DOT regulations regarding transportation of TRU-contaminated waste. This activity may take place at the Waste Receiving and Processing Facility for contact handled-TRU waste and at a planned future processing facility for remote handled-TRU waste.

5.2.6 Liquid

5.2.6.1 Liquids from Unplanned Releases

If a release occurs, the notification of contractor spill release support is required. The reporting requirements will be met as prescribed by DOE O 232.1A, *Occurrence Reporting and Processing Operations*. The contractor point of contact will determine the actions required to address the spill and determine if the lead regulatory agency needs to be notified.

Spills (unplanned releases) that occur in clean areas that are being used in support of a CERCLA remediation are appropriate for disposal at the ERDF, when the following conditions exist:

1. The spill occurred from equipment supporting the CERCLA activity.
2. The waste meets the ERDF waste acceptance criteria (WCH-191).
3. The spill occurred within the CERCLA OU boundary or onsite area.

A “clean area” is defined as an area supporting a CERCLA remediation activity that is not contaminated with the contaminants of concern found in the active remediation areas (DOE-RL et al. 2007).

Liquid that is not treated to meet the ERDF acceptance criteria will be shipped to the 2025-E Effluent Treatment Facility (ETF) or an appropriate offsite facility. The ETF is an approved noncontiguous onsite facility pursuant to CERCLA Section 104(d)(4) to store and treat liquid waste generated from remedial actions, provided the waste acceptance criteria can be met.

5.2.6.2 Decontamination Fluids

Decontamination fluids (i.e., water and/or nonhazardous cleaning solutions) from cleaning equipment and tools used in the OU may be discharged to the ground in accordance with Section 4.3.2. If decontamination fluids are collected and they are above the collection criteria, they will be designated and transported to the ETF. Small volumes of nondangerous decontamination fluids may be stabilized to eliminate free liquids and then disposed to the ERDF if the waste acceptance criteria can be met.

5.2.6.3 Liquid Remaining in Pipes

Liquids that may remain in pipelines to be remediated will be collected to the extent reasonably practicable, designated, and transported to the ETF or other facility as authorized by the lead regulatory agency. If the liquid is water and contains contaminants in levels below those listed in WAC 173-200 or groundwater cleanup standards in WAC 173-340-720, it may be used as dust suppressant. Water above the WAC 173-200 or WAC 173-340-720 limits may be used as dust suppressant following approval by the lead regulatory agency.

Pipeline removal may be a planned remedial action or an activity made necessary by an unplanned discovery. Projects perform historical research to locate buried pipelines and learn as much as possible about their past functions and what liquids they may currently hold. Based upon that research, and observations and data gathered during remedial action, a graded approach will be used for spill control practices implemented during pipeline removal. The most stringent efforts will be used for pipes containing or expected to contain dangerous waste liquids. To the extent practicable, those pipelines will be tapped and liquids drained, containerized, and properly disposed.

Mitigative measures required in most cases will lie somewhere below those extremes. Spill control practices (spill kits, absorbents, liners, catch basins, etc.) will be used to minimize the quantities of nondangerous waste liquids that may be released to the soil. Pipelines will not be deliberately breached unless their contents are known or measures are in place to positively contain any liquids that may be discharged. Proposed pipeline remediation will be discussed with the regulators so they understand the approach to be used, spill controls that will be employed, and uncertainties or risks of unknown liquids or inadvertent discharges.

5.2.7 Used Oil and Hydraulic Fluids

Used oil and hydraulic fluids generated during operation of machinery at the waste sites will be radiologically released and sent offsite for recycling or disposal, as appropriate, or may be stabilized in accordance with ERDF waste acceptance criteria (WCH-191) and disposed to ERDF if the fluid contacted contaminated media associated with the waste site.

5.2.8 Returned Sample Waste

Screening and analysis of both solid and liquid samples may be conducted at the waste sites, offsite or onsite laboratories, and/or the Radiological Counting Facility. These samples may be returned to the OU. Unused samples and associated laboratory waste from offsite analyses will be managed by the applicable laboratory in accordance with contract specifications. Waste from field screening and onsite laboratories will be managed depending on whether it has been altered by analysis. Altered samples will be contained and disposed at the ETF, ERDF, or other appropriate facilities as authorized by the lead regulatory agency, depending on waste designation. Unaltered liquid waste generated during sample screening and analysis may be discharged to the ground near the point of generation, if it is below the collection criteria limits, or disposed at the ETF, ERDF, or other appropriate facilities if it is above the collection criteria. Some liquids may be neutralized and/or stabilized to meet the disposal facility's waste acceptance criteria. Pursuant to 40 CFR 300.440, DOE-RL approval is required before returning unused samples or waste from onsite or offsite laboratories. Approval of this RDR/RAWP constitutes DOE-RL remedial project manager approval for shipment of offsite and onsite laboratory sample waste back to the waste site of origin.

5.2.9 618-10 and 618-11 Concreted Drums

At the 618-10 and 618-11 Burial Grounds, some high-activity waste and possibly small amounts of plutonium-contaminated liquid waste were sealed in concreted 208-L (55-gal) drums. Some concreted drums also contained an additional 2.5 or 5 cm (1 or 2 in.) of lead shielding. One type of drum had a 20-cm (8-in.)-diameter galvanized metal culvert centered in the 208-L (55-gal) drum, surrounded by concrete on the bottom and sides. The culvert may also have lead wrapped around it, depending on shielding requirements. High-activity liquid or solid waste was placed in the culvert. The culvert was capped with a lead plate and concrete poured in to fill the void space. Another type of drum had the waste placed inside the container and then concrete poured around the containers to provide shielding and to prevent shifting of contents. Opening these concrete drums for examination and processing would present a very high risk due to the radiological contents. If the outer drum is intact and the concrete cap is seen to be intact, the concrete is reasonably expected to be intact. When the concrete in these drums is intact, it meets the macroencapsulation standard of 40 CFR 268.42 for radioactive lead solids. When the outer drum is not intact, but the concrete within the outer drum can be seen as intact on the sides and the top, the concrete can reasonably be expected to be intact. Intact concrete waste will be overpacked with an absorbent filling the annulus between the concreted drum and the overpack drum to preclude migration of potential liquids. In this form, the overpacked drum can be disposed in the ERDF. If the concrete in these drums is not intact, the drums will be overpacked and filled with absorbent. Macroencapsulation will be performed either at the waste site and then disposed at ERDF, or the macroencapsulation treatment will be performed at ERDF prior to disposal.

5.3 Waste Handling, Packaging, and Labeling

Materials requiring collection will be placed in containers appropriate for the material and the receiving facility. Although ERDF containers will be used for most wastes, an alternative "truck and pup" style of container may be used for nonradionuclide-contaminated waste.

Waste moved outside of the AOC must meet all substantive requirements of WAC 173-303 and DOT requirements, as appropriate. In addition, PCB wastes will be managed in accordance with substantive provisions of 40 CFR 761, and asbestos waste will be managed in accordance with 40 CFR 61. Waste will be packaged, marked, and labeled in accordance with ARARs. If waste is determined to be SNF or TRU waste, it will be packaged in accordance with the appropriate criteria as determined at the time of shipment to an approved facility.

5.4 Storage

In general, waste unearthed in support of this RDR/RAWP will be disposed at the ERDF or other approved onsite or offsite facility. As necessary, waste will be stored within the AOC, in onsite container storage areas, in staging piles, or at the ERDF as described in the following subsections.

5.4.1 Area of Contamination

Waste that is excavated and held (i.e., not immediately transported to the ERDF) for further analysis, treatment, or any other reason will be typically managed within the AOC. The AOC approach was discussed in the NCP (55 FR 8666) with regard to remedial actions under CERCLA. The guidance states that the AOC can be equated to a RCRA landfill where movement within the area would not be considered land disposal and would not trigger the requirements of Subtitle C, such as 90-day storage or LDRs. Any movement of soil outside of the AOC but within the CERCLA onsite area will trigger compliance with all ARARs, such as RCRA provisions for management of dangerous waste. The AOC for each waste site will be delineated in the project drawings and are considered part of this RDR/RAWP. These drawings may be provided to the lead regulatory agency upon request.

5.4.2 Container Storage Areas

Items that are not amenable to storage within the AOC, and that can readily and safely be removed (e.g., bagged PPE and sample returns), may be managed outside of the AOC within container storage areas. Container storage will also be used for ancillary waste generated in support of the remedial action (e.g., spill cleanup material). Substantive requirements of 40 CFR Subpart I and WAC 173-303-630 must be met for container storage areas storing regulated dangerous waste. If container management occurs on soil, the area may be subject to sampling after all waste is removed and the area is no longer needed for container management.

5.4.3 Staging Piles

As an alternative to storage within the AOC or in containers, waste that is not immediately transported to the ERDF or other EPA-approved disposal facility may be stored in staging piles. The staging piles must be operated in accordance with the standards and design criteria prescribed in 40 CFR 264.554, paragraphs (d) through (k). General requirements for the staging piles include the following.

- Staging piles are used only during remedial operations for temporary storage at a facility and must be located within the contiguous property where the wastes to be managed in the staging piles originated.
- The SPA must be designed to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment and minimize or adequately control cross-media transfer. To protect human health and the environment, this can include installation of berms, dust control practices, or using plastic liners/covers, as appropriate. A release of a hazardous substance outside the SPA confines into the underlying soil or ambient air will be considered a release into the environment, and immediate notification under CERCLA will be pursued in accordance with 40 CFR 302, if the quantity involved exceeds a reportable quantity over a 24-hour period, and/or in accordance with other regulation(s), as applicable. However, if hazardous substances are discovered within the confines of an approved staging pile, it is not considered a release (DOE-RL et al. 2005a).
- The staging pile must not operate for more than 2 years (measured from the first time remediation waste is placed into the pile), except when the EPA grants an operating term extension. A record of the date when remediation waste was first placed in the staging pile must be maintained until final closeout of the site is achieved.
- Ignitable or reactive waste must not be placed in a staging pile unless it has been treated or mixed before being placed in the pile so that the waste no longer meets the definition of ignitable or reactive waste, or the waste is managed in order to protect it from exposure to any material or condition that may cause it to ignite or react.
- Incompatible wastes may not be placed in the same staging pile, unless the requirements in 40 CFR 264.17(b) have been met. The incompatible materials must be separated or they must be protected from each other with a dike, berm, wall, or other device. Remediation waste may not be piled on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 264.17(b).
- Within 180 days after the operating term of the SPA located in a previously uncontaminated area expires, the SPA must be closed in accordance with 40 CFR 264.258(a) and 40 CFR 264.111, or 40 CFR 265.258(a) and 40 CFR 265.111. This includes removing all remediation waste, contaminated containment system components, contaminated structures and equipment, and leachate.

Approval of this RDR/RAWP by the EPA constitutes general authorization to operate staging piles during remediation of the 300-FF-2 OU. Specific SPA locations will be identified on project drawings and approved by the EPA in unit manager's meetings or other documented means of communication. Field operation of staging piles within the referenced regulatory provisions will be accomplished through the following controls:

- The SPA will be surrounded with a minimum of a 15-cm (6-in.) berm to control run-on/runoff prior to use.

- Dust control practices will be deployed consistent with soil piles managed in the AOC, including the use of crusting agents, as necessary, to minimize migration/leaching or contaminants into underlying soil.
- Surveys of the SPA will be performed prior to waste placement to ensure no cross-media transfer or staging of waste on previously contaminated areas. A staging pile shall be remediated within 180 days after the operating period per 40 CFR 264.554(j) and (k).
- Gross sorting of waste will be performed within the AOC to identify and remove drums or other containers from the bulk soil prior to moving the soil to the staging piles. Additional sorting may be required on bulk soil prior to moving the soil to the SPA. Any dangerous or unknown waste identified will be packaged and managed appropriately (drums) within the SPA and within close proximity to the specific staging pile. Drums will be properly labeled, managed, and inspected weekly, or as described in RCC Project waste management procedures.

Once characterization and designation of the material is completed, the waste will be loaded into containers for transport to the ERDF or shipped on site or off site for treatment and/or disposal, as appropriate. To close out the SPAs after the waste has been removed, samples of the residual soil will be collected in accordance with the current 300 Area SAP; specific sampling details may be presented in a site-specific sampling instruction prepared in accordance with the SAP. In cases where staging piles for industrial waste sites are located in an uncontaminated area, if the sample results meet unrestricted cleanup levels, no further action or assessment is necessary. If the sample results exceed the unrestricted cleanup levels but are below the industrial cleanup levels, institutional controls will be applied to the SPA consistent with a waste site.

5.4.4 Environmental Restoration Disposal Facility Drummed Waste Staging Area

On a case-by-case basis, a staging area may be available at the ERDF for drummed wastes from the 300 Area remedial action sites that require special handling and/or treatment not currently available, such as thermal treatment of a mixed radioactive/dangerous waste. Drummed waste will be characterized at the site prior to transport to the ERDF staging area. All drummed waste sent to the ERDF staging area will be stored in accordance with requirements prescribed by the ERDF ROD amendment (EPA 2002).

5.5 Waste Transportation

Packaging, marking, and labeling for transportation will be in accordance with DOT 49 CFR requirements, procedures, and the ARARs, as appropriate. With appropriate documentation (e.g., safety analysis report for packaging or risk-based exemption), packaging exceptions to DOT requirements that provide an equivalent degree of safety during transportation may be used for waste shipments. Coordination and preparation of these documents will be approved by the DOE-RL. ERDF roll-off-type containers will be used for most bulk wastes. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans. Containers will be sealed and shipped to the identified disposal facility as quickly as economically feasible. Waste will be transported in accordance with WAC 173-303, DOT regulations, and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, as appropriate.

5.6 Waste Treatment

When necessary, treatment is one of the selected remedy elements for the 300 Area waste sites. Treatment may be conducted at the site, at ERDF (in special cases), or at an EPA-approved offsite facility. Remediation of the VPUs at the 618-10 and 618-11 Burial Grounds, which may contain principal threat waste, includes integrated treatment, as described in Section 4.3.2.3.

If LDR wastes are encountered, the requirements of 40 CFR 268 will be applied, unless a treatability variance is approved by the EPA. Offsite treatment must be performed at a facility approved by the EPA in accordance with 40 CFR 300.440. Return of treated waste from offsite treatment facilities for disposal at ERDF will require additional authorization from DOE-RL. Disposal of waste forms at the Waste Isolation Pilot Plant is considered equivalent to land disposal treatment.

Treatment will be required for LDR material unless a treatability variance or ARAR waiver is requested by DOE-RL and approved by the regulatory agencies. If LDR wastes are encountered, the requirements of 40 CFR 268 and WAC 173-303-140 will be applied. Should LDR material be encountered, it will be temporarily stored within the AOC or staging piles and disposed in accordance with applicable regulations. If treatment is required to address LDR wastes, DOE-RL will obtain regulatory agency approval. An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b). Debris material may be treated in accordance with WCH-539, *Treatment Plan for Macroencapsulation of 300-FF-2 Operable Unit Debris*.

Elemental mercury is known to exist in certain 300 Area underground piping systems (e.g., the Retired Radioactive Liquid Waste System). Radiological dose rates associated with these piping systems preclude phase separation (retrieval) of the elemental mercury. Therefore, piping containing elemental mercury will be stabilized by injecting an amended (sulfur-containing) grout. Following stabilization, the segments will be removed and placed in waste packages. The packaged piping debris will then be macroencapsulated with grout prior to disposal at ERDF.

This page intentionally left blank.

6 References

36 CFR 60, "National Register of Historic Places," *Code of Federal Regulations,* as amended.

36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*, as amended.

36 CFR 800, "Protection of Historic Properties," *Code of Federal Regulations*, as amended.

40 CFR 61, "National Emissions Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

40 CFR 264.554, "Staging Piles," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, *Code of Federal Regulations*, as amended.

40 CFR 268, "Land Disposal Restrictions," *Code of Federal Regulations*, as amended.

40 CFR 300, "National Oil and Hazardous Substances Contingency Plan," *Code of Federal Regulations*, as amended.

40 CFR 302, "Designation, Reportable Quantities, and Notification," *Code of Federal Regulations*, as amended.

40 CFR 373, "Reporting Hazardous Substance Activity when Selling or Transferring Federal Real Property," *Code of Federal Regulations*, as amended.

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," *Code of Federal Regulations*, as amended.

43 CFR 10, "National American Graves Protection and Repatriation Regulations," *Code of Federal Regulations*, as amended.

49 CFR 100 through 185, "Transportation," *Code of Federal Regulations*, as amended.

50 CFR 83, "Rules Implementing the Fish and Wildlife Conservation Act of 1980," *Code of Federal Regulations,* as amended.

50 CFR 402, "Interagency Cooperation – Endangered Species Act of 1973," *Code of Federal Regulations,* as amended.

55 FR 8666, "National Oil and Hazardous Substances Contingency Plan," *Federal Register,* Vol. 55, No. 46, p. 8666.

Archeological and Historic Preservation Act of 1974, 16 U.S.C. 469-469c, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE O 232.1A, *Occurrence Reporting and Processing Operations,* as amended, U.S. Department of Energy, Washington, D.C.

DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets*, as amended, U.S. Department of Energy, Washington, D.C.

DOE/EIS-0222-F, 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005, *Action Memorandum #1 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2006a, *Action Memorandum #2 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland ,Washington.

DOE-RL, 2006b, *Action Memorandum #2 for the 300 Area Facilities*, U.S. Department of Energy, Richland Operations Office, Richland ,Washington.

DOE-RL, Ecology, and EPA, 2005a, *100 Area Unit Managers' Meeting Minutes*, CCN 123732, dated June 23, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2005b, *100 Area Unit Managers' Meeting Minutes*, CCN 128832, dated December 5, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2005c, *100 Area Unit Managers' Meeting Minutes*, CCN 129623, dated July 28, 2005, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE-RL, Ecology, and EPA, 2007, *100 Area Unit Managers' Meeting Minutes*, CCN 133749, dated April 12, 2007, U.S. Department of Energy, Richland Operations Office, Washington State Department of Ecology, and U.S. Environmental Protection Agency, Richland, Washington.

DOE/RL-94-150, 2013, *Bald Eagle Management Plan for the Hanford Site, South Central Washington*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-32, 2001, *Hanford Site Biological Resources Management Plan*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-19, 2002, *Mitigation Action Plan for the 300 Area of the Hanford Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-73, 2005, *324 Building Radiochmeical Engineering Cells, High-Level Vault, Low-Level Vault, and Associated Area Closure Plan*, Rev. 3, U.S Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-36, 2011, *Hanford Sitewide Transportation Safety Document*, Rev. 1E, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-41, 2009, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-47, 2009, *Remedial Design Report/Remedial Action Work Plan for the 300 Area* , Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-48, 2011, *300 Area Remedial Action Sampling and Analysis Plan*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-77, 2007, *Removal Action Work Plan for 300 Area Facilities*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-21, 2011, *River Corridor Baseline Risk Assessment, Volume II: Human Health Risk Assessment*, Volume II, Parts 1 and 2, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2014-13, *Integrated Remedial Design/Remedial Action Work Plan for the 300 Area (300-FF-1, 300-FF-2, & 300-FF-5 Operable Units)*, Rev. 0, U.S. Department of Energy, Richland, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order,* 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1989, *Risk Assessment Guidance for Superfund (RAGS)*, Volume I – Human Health Evaluation Manual (HHEM) (Part A Baseline Risk Assessment), Interim Final, Office of Emergency and Remedial Response, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1996, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units, Hanford Site, Benton County, Washington*, July 1996, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, April 2001, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2002, *Amended Record of Decision for the Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

Migratory Bird Treaty Act of 1918, 16 U.S.C. 703, et seq.

OSWER Directive 9285.7-55, 2003, *Guidance for Developing Ecological Soil Screening Levels*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended.

WAC 173-200, "Water Quality Standards for Ground Waters of the State of Washington," *Washington Administrative Code*, as amended.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 2007.

WAC 173-350, "Solid Waste Handling Standards," *Washington Administrative Code*, as amended.

WAC 173-400, "Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended.

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended.

WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," *Washington Administrative Code*, as amended.

WAC 232-12-292, "Habitat Buffer Zone for Bald Eagles," *Washington Administrative Code*, as amended.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended.

WCH-126, 2007, *600 Area Remediation Design Solution Waste Packaging, Transportation, and Disposal Requirements*, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH-127, 2007, *600 Area Remediation Design Solution Technology Assessment and Deselection Report*, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH-191, 2014, *Environmental Restoration Disposal Facility Waste Acceptance Criteria,* Rev. 3, Washington Closure Hanford, Richland, Washington.

WCH-539, 2013, *Treatment Plan for Macroencapsulation of 300-FF-2 Operable Unit Debris*, Rev. 2, Washington Closure Hanford, Richland, Washington.

Appendix A

300 Area Waste Site Information

This page intentionally left blank.

A1. 300 Area Waste Site Summary

A summary of the 300-FF-1 and 300-FF-2 Operable Unit waste sites that have undergone or will be undergoing remedial design and remedial action are presented in this appendix as Table A-1. The information for waste sites that are included in Table 1 of the *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (300 Area ROD) (EPA 2013) identifies the decision under that ROD, and their dispositioning under earlier RODs (EPA 1996, 2001). The 300 Area ROD was developed concurrently with ongoing remedial actions; as a result, 43 sites remediated or evaluated under the interim action ROD (EPA 2001) were not quantitatively evaluated in development of the 300 Area ROD. These sites therefore have a remediation decision under the 300 Area ROD, which is reflected in Table A-1. However, further activities for these waste sites may be limited to verification that interim actions taken remain protective under the 300 Area ROD requirements.

Since the 300-FF-2 ROD in 2001, sites remediated using the plug-in approach were documented in Explanations of Significant Difference (ESDs) (EPA 2004, 2009). A third ESD (EPA 2011) addressed waste handling considerations and did not include any documentation of additional sites considered with the plug-in mechanism. The 2009 ESD (EPA 2009) also included a change in the way plug-in waste sites were reported. The new provision authorized that additions of plug-in and candidate sites would be documented in annual "Fact Sheets" included in the Tri-Party Agreement Administrative Record.

Fact sheets were published annually in 2010, 2011, and 2012 by the U.S. Department of Energy to identify the plug-in and candidate sites that met the criteria to add them to the 300-FF-2 ROD (EPA 2001). Waste sites that were added in this manner are documented in the following references:

- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2010* (DOE-RL 2010)
- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2011* (DOE-RL 2011).
- Fact Sheet: *300 Area "Plug-In" Waste Sites for Fiscal Year 2012* (DOE-RL 2012).
- No fact sheet was issued for fiscal year 2013.

Information related to current site knowledge and status was also compiled from the following resources:

- Waste Information Data System (WIDS)
- Stewardship Information System (SIS)
- BHI-00012, *300-FF-2 Operable Unit Technical Baseline Report*
- BHI-00768, *100 and 300 Area Burial Ground Remediation Study*
- DOE/RL-96-42, *Limited Field Investigation Report for the 300-FF-2 Operable Unit*
- DOE/RL-99-40, *Focused Feasibility Study for the 300-FF-2 Operable Unit*
- OSR-2010-0002, *300 Area Orphan Sites Evaluation Report.*

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300 RLWS, 300 Area Radioactive Liquid Waste Sewer	Consists of a network of underground, double-encased stainless-steel pipe (encased in reinforced-fiberglass or plastic pipe as secondary containment) draining to the 340 Complex. Replaced the original radioactive liquid sewer (300 RRLWS, Retired Radioactive Liquid Waste Sewer) in 1979.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300 RRLWS, 300 Area Retired Radioactive Liquid Waste Sewer System	A network of 5-, 8-, 10-, and 15-cm (2-, 3-, 4-, and 6-in.) single-walled stainless steel piping and carbon steel fittings buried between 3 and 6 m (10 and 20 ft) below grade. A separate 8-cm (3-in.) carbon steel transfer line installed in 1960 connected the 309 Building to the 340 Complex. The system was replaced with the double-encased pipe of the 300 Area Radioactive Liquid Waste System (300 RLWS).	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300 VTS, 300 Area Vitrification Test Site	The site was used in the 1980s and 1990s as a field demonstration site for the vitrification (glassification) of soils containing waste simulates.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00009. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action.
300-1, Old N. Richland Auto Maintenance Yard	Reclassified to “No Action” by WSRF 98-081, 2/24/1999. No Decision Document.	300 Area ROD (EPA 2013), No Additional Action.
300-2, Contaminated Light Water Disposal	Contaminated Light Water Disposal Site. On September 29, 1965, a major contamination event occurred at the 309 Building, Plutonium Recycle Test Reactor (PRTR). When radionuclide contamination (due to neutron activation) was detected in the secondary coolant water stream going to the Columbia River, the water was pumped to the ground. About 189,250 L (50,000 gal) of secondary coolant water containing short-lived radionuclides was disposed to the ground. At no time did release of reactor material (transuranics or fission products) to the secondary coolant occur. Also see 300-283.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Also see 300-283. No Action. WSRF 2013-039, RSVP CCN 171178. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-4, Substation Soil Contamination	The site consists of the contaminated soil inside the southwest corner of the fenced (active) electrical substation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-5, Fire Station Fuel Tanks, Fire Station	The site was two underground fuel tanks, the pump island, ancillary piping, and contaminated soil. The tanks were removed in 1992.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-6, 366/366A Fuel Oil Bunkers	This site is the former location of four fuel oil underground storage tanks. Residual petroleum-related soil contamination remains with potential radiological contamination from adjacent waste sites. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-7, Undocumented Solid Waste Burial Ground	The site is a small rise that extends to the north and west from the 300 Area North Parking Lot. Surface debris piles can be seen and subsurface disturbances have been identified with ground-penetrating radar. Currently, the site is covered with natural vegetation. Some of the visible surface debris consists of concrete, trash, and cables.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-8, Aluminum Recycle Storage Area	The site consisted of six irregularly shaped soil contamination areas. The area was used to stage aluminum scrap from fuel fabrication operations to be sold to salvage contractors.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-9, Solid Waste Burial Ground	In 1952, an area of contamination was accidentally uncovered while installing poles for a new power line. This burial ground was supposedly used to dispose of solid uranium waste in 1944.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-10, Burial Trench West of Process Trenches	Reclassified to “Closed Out” by WSRF 99-105, 12/17/1997. TPA change form (Control Number 116) lists the site as Closed Out.	300 Area ROD (EPA 2013), No Additional Action.
300-11, Pumphouse Underground Gasoline Tank	The site was releases to the soil that were discovered following the removal of an underground gasoline tank in September 1992.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-15, 300 Area Process Sewer System	The site is an underground process sewer extending throughout the 300 Area for the disposal of process wastes such as steam condensate, cooling water, and nonregulated liquids. The piping consists primarily of 20-cm (8-in.) vitrified clay pipes with acid-proof joints, as well as cast-iron, stainless-steel, carbon steel, and polyvinyl chloride. 300-15:2 Process Sewer North of Apple St.; Remediated and Interim Closed Out; RSVP CCN 170618; WSRF 2012-120, 3-21-13.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). See subsites. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-16, Solid Waste Near 314 Building	On March 6, 1992, May 4, 1994, and September 22, 1995, radioactive contamination (yellow-cake uranium) was discovered on the bottom ends of several utility poles that had been removed. 300-16:1 Utility Pole NW of 314 Bldg. Interim Closed Out, RSVP CCN 163709, WSRF 2011-105, 1-18-2012. 300-16:2 Utility Pole East of 314 Bldg; Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300-16:3 Utility Pole SE of 314 Bldg; Remediated and Interim Closed Out; RSVP CCN 162824, WSRF 2011-100, 11-28-2011.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). See subsites. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-18, SCA #4, Surface Contamination Area #4	The site was identified during routine surveillance activities in 1993 as soil and metal shavings with contamination levels of 3,000 to 4,000 disintegrations per minute and six pieces of contaminated concrete reading 2,000 to 4,000 disintegrations per minute.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed. See CVP-2005-00004. 300 Area ROD (EPA 2013), No Additional Action.
300-22, 309 Building B-Cell Cleanout Leak	The site is an unplanned release from a parted hose coupling that contaminated the ground outside the emergency airlock of the 309 Building on September 20, 1962.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-24, Soil Contamination at the 314 Metal Extrusion Building	The oxide burner operations caused contamination to spread and be deposited on the south side of the facility near the southwest corner of the building and outside the door to the facility. WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-28, Contamination Found Along Ginko Street	Contaminated asphalt and soil beneath Ginko Street found during excavation activities associated with the installation of a fiber optic telephone system in 1994. WSRF includes 300-28, 300-43, 300-48, 300-249, and 300-16:3 waste sites (300-161 removed; rejected 98-180).	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-29, 305-B Berm	The site was a U-shaped soil berm that surrounded the east wing of the 305-B Chemical Waste Storage Building.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was reclassified to no action per WSRF 2004-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-32, 333 Building Remaining Soils after D&D	This site is the former 333 N Fuels Manufacturing Building; New Fuel Cladding Facility. The remaining concrete slab and associated piping have been removed. RTD memo CCN 164401. EPA remediation and sampling approval CCN 169058.	Candidate Waste Site; 300-FF-2 ESD (EPA 2009). Went RTD CCN 164401. Interim Closed Out; RSVP CCN 170617; WSRF 2013-006, 3-21-13. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-33, 306W Metal Fabrication Development Building Releases. (With 300-256 and 300-41)	The site is the contaminated soil around and under the 306W Building. The area around the 306W Building is paved and posted as having underground radioactive contamination.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2010-058. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-34, 300 Area Process Sewer Leak	The site was a release to soil that was discovered during excavation to install a new manhole (PS-87). PS-87 is a 0.7-m (2.3-ft)-diameter sewer opening with a round metal cover at grade.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-37	PCB Leak to Soil at 335A. WSRF 2013-108 CCN 172456. 8/15/2013.	Rejected.
300-39	309 Bldg. Fuel Storage Basin. WSRF 2013-096 CCN 172455. 8/13/2013.	Rejected.
300-40, Corroded Vitrified Clay Process Sewer Pipe	This leg of pipe collected rain water drainage from the 311 Tank Farm and the 303-F floor drains. The piping also collected effluent from the 311 Stillhouse. WSRF includes 300-40, UPR-300-40, UPR-300-39, UPR-300-45 Waste Sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-41, 306E Neutralization Tank. (With 300-33 and 300-256)	The site consists of a neutralization tank and valve pit. The tank may contain uranium and thorium sludge.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2010-058. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-43, Unplanned Release Outside 304 Building	The site is uranium-contaminated soil around the 304 Building (formerly the 304 Concretion Facility) in the 300 Area. The site also includes residual contamination remaining in the 304 Storage Area (304 SA). WSRF includes 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180)	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-45, Bird Droppings Area	Reclassified to “Closed Out” by WSRF 99-110, 5/13/1998. TPA change form (Control Number 118) lists the site as Closed Out.	300 Area ROD (EPA 2013), No Additional Action.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-46, Soil Contamination and French Drains Surrounding 3706 Building	This site estimates the extent of uranium, transuranic and chemical contamination of the 3706 Building and the surrounding area. Remediated and Interim Closed Out; RSVP CCN 171316; WSRF 2013-007, 5/17/13.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 171316; WSRF 2013-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-48, Thorium Oxide and Fuel Fab Chemical Wastes Around 3732 Building	This site is the 3732 Building foundation and the surrounding soil contamination. The site appears as a gravel-covered mound. WSRF includes 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180)	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Also in the 300-FF-2 ROD. Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-53, UPR East of 303-G	Reclassified to “Closed Out” by WSRF 99-014, 2/12/1999.	300 Area ROD (EPA 2013), No Additional Action.
300-57	335 90-Day Waste Accumulation Area. WSRF 2013-104 CCN 172456. 8/15/2013	Rejected
300-80, incorrectly described as 314 Building Stormwater Runoff, Misc Stream #268	The site was a square concrete structure adjacent to the 314 Building and next to a fenced stairway leading down. The site was covered by a steel plate marked with a sign “Radioactive material, internally contaminated.” WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-109, 333 Building Stormwater Runoff, Misc Stream #455	DOE/RL-95-82, *Inventory of Miscellaneous Streams*, states the injection well is below grade. A site visit on October 26, 1998, could not visually identify any surface features resembling a drain north of the 333 Building. The site was revisited on November 11, 1998, with a facility representative. A white PVC pipe emerges laterally from the asphalt in the approximate location described in DOE/RL-95-82, *Inventory of Miscellaneous Streams*.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim closed out. See CVP-2010-00004. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-110, 333 Building Stormwater Runoff, Misc Stream #456	The site is a 0.41-m (1.4-ft)-diameter drain with a metal grate labeled “Internal Radioactive Contamination” due to its proximity to the 618-1 Burial Ground. The drain has a dirt bottom that is approximately 0.61 m (2 ft) below the surface of the asphalt and an overflow line that drains to the process sewer.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-121, 3621D Building Stormwater Runoff, Misc Stream #403, Injection Well #26	The site is a french drain with a concrete base. The drain is covered by a 1.4-m (4.5-ft) metal lid. The lid appears to fit flush with the concrete base and is labeled “Confined Space” and has “FD 26” written on it. The site is surrounded by sandy soil and rocks.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-123, 366 Bldg. Fuel Oil Bunker Loading Station French Drain	The site is a french drain that received steam condensate from the 366 Building fuel oil bunker loading station. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-161	3707D Building Stormwater Runoff, Miscellaneous Stream #441. Remediated with 300-28, 300-43, 300-48, 300-249 and 300-16:3 waste sites (300-161 removed; rejected 98-180).	Rejected; WSRF 98-180. Remediated with 300-28 RSVP, WSRF 2011-100, 10-31-2011.
300-175, 3714 Building Steam Condensate, Misc Stream #434	The site is a 36-cm (14.2-in.)-diameter concrete french drain with a metal cover. The inside is dry and filled with cobbles. There are no steam lines entering the site, and no steam lines are visible inside the drain.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-214, 300 Area Retention Process Sewer	The site is an underground carbon steel and polyvinyl chloride pipeline connecting the 300 Area laboratory facilities (308, 324, 325, 326, 327, and 329 Buildings) to the 307 Retention Basins. The Retention Process Sewer (RPS) provides radioactive monitoring and transport of nonhazardous, potentially radioactive process waste.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-218, 314, 314A, and 314B Buildings	This site consists of the former 314 and 314A Building areas. All above-grade portions of the buildings have been demolished, but below-grade portions are suspected of being contaminated. WSRF includes 300-24, 300-80, 300-218, 300-16:2 waste sites at 314 Metal Extrusion Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; CVP-2011-00004; WSRF 2011-071. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-219, 300 Area Waste Acid Transfer Line	This site consists of the transfer lines connecting the various components of the 300 Area Acid Treatment Plant (WATS) and the 300 Area Uranium Recovery Operations. Remediated with 300-224 WATS and 333 WSTF.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-223	384 Powerhouse Day Tanks. WSRF 2001-042 CCN 171757. 7/8/2013.	Final Closed Out.
300-224, WATS and U-Bearing Piping Trench	The site is a subsurface concrete pipe trench with concrete block and metal plate covers. The pipe trench has several sections that allow piping connections to be made between process operations in the 313 Building, the 303-F Building, the 311 Tank Farm, the 333 Building, the 334-A Building, and the 334 Tank Farm. Remediated with 300-219 and 333 WSTF.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-231, Transformer Pad	Vitrification Test Site Transformer Pad. WSRF 2013-109 CCN 172456. 8/15/2013	Consolidated.
300-249, 304 Building, Residual Rad Contamination	304 Building, Residual Rad Contamination. WSRF includes 300-28, 300-43, 300-48, 300-249, and 300-16:3 waste sites (300-161 removed; rejected 98-180).	Remediated and Interim Closed Out; RSVP CCN 162824; WSRF 2011-100. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-251, Unplanned Release Outside 303-K Building	The site consists of uranium contaminated soil around and under the 303-K Building (also known as the 303-K Contaminated Waste Storage). The 303-K Building was removed and clean closed on July 22, 2002.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2011-042. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-253, 384-W Original Brine Pit	Reclassified to “No Action” by WSRF 99-042, 5/26/1999.	300 Area ROD (EPA 2013), No Additional Action.
300-255, 309 Tank Farm Contaminated Soil	The site is contaminated soil located inside the 309 Building Tank Farm fenced area. The source of the contamination was probably the piping related to tanks 309-TW-1, 309-TW-2, and 309-TW-3.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-256, 306E Fabrication and Testing Laboratory Releases. (With 300-33 and 300-41)	The site is contaminated soil under and around the 306E Building. The area around the 306E Building is paved and posted as having underground radioactive contamination.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2010-058. 300 Area ROD (EPA 2013), No Additional Action. Reclassify to Final Status.
300-257, 309 Process Sewer to River	The site is process sewer piping that was originally connected to the 309 Buildings Rupture Loop Holding Tank. The tank was removed in the late 1970s, but the piping remains. RESRAD calc brief done for outfall (overflow) to the river.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). No Action. WSRF 2010-074; RSVP CCN 171702, 6/27/13. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-258, Abandoned Pipe Trench	The site is an abandoned subsurface concrete pipe trench. The top of the pipe trench is level with the ground surface and is covered with metal plates to allow vehicle traffic on the north side of the 306E Building to drive over the pipe trench. Between the 333 Building fence and the 334 Tank Farm, the trench is primarily surrounded by gravel.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 155049; WSRF 2011-082. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-259, Contamination Area Surrounding 618-1 Burial Ground	The Contamination Area is located in the northeast corner of the 300 Area, north and east of the 618-1 Burial Ground.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. See WSRF 2009-059. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-260, Contaminated Soil West of 313 Building	The site is currently surrounded by light posts and a yellow rope, but no signs of any kind are present. A small amount of equipment and large wooden boxes are stored inside the roped area.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). No Action. See WSRF 2010-074; CCN 155798. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-262, Contaminated Soil West of South Process Pond	The contaminated soil was discovered in 1994 during excavation activities to install a utility pipeline.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and closed. See CVP-2003-00002. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-263, 324 Building Diversion Tank	The site is an inactive catch tank. The tank was set up to hold contaminated process solutions that were too hot to send directly to the crib without additional treatment. After the tank was put on line, it was intended to be used as a diversion tank in the event of a radioactive release from the facility (324 Building). Shortly after the tank was installed, the 340 Complex came on line. At that time, the piping system to the diversion tank in the 324 yard was bypassed and capped. Since that time, the 324 Building has transferred its waste to the 340 Complex.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-264, 327 Building Post Irradiation Testing Laboratory (PTL)	The 327 Building was demolished by D4 in May 2012 with residual soil contamination removed in June 2012. DOE-RL and EPA agreed that GPERS surveys and radiological soil samples were sufficient for Interim Close Out. WSRF 2012-038, CNN 166408, 6/13/2012.	RTD Waste Site; Action Memorandum (DOE-RL 2006). Remediated and Interim Closed Out. See WSRF 2012-038, CCN 166408, 6/13/2012. Rejected, WSRF 2013-110 CCN 172455. 8/13/2013.
300-265, Pipe Trench Between 324 and 325 Buildings	The site is a 5-cm (2-in.) underground encased stainless-steel waste transfer line encased within a 10-cm (4-in.) fiberglass-reinforced epoxy pipe. Inside the pipeline are two other stainless-steel Schedule 40 pipes, one is 3/8 in. and the other is 3/4 in.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-268, 3741 Building Foundation	The contamination related to this building was a result of passive dust from machining irradiated uranium, graphite, and other metallic samples from the 305 Test Pile. The contamination, if remaining, would be associated with any remaining concrete foundation. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-269, 331-A Virology Laboratory Foundation	The site is a rectangular concrete building foundation. Air conditioner units are installed on the concrete foundation to support the adjacent 331 facility.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-270, Unplanned Release at loading dock east of 313 Building	The “unplanned release” is a milky-white flow of water that came out of a pipe located below the loading dock on the east side of the 313 Building. The pipe drains stormwater from the roof of the 313 Building. The release was on to the surface of the ground, in an area of compacted gravel and soil. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-006. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-273, Fuel Oil Transfer Pipeline	This site is an encased underground pipeline that transferred fuel oil from the 366 fuel oil bunkers to underground day tanks at the 384 Powerhouse. Remaining soils also have the potential for radiological contamination from adjacent waste sites. WSRF 2011-107 includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-274, Surface Debris	This site consists of surface debris (transite, wood, asphalt, metal, and broken glass) located across the 300-FF-1 Operable Unit. The segment of the 300-274 waste site near the 618-4 Burial Ground was found to contain PCB oil-stained soil to a depth of 4.6 m (15 ft).	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; WSRF CCN 171182; WSRF 2011-091. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-275, Potential Landfill on River Edge	This site consists of surface debris (asbestos-containing shingles and concrete, trash) and subsurface debris of unknown type.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Site has been remediated and interim closed. See WSRF 2008-059. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
300-276, 3607 Sanitary System Misc. Components	The site includes the surface and subsurface sewer system components downstream of manhole SS6. Remediated and Interim Closed Out; RSVP CCN 162933; WSRF 2011-102.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Interim Closed Out. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-277, 300 Area Queue Soil Contamination	300 Area Queue Soil Contamination.	Accepted Site. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-279, 3716 Automotive Repair Building Fuel Tanks.	3716 Automotive Repair Building Fuel Tanks. No Action. See WSRF 2012-034, RSVP CCN 166822, 7/16/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-280, Construction Debris Disposal Pit	Construction Debris Disposal Pit West of George Washington Way.	Candidate Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-281, Suspected Septic Tank	Suspected Septic Tank Near 325 Building. No Action. See WSRF 2012-036, CCN 166635, 7/5/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-282, Crib Near 3717-B Building	Crib Near 3717-B Building. Rejected. See WSRF 2011-052, 6/8/11, CCN 159272.	Candidate Waste Site. Rejected. DOE-RL 2011, 300 Area Fact Sheet. Not included in 300 Area Final ROD.
300-283, Contaminated Light Water Disposal Site #2.	Contaminated Light Water Disposal Site #2. On September 29, 1965, a major contamination event occurred at the 309 Building, Plutonium Recycle Test Reactor (PRTR). When radionuclide contamination (due to neutron activation) was detected in the secondary coolant water stream going to the Columbia River, the water was pumped to the ground. About 189,250 L (50,000 gal) of secondary coolant water containing short-lived radionuclides was disposed to the ground. At no time did release of reactor material (transuranics or fission products) to the secondary coolant occur. Also see 300-2.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. Also see 300-2. No Action. See WSRF 2012-053, RSVP CCN 166820, 7/16/2012. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-284, Sandblasting Area Near 3221 Building	Sandblasting Area Near 3221 Building. Residue removed by other remediation in the area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-285	300 Area Steam Condensate French Drains/Dry Wells, Ten French Drains and Dry Wells in 300 Area.	Not Accepted.
300-286, Potentially Contaminated French Drain	Three 300 Area Potentially Contaminated French Drain/Drywells. No Action. See WSRF 2012-037, RSVP CCN 166821, 7/16/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-287, Transite Debris West of Route 4 South	Transite Debris West of Route 4 South.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
300-288, Garnet Sand in Gravel Pit 6	Piles of Garnet Sand/Soil Mixture Within Gravel Pit 6.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
300-289, Stained Soil Area North of 300 Area	Stained Soil Area North of 300 Area.	Candidate Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-290, Rad Debris Area East of Horn Rapids Landfill.	Radiological Debris Area East of Horn Rapids Disposal Landfill. This site consists of debris, mostly rusted metal automotive parts, scraps of crumpled sheet metal, electrical wire debris, and engine gaskets in a posted Radiological Material Area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
300-291, Garnet Sand West of 350-A Paint Shop	Garnet Sand West of 350-A Paint Shop.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-292	315 Water Filter Plant Waste Pipeline Segments.	Rejected per WSRF 2011-038. CCN 165748. No ROD or ESD. Reclassify to Final Status.
300-293, 300 Area Misc. Pipelines.	300 Area Misc. Pipelines. The site was divided into two subsites: 300-293:1, 300 Area Misc. Pipelines - less than 2.5 ft bgs; No Action per WSRF 2011-056, 6/22/2011; CCN 160008. 300-293:2, 300 Area Misc Pipelines - greater than 2.5 ft bgs. No Action. See WSRF 2012-030, RSVP CCN 166650.	Candidate Waste Site. No Action. See Subsites. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), Reclassify to Final Status.
300-294, Garnet Sand East of 350 Building.	Garnet Sand East of 350 Building. Residue removed by other remediation in the area.	RTD Waste Site. See DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
300-295	384 Powerhouse Coal Ash Waste Pipeline Segments.	Rejected per WSRF 2011-039. CCN 165749. No ROD or ESD. Reclassify to Final Status.
300-296, Soil Contamination Under 324 Bldg B-Cell	Soil Contamination Under 324 Bldg B-Cell Sump.	Accepted Site. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
303-MSA, 303-M Storage Area	The storage pad was painted (including the curbs and area within about 0.9 m [3 ft] outside the curb) to fix all radioactive contamination. The storage pad was posted with “fixed radioactive contamination” signs on its surface.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
303-M UOF, 303M Uranium Oxide Facility	The facility was used to oxidize pyrophoric uranium metal turnings and chips and zircalloy-2 fines generated during fuel fabrication machining operations in the 333 Building. The metal turnings were received in 114-L (30-gal) drums filled with water for fire prevention. The metal turnings were removed, screened, hand fed into a shredder/chopper, and small bags of metallic fines were placed inside a burner chamber for oxidation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site was remediated and interim closed with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
305-B SF, 305-B Storage Facility	The 305-B Storage Facility was used to store, segregate, repackage, and sample hazardous and radioactive mixed waste generated by Pacific Northwest National Laboratory (PNNL) research laboratories in the 300 Area. (TSD Facility; EPA Signature Not Required on WSRF.)	Closure activities completed by WCH 8/7/2006 per WSRF 2008-051 in the Administrative Record. Letters #0070792 #0079299. Also see CCN170838. Final Closed Out per WSRF 2008-051 CCN 171756. 7/8/2013.
307 RB	307 Retention Basins. WSRF 2013-103 CCN 172455. 8/13/2013.	Rejected.
309-TW-1	309 Holdup Tanks, Tank #1. WSRF 2013-097 CCN 172455. 8/13/2013.	Rejected.
309-WS-1	309 Plutonium Recycle Test Reactor Vault. WSRF 2013-100 CCN 172455. 8/13/2013.	Rejected.
309-TW-2	309 Holdup Tanks, Tank #2. WSRF 2013-098 CCN 172455. 8/13/2013.	Rejected.
309-WS-2	309 Rupture Loop Annex (Rm. 20) . WSRF 2013-101 CCN 172455. 8/13/2013.	Rejected.
309-TW-3	309 Holdup Tanks, Tank #3. WSRF 2013-099 CCN 172455. 8/13/2013.	Rejected.
309-WS-3	309 Brine Tank. WSRF 2013-102 CCN 172455. 8/13/2013.	Rejected.
311 MT1, 311 Tank Farm Methanol Tank #1	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
311 MT2, 311 Tank Farm Methanol Tank #1	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
311-TK-40	300 Area Waste Acid Treatment System (WATS). WSRF 2001-100 CCN 171755. 7/8/2013.	Final Closed Out.
311-TK-50	300 Area Waste Acid Treatment System (WATS). WSRF 2001-101 CCN 171755. 7/8/2013.	Final Closed Out.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
313 ESSP, 313 East Site Storage Pad	The site is a large concrete pad with an asphalt ramp that connects the pad to Ginko Street. Previously, the site staged radiological waste from 313 Building operations and, during fuel fabrication operations, staged mixed waste from the 313 Centrifuge and uranium waste from the 313 Filter Press. The unit was also used to stage raw materials received by rail cars. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-005. 300 Area ROD (EPA 2013), Reclassify to Final Status.
313 MT, 313 Bldg. Methanol Storage Tank	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.
316-1, South Process Pond	South Process Pond.	EPA 1996, CVP-2003-00002, Interim Closed Out, WSRF 2000-112. 300 Area ROD (EPA 2013), Enhanced Attenuation.
316-2, North Process Pond	North Process Pond.	EPA 1996, CVP, BHI-01298 Closed Out, WSRF 99-050. 300 Area ROD (EPA 2013), Enhanced Attenuation.
316-3, 307 Disposal Trenches	The site consisted of two trenches, each 180 m (600 ft) long, 9.1 m (30 ft) wide at the east end, tapering to 3.0 m (10 ft) wide at the west end. The depth varied from 3.7 m (12 ft) to 8.2 m (27 ft). Each contained a 13-cm (5-in.) vitrified clay pipe that ran the entire length of the unit. The trenches ran in an east and west direction, approximately 6.1 m (20 ft) apart. From 1953 to 1963, effluent below discharge limits was released from the 307 Retention Basins and discharged to these trenches. When the trenches were taken out of service in 1963 the contaminated sediments were excavated and transported to the 618-10 Burial Ground. The trenches were backfilled with process pond scrapings in 1965, and a large portion of the location has been paved and fenced. In 1991 three boreholes were drilled through the trenches. Contamination was only found in the backfill.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. WSRF 2012-099. RSVP CCN (Pending). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels, Enhanced Attenuation.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
316-4, 321 Cribs, 300 North Cribs, 316-N-1, 616-4)	The site consists of two bottomless tanks buried 3 m (10 ft) below grade and resting on gravel strata. The tanks are 0.6 m (2 ft) apart, with a stainless steel overflow pipe connecting them just below the top of each tank. A total of 895.4 kg (1,974 lb) of uranium was discharged to the cribs as uranium-bearing organic wastes from the 321 Building between 1948 and 1954.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site partially excavated, tanks removed and backfilled; deep soil contamination remains. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
316-5, 300 Area Process Trenches	300 Area Process Trenches.	EPA 1996, CVP, BHI-01164 Closed Out, WSRF 98-108. 300 Area ROD (EPA 2013), Enhanced Attenuation.
331 LSLDF, Life Sciences Lab Drain Field	The site consists of an abandoned drain field. The unit is fed by one diversion box and four septic tanks. The unit discharged sanitary wastewater, and potentially animal waste, to the soil column. The site was abandoned in place after the waste system was connected to the 300 Area Sanitary Sewer.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). No Action; RSVP CCN 141797; WSRF 2008-020. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
331 LSLT1, Life Sciences Lab Trench No. 1	The site is an abandoned leaching trench that has been backfilled. The site was a rectangular excavation and includes connecting waste transfer lines. The 331 Leaching Trenches disposed of sanitary and animal wastes to the soil column.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
331 LSLT2, Life Sciences Lab Trench No. 2	The site is an abandoned leaching trench that has been backfilled. The site was a rectangular excavation and includes connecting waste transfer lines. The 331 Leaching Trenches disposed of sanitary and animal wastes to the soil column.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
333 ESHWSA, East Side Hazardous Waste Storage Area	The storage area is part of the asphalt paved area near the northeast corner of the 333 Building, within the building fence line. The area provided temporary storage for miscellaneous hazardous wastes in barrels, buckets, cans, and/or drums.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out with 618-1. See CVP-2010-00001. 300 Area ROD (EPA 2013), No Additional Action, Reclassify to Final Status.
333 LHWSA	618-1 Burial Ground, 618-1:1, 618-1:2, 333 LHWSA, UPR-300-13, UPR-300-14.	Remediated and Interim Closed Out with 618-1. See CVP-2010-00001. WSRF 2010-028. Reclassify to Final Status.
333-TK-7	300 Area Waste Acid Treatment System (WATS). WSRF 2001-109 CCN 171755. 7/8/2013.	Final Closed Out.
333-TK-11	300 Area Waste Acid Treatment System (WATS). WSRF 2001-105 CCN 171755. 7/8/2013.	Final Closed Out.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
333 WSTF, 333 West Side Tank Farm.	333 West Side Tank Farm. The site was an above-grade tank farm containing three cylindrical tanks that stood upright within a concrete containment basin. Remediated with 300-218 and 300-224 WATS.	RTD Waste Site; See DOE-RL 2011, 300 Area Fact Sheet. Remediated and Interim Closed Out; RSVP CCN 163629; WSRF 2011-106. 300 Area ROD (EPA 2013), Reclassify to Final Status.
340 Complex, 340 Radioactive Liquid Waste Handling Facility	The 340 Complex consists of the 340, 340-A, 340-B, and 3707-F Buildings, and two office trailers. Other 340 complex systems include the 307 Retention Basins, two tanks in an underground vault, six aboveground tanks in 340A, underground transfer pipes, load-out and decontamination equipment, and instrumentation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
3712-USSA, 3712 Bldg. Uranium Scrap Storage Area.	3712 Bldg. Uranium Scrap Storage Area. The 3712 USSA was a uranium metal storage unit. Fires occurred in 1979 from an inadequately cured billet and in 1985 from uranium fines.	RTD Waste Site; DOE-RL 2011, 300 Area Fact Sheet. Interim Closed Out; 8/16/2011; WSRF 2011-046; CCN 160789. 300 Area ROD (EPA 2013), Reclassify to Final Status.
400 PPSS, Process Pond & Sewer System	Consists of underground piping, a control structure, and two percolation ponds.	300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-36	4843 Waste Inspection Facility. WSRF 2013-107 CCN 172456. 8/15/2013.	Rejected.
400-37, Fuel Oil Tank South of 4732-B	This site is an underground fuel storage tank that may have been filled with sand and abandoned in place. It is near the southeast corner of the 4732-B Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-38, Fuel Oil Tank East of 4722-A	This site is an underground fuel storage tank that may have been filled with sand and abandoned in place. It is near the remaining concrete pad from the former 4722-A Building.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
400-41, Stained Soils near 4723 Building		Candidate, DOE-RL 2012, 300 Area Fact Sheet.
427 HWSA	427 Building Hazardous Waste Storage Areas. WSRF 2013-105 CCN 172456. 8/15/2013.	Rejected.
600-22, UFO Landing Site	No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	EPA 2013; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
600-46, Cutup Oil Dump (300 Area)	Letter 022804, 1995, "Voluntary Cleanup of the 300-FF-2 "CUTUP" Oil Dump Site at Hanford," to D. L. Duncan, U.S. Environmental Protection Agency, from R. G. McLeod, U.S. Department of Energy, Richland Operations Office, October 16.	WSRF 98-079. Closed Out. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-47, Dumping Area North of 300-FF-1	The site consisted of several areas of debris and irrigation pipes, four underground radioactive material areas, and one small soil contamination area. Debris included concrete, brick, cinder block, glass, stainless steel, plastic, tar roofing paper, wire, pipe, bottles, and screen.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00005. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-63, 300-N Lysimeter Area	The site is potentially contaminated soil and equipment. In 1978, the Buried Waste Test Facility was established to investigate recharge and radionuclide migration at the Hanford Site. Six drainage lysimeters 7.6 m (25 ft) deep and two weighing lysimeters 1.5 m (5 ft) deep were installed. Trace amounts of cobalt-60 and tritium were placed in lysimeters and migration of the contaminants was monitored.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
600-117, 300 Area Treated Waste Disposal Facility (310 TEDF)	Closed by D4 with a Facility Status Change Form. Decision Document: DOE-RL, 2006b, "Transmittal of Approved Action Memorandum Associated with Engineering Evaluation/Cost Analysis #3 for the 300 Area, DOE/RL-2005-87," CCN 131082 dated November 30, 2006, to P. L. Pettiette, Washington Closure Hanford, from S. L. Sedgwick, U.S. Department of Energy, Richland Operations Office, Richland, Washington.	Interim Closed Out. See WSRF 2012-117, 12/6/2012. WSRF CCN 171182. Rejected per WSRF 2013-112, 8/13/2013.
600-243, Petroleum Contaminated Soil	The site is a treatment facility for petroleum-contaminated soil using bioremediation technology.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Site has been remediated and interim closed. See WSRF 2007-033. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
600-259, Inactive Lysimeter Site East End, Special Waste Form Lysimeter	The special waste form lysimeter was constructed in the summer of 1983 and consisted of 10 soil-filled caissons around a central access caisson.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2005-00008. Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
600-276, Hanford Geotechnical Engineering and Development Facility, GEDF, Cold Test Facility, Little Egypt	The site is a large open field with a high mound of soil in the center surrounded with light posts and chain. A vehicle gate is posted "Authorized Personnel Only." The facility became operational in 1982 to test burial ground subsidence control alternatives. The original site consisted of three test areas. Each test area was a cluster of buried simulated waste with a center monitoring caisson. Several pipes extend vertically through the surface of the soil in some areas. A small pallet containing damaged bags of bentonite is located in the southeast corner of the area adjacent to some vertical pipes.	Candidate Waste Site; 300-FF-2 ESD (EPA 2009). Not Accepted. (See also 600-367.)
600-278, Bioremediation Pad in Gravel Pit 9	Petroleum-contaminated soil from beneath two 384 powerhouse day tanks was taken to Pit 9 for bioremediation. According to HNF-19536 bioremediation was successful. See SIS.	No Decision Document. Interim Closed Out. WSRF 2003-054, 5/4/2004.
600-290:1, Contaminated Pad West of 618-13	CVP for 618-13 Burial Ground and 600-290:1 Pad and Loading Dock near 618-13. The waste site is in the 300-FF-2 "Plug-In" Waste Site Factsheet covering fiscal year 2010, the first annual report documenting remediation using the plug-in approach of waste sites located in 300-FF-2. Available online at: http://www2.hanford.gov/ARPIR/?content=findpage&AKey=0084211	DOE-RL 2010, 300 Area Fact Sheet E1009034. Remediated with 618-13. CVP-2009-00005. WSRF 2009-055. WSRF 2009-032. 300 Area ROD (EPA 2013), Reclassify to Final Status with 618-13.
600-290:2; 300 West Storage Area	Contaminated Equipment Storage Area. No Action. See WSRF 2012-028, RSVP CCN 166657, 7/5/2012.	Candidate Waste Site. No Action. DOE-RL 2011, 300 Area Fact Sheet. 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
600-352-PL, Retention Process Sewer.	342 Lift Station to 310 Retention Transfer System.	Candidate Waste Site. DOE-RL 2012, 300 Area Fact Sheet. Final Consolidated; WSRF 2013-118.
600-367, Burial Pit Near Little Egypt	Pit was excavated to bury the remains of equipment and office trailer burned in a 1980s range fire.	300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.
600-386, Segment 5 Battery Remnant Area #1 in 300-FF-2	Accepted Discovery Site. Orphan site (OSR-2011-0002). In 300-FF-2 Operable Unit. Located north of TEDF, west of Stevens Ave., and south of the 618-10 waste site. RSVP CCN 167254, Interim Closed Out, WSRF 2012-051, 8/8/2012.	Discovery Site. Accepted. RTD. DOE-RL 2012, 300 Area Fact Sheet. Interim Closed Out. Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-1, Burial Ground No. 1, 318-1	The site consists of at least two trenches. It received waste from the 321 Building, 3741 contaminated machining operation, and 3706 Laboratory. Reports mention burial of a bronze crucible reading 179 mr/hr. Some buried waste may have been dissolved after a nitric acid tank leak in 1965.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2010-00001. WSRF 2010-028. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-2, Burial Ground No. 2, 318-2	The site consisted of three trenches containing waste from fuel fabrication and laboratory activities. Automobile batteries were found on the surface prior to surface stabilization in 1989. They were left in place and covered with 0.6 m (2 ft) of clean backfill material.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00010. WSRF 2006-062. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-3, Burial Ground No. 3, Dry Waste Burial Ground No. 3	The site consisted of a pit. Inventory included uranium-contaminated construction debris from the 311 Building and construction/demolition debris from remodeling of the 313, 303-J, and 303-K Buildings.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00005. WSRF 2006-035. 300 Area ROD (EPA 2013), Enhanced Attenuation.
618-4, Burial Ground No. 4, 318-4	The burial ground was a single disposal pit measuring approximately 32 m (105 ft) by 160 m (525 ft). Little historical information is available. It is believed to have operated from 1955 through 1961. Excavation found 786 drums containing depleted uranium waste in addition to piping, miscellaneous debris, and soil contaminated with lead, barium, oil, and PCBs.	RTD Waste Site; 300-FF-1 ROD (EPA 1996). Remediated and Interim Closed Out. See CVP-2003-00020. WSRF 2003-055. Reclassify to Final Status.
618-5, Burial Ground No. 5, 318-5	Single burning pit and storage area for aluminum silicate and bronze crucibles surrounded by two fences. Contained uranium-contaminated trash, uranium-contaminated aluminum silicate, and bronze crucibles, with radiation levels up to 200 mr/hr.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2003-00021. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
618-7, Solid Waste Burial Ground No. 7, Burial Ground #7, 318-7	Used for disposal of hundreds of drums containing zircaloy chips from the process of machining the ends of zircaloy-clad fuel elements at the 321, 3722, and 3732 Buildings. The chips may be contaminated with beryllium and uranium. They were considered to be pyrophoric and were put into 113.6-L (30–gal) iron drums that were filled with water prior to disposal. Other low-level material contaminated with uranium and thorium was also buried at the site.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). Site has been remediated and interim closed. See CVP-2008-00002. WSRF 2008-050. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-8, Burial Ground No. 8, 318-8, Early Solid Waste Burial Ground	It is suspected that the site contained debris from expansion and remodeling of the 313 Building in 1954. A parking lot was constructed over a majority of the site.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Site has been remediated and interim closed. See CVP-2006-00006. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
618-9, 300 West Burial Ground, 318-9, Dry Waste Burial Ground No. 9.	An Expedited Response Action was conducted in 1991-1992 to remove drums that contained uranium-contaminated organic solvents (hexone and kerosene). After removing 42 solvent-containing drums and more than 80 empty drums, plus scrap process equipment and debris, the soil of the empty trench was sampled and analyzed for organic and inorganic chemicals, metals, radioactive materials, and pesticides. Soil gas testing was performed to determine if organic vapors remained in the soil. No contaminants were found at concentrations above risk-based standards so the trench was backfilled and revegetated. EPA, 1991, *Expedited Response Action Appr oval for 618-9 Burial Ground*, February 1991, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. DOE/RL-91-38, 1992, *Engineering Evaluation of the 618-9 Burial Ground Expedited Response Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.	Expedited Response Action (EPA 1991) (DOE/RL-91-38). Remediated and Interim Closed Out. See WSRF 98-075. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-10, 300 North Solid Waste Burial Ground, 318-10	The site consists of 12 trenches and 94 VPUs. Trenches range in size from 97.5 m (320 ft) long by 21 m (70 ft) wide by 7.6 m (25 ft) deep to 15 m (50 ft) long by 12 m (40 ft) wide by 7.6 m (25 ft) deep. Vertical pipe units are 56-cm (22-in.)-diameter, 4.6-m (15-ft)-long waste receptacles constructed by welding five 208-L (55-gal) bottomless drums together. The column of drums were buried vertically. When they reached their waste capacity level, they were backfilled and topped with concrete. The walls of the typical drums used in the VPUs are expected to have lost integrity. The site contains a broad spectrum of low- to high-activity dry wastes, primarily fission products and some transuranic (TRU) waste from the 300 Area. Low-level wastes are buried in trenches, and medium- to high-activity beta/gamma wastes are mostly in the VPUs. Some higher activity wastes were placed in concrete-shielded drums and disposed in the trenches. The total quantity of plutonium or other transuranic elements within the 618-10 Burial Ground is estimated to be much less than the 618-11 Burial Ground (1 to 2 kg, or 2 to 4 lb) dispersed throughout the waste site. In addition to a small amount of transuranic-contaminated waste, records indicate that the 618-10 Burial Ground trenches also contain high-activity waste and buried drums of oil. During stabilization activities at the 618-10 Burial Ground in 1983, a noticeable puddle of oil appeared from beneath the soil surface after heavy equipment drove over a portion of the waste site, indicating a potential loss of drum integrity. The site perimeter is fenced and marked with concrete markers and posted with underground radioactive material signs. The site was surface stabilized with an additional 0.6 to 0.9 m (2 to 3 ft) of clean material and vegetated with grasses in 1983. The site operated from 1954 to 1963.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). 300 Area ROD (EPA 2013), RTD to Residential Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-11, Y Burial Ground, 318-11, 300 Wye Burial Ground	Site consists of 3 trenches, approximately 50 VPUs, and 4 large-diameter caissons. The trenches are 270 m (900 ft) long by 15 m (50 ft) wide (surface dimensions) and 7.6 m (25 ft) deep. The vertical pipe storage units (caissons) are 56-cm (22-in.)-diameter by 4.6-m-(15-ft)-long and were made by welding five 208-L (55-gal) drums together. The welded drums formed a cylinder that was buried vertically. The large-diameter caissons were constructed of 2.4-m (8-ft)-diameter corrugated metal pipe, 3 m (10 ft) long, with the top of the caisson being 4.6 m (15 ft) below grade, connected to the surface by an offset 9-cm (36-in.)-diameter pipe with a dome-type cap. These units were buried with approximately 4.6 m (15 ft) of space between them and are open to the soil at the bottom. A second caisson configuration involves a single 2.4-m (8-ft)-diameter by 3-m (10-ft)-long horizontal corrugated metal pipe caisson, 6.1 m (20 ft) below grade with two 61-cm (24-in.)-diameter chutes. The site contains a variety of low- to high-activity waste (including fission products and plutonium) from the 300 Area. It is believed that some elements of the buried inventory are chemically reactive in water and in air and could, under the right conditions, become pyrophoric. The trenches were used for contact-handled waste. Remote-handled waste was deposited in VPUs or into the caissons. The calculated total mass of plutonium in the 618-11 Burial Ground based on historical records and process knowledge is about 2,442 g, which includes 23 g in the trenches, 493 g in the VPUs, and 2,032 g in the caissons. The burial ground trenches also contain high-activity waste. In January 1999, levels of tritium that greatly exceeded concentrations usually found in area groundwater were identified in a well immediately downgradient of 618-11. Subsequent investigation indicated that the tritium was probably due to lithium-aluminate targets disposed in the burial ground and originated from a group of three caissons located near the north-central portion of the burial ground. However, in view of the fact that the targets had relatively low external dose rates, it is also possible that they may have been disposed to the trenches in the same general area. Shortly after the site was closed it was covered with 1.2 m (4 ft) of soil. The site was surface stabilized in 1983 with an additional 0.6 m (2 ft) of clean material and vegetated with grass. The burial ground is in close proximity to the Energy Northwest Hanford Generating Station #2 nuclear reactor, which presents unique circumstances for maintaining safeguards. The site operated from 1962 to 1967.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
618-13, Burial Ground 318-13, 303 Building Contaminated Soil Burial Site	The site was originally a single-use site for disposal of uranium–contaminated soil removed from the 303 Building perimeter in 1950. Covered with 0.6 m (2 ft) of clean soil. Reportedly later served as a safety shield for hexone drums stored in buildings west of the mound (prior to burial in the 618-9 Trench). Concrete foundation exists directly west of mound.	RTD; 300-FF-2 ROD (EPA 2001). Unrestricted Land Use per 300-FF-2 ESD (EPA 2004). Remediated and Interim Closed Out. CVP-2009-00005. WSRF 2009-032. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
4831 LHWSA	4831 Laydown Hazardous Waste Storage Area. WSRF 2013-106 CCN 172456. 8/13/2013.	Rejected.
UPR-300-1, 316-1A, 307-340 Waste Line Leak	The site was a release to the soil in the area between the 307 Retention Basins and the 340 Building. The release consisted of process effluent contaminated by transuranic fission products.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-2, Releases at 340 Facility	The site appears to be multiple releases from ongoing decontamination and waste handling activities starting in January 1954.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-4, Contaminated Soil Beneath 321 Building	The site is the soil beneath and south of the 321 Building. The site represents a number of releases that occurred from 1945 to 1988. This time period covers the development of the REDOX, PUREX processes, and numerous other pilot operations.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. RSVP CCN 172326; WSRF 2012-110. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-5, Spill at 309 Storage Basin	The site was a release that contaminated the storage basin area, the filter vault, the stack base, the truck stall, and the truck ramp outside the 309 Building. The waste was low-level radioactive water. The primary isotope was cesium-137.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-10, Contamination Under 325 Building	This release occurred in the radioactive waste sewer line that served the 325-B Hot Cells between the west basement wall of room 32 and the north foundation wall of room 202 of the 325 Building. It included waste from dissolution of highly radioactive samples including irradiated reactor fuels.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-11, Underground Radioactive Liquid Line Leak	The site was a release to the soil that involved a 1.22-m (4-ft)-diameter column of gravel-covered soil in the 340 Complex yard, located immediately south of the 340 Vault. The release occurred around and below a leaking flanged-tee that connected the Retired Radioactive Liquid Waste Sewer (RRLWS) to the 340 Vault.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
UPR-300-12, Contaminated Soil Beneath 325 Building	The site was an unplanned release that occurred in the basement floor on the east side of the 325-A Building. The waste migrated through cracks in the floor to the soil beneath the building. The site received radioactive rinse water overflow containing nitrate ions, promethium-147, fission products, and transuranic nuclides.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-300-13, UPR-300-14	618-1 Burial Ground, 618-1:1, 618-1:2, 333 LHWSA, etc.	Remediated and Interim Closed Out with 618-1. See CVP-2010-00001;WSRF 2010-028. Reclassify to Final Status.
UPR-300-17, Metal Shavings Fire	The site was the asphalt area at the southeast corner of Building 333. The waste consisted of oily rags and other waste material, including what was believed to be uranium shavings.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out. RSVP CCN 152208; WSRF 2010-014. 300 Area ROD (EPA 2013), No Additional Action; Reclassify to Final Status.
UPR-300-38, Soil Contamination Beneath 313 Building	The site is the contaminated soil beneath the 313 Building, as well as the concrete foundation. The full extent of contamination will not be determined until the 313 Building foundation has been removed and soil remediation occurs. The contamination resulted from multiple unplanned release events. CCN 165615 includes 300-270, 313 ESSP, and UPR-300-38.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim Closed Out; RSVP CCN 165615; WSRF 2012-004. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-39, Sodium Hydroxide Leak at 311 Tank Farm	About 1954, an unplanned release occurred in the 311 Tank Farm when one of two (37,854-L [10,000-gal]) tanks leaked a 50% sodium hydroxide solution into the soil. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001).. Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-40, Acid Release at 303-F Pipe Trench	Release to the soil between the 311 Tank Farm and the 303-F Building. Uranium-bearing acid containing nitric and sulfuric acid with uranium in solution and chromic acids with copper and zinc in solution. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001) . Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-41, 340 Building Phosphoric Acid Spill	Reclassified as Closed Out per WSRF 99-011, 2/24/1999. No Additional Action (waste site does not pose an unacceptable risk and does not require additional action).	300 Area ROD (EPA 2013), No Additional Action.

Table A-1. Waste Site Information

Site Name	Site Information	Site Status
UPR-300-42, 300 Area Powerhouse Fuel Oil Spill	The oil spill was caused by an overflow of a former underground tank due to a valve failure. The remaining soil may also contain radiological contamination. WSRF includes 300-6, 300-123, 300-268, 300-273, and UPR-300-42 Powerhouse Fuel Oil waste sites.	RTD Waste Site; 300-FF-2 ESD (EPA 2009). Remediated and Interim Closed Out; RSVP CCN 163646; WSRF 2011-107. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-45, 303-F Building Uranium-Bearing Acid Spill	The release was to the soil beneath the transfer piping adjacent to the 303-F Building. The release was identified as nitric and sulfuric acid with uranium in solution. WSRF includes 300-40, UPR-300-40, UPR-300-39, and UPR-300-45 waste sites.	RTD Waste Site; 300-FF-2 ROD (EPA 2001) . Remediated and Interim Closed Out; RSVP CCN 165496; WSRF 2012-007. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-46, Contamination North of 333 Building	The release was a layer of radioactively contaminated soil found during a pipe trench excavation.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). Remediated and Interim closed out. See CVP-2010-00004. WSRF 2010-009. 300 Area ROD (EPA 2013), Reclassify to Final Status.
UPR-300-48, 325 Building Basement Topsy Pit	The site is radioactively contaminated soil that occurred as a result of a release through a crack in the process sewer underneath the 325 Building foundation in room 30 under a sewer drain pipe elbow.	RTD Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.
UPR-600-22, WPPSS Windrow Site, 600-21	The area was contaminated prior to 1972 with particulate fallout from burial activities in the 618-11 Burial Ground. The contaminated area was covered by scraping the affected ground into windrows, which are a series of small parallel berms, approximately 0.6 m (2 ft), 0.9 m (3 ft) wide and 91 m (100 yd) long. The berms are arranged to form a triangle approximately 137 m (150 yd) by 91 m (100 yd) long. Perimeter berms are approximately 1.2 m (4 ft) tall.	Candidate Waste Site; 300-FF-2 ROD (EPA 2001). 300 Area ROD (EPA 2013), RTD to Industrial Cleanup Levels.

CCN = correspondence control number
CVP = cleanup verification package
D4 = Deactivation, Decontamination, Decommissioning, and Demolition
ESD = explanation of significant differences
PVC = polyvinyl chloride
ROD = record of decision
RSVP = remaining sites verification package
RTD = remove-treat-dispose
SIS = Stewardship Information System
UPR = unplanned release
VPU = vertical pipe unit
WSRF = waste site reclassification form

A2. References

BHI-00012, 1995, *300-FF-2 Operable Unit Technical Baseline Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI-00768, 1996, *100 and 300 Area Burial Ground Remediation Study*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00002, 2003, *Cleanup Verification Package for the South Process Pond (WIDS Site 316-1), the Retired Filter Backwash Pond (WIDS Site 300 RFBP), 300-262 Contaminated Soil, and Unplanned Release Sites UPR-300-32, UPR-300-33, UPR-300-34, UPR-300-35, UPR-300-36, UPR-300-37, and UPR-300-FF-1,* Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00020, 2004, *Cleanup Verification Package for the 618-4 Burial Ground*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00021, 2004, *Cleanup Verification Package for the 618-5 Burial Ground*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00004, 2005, *Cleanup Verification Package for the 300-18 Waste Site*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00005, 2005, *Cleanup Verification Package for the 600-47 Waste Site*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2005-00007, 2005, *Cleanup Verification Package for the 300-8 Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00008, 2006, *Cleanup Verification Package for the 600-259 Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00009, 2006, *Cleanup Verification Package for the 300 VTS Waste Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00005, 2006, *Cleanup Verification Package for the 618-3 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00006, 2006, *Cleanup Verification Package for the 618-8 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00010, 2006, *Cleanup Verification Package for the 618-2 Burial Ground*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2011-00004, 2011, *Cleanup Verification Package for the 314 Building Waste Sites,* Rev. 0, Washington Closure Hanford, Richland, Washington.

DOE/RL-91-38, 1992, *Engineering Evaluation of the 618-9 Burial Ground Expedited Response Action*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-95-82, 1995, *Inventory of Miscellaneous Streams*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-42, 1996, *Limited Field Investigation Report for the 300-FF-2 Operable Unit*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-99-40, 2000, *Focused Feasibility Study for the 300-FF-2 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2006, "Transmittal of Approved Action Memorandum Associated with Engineering Evaluation/Cost Analysis #2 for the 300 Area, DOE/RL-2005-84," CCN 127831 dated May 10, 2006, to P. L. Pettiette, Washington Closure Hanford, from S. L. Sedgwick, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2010, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2010*, AR/PIR Document Number E1009034, October 2010, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2011, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2011*, AR/PIR Accession Number 1109011799, August 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2012, *Fact Sheet: 300 Area "Plug-In" Waste Sites for Fiscal Year 2012*, *- Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 2001 Interim Action Record of Decision for 300-FF-2*, AR/PIR Accession Number 1301070488, September 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 1991, *Expedited Response Action Approval for 618-9 Burial Ground*, February 1991, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 1996, *Record of Decision for the 300-FF-1 and 300-FF-5 Operable Units*, *Hanford Site, Benton County, Washington,* July 1996, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit*, *Hanford Site, Benton County, Washington,* April 2001, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2004, *Explanation of Significant Difference for the 300-FF-2 Operable Unit Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2009, *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2011, *Explanation of Significant Differences for the 300-FF-2 Operable Unit Interim Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area, Record of Decision for the 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site, Benton County, Washington,* November 2013, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

OSR-2010-0002, 2010, *300 Area Orphan Sites Evaluation Report*, Rev. 0, Washington Closure Hanford, Richland, Washington.

OSR-2011-0002, 2011, *100-F/IU-2/IU-6 Area-Segment 5 Orphan Sites Evaluation Report*, Rev. 0, Washington Closure Hanford, Richland, Washington

Waste Site Reclassification Form, Control Number 2004-100, *300-29,* January 2005, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2007-033, *600-243*, November 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-020, *331 LSLDF,* October 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-051, *305-B SF*, August 2008, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2008-059, *300-275*, August 2009, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2010-058, *300-33, 300-256, 300-41*, U.S. Department of Energy, September 2010, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2010-074, *300-260*, U.S. Department of Energy, January 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-038, *300-292*, U.S. Department of Energy, May 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-042, *300-251*, U.S. Department of Energy, September 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-046, *3712 USSA*, U.S. Department of Energy, August 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-056, *300-293:1*, U.S. Department of Energy, July 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-082, *300-258*, U.S. Department of Energy, September 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-091, *300-274*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-100, *300-28, 300-43, 300-48, 300-249, and 300-16:3*, U.S. Department of Energy, November 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-102, *300-276*, U.S. Department of Energy, December 2011, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-106, *300-219, 300-2234, 333 WSTF*, U.S. Department of Energy, January 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2011-107, *300-6, 300-123, 300-268, 300-273, and UPR-300-42*, U.S. Department of Energy, January 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-004, *UPR-300-38*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-005, *313 ESSP*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-006, *300-270*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-007, *UPR-300-40, UPR-300-39, and UPR-300-45*, U.S. Department of Energy, April 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-028, *600-290:2*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-030, *300-293:2*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-034, *300-279*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-034, *300-279*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-037, *300-286*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-038, *300-264*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-053, *300-283*, U.S. Department of Energy, July 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-110, *UPR-300-4*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-117, *600-117*, U.S. Department of Energy, December 2012, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2012-120, *300-15:2*, U.S. Department of Energy, April 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-007, *300-46*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-039, *300-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-096, *300-39*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-097, *309-TW-1*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-098, *309-TW-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-099, *309-TW-3*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-100, *309-WS-1*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-101, *309-WS-2*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-102, *309-WS-3*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-103, *307-RB*, U.S. Department of Energy, May 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-104, *300-57*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-105, *400 HWSA*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-106, *4831 LHWSA*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-107, *400-36*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-108, *300-37*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-109, *300-231*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-110, *300-264*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-111, *313 URO*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Reclassification Form, Control Number 2013-112, *600-117*, U.S. Department of Energy, August 2013, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Appendix B

Guidance for Preparation of Cleanup Verification Packages

This page intentionally left blank.

Contents

Tables

B1. Purpose

The purpose of this appendix is to provide guidance to assist both authors and readers of documents for final closeout of Hanford Site 300 Area waste sites in accordance with the final action *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (hereafter referred to as the 300 Area ROD) (EPA 2013), and the TPA-MP-14 procedure in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*. The waste site reclassification form (WSRF) is the documentation of approval of the lead agencies for individual waste site reclassification. The WSRF may be incorporated within a larger document for format and presentation purposes, but the document is considered to be a supporting attachment. For previous interim and final waste site reclassifications in the 300-FF-1 and 300-FF-2 Operable Units, cleanup verification packages (CVPs) were written to reclassify radioactive liquid effluent sites and burial grounds while remaining sites verification packages were written to reclassify sites termed "candidate sites" or "remaining sites." Under the 300 Area ROD, CVPs will be used as the primary supporting document for waste site reclassification. A CVP is not required if appropriate reclassification basis can be provided in a stand-alone WSRF or via supporting attachments other than a CVP. Authors will use this appendix as guidance for preparing final reclassification documentation.

B2. Objective

The overall objective of the CVPs under the 300 Area ROD (EPA 2013) is to demonstrate that, under the appropriate land-use scenario, the relevant waste sites have been remediated and may be reclassified to final closeout status. The 300 Area ROD provides the U.S. Department of Energy, Richland Operations Office, with the authority and guidelines to conduct continuing remedial actions at waste sites in the 300 Area and to propose waste sites for final closeout. The 300 Area ROD specifies the remedial action objectives (RAOs), and associated cleanup levels (CULs) that define the extent to which the waste sites require cleanup to protect human health and the environment.

B3. Scope

The scope of this guidance is limited to the CVPs for the 300-FF-2 Operable Unit remedial actions covered by this remedial design report/remedial action work plan (RDR/RAWP). This is a guidance document, not a requirements document, and deviations from the guidance are acceptable.

The following are potential examples where it may be appropriate to deviate from this guidance:

- For approximately 43 sites that were remediated or determined not to require remediation and received associated interim reclassification prior to issuance of the 300 Area ROD, but did not receive quantitative evaluation during development of the ROD. The remedy selected for these sites was remove, treat, and dispose to preserve the intent of the interim action remedy being implemented during ROD development. Because CVPs and remaining sites verification packages have already been written under interim actions for these sites, additional final reclassification supporting documentation may be limited to numerical demonstration that the interim action activities remain protective under the CULs of the 300 Area ROD.

- For sites that are identified for "no additional action" under the 300 Area ROD, final WSRFs may be prepared with no further explanation or supporting documentation.

- For small sites with limited analytical data sets, the lead agencies may agree to attach the analytic data and/or a simple comparison table to the TPA-MP-14 WSRF (RL-TPA-90-0001) with a location map and a brief description of the action(s) performed. No other effort may be needed for reclassification or cleanup verification of such waste sites.

- Site-specific guidance from the lead agencies may specifically provide an alternate method for a portion of the CVP or for an entire CVP. This site-specific guidance should be documented, and specifically noted in the CVP as approved by the lead agencies.
- Continuing process improvements may require deviation from this guidance in an effort to improve the closeout documents. These process changes will be incorporated into this appendix during future revisions of this document. Material process changes and decision-maker concurrence with material CVP changes will be documented in meeting minutes, in Tri-Party Agreement Change Notices, or by chronicling other correspondence.

The remainder of this guidance describes the typical steps involved in the preparation of the CVP closeout documents.

B4. Cleanup Verification Packages

B4.1 Executive Summary

The executive summary restates (at a higher level) the contents of the CVP. This includes a table documenting the achievement of CULs and RAOs for the given waste site. Table B-1 is provided as an example.

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain radionuclide total excess cancer risk of <1 x 10^{-4} over 1,000 years.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Maximum radionuclide excess cancer risk estimated using a sum of fractions evaluation is 1.22 x* 10^{-5}. **Or:** *Site-specific radionuclide excess cancer risk calculated by RESRAD is 1.1 x* 10^{-6}.	*NA* *Yes* *Yes*
Direct Exposure – Nonradionuclides	Attain individual COC CULs.	**Example Language:** *All individual COC concentrations are below the CULs.*	*Yes*
Meet Nonradionuclide Risk Requirements	Attain a hazard quotient of <1 for all individual noncarcinogens.	**Example Language:** *The hazard quotients for individual nonradionuclide COCs in the shallow zone and overburden are less than 1.*	*Yes*
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	**Example Language:** *The cumulative hazard quotient (enter value) is less than 1 for the shallow zone and overburden.*	*Yes*

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
	Attain an excess cancer risk of <1 x 10^{-6} for individual carcinogens.	**Example Language:** *Excess cancer risk values for individual nonradionuclide COCs are less than 1 x 10^{-6}.*	*Yes*
	Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	**Example Language:** *Total excess cancer risk (enter value) is less than 1 x 10^{-5}.*	*Yes*
Groundwater/ River Protection – Radionuclides	Attain single radionuclide COC groundwater and river protection CULs.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Residual concentrations of radionuclide COCs meet soil CULs for the protection of groundwater and the Columbia River* [c].	*NA* *Yes*
	Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. [a]	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Compliance is demonstrated by individual components meeting CULs in Table D-1 of Appendix D. (If these are not attained see Section D.5.)*	*NA* *Yes*
	Meet drinking water MCL for alpha emitters.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *There are no alpha-emitting COCs for this site.* **Or:** *No alpha-emitting COCs are predicted to migrate to groundwater within 1,000 years.*	*NA* *NA* *Yes*
	Meet total uranium drinking water standard of 30 µg/L MCL (40 CFR 141.66). [a]	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Residual concentrations of total uranium are less than CULs for uranium metal in Table D-1 of Appendix D and Table 4 of the Final ROD.*	*NA* *Yes*

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/ River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river CULs.	**Example Language:** *Residual concentrations of COCs meet soil CULs for the protection of groundwater and the Columbia River.* [b]	*Yes*

Example Footnotes:

a “National Primary Drinking Water Regulations” (40 *Code of Federal Regulations* 141.66).

b Under the Final ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

COC = contaminant of concern

CUL = cleanup level

MCL = maximum contaminant level

NA = not applicable

The WSRFs may be prepared for individual waste sites or for groups of sites, and are prepared in accordance with TPA-MP-14. The WSRF may be incorporated within the CVP document, or the CVP may be presented as an attachment to the WSRF, but the WSRF serves as the documentation of approval of the lead agencies for waste site reclassification. There is no further, separate approval of the CVP. A sample WSRF is provided below.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Reclassification Category: Interim ☐ Final ☒

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The [WIDS Number and Site Name] waste site is located within the 300-FF-2 Operable Unit and is identified as a waste site requiring remediation in the *Hanford Site 300 Area, Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site, Benton County, Washington* (300 Area ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2013). The [WIDS Number] waste site consisted of contaminated soils around and beneath the [XXX] Building.

Remediation of the [WIDS Number] waste site was conducted between [Dates]. Approximately XXXX bank cubic meters (BCM) (XXXX bank cubic yards [BCY]) of soil, rock, building debris, and piping were removed from the excavation and disposed to the Environmental Restoration Disposal Facility (ERDF).

The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Final Closed Out.

Basis for reclassification:

Following remediation, verification sampling for the [WIDS Number] waste site was conducted on [Dates]. The sample results were evaluated in comparison to the cleanup levels (CULs) and remedial action objectives (RAOs) from the 300 Area ROD (EPA 2013) and DOE/RL-2014-13, *Remedial Design Report/Remedial Action Work Plan for the 300 Area,* (300 Area RDR/RAWP), Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2014). In accordance with this evaluation, the verification sampling results support a reclassification of the [WIDS Number] waste site to Final Closed Out. The current site conditions achieve the CULs and RAOs established by the 300 Area ROD (EPA 2013) and the 300 Area RDR/RAWP (DOE-RL 2014). The waste site was remediated to achieve cleanup levels for an industrial land use scenario and to protect groundwater and the Columbia River. The results of verification sampling show that residual contaminant concentrations meet human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection in the shallow zone (i.e., surface to 4.6 m [15 ft] deep). The contamination in the vadose zone was removed to meet the industrial cleanup levels. The [WIDS Number] waste site does not meet the CULs and RAOs for unrestricted (residential) land use; therefore, institutional controls to maintain industrial land use are required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the* [WIDS Number and Site Name] (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Regulator comments:

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☒ Yes ☐ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

Institutional control required to maintain industrial land use. Please see the *Cleanup Verification Package for the* [WIDS Number and Site Name] (attached).

DOE Project Director (printed)	Signature	Date
N/A Ecology Project Manager (printed)	Signature	Date
EPA Project Manager (printed)	Signature	Date

B4.2 Statement of Protectiveness

This section is a paragraph stating that the waste site attains RAOs of the relevant ROD and discussing the pertinent future land use for the area. Whether or not institutional controls are necessary is explained. Table 1-1 of this RDR/RAWP Addendum identifies the land use specified for all waste sites requiring remediation. Where industrial land use is identified, the CVP author should evaluate whether or not residential CULs have also been attained. If so, appropriate demonstration should be included within the CVP with a summary statement here, and an institutional control for industrial land use does not need to be applied to the site. If residential CULs are not attained, this should be briefly identified, but a detailed demonstration should not be presented within the CVP.

B4.3 Site Description and Background

The site history, waste disposal history, site physical dimensions, and location are summarized in this section of the CVP, and a figure(s) showing the vicinity map and/or site plan are provided.

B4.4 Field Screening Sampling Activities (If Applicable)

Field screening sampling prior to remediation is appropriate if the location, nature, and potential contamination are not well known. The purpose of this section is to summarize results of field screening sampling activities (if any) performed for waste sites. The type of information to be provided would include objectives and dates of site visits, dates of sampling, participation by the U.S. Department of Energy, Richland Operations Office or regulatory agencies, and any findings or determinations (e.g., nature and extent of contamination, visible description of staining, waste form) that resulted from the site visit.

B4.4.1 Geophysical Investigations

This section describes geophysical surveys performed at the site including figures showing possible nature and extent of below-ground features.

B4.4.2 Sample Design for Field Screening

The purpose of this section is to summarize the site-specific work instruction or other documentation/processes leading to sampling (e.g., a phased approach using focused sampling and/or statistical sampling with sample numbers and locations determined by Visual Sample Plan[1] [VSP] software). This section typically includes a figure showing locations of samples and a sample summary table similar to Table B-2 with a discussion of the contaminants of concern, providing an explanation of how they were derived (e.g., based on professional judgment, process knowledge, waste characterization, analogous site information, visible inspection of waste forms). An example of a VSP sample design is discussed at the end of Section B4.5.

---

[1] Visual Sample Plan is a site map-based user-interface statistical sample design program. **Reference:** PNNL-19915, 2010, *Visual Sample Plan 6.0 User's Guide*, available at http://vsp.pnnl.gov/documentation.stm, Pacific Northwest National Laboratory, Richland, Washington.

Table B-2. Field Screening Sample Summary

Sample Location	Sample Media	Sample Number	WSP Coordinate Locations	Depth (m bgs)	Sample Analysis
Example Information					
Septic tank	*Septic tank contents*	*J01XN2*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA, VOA*
		J01XN6			*Hexavalent chromium*
Duplicate septic tank samples	*Septic tank contents*	*J01XN3*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA, VOA*
		J01XN7			*Hexavalent chromium*
Ash located east of septic tank	*Ash*	*J01XN1*	*N 147917 E 580882*	*0.5*	*ICP metals, PCB, pesticides, mercury, SVOA*
		J01XN5			*Hexavalent chromium*
Equipment blank	*Silica sand*	*J01XN4*	*NA*	*NA*	*ICP metals, mercury, SVOA, PCB, pesticides*

Source: Field Sampling, Logbook xxxxxx. Reference, WCH xxxx

bgs = below ground surface

GEA = gamma energy analysis

ICP = inductively coupled plasma

NA = not applicable

PCB = polychlorinated biphenyl

SVOA = semivolatile organic analysis

VOA = volatile organic analysis

WSP = Washington State Plane

B4.4.3 Field Screening Sample Results

The purpose of this section is to describe the results of field screening sampling activities and compare sampling results to the CULs, as appropriate. This section also documents the recommendation of remedial action for the given waste site. Analytical data from field screening sampling are typically provided in an appendix to the CVP.

B4.5 Remedial Action Summary

A description of the excavation and disposal activities for remedial action is given in this section, which may include figures of pre- and post-remediation topographic contours. Appropriate information includes the dates of waste site excavation, description (and photographs if applicable) of materials excavated, disposal location of waste material, general excavation dimensions and elevations, locations of overburden and staging piles (if applicable), and amount of material disposed from the site. Pre- and post-remediation photographs and site maps showing pre-remediation Waste Information Data System boundaries compared to post-remediation site boundaries may be provided. Maps showing post-remediation site contours should be provided if available. Waste volumes provided are for a general sense of scale only.

Additionally, the CVP will discuss significant materials that may have been left at the site (if any) and what significant materials were removed. A summary of field screening or in-process sampling activities (if applicable) that guided remedial actions is also included.

B4.6 Verification Sampling Activities

This section describes the information used to develop the sampling designs for cleanup verification sampling, including reference to appropriate documents and dates of sampling.

B4.6.1 Contaminants of Concern for Verification Sampling

Waste site contaminants of concern (COCs) identified for cleanup verification, typically via a site-specific verification sampling instruction, are listed in this section. The rationale for the final site COC list is discussed in this section.

B4.6.2 Verification Sample Design

A brief explanation regarding the remedial excavation decision units and cleanup verification sampling is included in this section. Statistical sample designs for cleanup verification sampling of waste sites are typically developed in a work instruction using VSP software. However, a statistical sample design may not be appropriate for all waste sites, and focused sampling may be agreed upon with the lead agencies. Focused samples may also be agreed upon to obtain additional information where waste site anomalies occurred.

The description of the verification sample design typically includes information pertaining to the location, individual Hanford Environmental Information System (HEIS) sample numbers, Washington State Plane coordinates, and analytical methods requested for all samples collected. This information is typically presented in a table with an accompanying figure showing the sample locations overlain on a map of the area including the remediation footprint of the waste site(s).

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below ground surface (bgs) per WAC 173-340-740(6)(d) (Ecology 2007). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) or more bgs are referred to as being in the deep zone, whereas the materials above 4.6 m (15 ft) bgs are referred to as being in the shallow zone. The direct exposure CULs are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection CULs are applicable to soils in both the shallow and the deep zones. However, if a site 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 regardless of the depth of the excavation. This is advantageous for site closeout because a site that does not require a separate deep zone evaluation will also have no requirement for deep zone institutional controls. A discussion regarding the rationale for decision unit selection is given. Decision units may be identified based on depth, spatial, and/or process history considerations.

Sampling dates and the number of samples collected per decision unit are also discussed in this section. If any focused sampling was conducted, a summary of this activity and its rationale is also included.

B4.6.3 Visual Sample Plan Statistical Sampling Designs

The VSP software uses the remediation footprint of the site to develop a systematic grid for verification soil sample collection. The development of a statistical sampling design is typically presented in the verification sampling work instruction. The statistical sampling design is typically briefly presented in the CVP as a figure, a table, and brief text discussing the associated statistical assumptions for the waste site. The VSP software determines the number and coordinates of sampling locations for a statistically defensible sampling design within the sampling area.

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit (UCL) on the sample mean, with the cleanup level (WAC 173-340-740[7]) (Ecology 2007). The working hypothesis (or "null" hypothesis) is that the mean value at the site is equal to or exceeds the action threshold (the site is "dirty"). The alternative hypothesis is that the mean value is less than the threshold (the site is "clean"). The VSP software calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

VSP uses a nonparametric systematic sampling approach with a random start to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the site conceptual model and analogous information (i.e., data from similar sites) indicate that typical parametric assumptions may not be true.

Both parametric and nonparametric equations rely on assumptions about the population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. Alternatively, if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation was used.

The Washington State Department of Ecology (Ecology) publication *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. Therefore, a systematic grid sampling design with a random start is selected for use in VSP. Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used.

B4.6.3.1 Inputs for VSP Calculation of Number of Samples

The VSP software equation used to calculate the number of samples for a statistical sample design is based on a Sign test (see Gilbert et al. 2001 for discussion). For a typical waste site, the null hypothesis is rejected in favor of the alternative if the mean is sufficiently smaller than the threshold. The number of samples to collect is calculated such that, if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

To use VSP to calculate the number of samples, n, it is necessary to have some estimate of the sample standard deviation (S). A standard deviation value of 40% of the unit action level has been assumed (see Table B-3). Using this standard deviation value and an acceptable gray region width (typically 50% of the action level) in VSP, the number of verification samples to collect in this example is 12.

Table B-3. VSP User Inputs.

Parameter	Value	Basis
S	0.40	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.40 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point (EPA et al. 2000, p. 5-26). A value of 0.40 is used because 0.40 is a larger estimated standard deviation than 0.30. Choosing a value of 0.40 implies that a larger sample size will be calculated when all other inputs are equal. Thus, 0.40 is a more conservative value than 0.30.
Δ	0.50	This is the width of the grey region. It is a user-defined value relative to a unit action level. The value of 0.50 is a MARSSIM-suggested default value balancing unnecessary remediation cost with sampling cost (EPA et al. 2000, p 2-9).
α	5%	This is the error rate associated with deciding a dirty site is clean when the true mean is equal to the Action Level. It is a maximum error rate since dirty sites with true means above the Action Level will be easier to detect. A value of 5% is chosen as a practical balance between health risks and sampling cost (EPA 2006, pp. 56, 57).
β	20%	This is the error rate associated with deciding a clean site is dirty when the true mean is at the lower bound of the gray region (LBGR). It is the maximum such error rate outside of the gray region, because cleaner sites with true means less than the LBGR will be less likely to fail. A value of 20% is chosen as a practical balance between unnecessary remediation cost and sampling cost (EPA 2006, pp. 56, 57).
$Z_{1-\alpha}$	1.64485	This is a value automatically calculated by VSP based on the user-defined value of α. (α = 5%; see above.)
$Z_{1-\beta}$	0.841621	This is a value automatically calculated by VSP based on the user-defined value of β. (β = 20%; see above.)
MARSSIM overage	20%	MARSSIM (EPA et al. 2000, p. 2-31) suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n.

DQO = data quality objective
MARSSIM = *Multi-Agency Radiation Survey and Site Investigation Manual* (EPA et al. 2000)
VSP = Visual Sample Plan

B4.7 Verification Sampling Results

The verification samples collected are submitted to offsite laboratories certified to perform the requisite analyses using U.S. Environmental Protection Agency (EPA)-approved analytical methods. The laboratory-reported analysis data from the sampling are used in the statistical calculations (as appropriate) and are included in appendices to the CVP.

The primary statistical calculation to support cleanup verification is the 95% UCL on the arithmetic mean of the data. All UCL calculations are performed with EPA's ProUCL software[2]. The 95% UCL values for detected COCs in statistical data sets are calculated for each decision unit according to the following:

- If there are five or more detections of a given COC within a data set, and the COC is detected in 25% or more of the total samples, a UCL is calculated. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are less than five detections of a given COC within a data set, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If a given COC within a data set is detected in five or more samples, but is detected in 25% or less of the total samples, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are no detections of a COC within a data set, then there is no calculation or further evaluation performed for the COC.

For the statistical evaluation of primary/duplicate sample pairs, the following is applied to determine the value to be used in the UCL calculation:

- If detections are reported for both the primary and duplicate, the maximum concentration is used.
- If one detection and one nondetection are reported, the detected concentration is used.
- If both the primary and duplicate are reported as nondetects, the higher detection limit is used (as a nondetect within ProUCL).

The statistical values represent the COC concentrations for each decision unit (e.g., overburden, shallow zone, or deep zone soils). All UCL calculations are performed with EPA's ProUCL software. For sample results that are nondetects (i.e.., a "U" is included with the data flags), the full reported minimum detectable activity (radionuclides) or practical quantitation limit (nonradionuclides) value is used as the concentration. Data are then identified as detected (1) or nondetected (0) in the ProUCL data input. In cases that ProUCL output identifies more than one potential UCL for a given data set, the UCL with the highest value is chosen. ProUCL cannot compute UCLs for data sets with less than five results; therefore, analysis of any statistical data sets with less than five results will be determined in consultation with the lead regulatory agency. The 95% UCL calculation brief is included in an appendix to the CVP.

For focused sampling, no statistical evaluation is performed and the maximum detected value is used for comparison with the CULs.

Comparisons of quantified COC results against the CULs for the waste site are summarized in appropriate tables. Comparison to statistical contaminant concentrations and comparisons to focused sampling results are presented in separate tables. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Ecology Cleanup Levels and Risk Calculations (CLARC) Database or other reference databases for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered COCs and are not included in tables for

---

2 ProUCL may be downloaded at http://www.epa.gov/osp/hstl/tsc/software.htm.

comparison to CULs even though results for these constituents are routinely provided by the laboratories. Where asbestos is identified as a site COC, verification of cleanup completion may be based on visual identification of no residual asbestos-containing material by a certified asbestos inspector, and should be described in the CVP.

Contaminants of concern were selected in the 300 Area ROD based upon the 300 Area Remedial Investigation/Feasibility Study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*), which included a risk assessment. In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the DOE and EPA Project Managers for determination of a path forward.

Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 may be detected in waste site samples, but are excluded from evaluation in these tables because these isotopes are not related to the operational history of the Hanford Site. The thorium and radium detected in environmental samples are associated with background quantities of uranium naturally present in soil.

The laboratory-reported data results for all constituents are stored in a project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are included as an attachment to the 95% UCL calculation.

B4.8 Verification Sample Data Evaluation

This section describes the evaluation of the sampling data in terms of comparison to the CULs, the radionuclide risk requirements, and the nonradionuclide risk requirements. Ideally, evaluation of the results listed in the tables reporting the sample results indicates that all COCs were quantified below CULs. In this case, residual concentrations of site COCs are protective in relation to the requirements for direct exposure and groundwater and river protection.

B4.8.1 Comparison of Sample Data to the CULs

Typically, with the exception of a few contaminants, evaluation of the results from verification sampling at a waste site against the CULs in Table D-1 will indicate that all COCs are quantified below the CULs. Exceedance of cleanup levels for direct exposure or groundwater and river protection will seldom occur but would trigger additional cleanup, a site-specific risk analysis, or other evaluation based on the likelihood of a threat to human health. Residential and industrial soil CULs to be protective of groundwater and the river were calculated based on federal drinking water standards as described in Section 8.2 of the 300 Area ROD (EPA 2013). Parameters specific to a residential or industrial scenario were used in modeling calculations. Specifically, the residential scenario assumed a groundwater recharge rate of 72 mm/yr, representing an irrigated condition, while the industrial scenario assumed a groundwater recharge rate of 25 mm/yr, representing no irrigation. The consideration of lesser amounts of irrigation in areas with institutional controls for industrial use allows higher soil CULs to be protective of the same federal drinking water standards.

Per the MTCA Cleanup Regulation (Ecology 2007), WAC 173-340-708(8), compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs) is determined by considering mixtures of carcinogenic PAHs as a single hazardous substance and using the cleanup levels established for benzo(a)pyrene as the cleanup level for mixtures of carcinogenic PAHs. Statistical values representing the PAH COC concentrations for each decision unit are calculated, or the maximum detected value is selected per the guidelines in Section B.4.6 and for focused samples. The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor as shown in Table B-4b to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table D-1 to determine compliance. The result of the determination of the total toxic equivalent concentration of benzo(a)pyrene is shown in Table B-4a and is included in Table B-4b.

Table B-4a. Toxic Equivalent Concentrations of Benzo(a)Pyrene [a]

Carcinogenic Polyaromatic Hydrocarbons	Maximum or Statistical Result (mg/kg)	Toxic Equivalency Factors (Unitless)	Toxic Equivalent BAP Concentration mg/kg
Benzo[a]pyrene	*0.005*	1	*0.005*
Benzo[a]anthracene	*0.005*	0.1	*0.0005*
Benzo[b]fluoranthene	*0.004*	0.1	*0.0004*
Benzo[k]fluoranthene	*0.0076*	0.1	*0.00076*
Chrysene	*0.06*	0.01	*0.0006*
Dibenz[a,h]anthracene	*0.024*	0.1	*0.0024*
Indeno[1,2,3-cd]pyrene	*0.04*	0.1	*0.004*
Total Toxic Equivalent Concentration of Benzo(a)pyrene			*0.01366*

a From WAC 173-340-708(8)(e), Table 708-2 (Ecology 2007)

BAP = benzo(a)pyrene

An example table showing a comparison of the statistical or maximum results as determined in the 95% UCL calculation to the direct exposure cleanup levels and groundwater and river protection cleanup levels is shown in Table B-4b. All cleanup verification sampling results from either the industrial or residential land use areas will initially be compared against cleanup levels for residential land use. If the verification sampling results are less than residential CULs the comparison table for cleanup verification will report the comparison against residential CULs because institutional controls to preserve industrial land use are not required for waste sites that meet residential CULs. However, if residential CULs cannot be met (and the waste site is within the industrial zone), the comparison table for cleanup verification will report the comparison against industrial CULs and institutional controls to preserve industrial land use will be required to be stated in the CVP and WSRF.

The ecological risk evaluations have concluded that 300-FF-2 interim remedial actions that achieved interim action ROD CULs to protect human health were also protective of ecological receptors, as described in Section 2.4.4 of the RDR/RAWP. No further evaluation or screening of potential ecological risk is performed in CVPs.

Table B-4b. Comparison of Maximum or Statistical Contaminant of Concern Concentrations to Residential Cleanup Levels[a]

COC	Maximum or Statistical Result [b] (pCi/g)	Radionuclide Shallow Zone CULs (pCi/g)	Radionuclide Groundwater and River Protection CULs (pCi/g)	Does the Statistical Result Exceed CULs? [c]
Example Residential Results:				
Cesium-137	*0.036*	*4.4*	*NA*	*No*
Strontium-90	*0.49*	*2.3*	*NA*	*No*
COC	**Maximum or Statistical Result[b] (mg/kg)**	**Nonradionuclide Direct Exposure CULs (mg/kg)**	**Nonradionuclide Groundwater and River Protection CULs (mg/kg)**	**Does the Statistical Result Exceed CULs?[c]**
Example Residential Results:				
Arsenic	*3.5 (<BG)*	*20*	*20*	*No*
Beryllium	*0.35 (<BG)*	*160*	*NA*	*No*
Chromium (total)	*9.0 (<BG)*	*120,000*	*NA*	*No*
Chromium (hexavalent)	*0.6*	*2.1*	*2.0*	*No*
Copper	*13.0 (<BG)*	*3,200*	*3,400*	*No*
Lead	*10.4*	*250*	*1,480*	*No*
Manganese	*318 (<BG)*	*11,200*	*NA*	*No*
Mercury	*0.03*	*24*	*8.5*	*No*
Nickel	*10.0 (<BG)*	*1,600*	*NA*	*No*
Vanadium	*38.6 (<BG)*	*400*	*NA*	*No*
Zinc	*47.8 (<BG)*	*24,000*	*NA*	*No*
Benzo(a)pyrene	*0.01366[d]*	*0.14*	*NA*	*No*
Chrysene	*0.06*	*137*	*NA*	*No*

Example Footnotes:

a CULs obtained from Appendix D, Table D-1 of this document.

b Background (BG) values from the remedial investigation/feasibility study gap analysis (ECF-HANFORD-11-0038) are used for antimony, boron, cadmium, lithium, mercury, molybdenum, and silver. Background values for all other radionuclides and metals are obtained from DOE/RL-92-24 and DOE/RL-96-12.

c Under the 300 Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

d Evaluation of the compliance of benzo(a)pyrene with cleanup levels includes the toxic equivalency concentrations of the carcinogenic PAHs in Tables 2-1 and B-4a.

-- = not applicable
BG = background
COC = contaminant of concern
WAC = *Washington Administrative Code*
CUL = cleanup level
NA = not available; no cleanup level calculated
RDL = required detection limit

While not identified as COCs, the analytes in Table B-4c were detected above background levels in the example cleanup verification samples. These detections were below risk-based cleanup levels calculated during development of the 300 Area ROD. Therefore, these constituents do not warrant consideration as COCs. Data for all analytes are included in the appendices.

Table B-4c. Example Detected Waste Site Analytes Not Identified as COCs

Anthracene	Dibenz(a,h)anthracene	Phenanthrene
Benzo(a)anthracene	Fluoranthene	Pyrene
Benzo(b)fluoranthene	Fluorene	

B4.8.2 Evaluation of Attainment of Radionuclide and Nonradionuclide Risk Requirements

This section discusses how the verification sampling data are used in demonstrating attainment of radionuclide and nonradionuclide risk requirements.

B4.8.2.1 Radionuclide Evaluation of Risk and Dose

In addition to meeting the radionuclide CULs of Table D-1 the residual soil radionuclide activities must also meet the risk and radiological dose standards of 40 CFR 300 for direct exposure and 40 CFR 141 for protection of groundwater. The individual radionuclide cleanup verification statistical or focused data values may be entered into the RESidual RADioactivity (RESRAD) computer code (current version 6.5 [ANL 2009]) to predict the direct exposure cancer risk and the impact on groundwater and the river from residual radionuclide activities. General RESRAD input parameters for evaluation of carcinogenic risk per the Final ROD are presented in Tables D-4 and D-5 of Appendix D. Separate RESRAD runs are performed for separate decision units of a waste site area (e.g., the excavation footprint, overburden, and staging pile areas). Per Section 7.1.2 of the 300 Area ROD, the cancer risk limit for soil radionuclide CULs was set at a $1x10^{-4}$ risk limit or 15 mrem/yr for isotopes where the latter is more conservative. Soil radionuclide CULs must also meet the multi-contaminant total cancer risk limit of $1x10^{-4}$. These soil risk limits are applied to both the industrial and residential scenarios.

The "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP) (40 CFR 300.430) establishes that CERCLA cleanups should generally achieve a level of residual risk of 10^{-4} to 10^{-6}. However, EPA guidance states that the upper boundary of the risk range is not a discrete line at 10^{-4} and a specific risk estimate around 10^{-4} may be considered acceptable, if justified based on site-specific conditions. If this circumstance occurs appropriate discussion shall be presented in the CVP. The results of the RESRAD radionuclide cancer risk predictions for the all-pathways scenarios for the units of the waste site area are typically presented as excess lifetime cancer risk (ELCR) versus time (years). These ELCR determinations represent the cancer risk contributions from soils at relevant time periods. Because of radioactive decay, the risk usually decreases over time and the maximum predicted ELCR occurs at the present time. However, there may be instances where radionuclides decay to more radioactive daughter products causing risk to increase over time. All ELCR predictions must be less than the individual and total cancer risk limit of $1x10^{-4}$ to meet the CULs. The RESRAD computations are shown in detail in calculation briefs presented in an appendix to the CVP. A figure may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

Alternatively, for waste sites with few radionuclide COCs at concentrations well below the individual radionuclide CULs, Table B-5a provides a typical comparison of the shallow zone (including overburden) radionuclide cleanup verification statistically quantified values to direct exposure single radionuclide 1×10^{-4} cancer risk values using a sum of fractions evaluation. The columns on the left side of Table B-5a are the COCs and the 95% UCL values, corrected for background, as appropriate. Uranium background is subtracted from the analyses for all soil samples but background for other radionuclides is only subtracted from the overburden soil analysis. This accounts for anthropogenic and naturally occurring radionuclide background in surface soils. Only uranium background concentrations are accounted for in shallow and deep zone soils by subtracting uranium isotope concentrations from the statistical values or maximum values. The fourth column presents the single radionuclide 1×10^{-4} cancer risk equivalence activity, and the last two columns present the statistical values divided by the cancer risk equivalence activity. In the Table B-5a example for residential cleanup the total predicted radionuclide cancer risk based on sum of fractions determination is less than 1×10^{-4} so no further evaluation is necessary. However, the Table B-5b sum-of-fractions evaluation for an industrial cleanup is greater than 1×10^{-4}, so further evaluation using RESRAD with site-specific input parameters is necessary.

Table B-5a. Sum-of-Fractions Evaluation of Radionuclide Direct Exposure Risk for Residential Cleanup

COCs	95% UCL Statistical Values (pCi/g)		Activity Equivalent to 1×10^{-4} cancer risk [a] (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Example Results:					
Cesium-137	0.044 (ND)	0 (<BG) (ND)	4.4	0.010	0
Cobalt-60	0.047 (ND)	0.049 (ND)	1.4	0.034	0.035
Europium-152	0.100 (ND)	0.15 (ND)	3.3	0.030	0.045
Europium-154	0.14 (ND)	0.14 (ND)	3	0.047	0.047
Europium-155	0.12 (ND)	0.08 (ND)	125	0.001	0.001
Sum of Fractions				0.122	0.128
Cancer Risk				1.22×10^{-5}	1.28×10^{-5}

Example Footnotes:

a Single radionuclide 1×10^{-4} cancer risk equivalence values and derivation methodology are presented in Table 4 of the 300 Area ROD (EPA 2013).

COC = contaminant of concern

ND = not detected (in all samples in the data set)

Table B-5b. Attainment of Radionuclide Direct Exposure Cleanup Levels for Industrial Cleanup

COCs	Shallow Zone Focused Sample Analyses (pCi/g)	Activity Equivalent to $1x10^{-4}$ cancer risk [a] (pCi/g)	Fraction
Example Results:			
Americium-241	0.711	210	0.0034
Cesium-137	0.126	4.4	0.0286
Plutonium-239/240	0.356	245	0.0015
Plutonium-241	3.33	12,900	0.0003
Technetium-99	1.19	166,000	0.0001
Uranium-233/234	77.5 (amount above BG)	167	0.4641
Uranium-235	7.14 (amount above BG)	16	0.4462
Uranium-238	86.3 (amount above BG)	167	0.5168
Sum of Fractions			1.4610
Cancer Risk			$1.46x10^{-4}$

Example Footnotes:

a Single radionuclide $1x10^{-4}$ cancer risk equivalence values and derivation methodology are presented in Table 4 of the 300 Area ROD (EPA 2013).

b Uranium background is subtracted from the analyses for all soil samples, but background for other radionuclides is only subtracted from the overburden soil analyses.

BG = background

COC = contaminant of concern

B4.8.2.2 Nonradionuclides Evaluation of Risk Standards

The comparison tables, using Table B-4b as an example, provide a comparison of the nonradionuclide cleanup verification maximum or statistical values to the direct exposure, groundwater protection, and river protection CULs.

Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For COCs with noncarcinogenic effects, WAC 173-340 specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose (WAC 173-340-200). Hazard quotients for individual noncarcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-1 of WAC 173-340 (2007) as shown in Table D-2a. Similarly, the cancer risks for individual carcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-2 of WAC 173-340 (2007), as shown in Table D-2b. Where residential land use cleanup and risk standards cannot be met in the industrial land use areas of the 300 Area, the industrial hazard quotient and cancer risk must be calculated by substituting the appropriate industrial land use daily intake factor from Equations 745-1 and 745-2 of WAC 173-340 (2007) in Tables D-2c and D-2d of Appendix D into the spreadsheets.

Calculation and application of hazard quotient and cancer risk for residential and industrial land use under WAC 173-340 (2007) is discussed further in Table D-2 of Appendix D. Values for the reference doses (RfDs) and cancer potency factors (CPFs) for use in calculating the hazard quotient and cancer risk in are provided in Table D-3.

Individual hazard quotients and the sum of individual hazard quotients for a waste site must be less than 1.0. For cumulative carcinogenic COCs, the cumulative excess cancer risk must be less than 1×10^{-5}. For multiple carcinogenic COCs, the risks of the individual COCs (described above) are summed. If no risk associated with a single COC exceeds 1×10^{-6} for residential land use or 1×10^{-5} for industrial land use, and if the sum of the individual COC risk does not exceed 1×10^{-5}, then the carcinogenic risk requirements have been met.

Typically, the results of evaluation of the attainment of noncarcinogenic and carcinogenic individual and cumulative risk standards are presented in a calculation brief that is included in an appendix to the CVP.

Site-Specific Evaluation of Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For instances where the conservative approach does not result in a determination that the sum of individual noncarcinogenic hazard quotients is less than 1.0 or that the individual or cumulative carcinogenic risks are less than 1×10^{-6} and 1×10^{-5}, respectively, site-specific risk evaluations may be performed. The noncarcinogenic hazard quotient calculation may use an occupancy factor in Equations 740-1 and 740-2 from WAC 173-340-740(3) for residential land use and in Equations 745-1 and 745-2 from WAC 173-340-745(5) for industrial land use to account for the amount of time individuals may actually spend on a waste site. For small waste sites (less than 1,000 m^2) a site-specific calculation may be performed utilizing an area factor to account for the size of the waste site and, hence, the daily intake.

B4.8.3 Groundwater Cleanup Levels Attained

The groundwater CULs are applicable to all decision units (e.g., shallow zone, deep zone, and overburden). Soil CULs for radionuclides and nonradionuclides for the protection of groundwater and the river are summarized in Table D-1 of Appendix D. These were calculated during development of the 300 Area ROD (EPA 2013) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code. Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

B4.8.3.1 Radionuclide Groundwater Cleanup Levels Attained

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table D-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table D-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation as described in Section D.5.2 of Appendix D to determine if residual soil concentrations may actually be protective of groundwater. Comparison of peak radionuclide concentrations predicted by a site-specific RESRAD evaluation against the groundwater CULs is presented in a table similar to Table B-6.

Table B-6. RESRAD Predicted Peak Radionuclide Groundwater Concentrations Compared to Cleanup Levels

Radionuclide	Peak Concentration (pCi/L)	CUL (pCi/L)	CULs Attained? (Yes/No)
Example Language:			
Tritium	*18,500*	*20,000*	*Yes*

Example Footnotes:

BCL = below cleanup level
CUL = cleanup level

B4.8.3.2 Nonradionuclide Groundwater Cleanup Levels Attained

Comparison table(s), such as Table B-4b, provide a tool for evaluation of the nonradionuclide cleanup verification data against the groundwater and river protection CULs. Residential and industrial soil CULs, protective of groundwater and the river, were calculated based on federal drinking water standards as described in Section 8.2 of the 300 Area ROD (EPA 2013). Parameters specific to a residential or industrial scenario were used in the STOMP model to perform these calculations. Under the Final ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection would trigger additional evaluation based on risk to human health that could induce additional cleanup, a site-specific risk analysis, or other actions.

B4.9 Data Quality Assessment Process

The data quality assessment (DQA) has been integrated into the CVP and is presented here as a subsection. The DQA is very briefly summarized in the body of the CVP, with the detailed DQA (as represented in the following sections) placed in an appendix to the CVP. The DQA process involves evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use (EPA 2000). The DQA process completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the DQO process.

The DQA process is not intended to be a definitive analysis of a project or problem, but instead provides an assessment of the reasonableness of the data that have been generated (EPA 2000).

The DQA focuses on the laboratory data, statistical error tolerances, and the overall DQO, specifically by addressing the question, "Are the data of the right type, quality, and quantity to support their intended use?" The intended use of the data is to make the appropriate decision regarding whether the site meets the RAOs as defined by the CULs. The site closeout or cleanup decision rules are the CULs. Completion of a CVP following this guidance inherently is the functional equivalent of performing a DQA for a waste site.

The DQA may not be performed on field screening data, if the field screening data are not used in decisions regarding the rejection of the null hypothesis (a decision that the site is "clean"). Therefore, field decisions that the site is "dirty" will be made based on the field screening data with the understanding that the decision to remediate a site determined to be contaminated based on field readings may not be within error tolerances. This is a project risk management decision and is deemed as an acceptable risk by project decision makers.

After sampling is completed, sample data packages are validated, including review of the following items, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- Matrix spike recovery
- Surrogate recovery
- Matrix spike/matrix spike duplicate results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness.

For CVPs and related documents (e.g., leachability study reports, data summary reports), all laboratory-applied "J" flags on radionuclide results will be deleted. A footnote will be included in the radionuclide data summary tables indicating that, because of laboratory reporting conventions, these results may have a nonrelevant "J" qualifier in the HEIS database and/or in the analytical report.

Where the "J" qualifier is applied through the validation process, the qualifier will not be deleted and the traditional "estimated" footnote will be presented. The footnote will also direct the reader to the DQA section of the document. The DQA section provides additional discussion regarding the reasons why the "J" qualifier was applied during validation and also discusses the usability of the data.

Data qualified as not detected (i.e., "U") indicate that the appropriate analysis was performed but that the analyte was not detected. The concentration associated with "U" qualified data represents the practical quantitation limit (PQL). The analyte may or may not exist in the sample at concentrations below the PQL.

Data qualified as rejected (i.e., "R") indicate that the data are not useable due to a major quality assurance/quality control deficiency. All other qualified results are considered accurate within the standard errors associated with environmental samples and the individual analytical methods performed.

The adequacy of laboratory quality assurance/quality control is evaluated as a subset of the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) in DOE/RL-2001-48, *300 Area Remedial Action Sampling and Analysis Plan* (300 Area SAP). This evaluation is presented in a validation report that is prepared by a third-party contractor, who determines whether the laboratory met the required target detection limits of precision, accuracy, and completeness.

Reported analytical detection levels are compared to the specified detection limits in the 300 Area SAP (DOE/RL-2001-48). The data validation notes any analyses in which the PQL or minimal detectable activity was above the 300 Area SAP-specified required quantitation limits (RQLs). The RQLs are based on optimal conditions. Interferences and different matrices may significantly affect the PQLs. PQLs that exceed the specified RQLs do not necessarily invalidate the data for decision-making purposes; however, the exceedances need to be evaluated on a case-by-case basis within the DQA.

An evaluation of the matrix spike/matrix spike duplicate samples and the associated percent recoveries and relative percent differences is also performed. Acceptable limits are presented in the 300 Area SAP (DOE/RL-2001-48). However, it should be noted that the matrices of environmental samples are not homogenous. The natural heterogeneities in the matrices can cause significant variability in the percent recovery and relative percent difference calculations which can exceed the limits presented in the

300 Area SAP. Exceedances observed in the data set need to be evaluated on a case-by-case basis, to determine if there is any indication that the analytical system or methodology is at fault.

B4.10 Summary for Waste Site Reclassification

The purpose of this section is to provide a statement that the given waste site has been evaluated in accordance with the 300 Area ROD and that the results of the verification sampling support a reclassification (in accordance with the TPA-MP-14 process [RL-TPA-90-0001]) of the given waste site to “final closed out” or “final no action.”

When field screening or sampling results indicate that residual concentrations of contaminants at the site meet the CULs for direct exposure, groundwater protection, and river protection without remediation, “final no action" is the appropriate reclassification status. Per the conceptual site model stated in the 300 Area decision documents, waste site contamination does not extend into deep zone soils if it is not found in the shallow zone. Hence, sampling activities are normally not required for deep zone soils and institutional controls to prevent uncontrolled drilling or excavation into the deep zone are generally not required.

When the waste site has been remediated in accordance with the 300 Area ROD or other decision documents, this is stated and the applicable version of the RDR/RAWP is cited. The amount of material for disposal at the Environmental Restoration Disposal Facility is noted for a general sense of magnitude. Sampling conducted to verify the completeness of remediation is briefly discussed and analytical results for the waste site shown to meet the cleanup objectives for direct exposure and groundwater and river protection are noted. Accordingly, it is stated that waste site reclassification to "final closed out" is supported for the waste site. The maximum depth of the waste site excavation area is identified as necessary to describe potential deep zone considerations and the possible need for institutional controls to prevent future intrusion into deep zone contamination. However, if the entire excavation area may be considered one decision unit and closed out using the more restrictive shallow zone cleanup criteria, then institutional controls to prevent uncontrolled drilling or excavation into the deep zone may not be required.

B5. References

40 CFR 141, “National Primary Drinking Water Regulations,” *Code of Federal Regulations*, as amended.

40 CFR 300, “National Oil and Hazardous Substances Pollution Contingency Plan,” *Code of Federal Regulations*, as amended.

ANL, 2009, *RESRAD for Windows*, Version 6.5, October 30, 2009, Argonne National Laboratory, Environmental Assessment Division, Argonne, Illinois.

DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes,* Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-12, 1996, *Hanford Site Background: Part 2, Soil Background for Radioactive Analyte*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-48, 2011, *300 Area Remedial Action Sampling and Analysis Plan,* Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Ecology, 1995, *Guidance on Sampling and Data Analysis Methods*, Publication No. 94-49, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2007, WAC 173-340, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, November 2007 Revision.

EPA, 1976, *National Primary Drinking Water Regulations*, EPA-570-76-003, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1989, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2000, *Guidance for Data Quality Assessment: Practical Methods for Data Analysis*, EPA/600/R-96/084, QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, WPa/240/B-06/001 U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, , U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, DOD, DOE, and NRC, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, EPA 402-R-97-016, DOE/EH-0624, NUREG-1575, Rev. 1, U.S. Environmental Protection Agency, U.S. Department of Defense, U.S. Department of Energy, and U.S. Nuclear Regulatory Commission, Washington, D.C. Available online at: http://www.epa.gov/radiation/marssim.

RL-TPA-90-0001, 2011, *Tri-Party Agreement Handbook Management Procedures,* Rev. 2, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.

WAC 173-340, 2007, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, November 2007 Revision.

This page intentionally left blank.

Appendix C

Revegetation Plan for the 300 Area

This page intentionally left blank.

C1. Introduction

This revegetation plan addresses waste sites covered in this 300 Area remedial design report/remedial action work plan (RDR/RAWP) that will be remediated as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* remedial action project. This appendix addresses sites in the 300-FF-2 Operable Unit (OU). Each site requiring remediation and the associated support facilities (roads, spoils piles, etc.) that are disturbed during remediation will be revegetated under this plan. Sites in the 300-FF-2 OU previously remediated under interim actions, but for which revegetation had not yet been performed, will also be performed under this plan.

This plan is generic; site-specific conditions will be evaluated and adjustments made when necessary. Land-use considerations will also affect the intensity of revegetation of the 300 Area waste sites. Some sites within the 300 Area have been designated for continued or future industrial land use. Other portions of the 300-FF-2 OU have been proposed as resources of concern by DOE/RL-96-32, *Hanford Site Biological Resources Management Plan* (BRMaP), because they contain high-quality shrub-steppe habitat, which is classified as a priority habitat by the Washington Department of Natural Resources (WDNR 1995). Consultations with Tribes and the Natural Resource Trustee Council will also occur, as appropriate, for additional input.

This revegetation plan is based on the information provided in the BRMaP (DOE-RL-96-32) and results of other revegetation efforts that have occurred across the Hanford Site.

C2. Mitigation Action Plan

DOE/RL-2002-19, *Mitigation Action Plan for the 300 Area of the Hanford Site*, addresses mitigation actions for waste sites in the 300-FF-2 OU. The mitigation action plan (MAP) provides guidance to the design and field staff to ensure that natural and cultural resources are protected during field activities. The plan includes avoidance and minimization steps in mitigation. Special consideration is also given to the local Native American Tribes and nations for cultural resource concerns.

Much of the nonindustrial and less-disturbed 300 Area contains recovering mid-seral communities of shrub (bitterbrush [*Purshia tridentata*] and snow buckwheat [*Eriogonum niveum*]), perennial grass (e.g., Sandberg's bluegrass [*Poa sandbergii*]), and annual grass (e.g., cheatgrass [*Bromus tectorum*]) species on sandy soils. Portions of the habitat in this area have been proposed as a Level III resource of concern in the BRMaP (DOE/RL-96-32). Level III biological resources are of concern because of their state listing; potential for federal or state listing; unique or significant value for plant, fish, or wildlife species; special administrative designation; or environmental sensitivity. The BRMaP does not identify a resource level of concern for the southern portion of the 300-FF-2 OU adjacent to the industrialized 300 Area due to extensive disturbance and lack of vegetation.

Remediation of the 300 Area waste sites is anticipated to involve extensive excavation, which has the potential to impact natural resources. These sites will be identified in field surveys prior to initiation of remediation. If remedial actions demonstrate the potential for disturbing species of concern or removing high-quality habitat, supplemental mitigation (in addition to actions listed in the MAP [DOE/RL-2002-19]) may be needed.

C3. Site Descriptions

The vegetative status for waste sites that were remediated and the nearby areas for support facilities during remediation have been assessed in various ecological and cultural resources reviews.
The remaining sites will be evaluated for cultural and ecological resources prior to the commencement of

remedial actions at those sites. The vegetative status of the 300 Area varies, but ranges from nonvegetated/industrial (e.g., the parking lot above the 618-8 Burial Ground) to a mixture of nonvegetated and vegetated with low-quality communities, such as cheatgrass/Russian thistle (*Bromus tectorum/Salsola kali*) and rabbitbrush/cheatgrass (*Chrysothamnus nauseosus/Bromus tectorum*), and high-quality mature shrub-steppe habitat containing sagebrush (*Artemisia tridentata*), bitterbrush, rabbitbrush (*Chrysothamnus nauseosus*), and snow buckwheat. The soils in the 300-FF-2 OU are predominantly sandy soils, although remediated sites will consist of backfill from site stabilization. Wildlife that uses the 300 Area includes mule deer, coyotes, geese, badgers, birds, and small mammals such as Great Basin pocket mice and deer mice. Detailed descriptions of the habitat present at the 300-FF-2 OU sites were recorded in *Ecological Resources Review of Remedial Design Package for Nine 300-FF-2 Waste Sites* (00-ER-039) (BHI 2000) and other 300 Area ecological reports (e.g., DOE/RL-2002-19; BHI-00170, *Ecological Investigation Report for the 300-FF-2 Operable Unit*; Rickard et al. 1990).

C4. Purpose of Revegetation

The goal of revegetation in the 300 Area is to restore the remediated waste sites and support areas not identified for future land use to communities dominated by native plant species, as appropriate. Revegetation is valuable for the prevention of runoff, erosion, and infiltration. In some areas, shrubs such as sagebrush and bitterbrush may be planted to provide habitat and structure for nesting birds. Native grasses and forbs that are adapted to the site conditions will be planted to provide an understory. The methods used for revegetation will reflect what is feasible on a site-by-site basis. Future land use and the duration of project activities are factored into mitigation and revegetation planning.

C5. Topsoil and Backfill Material

Fine-grained topsoil, such as sandy loam, is of low availability on the Hanford Site. In the few places where it exists, such as McGee Ranch and the Fitzner Eberhardt Arid Lands Ecology Reserve, removal may cause unacceptable ecological effects at the borrow sites. The "Hanford Comprehensive Land-Use Plan Environmental Impact Statement" (64 *Federal Register* 61615) precludes the use of borrow materials from McGee Ranch; therefore, backfill from nearby borrow pits will be used. The backfill material from the borrow pits was originally deposited by the Columbia River, and a slow, natural revegetation of this backfill can be seen at the borrow sites that have been abandoned. Native species, including sagebrush and Sandberg's bluegrass, have become established in inactive borrow pits. The density of the vegetative cover at the abandoned borrow pits, however, is less than at other sites such as the abandoned pre-Hanford farmland, which is usually dominated by cheatgrass and tumblemustard (*Sisymbrium altissimum*). The soils at the abandoned fields consist of much finer grained materials, with greater moisture-holding capacity and nutrient properties than at the borrow sites. These fine-grained soils tend to favor cheatgrass, which often excludes establishment of shrubs.

Other sources of backfill that may be considered for use include uncontaminated concrete rubble from nearby demolished buildings. If revegetation will occur at the site and secondary material (i.e., inert crushed concrete or other course material) is used as backfill, it will be placed at least 2 to 3 m (6 to 10 ft) below final grade to the extent practicable. The smaller grained material (i.e., cobble, sand, soil), which is necessary for sufficient plant rooting, will be used near the surface.

C6. Site Preparation

On a case-by-case basis, clean overburden may be used as backfill for an entire excavation when conditions warrant. Conditions may include excavations that are long and shallow in nature, making use of new material on top impractical. Overburden may only be used if it has undergone sampling and analytical results demonstrate that cleanup levels have been met. For those sites that are currently vegetated, the top 15 to 46 cm (6 to 18 in.) of clean overburden will be stripped, saved, and used as the topsoil for the excavation. If needed, this material may be spread into a thinner layer (about 5 to 10 cm [2 to 4 in.]) and used as topsoil for several adjacent sites.

The Tri-Parties have determined that waste sites within the 300 Area "industrialized core zone and contiguous areas" will be regraded in a manner that will provide positive drainage away from areas where residual subsurface contamination could result in adverse groundwater impacts. The grading, to the extent practicable, will maximize the amount of large flat areas and minimize rolling contours or depressions where water may accumulate. For waste sites outside of the industrial zone, the final surface contour will be graded to match the surrounding terrain by creating gentle slopes instead of a flat surface. Any large boulders remaining on the sites that are to be revegetated should be buried deep in the excavation or randomly grouped on the surface to create additional wildlife habitat. Based on site-specific considerations, the lead regulatory agency may approve backfill to less than surrounding grade, in which case depressions may remain.

C7. Species to be Planted

The plant species seeded will be selected based on seed availability and species appropriateness for the structure of the soils to be revegetated. Native species found to be growing on the Hanford Site will be used for a majority of revegetation efforts. Seeds manually collected from native plants, such as sagebrush, yarrow (*Achillea millefolium*), Carey's balsamroot (*Balsamorhiza careyana*), pine bluegrass (*Poa scabrella*), and snow buckwheat, may be collected and will be added to the planting mixture as available and as appropriate to each site. Additional seeds of other species may be provided by the Tribes and Trustees and combined with the species described above.

The methods used for seeding will vary, depending on soil type and conditions. For example, drill-seeding works best on soils with minimal amounts of rock, while broadcast seeding may be preferable on rocky soils. Seeds that are uncleaned or of an unsuitable shape or size may be broadcast over the site before the other seeds are planted. The action of the planting and mulching equipment will help set the broadcast seeds. Areas that have been used for support facilities and haul roads may have excessively compacted ground, making the area unsuitable for planting. If necessary, the soils in these areas will be loosened by ripping the soil with heavy equipment. If a seed drill is not appropriate at these areas, broadcast seeding with subsequent mulching may be used to plant seeds. Seeding each year will generally occur between November and mid-January.

On sites where more intensive revegetation is required, sagebrush and bitterbrush tublings are normally planted between November and January in the backfilled areas at a density ranging between 500 to 1,000 plants/ha (200 to 400 plants/acre), depending on the site.

C8. Fertilizer and Straw Mulch

While the usefulness of fertilizers is sometimes in question when seeding native species, the backfill material excavated from borrow pits is often deficient of nutrients. The cobble composition of excavated backfill material does not promote the establishment of cheatgrass as does finer grained topsoil. Therefore, the addition of some fertilizers may help the native planted species become established. To help clarify the role of fertilizer on native plant establishment, different types of fertilizer and rates may be applied to parts of revegetation sites. The success of each fertilized area will be monitored and compared after the first and second years for plant establishment and cost effectiveness. The fertilizer will be applied at the same time as the seeds, and the type and rate will be determined on a site-specific basis. Straw mulch will be spread on the surface at a rate of 4.5 metric ton/ha (2 tons/acre) and crimped into the seedbed.

C9. Irrigation

Any form of applied irrigation within the 300 Area industrial zone is prohibited.

When irrigation is feasible for sites outside the industrial zone, it will generally occur only at the time of initial seeding. No additional irrigation is planned at this time. The presence of cobble and larger gravels used as backfill on the sites act as a mulch, helping to conserve moisture. The effects of supplemental irrigation on restoration success were tested at a restoration site in the 100-B/C Area during 1999 and 2000. The results at this test site indicated that supplemental irrigation in the spring did little to improve the survival of planted sagebrush (BHI-01406, *2000 Environmental Restoration Contractor Revegetation Monitoring Report*). Vegetation analysis from other similar revegetation sites indicate that it is more beneficial to add supplemental water during the planting process to increase germination, with little observed benefit of irrigation after planting.

C10. Monitoring and Success Criteria

The revegetated areas will be monitored for 5 years following planting. Monitoring will be conducted using methods from Daubenmire (1970) to estimate percent canopy cover and frequency of occurrence for each species. All species observed on the sites, including those not captured in the sampling plot frames, will be recorded. If the canopy cover of seeded plants is less than 1% in the spring of the second year, reseeding may occur the following fall, if the cause of the reduced success can be identified and rectified. After 5 years, the criteria for success will be a total canopy cover of greater than 25% for native plants. If this is not achieved, the cause should be identified and rectified with additional plantings, fertilization, irrigation, or soil amendments, as applicable.

The vegetative cover and composition at each site following a revegetation effort will be site specific. Several factors, including seedbed, moisture regime, and topographic features, influence a native plant community establishment and success. Caution should be exercised when comparing success between different locations.

C11. References

64 FR 61615, "Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS), Hanford Site, Richland, Washington; Record of Decision (ROD)," *Federal Register*, Vol. 64, No. 218, pp. 61615, November 12, 1999.

BHI-00170, 1995, *Ecological Investigation Technical Report for the 300-FF-2 Operable Unit*, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

BHI-01406, 2000, *2000 Environmental Restoration Contractor Revegetation Monitoring Report*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

BHI, 2000, "Ecological Resources Review of Remedial Design Package for Nine 300-FF-2 Waste Sites (00 ER-039)," CCN 083958, interoffice memorandum to S. Parnell, Bechtel Hanford, Inc., Richland, Washington, November 13.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

Daubenmire, R., 1970, *Steppe Vegetation of Washington*, Technical Bulletin 62, Washington Agricultural Experiment Station, Pullman, Washington.

DOE/RL-96-32, 2013, *Hanford Site Biological Resources Management Plan*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2002-19, 2002, *Mitigation Action Plan for the 300 Area of the Hanford Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Rickard, W. H. Jr, R. E. Fitzner, and C. A. Brandt, 1990, *Biota of the 300-FF-1 Operable Unit*, EMO 1016, Environmental Management Operations, Richland, Washington.

WDNR, 1995, State *of Washington Natural Heritage Plan: 1993/1995 Update*, Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, Washington.

This page intentionally left blank.

Appendix D

Development of Cleanup Levels and Summary of RESRAD Methodology

This page intentionally left blank.

D1. Introduction

As described in the *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1* (300 Area ROD) (EPA 2013), cleanup levels (CULs) have been developed for each media and/or exposure pathway to provide protection of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs).

Soil CULs for 300 Area contaminants of concern (COCs) were developed based on direct human contact as well as groundwater and surface water protection and are summarized in Table 4 of the 300 Area ROD (EPA 2013). Cleanup levels from this ROD are summarized in Table D-1 of this appendix. These CULs apply to soil and engineered structures that include pipelines and debris. The CULs do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying CULs to sediment/scales within pipelines or other structures. The need for remedial action is based on the existence of soil contamination. Direct contact CULs for nonradionuclides are based on current Washington State Department of Ecology 2007 standards at *Washington Administrative Code* (WAC) 173-340. The direct contact soil CULs for radionuclides were set at either the risk-based level of 1×10^{-4} cancer risk or the radiation dose limit of 15 mrem/yr that was used in the 300-FF-2 interim action ROD (EPA 2001), whichever is lower.

The objective of this appendix is to document the development of CULs for nonradionuclide and radionuclide COCs at the 300 Area that are protective of human health and the environment. Impacts to human health are addressed by evaluation of direct contact/exposure and groundwater/Columbia River pathways. The CULs for comparison against residual soil contamination concentrations and evaluation of site risk are contained in the 300 Area ROD (EPA 2013) based on development during the 300 Area remedial investigation/feasibility study (RI/FS) (DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units;* DOE/RL-2010-99-ADD1, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*); DOE/RL-2010-99, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*) and are summarized in the following sections.

Cleanup levels are developed for waste site COCs to attain acceptable levels of human health risk and to protect groundwater and the Columbia River. Because of uncertainty with the nature and extent of contamination, the CULs are evaluated as if exposure comes from individual constituents and CULs are set at acceptable risk levels for exposure to individual constituents. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated to ensure that the waste site meets total risk limits as specified in the 300 Area ROD (EPA 2013). When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the remedial action objectives of the 300 Area ROD.

D2. Nonradionuclide Cleanup Levels

Numeric CULs, expressed in terms of concentration (mg/kg), were developed for 300 Area nonradionuclide COCs using the version of WAC 173-340 (Ecology 2007) that was in effect at the time the 300 Area ROD (EPA 2013) was approved. Soil residential CULs for nonradionuclides were calculated using the WAC 173-340-740 chemical standards for unrestricted use for all COCs using a hazard index of one and a cancer risk of 1×10^{-6}. Soil industrial CULs for nonradionuclides were calculated using the WAC 173-340-745 chemical standards for industrial use for all COCs using a hazard index of one and a cancer risk of 1×10^{-5}.

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Radionuclides	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	
Americium-241	32	--	210	--	ROD
Cesium-137	4.4	--	18	--	ROD
Cobalt-60	1.4	--	5.2	--	ROD
Europium-152	3.3	--	12	--	ROD
Europium-154	3.0	--	11	--	ROD
Europium-155	125	--	518	--	ROD
Iodine-129	0.076	12.8	1,940	37.1	ROD
Plutonium-238	39	--	155	--	ROD
Plutonium-239/240	35	--	245	--	ROD
Plutonium-241	854	--	12,900	--	ROD
Strontium-90	2.3	227,000	1,970	--	ROD
Technetium-99	1.5	272	166,000	420	ROD
Tritium (H-3)	459	9,180	1,980	12,200	ROD
Uranium-233/234	27.2	--	167	--	ROD
Uranium-235	2.7	--	16	--	ROD
Uranium-238	26.2	--	167	--	ROD
Total uranium	56.1	--	350	--	ROD
Metals	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Antimony	32	252	1,400	760	ROD
Arsenic	20	20	20	--	ROD
Barium	16,000	--	700,000	--	ROD
Beryllium	160	--	7,000	--	ROD
Cadmium	80	176	3,500	--	ROD
Chromium, total	120,000	--	>1,000,000	--	ROD
Chromium VI	2.1	2.0	10,500	2.0	ROD
Cobalt	24	--	1,050	--	ROD
Copper	3,200	3,400	140,000	--	ROD
Lead	250	1,480	1,000	--	ROD
Lithium	160	--	7,000	--	ROD

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Manganese	11,200	--	490,000	--	ROD
Mercury	24	8.5	1,050	--	ROD
Nickel	1,600	--	70,000	--	ROD
Selenium	400	302	17,500	912	ROD
Silver	400	--	17,500	--	ROD
Strontium	48,000	--	>1,000,000	--	ROD
Tin	48,000	--	>1,000,000	--	ROD
Uranium	81	102	505	157	ROD
Vanadium	400	--	17,500	--	ROD
Zinc	24,000	64,100	>1,000,000	--	ROD
Inorganics and TPH	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Cyanide	48	636	42	1,960	ROD
Fluoride	4,800	--	210,000	--	ROD
Nitrate	568,000	13,600	>1,000,000	21,000	ROD
TPH, Normal paraffin (kerosene)	2,000	2,000	2,000	2,000	ROD
TPH, Diesel	2,000	2,000	2,000	2,000	ROD
TPH, Motor oil	2,000	2,000	2,000	2,000	ROD
Volatile Organic Analytes	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Benzene	0.57	0.82	5.7	1.4	ROD
Carbon tetrachloride	0.61	0.44	6.1	0.86	ROD
Chloroform	0.24	1.3	2.4	2.1	ROD
Dichloroethylene;1,2-, total	720	55	31,500	89	ROD
Dichloroethylene;1,2-,cis	160	11	7,000	18	ROD
Ethyl Acetate	72,000	--	>1,000,000	--	ROD
Hexachlorobutadiene	13	--	1,680	--	ROD
Hexachloroethane	2.5	23	25	72	ROD
Methyl ethyl ketone (2-butanone)	28,400	1,670	62,200	2,590	ROD
Methyl isobutyl ketone (4-M,2-P)	6,400	285	28,700	445	ROD

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	
Tetrachloroethene	20	2.4	82	6.0	ROD
Toluene	4,770	1,150	10,400	2,190	ROD
Trichloroethane;1,1,1-	3,660	361	8,000	686	ROD
Trichloroethylene (trichloroethene; TCE)	1.1	1.3	3.5	2.4	ROD
Vinyl chloride	0.53	0.013	5.2	0.021	ROD
Xylene	103	4,700	227	11,090	ROD
Semivolatile Organic Analytes	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Benzo(a)pyrene	0.14	--	18	--	ROD
Chrysene	14	--	1,800	--	ROD
Ethylene glycol	160,000	5,030	>1,000,000	7,770	ROD
Hexachlorobutadiene	13	--	1,680	--	ROD
Hexachloroethane	2.5	23	25	72	ROD
Tributyl phosphate	111	217	14,600	658	ROD
Pesticides and PCBs	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
PCB Aroclor-1016	5.6	--	245	--	ROD
PCB Aroclor-1221	0.5	0.017	66	0.026	ROD
PCB Aroclor-1232	0.5	0.017	66	0.026	ROD
PCB Aroclor-1242	0.5	0.14	66	--	ROD
PCB Aroclor-1248	0.5	0.13	66	--	ROD
PCB Aroclor-1254	0.5	--	66	--	ROD
PCB Aroclor-1260	0.5	--	66	--	ROD

Footnotes from the 300 Area ROD, Table 4:

-- = Not available; no CUL calculated (contaminant is not predicted to reach groundwater).

CUL basis for radionuclides is a cancer risk of 1×10^{-4} or 15 mrem/yr dose, whichever is more conservative. For uranium, 15 mrem/yr is more conservative, so that is the basis for the uranium isotopes total CUL. That total is divided among the individual uranium isotopes using the natural ratio of isotopes.

No uranium isotope CUL is selected for groundwater and river protection because the maximum contaminant level is used, which is based on uranium metal.

CUL basis for chemicals is the more conservative of a hazard index of one or the cancer risk. The cancer risk is 1×10^{-6} for residential cleanup and 1×10^{-5} for industrial cleanup based on MTCA.

Basis for soil CUL for groundwater and river protection is the STOMP soil leach model.

For pipelines too small for people to enter, CULs apply to the contaminated pipelines including the mass of the pipes. CULs for structures and debris also account for the mass of the object.

Table D-1. Soil Cleanup Level Summary from the 300 Area Record of Decision

Contaminant	Residential Soil CULs		Industrial Soil CULs		Source [a]
	Direct Exposure	Protective of Groundwater and River	Direct Exposure	Protective of Groundwater and River	

a Cleanup levels in this table are obtained from the 300 Area ROD. Residential and industrial cleanup levels protective of groundwater and the river are described in Section 8.2 of the ROD. Parameters specific to a residential or industrial scenario were used in STOMP modeling calculations. Under the 300 Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

ROD = EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

CUL = cleanup level
MTCA = Model Toxics Control Act
PCB = polychlorinated biphenyl
ROD = Record of Decision
STOMP = Subsurface Transport Over Multiple Phases
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis

The direct exposure cleanup levels tabulated in Table D-1 apply to the upper 4.6 m (15 ft) of the soil column per WAC 173-340-740(6)(d) and represent concentrations for individual COCs that will be protective of human health from direct contact with contaminated waste for a residential land-use scenario. WAC 173-340 also specifies the evaluation of hazard quotients and excess carcinogenic risk. These parameters can be derived by rearranging Equations 740-1, 740-2, 745-1, and 745-2 of WAC 173-340, as shown in Tables D-2a, D-2b, D-2c, and D-2d, respectively. Values for the reference doses (RfDs) and cancer potency factors (CPFs) are provided in Table D-3. Institutional controls to prevent deep excavation or well drilling will be required if the applicable direct exposure CULs are not attained in the soil below 4.6 m (15 ft) in depth.

D3. Groundwater and River Protection Cleanup Levels for Radionuclide and Nonradionuclide Contaminants In Soil

Soil CULs for radionuclide and nonradionuclide COCs for the protection of groundwater and surface water are summarized in Table D-1. These were calculated as described in the 300 Area ROD (EPA 2013) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code with a one-dimensional model for all contaminants except uranium. For uranium, the STOMP code was used with a two-dimensional model that includes the effects of uranium's more complex sorption behavior. For highly mobile contaminants (retardation coefficient <2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. For the 300 Area industrial complex and 618-11 Burial Ground, a groundwater recharge rate of 25 mm/yr was used for the long term, representing a permanently disturbed soil with cheatgrass vegetative cover. For areas outside the 300 Area industrial complex and 618-11 Burial Ground where CULs are based on a residential scenario, a groundwater recharge rate of approximately 72 mm/yr was used representing an irrigated condition. Based on this model, no soil CUL for groundwater or river protection is calculated for some contaminants because the contaminant is calculated to not reach the groundwater within 1,000 years.

Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions. Site-specific evaluation of the attainment of National Primary Drinking Water Standards for radionuclides is described in Section D.5.2 of this appendix.

D4. Radionuclide Cleanup Levels

Cleanup levels for radionuclide COCs are summarized in Table D-1 of this appendix. Soil radionuclide cleanup levels for the 300 Area of the Hanford Site are based upon determinations of individual radionuclide activities that will be protective of a direct exposure carcinogenic risk limit of $1x10^{-4}$, or a 15 mrem/yr radiological dose limit for isotopes where that is more conservative. The RESidual RADioactivity (RESRAD) model was selected by the Tri-Parties as the radionuclide risk and dose assessment model for generating CULs for radionuclide contaminants in soil and for verifying that concentrations remaining after remedial action achieve cleanup levels to meet the cumulative carcinogenic risk limit of $1x10^{-4}$. The RESRAD model was developed by Argonne National Laboratory (ANL 2001, 2009) to implement U.S. Department of Energy (DOE) guidelines for residual radioactive material in soil. The most current version of RESRAD will be used for conducting radionuclide risk assessments.

Table D-2a. Parameters for Hazard Quotient for Residential Land Use

Rearrange Equation 740-1 of WAC 173-340 (2007)		
Hazard Quotient = (Concentration)*(SIR*AB1*EF*ED)/(RfD*ABW*UCF*AT)		
Hazard Quotient = (Concentration)*(Daily Intake Factor)/(RfD)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	6	years, Averaging Time
RfD	(Variable)	Chemical Specific Reference Dose
Daily Intake Factor =	**1.25E-05**	**per day**

Table D-2b. Parameters for Excess Cancer Risk for Residential Land Use

Rearrange Equation 740-2 of WAC 173-340 (2007)		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*EF*ED)/(ABW*UCF*AT)		
Cancer Risk = (Concentration)*(Daily Intake Factor)*(CPF)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	75	years, Averaging Time
CPF	(Variable)	Chemical Specific Cancer Potency Factor
Daily Intake Factor =	**1.00E-06**	**per day**

Table D-2c. Parameters for Hazard Quotient for Industrial Land Use

Rearrange Equation 745-1 of WAC 173-340 (2007)		
Hazard Quotient = (Concentration)*(SIR*AB1*EF*ED)/(RfD*ABW*UCF*AT)		
Hazard Quotient = (Concentration)*(Daily Intake Factor)/(RfD)		
Variable	Value	Description
SIR	50	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	0.4	unitless, Exposure Frequency
ED	20	years, Exposure Duration
ABW	70	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	20	years, Averaging Time
RfD	(Variable)	Chemical Specific Reference Dose
Daily Intake Factor =	**2.86E-07**	**per day**

Table D-2d. Parameters for Excess Cancer Risk for Industrial Land Use

Rearrange Equation 745-2 of WAC 173-340 (2007)		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*EF*ED)/(ABW*UCF*AT)		
Cancer Risk = (Concentration)*(Daily Intake Factor)*(CPF)		
Variable	Value	Description
SIR	50	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	0.4	unitless, Exposure Frequency
ED	20	years, Exposure Duration
ABW	70	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	75	years, Averaging Time
CPF	(Variable)	Chemical Specific Cancer Potency Factor
Daily Intake Factor =	**7.62E-08**	**per day**

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Metals			
Antimony	0.13	4.00E-04	--
Arsenic	6.5	3.00E-04	1.50E+00
Barium	132	2.00E-01	--
Beryllium	1.51	2.00E-03	--
Boron	3.9	2.00E-01	--
Cadmium	0.563	1.00E-01	--
Chromium, total	19	1.50E+00	--
Chromium VI	--	3.00E-03	--
Cobalt	16	3.00E-04	--
Copper	22	4.00E-02	--
Lead	10	NA	NA
Lithium	13.3	2.00E-03	--
Manganese	512	1.40E-01	--
Mercury	0.013	3.00E-04	--
Molybdenum	0.47	5.00E-03	--
Nickel	19.1	2.00E-02	--
Selenium	0.78	5.00E-03	--
Silver	0.17	5.00E-03	--
Strontium	--	6.00E-01	--
Tin	--	6.00E-01	--
Uranium	3.2	3.00E-03	--
Vanadium	85	5.00E-03	--
Zinc	68	3.00E-01	--
Inorganics			
Chloride	--	NA	NA
Cyanide	--	6.00E-04	--
Fluoride	2.8	6.00E-02	--
Nitrate	52	7.10E+00	--
Nitrite	--	1.00E-01	--

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Nitrogen in Nitrite and Nitrate	--	1.60E+00	--
Sulfate	--	NA	NA
Volatile Organic Compounds			
Acetone	--	9.00E-01	--
Benzene	--	4.00E-03	5.50E-02
Carbon tetrachloride	--	4.00E-03	7.00E-02
Chloroform	--	1.00E-02	3.10E-02
Dichloroethylene; 1,1- (dichloroethene)	--	5.00E-02	--
Dichloroethylene;1,2-, total	--	9.00E-03	--
Dichloroethylene;1,2-,cis	--	1.00E-02	--
Ethyl Acetate	--	9.00E-01	--
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachloroethane	--	1.00E-03	1.40E-02
Methyl Ethyl Ketone (2-butanone)	--	6.00E-01	--
Methyl Isobutyl Ketone (4-M,2-P)	--	8.00E-02	--
Methylene chloride	--	6.00E-02	7.50E-03
Tetrachloroethene	--	1.00E-02	5.40E-01
Toluene	--	8.00E-02	--
Trichloroethane;1,1,1-	--	2.00E+00	--
Trichloroethylene (Trichloroethene; TCE)	--	--	8.90E-02
Vinyl Chloride	--	3.00E-03	7.20E-01
Xylene	--	2.00E-01	--
Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons			
Acenaphthene	--	6.00E-02	--
Anthracene	--	3.00E-01	--
Benzo(a)anthracene	--	--	7.30E-01
Benzo(a)pyrene	--	--	7.30E+00
Benzo(b)fluoranthene	--	--	7.30E-01
Benzo(k)fluoranthene	--	--	7.30E-01

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Benzo(g,h,i)perylene	--	NA	NA
Bis(2-chloro-1-methylethyl) ether	--	4.00E-02	7.00E-02
Bis(2-chloroethoxy)methane	--	3.00E-03	--
Bis(2-chloroethyl) ether	--	NA	NA
Bis(2-ethylhexyl) phthalate	--	2.00E-02	1.40E-02
Bromophenylphenyl ether; 4-	--	NA	NA
Butylbenzylphthalate	--	2.00E-01	1.90E-03
Carbazole	--	--	2.00E-02
Chloro-3-methylphenol, 4-	--	1.00E-01	--
Chloroanilene; 4-	--	4.00E-03	2.00E-01
Chloronaphthalene; 2-	--	8.00E-02	--
Chlorophenol, 2-	--	5.00E-03	--
Chrysene	--	--	7.30E-02
Dibenz[a,h]anthracene	--	--	7.30E-01
Dibenzofuran	--	1.00E-03	--
Dichlorobenzene; 1,2-	--	9.00E-02	--
Dichlorobenzene; 1,3-	--	3.00E-02	--
Dichlorobenzene, 1,4-	--	7.00E-02	5.40E-03
Dichlorobenzidine; 3,3-	--	--	4.50E-01
Dichlorophenol; 2,4-	--	3.00E-03	--
Diethylphthalate	--	8.00E-01	--
Dimethylphthalate	--	1.00E+00	--
Dimethylphenol; 2,4-	--	2.00E-03	--
Di-n-butylphthalate	--	1.00E-01	--
Dinitro-2-methylphenol; 4,6-	--	1.00E-04	--
Dinitrophenol; 2,4-	--	2.00E-03	--
Dinitrotoluene, 2,4-	--	2.00E-03	3.10E-01
Dinitrotoluene; 2,6-	--	1.00E-03	--
Ethylene glycol	--	2.00E+00	--
Fluoranthene	--	4.00E-02	--

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Fluorene	--	4.00E-02	--
Hexachlorobenzene	--	8.00E-04	1.60E+00
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachlorocyclopentadiene	--	6.00E-03	--
Hexachloroethane	--	7.00E-04	4.00E-02
Indeno(1,2,3-cd)pyrene	--	--	7.30E-01
Isophorone	--	2.00E-01	0.00095
Methylnaphthalene, 2-	--	4.00E-03	--
Methylphenol; 2- (cresol;o-)	--	5.00E-02	--
Methylphenol; 4- (cresol;p-)	--	1.00E-01	--
Naphthalene	--	2.00E-02	--
Nitroaniline; 2-	--	1.00E-02	--
Nitroaniline; 3-	--	3.00E-04	2.10E-02
Nitroaniline; 4-	--	4.00E-03	2.00E-02
Nitrobenzene	--	2.00E-03	--
Nitrophenol; 4-	--	8.00E-03	--
Nitrosodi-n-dipropylamine, n-	--	--	7.00E+00
Nitrosodiphenylamine;N-	--	--	4.90E-03
Pentachlorophenol	--	3.00E-02	1.20E-01
Phenol	--	3.00E-01	--
Pyrene	--	3.00E-02	--
Tributyl Phosphate	--	1.00E-02	9.00E-03
Trichlorobenzene, 1,2,4-	--	1.00E-02	2.90E-02
Trichlorophenol; 2,4,5-	--	1.00E-01	--
Trichlorophenol; 2,4,6-	--	1.00E-03	1.10E-02
Pesticides and Polychlorinated Biphenyls			
Aldrin	--	3.00E-05	1.70E+01
BHC, Alpha-	--	8.00E-03	6.30E+00
BHC, beta	--	--	1.80E+00
BHC, gamma (Lindane)	--	3.00E-04	1.10E+00

Table D-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] $(mg/kg\text{-}day)^{-1}$
Chlordane	--	5.00E-04	3.50E-01
Dalapon	--	3.00E-02	--
Db; 2,4- [4-(2,4-dichlorophenoxy) butanoic acid]	--	8.0E-03	--
DDD, 4,4'-	--	--	2.40E-01
DDE, 4,4'-	--	--	3.40E-01
DDT, 4,4'-	--	--	3.40E-01
Dicambra	--	3.00E-02	--
Dichlorophenoxyacetic acid; 2,4-	--	1.00E-02	--
Dieldrin	--	5.00E-05	1.60E+01
Dinoseb (DNBP)	--	1.00E-03	--
Endosulfan (I, II, sulfate)	--	6.00E-03	--
Endrin (and ketone, aldehyde)	--	3.00E-04	--
Heptachlor	--	5.00E-04	4.50E+01
Heptachlor epoxide	--	1.30E-05	9.10E+00
Methoxychlor	--	5.00E-03	--
Polychlorinated biphenyls	--	--	2.00E+01
PCB Aroclor 1016	--	7.00E-05	7.00E-02
PCB Aroclor 1221	--	--	2.00E+00
PCB Aroclor 1232	--	--	2.00E+00
PCB Aroclor 1242	--	--	2.00E+00
PCB Aroclor 1248	--	--	2.00E+00
PCB Aroclor 1254	--	2.00E-05	2.00E+00
PCB Aroclor 1260	--	--	2.00E+00
Silvex (tp;2,4,5-)	--	8.00E-03	--
Toxaphene	--	--	1.10E+01
Trichlorophenoxyacetic acid;2,4,5-	--	1.00E-02	--

a Background from ECF-HANFORD-11-0038,2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

b Oral reference dose and cancer potency factor values from Table G-17 of DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*.

Single radionuclide soil concentrations corresponding to a carcinogenic risk limit of $1x10^{-4}$ in a rural-residential scenario were calculated using RESRAD version 6.5 (ANL 2009) and the appropriate parameters from the 300 Area RI/FS report (DOE/RL-2010-99), Appendix G, Table G 6, for an unrestricted land-use scenario and from Table G-7 for an industrial land-use scenario. Determinations of radionuclide cleanup levels to be protective of human health direct exposure carcinogenic risk are reported in a calculation brief (ECF-HANFORD-10-0429, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FA) Report*) and summarized in Table 4 of the 300 Area ROD (EPA 2013). The tables of RESRAD input parameters are reproduced in this appendix as Tables D-4 and D-5.

D5. Using RESRAD for Waste Site Radionuclide Cleanup Verification

Where more than one radionuclide is detected and radionuclide cleanup levels in Table D-1 are not exceeded, a sum-of-fractions evaluation or a RESRAD evaluation must be performed to determine that the cumulative carcinogenic risk limit of $1x10^{-4}$ is not exceeded. The input parameters and assumptions used in RESRAD to generate the radionuclide direct exposure cleanup levels presented in this remedial design report/remedial action work plan are summarized in Tables D-4 and D-5. For the purpose of site cleanup verification, the RESRAD input values (e.g., the thickness of the contaminated zone, the thickness of the uncontaminated zone, and the size of the waste site) will be determined on a site-specific basis. RESRAD calculates all radionuclides in the decay chain (daughters) in calculating ingrowth and decay. It has not been determined if any daughters were present at the time of waste emplacement, but they would be insignificant dose contributors; therefore, estimated daughters are not included as input.

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
Exposure pathways	External Gamma: Inhalation: Plant Ingestion: Meat Ingestion: Milk Ingestion: Aquatic Foods: Drinking Water: Soil Ingestion: Radon:	NA	Active Active Active Active Active Active Active Active Suppressed	DOE/RL-96-17, Rev. 4
R011 – Contaminated Zone (CZ)	Area of CZ [a]	m^2	10,000 [a]	RESRAD default
	Thickness of CZ [a]	m	4.6 [a]	Shallow zone
	Length parallel to aquifer flow [a]	m	100 [a]	Square root of contaminated site area
	Radiation dose limit	mrem/yr	15	DOE/RL-99-40
	Elapsed time since waste placement	yr	0	RESRAD default
R012 – Principal Radionuclide Concentrations	All radionuclide contaminants of concern	pCi/g	Contaminant-specific	

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R013 – Cover and CZ Hydrological Data	Cover depth [a]	m	0	RESRAD default
	Cover material density	g/cm^3	1.6	DOE/RL-99-40
	Cover erosion rate	m/yr	Not Used	No cover
	Density OF CZ	g/cm^3	1.6	DOE/RL-99-40
	CZ erosion rate	m/yr	Not Used	Only used when rate is known
	CZ total porosity	Unitless	0.3	DOE/RL-99-40
	CZ field capacity	Unitless	0.25	DOE/RL-99-40
	CZ hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
	CZ b parameter	Unitless	15	DOE/RL-99-40
	Humidity in air	g/cm^3	8	RESRAD default
	Evapotranspiration coefficient	Unitless	0.91	WDOH/320-015
	Wind speed	m/sec	3.4	PNNL-12087
	Precipitation	m/yr	0.16	DOE/RL-96-17, Rev. 6
	Irrigation rate	m/yr	0.76	DOE/RL-96-17, Rev. 4
	Irrigation mode	NA	Overhead	RESRAD default
	Runoff coefficient	Unitless	0.2	RESRAD default
	Watershed area for nearby stream or pond	m^2	10,000,000	DOE/RL-99-40
	Accuracy for water/soil computations	NA	0.001	RESRAD default
R014 – Saturated Zone (SZ) Hydrological Data	Density of SZ	g/cm^3	1.6	DOE/RL-99-40
	SZ total porosity	Unitless	0.3	DOE/RL-99-40
	SZ effective porosity	Unitless	0.3	DOE/RL-99-40
	SZ hydraulic conductivity	m/yr	673,846	DOE/RL-99-40
	SZ hydraulic gradient	Unitless	0.0005	DOE/RL-99-40
	SZ b parameter	Unitless	3.5	DOE/RL-99-40
	Water table drop rate	m/yr	Not Used	Only used when rate is known
	Well pump intake depth below water table	m	4.6 (15 ft), typical RCRA well screen length	
	Nondispersion (ND) or mass balance (MB)	NA	ND	RESRAD default
	Well pumping rate	m^3/yr	250	RESRAD default
R015 – Uncontaminated and Unsaturated Strata Hydrological Data	Number of unsaturated strata [a]	Unitless	1 [a]	Site-specific
	Thickness [a]	m	5 [a]	Site-specific
	Soil density	g/cm^3	1.6	DOE/RL-99-40
	Total porosity	Unitless	0.3	DOE/RL-99-40
	Effective porosity	Unitless	0.3	DOE/RL-99-40
	Field capacity	Unitless	0.2	RESRAD default
	Soil-specific b parameter	Unitless	15	DOE/RL-99-40
	Hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
R016 – K_d for Individual Radionuclides	K_d for contaminated zone, uncontaminated zone, and saturated zone	mL/g	Contaminant-specific	DOE/RL-96-17, Rev. 6
	Saturated leach rate	yr^{-1}	Not used	Use Kd values
	Saturated solubility	g/mL	Not used	Use Kd values

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R017 – Inhalation and External Gamma	Inhalation rate	m^3/yr	7,300	WDOH/320-015
	Mass loading for inhalation	g/m^3	0.0001	WDOH/320-015
	Exposure duration	yr	30	RESRAD Default
	Indoor dust filtration factor	Unitless	0.4	RESRAD Default
	External gamma shielding factor	Unitless	0.4	DOE/RL-2010-99
	Indoor time fraction	Unitless	0.6	WDOH/320-015 15 hr/day, 350 days/yr
	Outdoor time fraction	Unitless	0.12	DOE/RL-2010-99 3 hr/day, 350 days/yr
	Shape factor	NA	Circular unless otherwise specified	
R018 – Ingestion Pathway Data, Dietary Parameters	Fruits, vegetables, and grain consumption	kg/yr	110	WDOH/320-015
	Leafy vegetable consumption	kg/yr	2.7	WDOH/320-015
	Milk consumption	L/yr	100	WDOH/320-015
	Meat and poultry consumption	kg/yr	36	WDOH/320-015
	Fish consumption	kg/yr	19.7	WDOH/320-015
	Other seafood consumption	kg/yr	0.9	RESRAD Default
	Soil ingestion	g/yr	73	WDOH/320-015
	Drinking water intake	L/yr	730	WDOH/320-015
	Drinking water contamination fraction	Unitless	1	RESRAD Default
	Household water contamination fraction	Unitless	1	RESRAD Default
	Livestock water contamination fraction	Unitless	1	RESRAD Default
	Irrigation water contamination fraction	Unitless	1	RESRAD Default
	Aquatic food contamination fraction	Unitless	0.5	RESRAD Default
	Plant food contamination fraction	Unitless	-1 [b]	RESRAD Default
	Meat contamination fraction	Unitless	-1 [b]	RESRAD Default
	Milk contamination fraction	Unitless	-1 [b]	RESRAD Default
R019 – Ingestion Pathway Data, Nondietary	Livestock fodder intake for meat	kg/d	68	RESRAD Default
	Livestock fodder intake for milk	kg/d	55	RESRAD Default
	Livestock water intake for meat	L/d	50	RESRAD Default
	Livestock water intake for milk	L/d	160	RESRAD Default
	Livestock intake of soil	kg/d	0.5	RESRAD Default
	Mass loading for foliar deposition	g/m^3	0.0001	RESRAD Default
	Depth of soil mixing layer	m	0.15	RESRAD Default
	Depth of roots	m	0.9	RESRAD Default
	Groundwater fractional usage – drinking water	Unitless	1	RESRAD Default
	Groundwater fractional usage – household	Unitless	1	RESRAD Default
	Groundwater fractional usage – livestock water	Unitless	1	RESRAD Default
	Groundwater usage – irrigation	Unitless	1	RESRAD Default

Table D-4. RESRAD Residential Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R021 – Radon		NA	Not used	Radon is not a COPC

a The stated numeric values are only used when RESRAD is used to determine generic cleanup levels. Otherwise, site-specific input values for these parameters are determined on a site-by-site basis. All other values are fixed at the values shown unless modified with regulator approval.

b The default value of -1 specifies that the contaminated fraction of this input will be calculated from the appropriate area factor in RESRAD (for a waste site of less than the default of 10,000 m^2 RESRAD calculates and applies an area factor based on the actual waste site area). Setting the default value in this column to zero will turn off the pathways entirely.

COPC = contaminant of potential concern
CZ = contaminated zone
GW = groundwater
ND = nondetect
RCRA = *Resource Conservation and Recovery Act of 1976*
RESRAD = RESidual RADioactivity

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
Exposure Pathways	Pathway External Gamma: Inhalation: Plant Ingestion: Meat Ingestion: Milk Ingestion: Aquatic Foods: Drinking Water: Soil Ingestion: Radon:	NA	Soil Status Active Active Suppressed Suppressed Suppressed Suppressed Suppressed Active Suppressed	DOE/RL-99-40
R011 – Contaminated Zone (CZ)	Area of CZ [a]	m^2	10,000 [a]	RESRAD default
	Thickness of CZ [a]	m	4.6 [a]	Shallow Zone
	Length parallel to aquifer flow [a]	m	100 [a]	Square root of contaminated site area
	Radiation dose limit	mrem/yr	15	DOE/RL-99-40
	Elapsed time since waste placement	yr	0	RESRAD default
R012 – Principal Radionuclide Concentrations	All radionuclide contaminants of concern	pCi/g	Contaminant-specific	
R013 – Cover and CZ Hydrological Data	Cover depth [a]	m	0	RESRAD default
	Cover material density	g/cm^3	1.6	DOE/RL-99-40
	Cover erosion rate	m/yr	Not used	No cover
	Density of CZ	g/cm^3	1.6	DOE/RL-99-40
	CZ erosion rate	m/yr	Not used	Only used when rate is known
	CZ total porosity	Unitless	0.3	DOE/RL-99-40
	CZ field capacity	Unitless	0.25	DOE/RL-99-40
	CZ hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
	CZ b parameter	Unitless	15	DOE/RL-99-40

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
R013 – Cover and CZ Hydrological Data (continued)	Humidity in air	g/cm^3	8	RESRAD default
	Evapotranspiration coefficient	Unitless	0.91	WDOH/320-015
	Wind speed	m/sec	3.4	PNNL-12087
	Precipitation	m/yr	0.16	DOE/RL-96-17, Rev. 6
	Irrigation rate	m/yr	0	DOE/RL-99-40
	Irrigation mode	NA	Overhead	RESRAD default
	Runoff coefficient	Unitless	0.2	RESRAD default
	Watershed area for nearby stream or pond	m^2	10,000,000	DOE/RL-99-40
	Accuracy for water/soil computations	Unitless	0.001	RESRAD default
R014 – Saturated Zone (SZ) Hydrological Data	Density of SZ	g/cm^3	1.6	DOE/RL-99-40
	SZ total porosity	Unitless	0.3	DOE/RL-99-40
	SZ effective porosity	Unitless	0.3	DOE/RL-99-40
	SZ hydraulic conductivity	m/yr	673,846	DOE/RL-99-40
	SZ hydraulic gradient	Unitless	0.0005	DOE/RL-99-40
	SZ b parameter	Unitless	3.5	DOE/RL-99-40
	Water table drop rate	m/yr	Not Used	Only used when rate is known
	Well pump intake depth below water table	m	4.6 m (15 ft), typical RCRA well screen length	
	Nondispersion (ND) or mass balance (MB)	NA	ND	RESRAD default
	Well pumping rate	m^3/yr	250	RESRAD default
R015 – Uncontaminated and Unsaturated Strata Hydrological Data	Number of unsaturated strata [a]	Unitless	1 [a]	Site-specific
	Thickness [a]	m	5 [a]	Site-specific
	Soil density	g/cm^3	1.6	DOE/RL-99-40
	Total porosity	Unitless	0.3	DOE/RL-99-40
	Effective porosity	Unitless	0.3	DOE/RL-99-40
	Field capacity	Unitless	0.2	RESRAD default
	Soil-specific b parameter	Unitless	15	DOE/RL-99-40
	Hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
R016 – K_d for Individual Radionuclides	K_d for contaminated zone, uncontaminated zone, and saturated zone	mL/g	Contaminant-specific	DOE/RL-96-17, Rev. 6
	Saturated leach rate	yr^{-1}	Not used	Use Kd values
	Saturated solubility	g/mL	Not used	Use Kd values
R017 – Inhalation and External Gamma	Inhalation rate	m^3/yr	8,400	DOE/RL-99-40
	Mass loading for inhalation	g/m^3	0.0002	DOE/RL-99-40
	Exposure duration	yr	30	RESRAD default
	Indoor dust filtration factor	Unitless	0.4	RESRAD default
	External gamma shielding factor	Unitless	0.4	DOE/RL-2010-99
	Indoor time fraction	Unitless	0.17	DOE/RL-2010-99 6 hr/day, 250 days/yr
	Outdoor time fraction	Unitless	0.057	DOE/RL-2010-99 2 hr/day, 250 days/yr
	Shape factor	NA	Circular	RESRAD default

Table D-5. RESRAD Industrial Input Parameters for the 300 Area

Category	Parameter	Units	User Input, Industrial Scenario	Reference
R018 – Ingestion Pathway Data, Dietary Parameters	Fruits, vegetables, and grain consumption	kg/yr	Not used in industrial scenario	
	Leafy vegetable consumption	kg/yr		
	Milk consumption	L/yr		
	Meat and poultry consumption	kg/yr		
	Fish consumption	kg/yr		
	Other seafood consumption	kg/yr		
	Soil ingestion	g/yr	25	DOE/RL-99-40
	Drinking water intake	L/yr	0	DOE/RL-99-40
	Drinking water contamination fraction	Unitless	0	DOE/RL-99-40
	Household water contamination fraction	Unitless	Not used in industrial scenario	
	Livestock water contamination fraction	Unitless		
	Irrigation water contamination fraction	Unitless		
	Aquatic food contamination fraction	Unitless		
	Plant food contamination fraction	Unitless		
	Meat contamination fraction	Unitless		
	Milk contamination fraction	Unitless		
R019 – Ingestion Pathway Data, Nondietary	Livestock fodder intake for meat	kg/d	Not used in industrial scenario	
	Livestock fodder intake for milk	kg/d		
	Livestock water intake for meat	L/d		
	Livestock water intake for milk	L/d		
	Livestock intake of soil	kg/d		
	Mass loading for foliar deposition	g/m^3		
	Depth of soil mixing layer	m		
	Depth of roots	m		
	Groundwater fractional usage – drinking water	Unitless	0	DOE/RL-99-40
	Groundwater fractional usage – household	Unitless	0	DOE/RL-99-40
	Groundwater fractional usage – livestock water	Unitless	0	DOE/RL-99-40
	Groundwater usage – irrigation	Unitless	0	DOE/RL-99-40
R021 – Radon		NA	Not used	Radon is not a COPC

a The stated numeric values are only used when RESRAD is used to determine generic cleanup levels. Otherwise, site-specific input values for these parameters are determined on a site-by-site basis. All other values are fixed at the values shown unless modified with regulator approval.

COPC = contaminant of potential concern
CZ = contaminated zone
GW = groundwater
ND = nondetect
RCRA = *Resource Conservation and Recovery Act of 1976*
RESRAD = RESidual RADioactivity
SZ = saturated zone

D5.1 Radionuclide Evaluation of Direct Exposure Risk

For waste sites with few radionuclide COCs at concentrations all below the individual radionuclide CULs, Table B-5a of Appendix B provides an example comparison of the shallow zone radionuclide cleanup verification data to direct exposure single radionuclide cancer risk values and the cumulative carcinogenic risk limit of $1x10^{-4}$ using a sum-of-fractions evaluation. Typically, this will be sufficient to demonstrate that direct exposure cumulative risk limitations are met. It is not necessary to perform a sum-of-fractions or RESRAD evaluation for a waste site or decision unit if there is only one detected radionuclide or if the residual concentrations of multiple radionuclide COCs are all below background or are less than one-tenth of the single radionuclide soil concentration equivalent to a $1x10^{-4}$ carcinogenic risk calculated by RESRAD. This is because no remediated waste site has been found with as many as 10 radionuclide COCs and the background values for Hanford Site radionuclides are much less than the 300 Area radionuclide direct exposure cleanup levels.

If the sum-of-fractions evaluation indicates the cumulative carcinogenic risk limit of $1x10^{-4}$ is exceeded, a site-specific RESRAD evaluation should be performed. The general process is to first determine the nature and extent of site-specific residual contamination (concentrations, thickness, and area of actual radionuclide contamination). This information is input to the RESRAD model with the general parameters from Table D-4 or D-5 for the residential or industrial scenario (as appropriate) to evaluate the direct exposure carcinogenic risk. No cover material is assumed to exist on top of the contaminated shallow zone unless existence of cover is explicitly stated. To perform the calculations, the parameters are entered into the RESRAD data menu, the residential or industrial exposure pathways are selected (as appropriate), and appropriate times for calculations are selected. Default times of 1, 3, 10, 30, 100, 300, and 1,000 years are used in a preliminary run to determine the year when the peak risk occurs from each radionuclide COC, pathway, and layer (e.g., shallow zone or deep zone).

The RESRAD software is run and the summary report and graphical output for radionuclide risk are accessed to determine the peak year(s) in 1,000 years. The summary report is accessed by viewing the file “summary.rep” in the RESRAD output. The graphical output for excess cancer risk of radionuclides is accessed by selecting:

Results: Standard Graphics

Type: Risk

Radionuclide: Individual

Pathways: Summed/External

If the peak year of the maximum risk for individual radionuclides indicated in the graphical output is not the same as the year of maximum dose/risk in the “Contaminated Zone and Total Dose Summary” of the summary report, then individual RESRAD runs should be performed for the individual radionuclides to find the individual years of peak dose/risk. The years of peak dose/risk are entered as calculation times in the RESRAD calculation, and the RESRAD software is rerun.

The health risk report (“intrisk/rep”) is accessed and the “All Pathways” total risk for each year of the RESRAD evaluation is recorded in an appropriate table. The table is included with other site-specific detailed information in a calculation brief presented in the calculations appendix to the cleanup verification package (CVP). A figure or figures may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

D5.2 Radionuclide Evaluation for Groundwater Protection

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table D-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table D-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation to determine if residual soil concentrations may actually be protective of groundwater. After remediation, residual radioactive and nonradioactive contaminants remaining in soil must be at such levels that concentrations of contaminants that could migrate through the soil column to groundwater do not exceed cleanup levels considered protective of groundwater in Table D-1. Protection of groundwater is intended to achieve CULs derived from MCLs promulgated under the federal National Primary Drinking Water Regulations (40 CFR 141).

D5.2.1 Attainment of Radionuclide MCLs

Separate maximum contaminant levels (MCLs) exist for strontium-90, tritium (H-3), radium-226, and radium-228. The MCLs for strontium-90 and tritium are 8 pCi/L and 20,000 pCi/L, respectively (40 CFR 141.66). The MCL for combined radium-226 and radium-228 is 5 pCi/L (40 CFR 141.66). The MCL for technetium-99 is 900 pCi/L as obtained from the *Soil Screening Guidance for Radionuclides: User's Guide* (EPA 2000). The MCL for total uranium (as uranium metal) is established at 30 µg/L (40 CFR 141.66). The MCL for individual alpha-emitting radionuclides (excluding radon and uranium) is 15 pCi/L (40 CFR 141.66). However, per the STOMP model evaluation of transport to groundwater summarized in Table D-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years, so residual soil concentrations of all alpha-emitting radionuclides are protective of groundwater and surface water.

To predict site-specific groundwater radionuclide activities, risk, and dose based on activities in soil, exposure pathways in the RESRAD input file for external gamma exposure, inhalation, soil ingestion, and radon are suppressed. Pathways for ingestion of plants, meat, milk, aquatic foods, and drinking water are active in the residential scenario. Only the drinking water pathway is active in the industrial scenario. Appropriate site-specific input parameters including contaminated site dimensions and radionuclide activities in soil and their distribution coefficients (K_d values) are entered into the RESRAD data menu and default calculation times of 1, 3, 10, 30, 100, 300, and 1,000 years are used for the initial calculation. The concentration of uranium metal in mg/kg is entered for uranium-238 as pCi/g, and the predicted uranium-238 groundwater concentration (as pCi/L in the RESRAD output) is the uranium metal concentration in µg/L. The basic radiation dose limit of 4 mrem/yr is input for groundwater protection.

The RESRAD software is run and the concentration report and graphical output for radionuclides in drinking water are accessed to determine which radionuclides do or do not reach groundwater in 1,000 years. The concentration report is accessed by viewing the file "concent.rep" in the RESRAD output. The graphical output for concentration of radionuclides in drinking water is accessed in the RESRAD version 6.5 Graphics Display (ANL 2009) by selecting:

Type: Concentration

Radionuclide: Individual

Media (Pathways): Drinking Water

If the drinking water concentrations predicted in the concentration report and the graphical output displays zero for the full 1,000 years, the contaminants do not impact groundwater within 1,000 years. Typically, the graphical output may show that strontium-90, technetium-99, and tritium (H-3) are predicted to reach groundwater within 1,000 years. The years of the maximum groundwater concentrations for these radionuclides are obtained from the RESRAD summary report for radiological dose in the RESRAD output table headed "Summed Dose/Source Ratios and Single Radionuclide Soil

Guidelines." The year of maximum groundwater concentration for each radionuclide is in the column headed by "tmin, years."

The year of maximum groundwater concentration for each radionuclide from the column headed by "tmin, years" is entered in the calculation times of the RESRAD inputs and the software is rerun. The concentration report and graphical output for radionuclides in drinking water are accessed to determine that the predicted years of maximum groundwater concentration are correct. If the predicted maximum groundwater (well water) concentrations in the concentration report, "concent.rep," for strontium-90, technetium-99, and tritium are less than their respective MCLs of 8 pCi/L, 900 pCi/L, and 20,000 pCi/L (and the predicted uranium-238 groundwater concentration [shown as pCi/L in the RESRAD output but read as µg/L] is less than the uranium metal MCL of 30 µg/L), residual soil concentrations of these constituents are predicted to be protective of groundwater and the river. The findings of the RESRAD evaluation are typically reported in a calculation brief included in the calculations appendix to the waste site CVP. If the groundwater concentrations predicted by RESRAD indicate that COCs impact groundwater, a table is provided in the calculation brief that shows the predicted peak concentration for each detected radionuclide COC and provides the individual MCLs for comparison, as shown in Table D-6 example.

Table D-6. Example Peak Radionuclide Groundwater Concentrations Compared to Maximum Contaminant Levels

Radionuclide	Groundwater Peak Concentration (pCi/L)	Year of Peak Concentration (years)	Groundwater MCL (pCi/L)
Americium-241	0 [a]	NA	15
Carbon-14	(Site-specific)	(Site-specific)	2,000
Cobalt-60	(Site-specific)	(Site-specific)	100
Cesium-137	(Site-specific)	(Site-specific)	60
Europium-152	0 [a]	NA	200
Europium-154	0 [a]	NA	60
Europium-155	0 [a]	NA	600
Nickel-63	(Site-specific)	(Site-specific)	50
Plutonium-238	0 [a]	NA	15
Plutonium-239/240	0 [a]	NA	15
Strontium-90	(Site-specific)	(Site-specific)	8
Technetium-99	(Site-specific)	(Site-specific)	900
Tritium (H-3)	(Site-specific)	(Site-specific)	20,000

a Per the STOMP model evaluation of transport to groundwater summarized in Table D-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years.

MCL = maximum contaminant level

D5.2.2 Attainment of 4 mrem/yr Drinking Water Radionuclide Dose Rate

The average annual activity of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr, per 40 CFR 141.66. To determine if any organ receives a dose of more than 4 mrem/yr, the dose to each organ is calculated for the radionuclide COCs that are predicted to migrate to groundwater. However, if only one radionuclide is predicted to reach groundwater and this radionuclide attains its MCL as discussed in Section D.5.2.1, it is not necessary to evaluate the attainment of the 4 mrem/yr drinking water dose rate.

An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087. The 4 mrem/yr equivalent concentration for each organ for each radionuclide is determined from the maximum permissible concentrations listed in Table 1 of NBS Handbook 69 (NBS 1963). The factor C4 (i.e., the concentration that will produce a dose of 4 mrem/yr to that organ) is calculated for each organ and radionuclide.

The C4 factors for the COCs are summarized in Table D-7.

Table D-7. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters

Radionuclide	Organ	C_4 [a], 4 mrem/yr Equivalent Concentration (pCi/L)
Carbon-14	Total Body	9,000
	Bone	2,000
	Fat	2,000
Cobalt-60	GI(LLI)	100
	Total Body	900
	Liver	3,000
Cesium-137	Bone	80
	GI(LLI)	2,000
	Total Body	200
	Liver	60
Europium-152	Bone	30,000
	GI(LLI)	200
	Total Body	2E+05
	Liver	1E+05
Europium-154	Bone	5,000
	GI(LLI)	60
	Total Body	7E+04
	Liver	6E+04
Europium-155	Bone	1E+05
	GI(LLI)	600
	Total Body	9E+05
	Liver	6E+05
H-3 (Tritium)	Total Body	20,000

Table D-7. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters

Radionuclide	Organ	C_4 [a], 4 mrem/yr Equivalent Concentration (pCi/L)
Nickel-63	Bone	50
	GI(LLI)	3,000
	Total Body	2,000
	Liver	600
Strontium-90	Bone	8
	GI(LLI)	100
	Total Body	8

a Calculated by methodology given in *National Interim Primary Drinking Water Regulations*, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity" (EPA 1997).

GI(LLI) = gastrointestinal tract-lower large intestine

The cumulative dose for each organ at time "t" needs to be calculated separately and using a sum-of-fractions equation, as shown in the formula below. If a radionuclide does not have a maximum permissible concentration for the organ of interest, the C4 factor for total body dose is used in the calculation. The calculations performed are documented in the comparison to drinking water standards calculation brief. The organs for which doses need to be computed are total body, bone, gastrointestinal tract-lower large intestine, and liver. The individual organ doses are summed and compared to 4 mrem/yr.

Doseorgan x (t) = [ConcA(t)/C4A(x) + ConcB(t)/C4B(x)+ …] x (4 mrem/yr)

If the total dose for organ "x" is less than 4 mrem/yr, then the standard is met.

A figure may be provided in the CVP that shows the calculated dose to each organ from groundwater. An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087.

D6. REFERENCES

40 CFR 131, "Water Quality Standards," Code of Federal Regulations, as amended.

40 CFR 141, "Federal Safe Drinking Water Act," Code of Federal Regulations, as amended.

40 CFR 143, "National Secondary Drinking Water Regulations," Code of Federal Regulations, as amended.

ANL, 2001, *Users' Manual for RESRAD 6.0*, ANL/EAD-4, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

ANL, 2009, RESRAD Version 6.5, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

Calc. No. 0100H -CA-V0087, 2006, *105-H Reactor Building (118-H-6) Fuels Storage Basin Comparison to Drinking Water Standards (MCL)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE/RL-96-17, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-99-40, 2000, *Focused Feasibility Study for the 300-FF-2 Operable Unit,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2010-99-ADD1, 2013, *Remedial Investigation/Feasibility Study for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, Addendum*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECF-HANFORD-10-0429, 2013, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FA) Report*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

ECF-HANFORD-11-0038, 2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Ecology, 2007, *Model Toxics Control Act Regulation and Statute: MTCA Cleanup Regulation, Chapter 173-340 WAC; Model Toxics Control Act, Chapter 70.105D RCW; Uniform Environmental Covenants Act, Chapter 64.70 RCW*, Publication No. 94-06, Revised November 2007, Washington State Department of Ecology, Toxics Cleanup Program, Olympia, Washington.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

EPA, 1997, National Interim Primary Drinking Water Regulations, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity," EPA-570/9-76-003, U.S. Environmental Protection Agency, Office of Water Supply, Washington D.C.

EPA, 2000, "Radionuclide Drinking Water MCLs," Table D.2 of *Soil Screening Guidance for Radionuclides: User's Guide*, EPA/540 R 00 007, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

NBS, 1963, *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure*, NBS Handbook 69, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

PNNL-12087, 1999, *Hanford Site Climatological Data Summary 1998 with Historical Data*, Pacific Northwest National Laboratory, Richland, Washington.

WAC 173-340, "Model Toxics Control Act--Cleanup," *Washington Administrative Code*, 1996.

WDOH/320-015, 1997, *Hanford Guidance for Radiological Cleanup*, Rev. 1, Division of Radiation Protection, Washington State Department of Health, Olympia, Washington.

Appendix E

Air Monitoring Plan for the 300 Area Waste Sites Remedial Action

This page intentionally left blank.

E1. Introduction

The remove, treat, and dispose (RTD) remedy for 300-FF-2 Operable Unit waste sites has the potential to emit (PTE) radionuclides. This remedy is being conducted under a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) Record of Decision (ROD) (EPA 2013). This air monitoring plan (AMP) addresses air emissions requirements for remedy implementation at waste sites in the 300 Area as listed in Section E1.1. Requirements for the 618-10 and 618-11 Burial Grounds and surrounding waste sites are addressed separately. This AMP does not address any air emissions requirements associated with the 300-FF-5 groundwater Operable Unit (OU) or enhanced monitored natural attenuation remedy implementation within the 300-FF-2 OU.

Quantification of radioactive emissions, implementation of best available radionuclide control technology (BARCT), and air monitoring have been identified as substantive requirements (i.e., applicable or relevant and appropriate requirements) of the *Clean Air Act of 1970* for the 300-FF-2 waste sites remedial action. These substantive requirements are implemented in accordance with *Washington Administrative Code* (WAC) 246-247-040.

E1.1 Planned Activities

Work scope includes completing ongoing remediation, or initiating new remediation of waste sites consisting of unplanned releases, contaminated soil, pipes, below-grade structures, etc., in the 300-FF-2 Operable Unit. Waste sites addressed by this AMP are identified in Table E-1. Any waste site additions to this AMP must be approved to the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office.

General remedial action operations include characterizing, excavating, sampling, sorting, size reducing, stockpiling, treating (if necessary), decontaminating, staging, containerizing, loading, backfilling, and transport of materials from the waste sites. Materials may include a wide range of chemically and/or radiologically contaminated soil, miscellaneous debris, and structural materials. Also included is test-pitting, trenching, and other activities that may be performed before or during remediation to further characterize and/or determine the limits of the waste sites.

Scattered debris within some of the waste sites will be picked up by hand; however, standard construction equipment will be used for excavation, loading, and hauling. The loading of contaminated material into waste containers may result in soil spilled on the waste containers and/or haul trucks. Haul trucks with loaded containers will enter a survey area where they will be screened to detect exterior contamination. A decontamination station will be established to decontaminate containers and haul trucks, as required. Waste containers and/or haul trucks will be decontaminated by conventional means such as brushing or wiping, or with high-efficiency particulate air (HEPA)-filtered vacuum cleaners. More aggressive decontamination methods (e.g., grinding or wet-grit blasting) may be used for decontamination if the other methods fail. Decontaminated trucks and containers will then proceed to the container transfer area from which the containers will be transported to the ERDF. A combination of HEPA-filtered vacuums, exhausters, and blowers may be used to support personnel and equipment decontamination activities, in egress tents, or glovebox type applications during the execution of the remedial action work scope. HEPA-filtered vacuum cleaners, HEPA-filtered enclosures, and gloveboxes may also be used for other applications during remediation as needed.

Table E-1. Summary of 300 Area Waste Sites Included

Waste Site	General Description
300-4	351 Substation Soil Contamination
300-7	Undocumented Solid Waste Burial Ground, North 300 Area
300-9	Early Solid Waste Burial Ground, North 300 Area
300-11	Gasoline release from 382 Underground Storage Tank
300-15	300 Area Process Sewer System
300-22	309 Building B-Cell Cleanout Leak
300-34	300 Area Process Sewer Leak
300-121	Contaminated French Drain
300-214	300 Area Retention Process Sewer
300-255	309 Tank Farm Contaminated Soil
300-263	324 Building Diversion Tank
300-265	Pipe Trench Between 324 and 325 Buildings
300-277	300 Area North Queue
300-280	Construction Debris, West of G-Way
300-284	Sand Blasting Site Near 3221
300-287	Transite Debris West of Route 4
300-288	Garnet Sands, Pit 6
300-289	Stained Soil North of 300 Area
300-290	Radiological Debris East of Horn Rapids Landfill
300-291	Garnet Sands West of 350A Paint Shop
300-294	Garnet Sands East of 350 Building
300-296	Soil Contamination Under 324 Building
300-RLWS	300 Area Radioactive Liquid Waste System
300-RRLWS	300 Area Retired Radioactive Liquid Waste System
340 Complex	340 Radioactive Liquid Waste Handling Facility
UPR-300-1	307-340 Waste Line Leak
UPR-300-2	Releases at the 340 Facility
UPR-300-5	Spill at 309 Storage Basin
UPR-300-11	Underground Radioactive Liquid Line Leak at 340

Excavated material will be sent primarily to the Environmental Restoration Disposal Facility (ERDF) for disposal. On a case-by-case basis, other EPA-approved disposal facilities may be used based on the specific waste stream designation.

Characterization sampling at radiological contaminated sites is included in the scope of this plan since the emissions from these activities (e.g., surface sampling, potholing) will generate negligible emissions.

E2. Airborne Source Information

There is a potential for radioactive airborne emissions resulting from remediation of waste sites in the 300-FF-2 Operable Unit. To determine the PTE, the calculated waste site inventories were multiplied by release fractions according to the requirements from WAC 246-247-030. A release fraction of 1×10^{-3} (for particulates) was applied to all soils, contaminated debris, and pipes. A release fraction of 1×10^{-6} was applied to radioactive solids removed whole, such as piping that has been internally stabilized with grout, epoxy, or other suitable material. For calculation purposes, it is conservatively assumed that tritium is present as a gas and a release fraction of 1 is applied. In addition, it is assumed that some of the soil will be collected in HEPA-filtered vacuums. However, HEPA-filtered vacuum use is anticipated to be limited if used at all. A release fraction of 1 is applied to this inventory as well.

The CAP88-PC model (Version 3.0) was used to determine the total effective dose equivalent (TEDE), or annual unabated offsite dose for each waste site. The PTE (curies per year) was the input for the computer model, and the model generated the annual unabated dose. The calculated total annual unabated offsite dose (TEDE) for the remedial actions by waste site are presented in Table E-2. Site-specific inventories, release fractions, and distances to the maximally exposed individual (MEI) are found in Calculation 0300X-CA-V0180, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*.

Table E-2. Summary of Total Effective Dose Equivalents for 300 Area Sites Included [a]

Waste Site	Unabated Total Effective Dose Equivalent to the Maximum Exposed Individual (mrem/yr)
300-4	To be determined prior to remediation
300-7	7.60E-03
300-9	8.39E-03
300-11	No radiological inventory
300-15	6.38E-03
300-22	3.06E-04
300-34	Bounded by 300-15 TEDE
300-121	No radiological inventory
300-214	8.25E-05
300-255	1.28E-05
300-263	0.00E+00
300-265	3.59E-03

Table E-2. Summary of Total Effective Dose Equivalents for 300 Area Sites Included [a]

Waste Site	Unabated Total Effective Dose Equivalent to the Maximum Exposed Individual (mrem/yr)
300-277	1.38E-04
300-280	No radiological inventory
300-284	No radiological inventory
300-287	No radiological inventory
300-288	No radiological inventory
300-289	No radiological inventory
300-290	Very little to no radiological inventory, bounded by Calculation 0300X-CA-V0180
300-291	No radiological inventory.
300-294	No radiological inventory.
300-296	To be determined prior to remediation
300-RLWS	2.75E-03
300-RRLWS	1.66E-03
340 Complex	1.44E-02
UPR-300-1	Included in 340 Complex TEDE
UPR-300-2	Included in 340 Complex TEDE
UPR-300-5	2.94E-05
UPR-300-11	Included in 340 Complex TEDE

Notes:

a Table 2 includes nonradiological sites that are bounded by the air monitoring plan and Calculation 0300X-CA-V0180, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*.

TEDE = total effective dose equivalent

E2.1 Best Available Radionuclide Control Technology

The following is the BARCT to be implemented during the waste site remedial action. This describes the controls to be implemented during the excavation, sorting, size reduction, stockpiling, and bulk material loading:

- Water will be applied during excavation, sorting, size reduction, container loading, stockpiling, and backfilling processes to minimize airborne releases.
- Soil fixatives will be applied to any contaminated soils and debris (inc1uding stockpiles) that will be inactive for more than 24 hours. Periodic monitoring (visual observation) shall be performed, as

determined by the project, of contaminated soils and debris that remain inactive for greater than 1 month. Reapplication of fixative or other control measure shall be performed if warranted by the periodic monitoring.

- Fixatives will be applied to contaminated soils and debris (including stockpiles) that will be inactive less than 24 hours at the end of work operations, if the sustained wind speed is predicted overnight to be greater than 32.2 kph (20 mph) based on the Hanford Meteorological Station morning forecast. This will allow the project enough time, if necessary, to prepare for the application of dust control measures. If a soil fixative has already been applied and the soil will remain undisturbed, further uses of fixatives will not be needed. The fixatives or other controls will not be applied when the contaminated soils are frozen, or if it is raining, snowing, or other freezing precipitation is falling at the end of work operations.
- The haul trucks transporting bulk materials will be covered to contain the materials while in transit to the ERDF.
- HEPA filters (e.g., HEPA-filtered vacuum cleaner) may be used during remediation activities. The use of HEPA filters has been generally accepted as BARCT. HEPA filters shall have efficiency testing performed upon installation and on an annual basis thereafter and must be demonstrated to have 99.95% removal efficiency.
- Additional measures for controlling small debris in waste piles may be prudent based on waste site conditions as determined by project personnel. Some additional measures that may be used are as follows: (1) application of a thin layer of other contaminated soil from the same waste site that is free of debris on the surface followed by normal fixative application, (2) application of a thin layer of uncontaminated soil that is free of debris on the surface followed by normal fixative application, (3) application of a bonded fiber fixative, and (4) covering the area containing small debris that is easily resuspended with a tarp or other appropriate material.

E3. Monitoring

During remediation of the 300 Area waste sites, monitoring activities will consist of using existing air monitoring stations 300 Area Northeast, 300 Area Southwest #2, 300 Trench, and 300 Water Intake. The operation of these monitors will follow the protocol established for these programs and operate at approximately 2 cfm. Activities such as building demolition and field remediation may somewhat alter air monitor locations. EPA approval will be obtained prior to moving any air monitor.

These air monitors are the means/methods to measure emissions. The operation of these monitors will follow the protocol established for these programs. The data from these monitors will be included in the annual reports prepared for the Hanford Site. Air samples are collected every 2 weeks and analyzed for total alpha and total beta emissions. These samples are also composited semi-annually and analyzed for isotopic uranium, isotopic plutonium, americium-241, strontium-90, and gamma-emitting radionuclides (gamma energy analysis). In addition, monthly tritium samples are collected from these monitors. Isotopic results that exceed 10% of the values in Table 2 of 40 CFR 61, Appendix E will be investigated and the adequacy of controls evaluated as appropriate.

Air monitors are run continuously and air monitor downtime will be minimized. If any one of the air monitor stations is out of operation for more than 48 hours during normal work operations (excluding weekends and holidays), the EPA will be notified. At least two air monitors must be operating for normal work operations, excavation, and loading activities to continue at the site.

Exhaust points from HEPA filters (and any ductwork, seams, or other potential release locations from enclosures) will be monitored on a routine basis for potential radionuclide releases and results recorded (e.g., post-survey results negative). Any positive survey results will require appropriate maintenance on the facility, exhauster, or vacuum to ensure that continued releases do not occur. Records of routine monitoring and necessary maintenance will be provided to EPA staff upon request.

There are other existing air monitors for other 300 area activities and thermoluminescent dosimeters (TLDs) in and near the perimeter of the 300 Area that provide information concerning air emissions and radiation fields. The location and data from these monitors and TLDs are reported each year in the Hanford Site Environmental Report and associated appendices.

E4. References

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, as amended.

Calculation 0300X-CA-V0180, 2014, *300 Area Remaining Sites Total Effective Dose Equivalent Calculation*, Rev. 0, Washington Closure Hanford, Richland, Washington.

Clean Air Act of 1970, 42 U.S.C. 7401, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

EPA, 2013, *Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code,* as amended.

DOE/RL-2014-13-ADD2
Draft A

Remedial Design Report/Remedial Action Work Plan Addendum for the 300 Area Groundwater

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-2014-13-ADD2
Draft A

Remedial Design Report/Remedial Action Work Plan Addendum for the 300 Area Groundwater

A. Lange
CH2MH,/ /

Date Published
May 2014

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

APPROVED
By Julia Raymer at 10:55 am, May 21, 2014

Release Approval | Date

Approved for Public Release;
Further Dissemination Unlimited

Printed in the United States of America

Contents

Appendix

Figures

Tables

Terms

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
CUL	cleanup level
DCE	*cis*-1,2-dichloroethene
DOE	U.S. Department of Energy
DWS	drinking water standard
EAA	Enhanced Attenuation Area
EPA	U.S. Environmental Protection Agency
ERT	electrical resistivity tomography
gpm	gallons per minute
HASP	health and safety plan
IC	institutional control
lpm	liters per minute
MNA	monitored natural attenuation
O&M	operations and maintenance
OU	operable unit
PNNL	Pacific Northwest National Laboratory
PRZ	periodically rewetted zone
QA	quality assurance
RA	remedial action
RAO	remedial action objective
RAWP	remedial action work plan
RDR	remedial design report
ROD	record of decision
ROI	radius of influence
RWP	radiological work permit
SAP	sampling and analysis plan
TCE	trichloroethene

1 Introduction

The 300 Area (U.S. Environmental Protection Agency [EPA] ID# WA2890090077) encompasses approximately 105 km^2 (40 mi^2) in the southeast portion of the Hanford Site in Benton County. The 300 Area contains three operable units (OUs), including two source (soil) OUs (300-FF-1 and 300-FF-2) and one groundwater OU (300-FF-5).

The remedial design report/remedial action work plan (RDR/RAWP) (DOE/RL-2014-13, *Integrated Remedial Design Report/Remedial Action Work Plan for the 300 Area*), hereinafter called the Integrated RDR/RAWP, addresses all three OUs and is accompanied by two addenda. The two addenda correspond to the two distinct media (soil and groundwater).

The RDR/RAWP Addendum for 300-FF-2 soils (referred to as the Soil Addendum) describes the work elements, performance measurements, construction management and oversight, schedule, and cost specific to remove, transport, and dispose pipeline void filling and temporary surface barriers for waste sites associated with the 300-FF-1 and 300-FF-2 OUs.

The RDR/RAWP Addendum for 300Area Groundwater (this document, referred to as the Groundwater Addendum) describes the work elements, construction management and oversight, schedule, and cost specific to enhanced attenuation using uranium sequestration in the vadose zone and periodically rewetted zone (PRZ) below the 300-FF-1 and 300-FF-2 OUs, in the top of aquifer at the 300-FF-5 OU, MNA, and groundwater monitoring. The remedial design and actions specific to the groundwater remedy will be implemented in a holistic manner across the 300-FF-1, 300-FF-2, and 300-FF-5 OUs to meet the remedial action objectives (RAOs) for groundwater. As such, the remedial design approach, remedial action (RA) management approach, environmental management and controls, RA completion, and cost/schedule components of the groundwater remedy presented in Chapters 3 through 7 of this Groundwater Addendum will not be subdivided by the three OUs. Monitoring as a component of monitored natural attenuation (MNA) as well as the remaining monitoring requirements for 300-FF-5 are integrated into a separate Performance Monitoring Plan that is part of the Remedy Implementation SAP.

1.1 Purpose

This Groundwater Addendum describes in detail how the uranium sequestration portion of the groundwater related remedies will be designed, installed, and operated to meet the RAOs identified in *Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site 300 Area* (EPA et al., 2013), hereinafter referred to as the 300 Area Record of Decision (ROD)/ROD Amendment). This addendum is the companion document to the Integrated RDR/RAWP Addendum for the 300-FF-2 Soils.

1.2 Scope

This Groundwater Addendum includes the RAs that will be implemented to meet the requirements of the 300 Area ROD/ROD Amendment. The groundwater components covered in this addendum for the three OUs are summarized in Table 1-1.

Uranium sequestration will be used in the vadose zone and PRZ to reduce the mobility of uranium that is the primary source of contamination in groundwater. Uranium sequestration will also be used in the top of the aquifer to reduce the mobility of uranium that may be mobilized during the vadose zone treatment process. MNA will be used for nitrate, tritium, trichloroethene (TCE), and *cis*-1,2-dichloroethene (DCE) in groundwater. Uranium and other contaminants in the groundwater will be monitored until cleanup levels (CULs) are met.

Table 1-1. Major Components of the Selected Groundwater Remedy

300-FF-1	300-FF-2 OU	300-FF-5 OU
Enhanced attenuation of uranium source mass using sequestration by phosphate application in the vadose zone and PRZ, and enhanced attenuation of uranium using sequestration by phosphate application at the top of the aquifer	Enhanced attenuation of uranium source mass using sequestration by phosphate application in the vadose zone and PRZ, and enhanced attenuation of uranium using sequestration by phosphate application at the top of the aquifer	Monitored natural attenuation for nitrate, tritium, TCE, and DCE in groundwater
		Groundwater monitoring for nitrate, tritium, TCE, DCE, uranium, gross alpha, and nitrate in groundwater
		Enhanced attenuation of uranium using sequestration by phosphate application at the top of aquifer
		Institutional controls*

* Details are described in Section 2.1 of the Integrated RDR/RAWP (DOE/RL-2014-13).

DCE = *cis*-1,2-dichloroethene

OU = operable unit

PRZ = periodically rewetted zone

TCE = trichloroethene

Institutional controls (ICs) are required before, during, and after the active phase of RA implementation where ICs are needed to protect human health and the environment. ICs are used to control access to residual contamination in soil and groundwater above standards for unrestricted use and unrestricted exposure.

Contaminated groundwater that migrates into the 300 Area from other areas, including from offsite and from the 200 Area, are not part of 300-FF-5 and are not being addressed by the 300 Area ROD/ROD Amendment or this RDR/RAWP.

1.3 Site Description and Background

1.3.1 Physical Setting

The physical setting for the 300 Area is provided in the Integrated RDR/RAWP for the 300 Area (DOE/RL-2014-13).

1.3.2 Nature and Extent of Contamination

The nature and extent of contamination for the 300 Area is provided in the Integrated RDR/RAWP for the 300 Area (DOE/RL-2014-13). Groundwater contaminants of concern (COCs) identified in the ROD for the 300-FF-5 OU are uranium, gross alpha, tritium, nitrate, TCE, and DCE. Groundwater contaminants do not exceed federal or state ecological protection standards near the river or where groundwater discharges into the river.

2 Basis for Remedial Action

The basis for RA for the 300 Area OU is described in the Integrated RDR/RAWP for the 300 Area, which includes the selected remedy, RAOs, and applicable or relevant and appropriate requirements (ARARs). CULs for the 300-FF-5 COCs are presented in Table 2-1.

Table 2-1. Cleanup Levels for 300-FF-5 Operable Unit Contaminants of Concern

Contaminant of Concern	CUL	Units	Basis for CUL
Uranium	30	µg/L	DWS
Tritium	20,000	pCi/L	DWS
Nitrate (as NO_3)	45,000	µg/L	DWS
Trichloroethene	4	µg/L	Risk assessment for drinking water
Cis-1,2-Dichloroethene	16	µg/L	Risk assessment for drinking water
Gross Alpha	15	pCi/L	DWS
Media: Groundwater Operable Unit: 300-FF-5 Available Use: Drinking water and all other uses Controls to Ensure Restricted Use: Yes			

Note: CUL for total uranium metal of 30 microgram per liter (µg/L) is also protective for the uranium isotopes (U-233/234, U-235, and U-238).

Bases for these CULs are risk limits and DWS ARARs to protect drinking water uses which also are protective of the river.

CUL = cleanup level

DWS = drinking water standard

Details of the specific remedial design approach for groundwater are described in Chapter 3.

This page intentionally left blank.

3 Remedial Design Approach

This chapter provides the remedial design approach for implementation of the selected remedy for groundwater and includes the design basis, conceptual design, and supplemental design task for the groundwater related RA activities. The Operations and Maintenance (O&M) Plan, that will be prepared for the groundwater injection implementation, was described in the Integrated RDR/RAWP (DOE/RL-2014-13). The conceptual design for enhanced attenuation using uranium sequestration in the vadose zone, PRZ, and top of the aquifer; MNA; and groundwater monitoring is presented in this chapter. ICs that are part of the remedy are described in Section 2.1 of the Integrated RDR/RAWP (DOE/RL-2014-13).

The companion documents associated with this Groundwater Addendum are summarized in Table 3-1.

Table 3-1. Companion Documents to Groundwater Addendum

Document Title	Purpose/Content	Document Status
Supplemental Post-ROD Field Sampling Instructions	Describes the drilling and sampling procedures for refining the location of the enhanced attenuation areas.	Sampling instructions will be prepared to implement and expedite a remedial design characterization field program in the summer of 2014.
Remedy Implementation SAP	Describes the waste management procedures; well installation and sampling procedures for the well, piezometer, and infiltration system installation for the Stage A and Stage B uranium sequestration implementation and performance monitoring; and the groundwater monitoring locations, parameters, and frequency of sampling for both the MNA and groundwater monitoring.	Document prepared under separate cover.
Operations & Maintenance Plan	Describes the phosphate formulations, injection and infiltration volumes and rates, operations and maintenance requirements for phosphate solution storage, distribution, and delivery, infiltration schedule, and monitoring during injection and infiltration.	Document prepared under separate cover after completion of the supplemental post-ROD field investigation.
Supplemental Post-ROD Field Investigation Summary	Summarizes findings from the supplemental post-ROD field investigation and includes proposed injection well, infiltration system, and piezometer locations for the Stage A uranium sequestration implementation.	Document prepared under separate cover after completion of supplemental field investigation.

Table 3-1. Companion Documents to Groundwater Addendum

Document Title	Purpose/Content	Document Status
Stage A Uranium Sequestration System Installation Report	Summarizes Stage A injection well, infiltration system, and piezometer installation results.	Document prepared under separate cover after completion of the Stage A installations.
Stage A Delivery Performance Report	Summarizes Stage A infiltration and injection results including refinements for Stage B.	Document prepared under separate cover after completion of the Stage A uranium sequestration.
Stage B Uranium Sequestration System Installation Report	Summarizes Stage B injection well, infiltration system, and piezometer installation results.	Document prepared under separate cover after completion of Stage B.
Uranium Sequestration Completion Report	Documents completion of uranium sequestration remedy and results.	Document prepared under separate cover after completion of Stage B.
Groundwater Monitoring Reports	Summarizes MNA and groundwater monitoring results.	Document prepared under separate cover.

MNA = monitored natural attenuation

ROD = record of decision

SAP = sampling and analysis plan

3.1 Design Basis

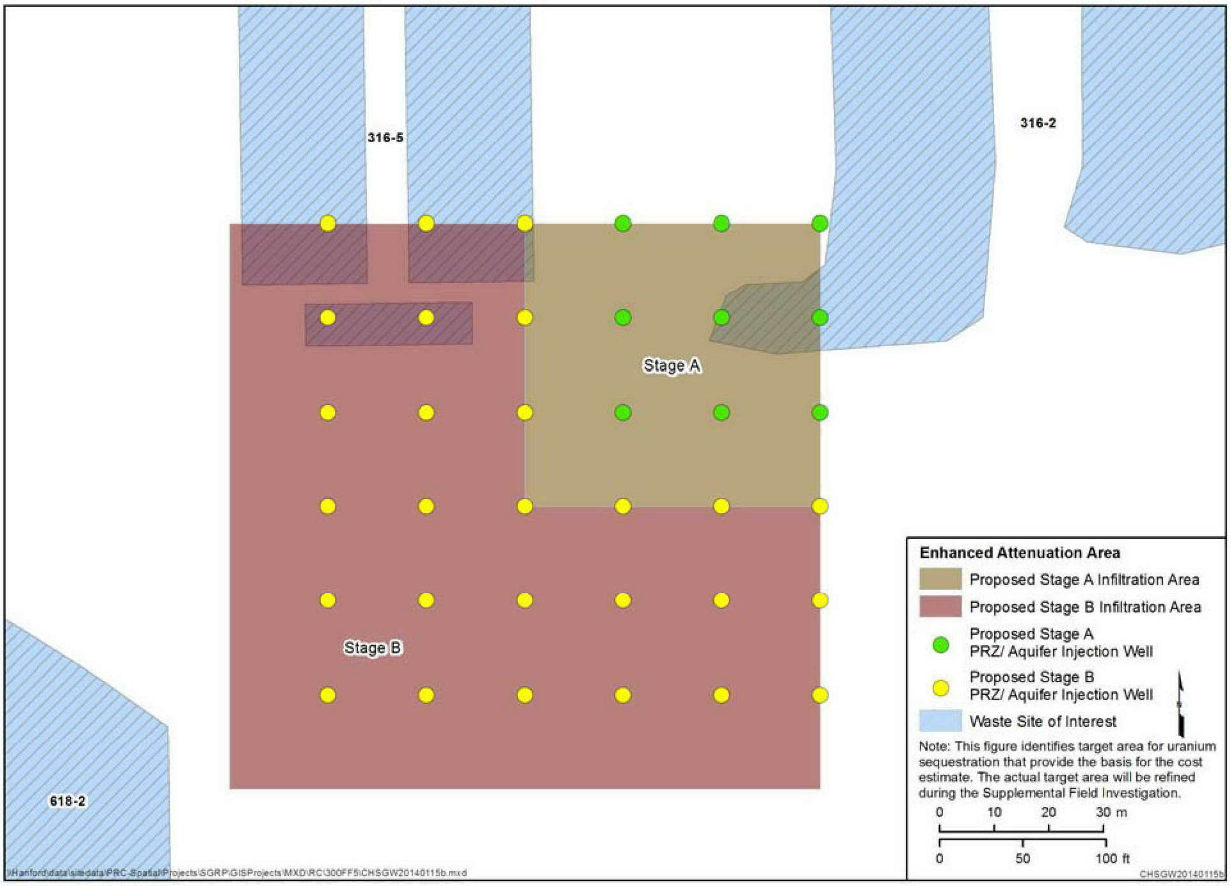
This section discusses the approach and design basis considerations for implementing the enhanced attenuation component of the 300 Area ROD.

3.1.1 Implementation Approach

The enhanced attenuation using the uranium sequestration component of the groundwater remedy involves infiltrating/injecting phosphate solutions to the vadose zone and PRZ to sequester, or bind, residual mobile uranium to form insoluble minerals. The target area for application of the phosphate solutions is a 1 ha (3 ac) area containing a persistent source of uranium contamination to groundwater. Uranium sequestration in the vadose zone and PRZ is anticipated to reduce the mass of soluble uranium entering the groundwater in this area, and thereby reduce the restoration timeframe for uranium in the groundwater. Injection of phosphate into the top of aquifer will be performed to mitigate potential impacts to the aquifer from uranium that may be carried downward during phosphate application in the vadose zone.

Uranium sequestration will be implemented using a staged approach. Stage A will consist of performing infiltration/injection in one quadrant of the Enhanced Attenuation Area (EAA), covering approximately 0.3 ha (0.75 ac). Stage A results will be used to refine the Stage B approach for the remaining 3 quadrants (0.9 ha [2.25 ac]). Figure 3-1 presents a schematic of the current EAA, infiltration areas, injection wells, and staged approach to implementation.

A supplemental post-ROD field investigation will be completed to refine the location of the EAA (Section 3.3) prior to implementation of the vadose zone infiltration and PRZ and aquifer injections. Refinements will be made to Stage A design based on the results of the supplemental post-ROD field investigation.



Note: The final EAA and wells will be based on the results of the post-ROD field investigation results.

Figure 3-1. Stage A and B Infiltration/Injection Enhanced Attenuation Area and Proposed Injection Well Locations

3.1.2 Design Basis Considerations

The contaminant distributions for the groundwater COCs are provided in the Integrated RDR/RAWP for the 300 Area (DOE/RL-2014-13, Section 1.3.2.2 and Figures 1-7, 1-8, and 1-9). The EAA for uranium sequestration activities was selected to treat the vadose zone and PRZ over the highest concentrations of uranium consistently detected in groundwater. The MNA and groundwater monitoring components of the 300-FF-5 ROD will address the remaining groundwater COC described in Section 1.3.2.2 of the Integrated RDR/RAWP (DOE/RL-2014-13). The monitoring locations, frequency, and analytes will be described in a Performance Monitoring Plan for the 300-FF-5 OU as part of the Remedy Implementation SAP.

Contaminant fate and transport modeling was performed to simulate and predict the movement of uranium from the vadose zone sediments, through the PRZ, and into the saturated zone, as well as the migration of uranium already present in the PRZ and saturated zone. The model predictions indicate a long-term declining trend in the dissolved uranium concentrations in groundwater for uranium transported from vadose zone sediments, with seasonal increases and decreases in concentrations as the water table rises and falls with river stage fluctuations. With no RAs, the dissolved uranium concentration is predicted to take approximately 28 years (starting in 2012) to drop below the CUL of 30 μg/L. With implementation of uranium sequestration, the estimated time to achieve the CUL for uranium is expected to range between 22 and 28 years. There is significant uncertainty in the estimated time to achieve the uranium CUL. This uncertainty is due to complex interactions of the contamination in the vadose zone, PRZ, and groundwater with the dynamic groundwater levels controlled by seasonal changes in the elevation of the river water.

Laboratory-scale (PNNL-21733, *Use of Polyphosphate to Decrease Uranium Leaching in Hanford 300 Area Smear Zone Sediment*) and field-scale (PNNL-17480, *Challenges Associated with Apatite Remediation of Uranium in the 300 Area Aquifer*) treatability studies were conducted at the 300 Area Industrial Complex to evaluate the use of phosphate to sequester (immobilize) uranium as a remedial technology. The purpose of the laboratory-scale studies was to evaluate application of phosphate to vadose zone and PRZ sediments to immobilize uranium to mitigate further uranium leaching to the aquifer. The purpose of the field study was to evaluate direct sequestration of dissolved uranium in groundwater by injecting phosphate into the aquifer. Preliminary infiltration testing has also been conducted at 300-FF-1 OU wastes sites in the 300 Area Industrial Complex. The results of preliminary infiltration testing indicated that in certain areas of the 300 Area Industrial Complex, infiltration rates may be limited. However, only a very small area was tested, which may not have been representative of the majority of the 300 Area. Infiltration rates around the former process ponds may be higher, as demonstrated during past liquid waste discharges.

Results from these treatability studies were used to estimate phosphate dosing rates for uranium sequestration in the vadose zone, PRZ, and aquifer.

3.2 Conceptual Design Summary

The conceptual design summary for the 300-FF-5 OU groundwater RAs describes design elements for the following:

- Uranium sequestration in the vadose zone, PRZ, and top of aquifer
- MNA
- Groundwater monitoring

Information on ICs is presented in Sections 2.2.6 through 2.2.8 of the Integrated RDR/RAWP (DOE/RL-2014-13).

3.2.1 Uranium Sequestration

Uranium sequestration will be completed by infiltrating and injecting phosphate solutions using a staged approach to reduce the mobility of uranium source mass in the vadose zone and PRZ in the area of highest uranium contamination. The EAA is illustrated in Figure 3-1. The treatment area is approximately 1.21 ha (3 ac). Phosphate will also be injected at the top of the aquifer to reduce the mobility of uranium that may have been released to the aquifer during the vadose zone treatment process. Prior to implementation, a supplemental post-ROD field investigation will be completed to refine the location of the EAA (Section 3.3).

Phosphate infiltration into the vadose zone will be accomplished using buried irrigation drip line or perforated piping. Injection wells will be used for injecting phosphate into a zone spanning the PRZ and top of the aquifer. The top of aquifer treatment zone will be in place during the infiltration of phosphate and maintained for a short period afterwards to react with any uranium that leaches into groundwater as a result of the phosphate solution applied to the vadose zone.

Phosphate injections will be performed when groundwater conditions are favorable (e.g., during lower river stages).The timing of the application in the PRZ will be scheduled to maximize phosphate contact with the PRZ when the PRZ is unsaturated.

Uranium concentration and leachability characterization will be conducted on vadose zone and PRZ soil samples collected before and after phosphate treatment to refine the groundwater model. Soil samples will be analyzed for grain size analysis, total uranium (<2 mm fraction), and semi-selective sequential and labile uranium leaching (<2 mm fraction). Groundwater monitoring will be conducted to assess changes in uranium concentrations and the lateral spread of phosphate.

A supplemental post-ROD field investigation will be implemented to support the design of uranium sequestration (Section 3.3). The designs for uranium sequestration, including the concentrations and volumes of specific phosphate blends, surface infiltration design, injection well construction requirements, infiltration and injection implementation, and performance monitoring are described in the following sections.

3.2.1.1 Uranium Sequestration Design for Vadose Zone

Infiltration Design. The target infiltration area is approximately 1.21 ha (3 ac) (Figure 3-1). A preliminary design infiltration rate of 1 cm/hr (0.39 in./hr) was selected based on application rates recommended by Pacific Northwest National Laboratory (PNNL) from results of the phosphate infiltration studies performed at the 100-NR-2 OU (0.7 to 1 cm/hr; 0.28 to 0.39 in./hr) (PNNL-20322, *100-NR-2 Apatite Treatability Test: Fall 2010 Tracer Infiltration Test*). This infiltration rate range was determined as the optimum range for minimizing phosphate retardation while maintaining unsaturated conditions. Initial infiltration field testing conducted by PNNL at the 300 Area in 2010 also showed that an application rate of 0.5 to 1 cm/hr (0.20 to 0.39 in./hr) was achievable, which is similar to the proposed infiltration rate. With an application rate of 1 cm/hr (0.39 in./hr), the target infiltration rate will be approximately 1,683 liters per minute (lpm) per ha (180 gallons per minute [gpm] per ac).

As described in the implementation approach (Section 3.1.1), a staged approach will be used for the uranium sequestration implementation. For phosphate infiltration into the vadose zone, Stage A will consist of one quadrant (approximately 0.3 ha [0.75 ac]) of the EAA (Figure 3-1). Results of the Stage A infiltration will be used to adjust the infiltration rate, as needed.

Infiltration Network Installation. The infiltration network will be installed approximately 1.8 m (6 ft) below ground surface (bgs) to prevent accumulation and wicking of sodium and phosphate up into the surficial soil, which would inhibit the establishment and growth of vegetation. The infiltration network will be installed using horizontal directional drilling methods (or equivalent) or trenching. Liquid distribution lines will consist of high density polyethylene irrigation drip line or perforated pipe spaced approximately 1.8 to 3 m (6 to 10 ft) apart. Additional details on the infiltration network installation and infiltration drip line/perforated pipe construction details will be presented in the Remedy Implementation SAP.

Vadose Zone Phosphate Formulation. The phosphate solution formulation for vadose zone infiltration, selected based on laboratory-scale treatability studies (PNNL-21733), is summarized in Table 3-2.

3.2.1.2 Uranium Sequestration Design for PRZ and Top of Aquifer

Injection Design. In total, 36 injections wells screened across the PRZ and top of aquifer (approximately 7.6 m to 13.7 m [25 to 45 ft] bgs) will be installed across the approximately 1.2 ha (3 ac) remediation area (Figure 3-1). Each injection well will be constructed with a filter pack seal, at the interface of the bottom of the PRZ and top of aquifer, to allow isolated injection (using inflatable packers) into either the PRZ or top of aquifer. The number and placement of injection wells were selected with a goal of optimizing the distribution of injected phosphate across the entire EAA. During phosphate injection, it is assumed that an injection radius of influence (ROI) of approximately 8 m (25 ft) will be achieved in each well, and the natural diurnal movement of groundwater (approximately 15 m/day [50 ft/day]) will distribute injected phosphate across the EAA.

The total planned injection volume per well is 167,895 L (44,360 gal) into both the PRZ and top of aquifer, or 335,815 L (88,715 gal) total into each injection well. The injection volume for each well was based on results of the phosphate injection tests performed by PNNL (PNNL-18529, *300 Area Uranium Stabilization Through Polyphosphate Injection: Final Report*). PNNL injection studies showed that 50 percent to 80 percent tracer arrival at a radial distance of 8.8 m (29 ft) could be achieved with an injection volume of approximately 172,747 to 417,940 L (45,640 to 110,420 gal) per well. The proposed injection volume per well for Stage A falls within this range. Assuming an 8 m (25 ft) injection ROI, injection interval thickness of 6 m (20 ft), and a total porosity of 0.302 (PNNL-22886, *System-Scale Model of Aquifer, Vadose Zone, and River Interactions for the Hanford 300 Area –Application to Uranium Reactive Transport*), the total injection volume for 36 injection wells is estimated to be approximately 61 percent of the total PRZ/aquifer pore volume of the 1.2 ha (3 ac) remediation area. An injection rate of approximately 189 lpm (50 gpm) per well is anticipated for isolated injections into the PRZ and top of aquifer.

Preliminary hydraulic modeling of the Stage A phosphate injection design (ECF-300FF5-14-0030, *Preliminary Evaluation of Extent of Polyphosphate Injection to Support the 300 Area Remediation at Hanford Site, Washington*, in Appendix A) indicates that appreciable concentrations of phosphate (approximately half the injected concentration) could persist over a period of few days to few weeks. The injected solution residence time depends on the injection location in the PRZ in relation to the water level fluctuations. At low river stage injections, the simulated phosphate concentrations continued to remain high in the zone located near the top of the PRZ and declined below the half of the injected concentration after about 40 days. Because the majority of the highly leachable uranium mass is expected to be present in and around the top of the PRZ and due to longer residence times in this portion of the vadose zone, favorable conditions for formation of hydroxyapatite and meta-autunite are expected.

Table 3-2. Phosphate Reagent Formulation for Uranium Sequestration in the Vadose Zone

Reagents	Molecular Weight (g/mole)	Formulation (Phosphate wt%)	Infiltration Concentration (mM)	Infiltration Concentration (mg/L)
NaH_2PO_4 (Monosodium Phosphate)	119.98	90	48	5,699
$Na_4P_2O_7$ (Pyrophosphate)	265.9	10	3	665
	Total	100	50	6,364

g/mole = grams per mole
wt% = percent by weight
mM = millimolar

As described in the implementation approach (Section 3.1.1), a staged approach will be used for the uranium sequestration implementation. For phosphate injection into the PRZ and aquifer, Stage A will consist of 9 wells in 1 quadrant of the EAA (Figure 3-1). The results of the Stage A injection will be used to adjust 27 wells in the remaining 3 quadrants of the EAA and the injection rates, as needed.

Injection Well Installation. Injection wells will be installed using appropriate drilling methods. All wells will be drilled with a 25 cm (10 in.) diameter temporary casing to allow construction of a 15 cm (6 in.)

diameter injection well (i.e., the boreholes were drilled to maintain a minimum 5 cm [2 in.] annular space around the permanent well, per WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells"). Table 3-3 presents general construction details for the injection wells. Additional details on the borehole drilling and well construction details will be presented in the Remedy Implementation SAP.

Well development will be conducted following installation. Well development is performed to settle the filter pack and remove fines from the borehole wall and filter pack.

PRZ/Aquifer Phosphate Formulation. The phosphate solution formulation for PRZ and aquifer injections is summarized in Table 3-4. The phosphate formulation is identical to that for the vadose zone infiltration, with an overall increase in compound concentrations to account for groundwater dilution associated with injecting 61 percent of the EAA pore volume.

Table 3-3. Typical Periodically Rewetted Zone/Aquifer Injection Well Construction Details

Well Type	Planned Drill Depth (bgs*)	Estimated Depth to Water (bgs)	Screen Length	Screen Placement (bgs)	Filter Pack Interval (bgs)a	Bentonite Pellet Intervals (bgs)	Bentonite Crumbles Interval (bgs)	Cement Seal Interval (bgs)
PRZ/ Aquifer Injection Well	15 m (48 ft)	Dependent on river stage (expected between 7.6 to 10.7 m [25 and 35 ft])	6 m (20 ft)	7.6 to 13.7 m (25 to 45 ft)	7.3 to 14 m (24 to 46 ft)	6.4 to 7.3 m (21 to 24 ft) 10.2 to 11.1 m (33.5 to 36.5 ft)	5.5 to 6.4 m (18 to 21 ft)	0 to 5.5 m (0 to 18 ft)

Note: All wells have a 15 cm (6 in.) diameter polyvinyl chloride casing and screen. Drill depth, screened interval, and bentonite seal intervals may vary slightly due to location-specific conditions.

* Filter pack interval to consist of 6 to 9 mesh Colorado silica sand or equivalent.

bgs = below ground surface

PRZ = periodically rewetted zone

Table 3-4. Phosphate Reagent Formulation for Uranium Sequestration in the Periodically Rewetted Zone/Aquifer

Reagents	Molecular Weight (g/mole)	Formulation (Phosphate wt%)	Injection Concentration (mM)	Injection Concentration (mg/L)
NaH_2PO_4 (monosodium phosphate)	119.98	90	78	9,409
$Na_4P_2O_7$ (pyrophosphate)	265.9	10	4	1,097
	Total	100	83	10,507

g/mole = grams per mole
wt% = percent by weight
mM = millimolar

3.2.1.3 Remediation Skids

Two remediation skids were designed (Figure 3-2) and constructed (Figure 3-3) as part of the apatite permeable reactive barrier remedy for the for the 100-NR-2 Groundwater OU, as specified in *U.S. Department of Energy 100-NR-1 and 100-NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary* (EPA, 2010). These remediation skids will be used at the 300 Area for blending phosphate concentrate solutions with feed water and distributing diluted phosphate solutions (Tables 3-2 and 3-4) to the infiltration network and injection wells. Feed water will be piped to the injection skids from either a nearby hydrant or the Columbia River.

Each remediation skid is capable of pumping phosphate concentrate solutions from tanker trucks or stationary tanks, and metering the solutions into feed water streams from the river or a hydrant, to form phosphate solutions for distribution to the infiltration network or well heads. Flow meters and sample ports are provided on each injection skid to monitor and collect samples of premixed phosphate solution. Feed water from the river or a hydrant will be transferred via aboveground piping to the remediation skids, where it will be blended with the phosphate concentrate in a static in-line mixing chamber. When river water is used as feed water, the feed water will be filtered prior to blending with the phosphate concentrate solutions. Following mixing, a transfer hose will distribute the dilute phosphate solutions to a manifold for distribution through the infiltration network or multiple injection wells.

The remediation skids are capable of delivering phosphate solution at a flow rate of at least 1,136 lpm (300 gpm). Minor component and fittings modifications will be made to the remediation skids, as needed, to facilitate the 300 Area feed water source, chemical dosing requirements, and infiltration/injection manifolding strategy. Remediation skid modifications are described in the O&M Plan.

The operational approach for the remediation skids is presented in the O&M Plan, which includes operational procedures to guide infiltration and injection operations, and performance monitoring to evaluate the arrival and distribution of phosphate solution in the vadose zone, PRZ, and aquifer.

3.2.1.4 Compliance with Underground Injection Control Regulations

The construction and intended use of the PRZ/aquifer injection wells (UIC Well Code: 5X26) meets the WAC 173-218-040(5)(a)(X), "Underground Injection Control Program," "UIC Well Classification Including Allowed and Prohibited Wells," definition of a Class V injection well: "Injection wells used for remediation wells receiving fluids intended to clean up, treat or prevent subsurface contamination."

3.2.1.5 MNA of Groundwater

Contaminants in groundwater in 300-FF-5 that will be managed through MNA are nitrate and tritium downgradient from the 618-11 Burial Ground and TCE and DCE at the 300 Area Industrial Complex. MNA includes monitoring to ensure the effectiveness of natural attenuation to meet CULs.

A Performance Monitoring Plan as part of the Remedy Implementation SAP will be prepared that will describe the MNA monitoring program including the wells to be sampled, frequency, and analytes.

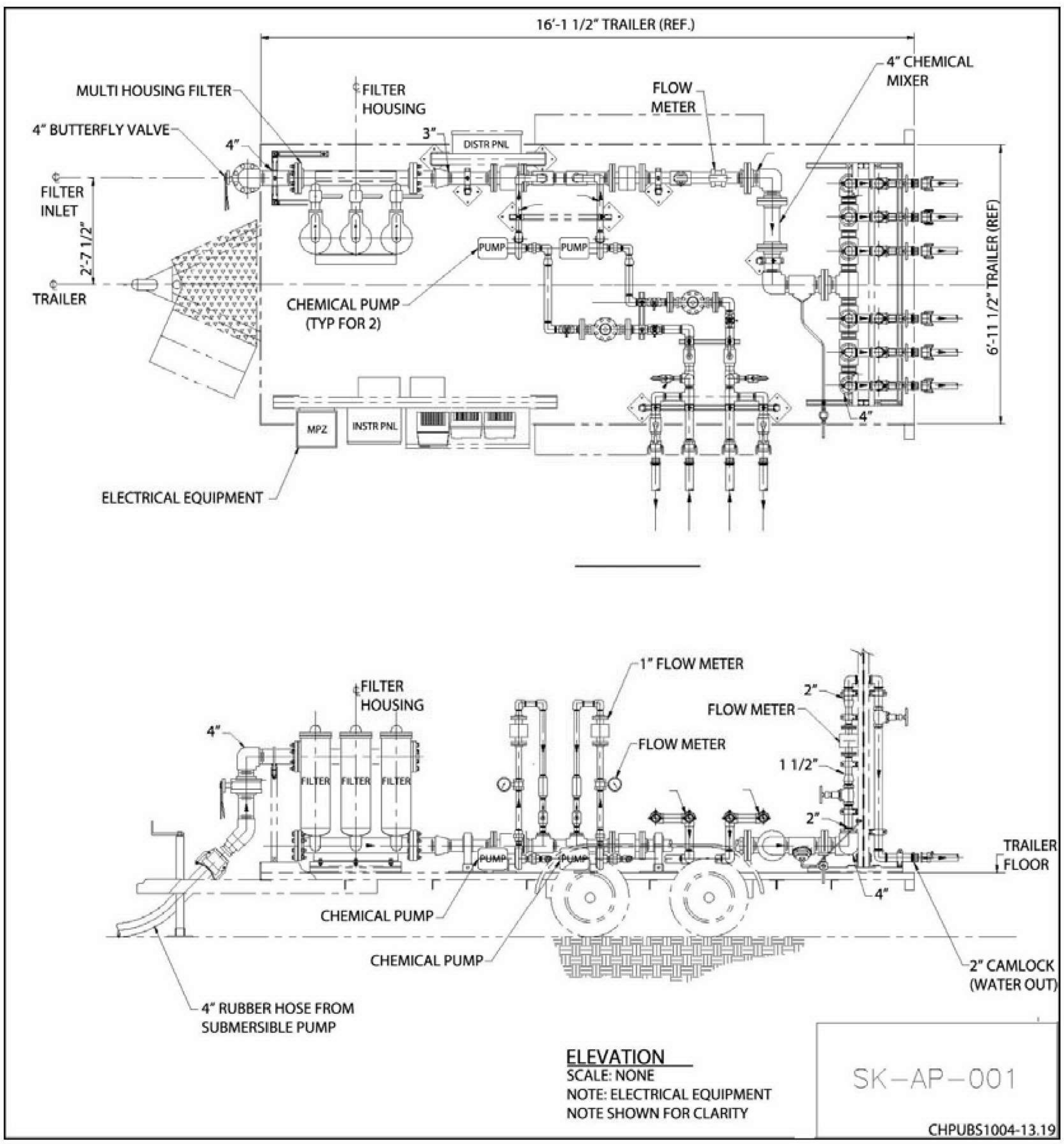


Figure 3-2. Generalized Schematic of Remediation Skid

Figure 3-3. Photograph of Constructed Remediation Skid

3.2.2 Groundwater Monitoring

Groundwater monitoring will be completed to document changes in contaminant concentrations and extent for all groundwater COCs. Monitoring will continue until COCs have attained the CULs and are expected to continue to meet CULs, and EPA approves termination of the monitoring. Sampling will include analyses for uranium, gross alpha, nitrate, TCE, and DCE at the 300 Area Industrial Complex; uranium and gross alpha downgradient from the 618-7 Burial Ground; and tritium and nitrate downgradient from the 618-11 Burial Ground.

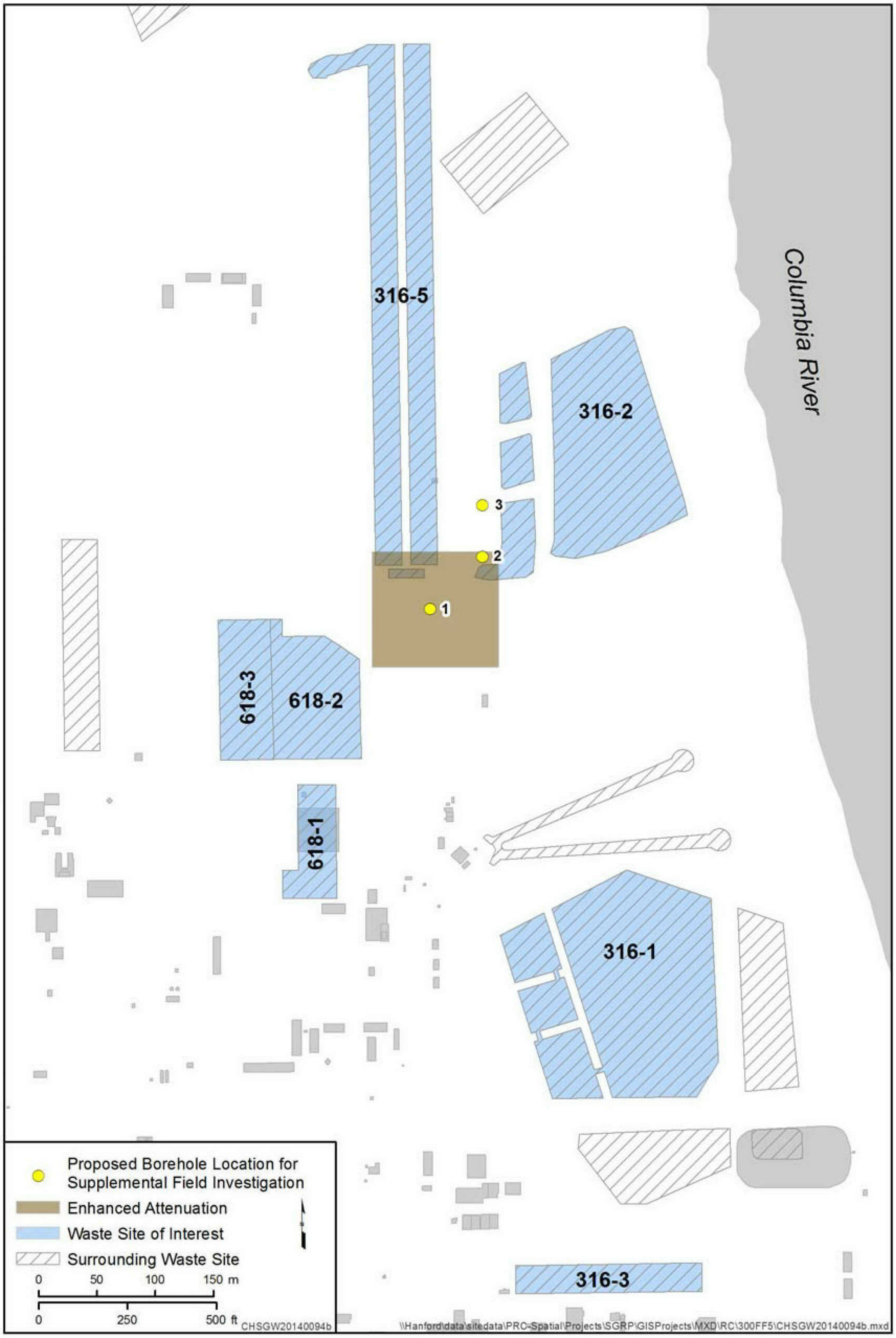
A separate Performance Monitoring Plan as part of the Remedy Implementation SAP will be prepared that will describe the sampling approach including the wells to be sampled, frequency, and analytes.

3.3 Supplemental Design Tasks

The current uranium sequestration EAA is shown in Figure 3-1. In support of the uranium sequestration actions, a supplemental post-ROD field investigation will be completed to collect soil uranium concentration and uranium leachability data that will be used to refine the location of the EAA and refine and evaluate the Stage A phosphate infiltration and injection design. The data collected from the three proposed boreholes will provide information on the distribution and mobility of uranium within the vadose zone and the PRZ from boreholes drilled within, and in the vicinity of, the planned EAA (Figure 3-4).

Sampling at the three boreholes will be conducted to obtain preliminary total-uranium concentration data along the length of the boreholes. The boring installation and sample collection will be described in SGW-56993, *Sampling Instruction for the 300-FF-5 Operable Unit Supplemental Post-ROD Field Investigation*, which will be prepared to implement and expedite the remedial design characterization field program in the summer of 2014.

Based on the revised conceptual model for labile uranium mass distribution in the vadose zone and PRZ, the location of the EAA may be refined. Refinements to the EAA and recommendations for the phosphate delivery strategy will be presented in a Supplemental Field Investigation Summary Report.



1
2 Figure 3-4. Proposed Soil Boring Locations for Supplemental Post-ROD Field Investigation

This page intentionally left blank.

4 Remedial Action Management and Approach

The Integrated RDR/RAWP (DOE/RL-2014-13) presents project team and change management approach associated with implementation of the selected remedies. For the groundwater remedy component, CH2M HILL Plateau Remediation Company is responsible for RDR/RA activities associated with uranium sequestration for the vadose zone, PRZ, and top of the aquifer; MNA; and groundwater monitoring. RA work tasks specific to the groundwater remedy are described in Section 4.1.

4.1 Remedial Action Work Tasks

For uranium sequestration, RA tasks include contractor procurement; borehole, piezometer, well installation, and development; infiltration network installation; soil and groundwater sampling; infiltration and injection; and groundwater monitoring. A Remedy Implementation SAP will be prepared describing the borehole, piezometer, and injection well installation procedures (including the coring and soil sample collection and analysis), and the infiltration network installation. An O&M Plan will be prepared describing the procedures for the phosphate infiltration and injection in the EAA.

RA associated with MNA and groundwater monitoring components are described in the Performance Monitoring Plan as part of the Remedy Implementation SAP. Because the 300 Area phosphate infiltration and injections will re-utilize the 100-NR-2 injection skids, no RA tasks are anticipated with the skid. It is assumed that no modifications are needed to permit truck and equipment access to the injection area.

4.1.1 Procurement and Construction

Site utility requirements for phosphate infiltration and injections include a generator and water supply. Columbia River water or water supplied by a nearby fire hydrant will be used for phosphate solution blending and injection. The U.S. Department of Energy (DOE) has water rights, and the National Marine Fisheries Service will be given a courtesy notification. A diesel generator will be used to operate the site facilities, infiltration/injection monitoring equipment, and ancillary equipment.

For the phosphate infiltration and injections, pre-blended aqueous phosphate mixture of food grade monosodium phosphate and pyrophosphate will be delivered in 18,927 L (5,000 gal) loads via tanker truck. The solution will be offloaded into holding tanks, with piping installed between the holding tanks and the remediation skid chemical feed pumps. Given that the 100-NR-2 injection skid will be deployed for the 300 Area injections, no procurement or construction associated with the skid are anticipated.

Other procurement activities that will be performed include obtaining drillers for piezometer and well installation, geophysical services including electrical resistivity tomography (ERT), analytical services, and infiltration system installation. The work will be accomplished using the most efficient combination of onsite resources, as well as service vendors.

4.1.2 Operational Approach

4.1.2.1 Stage A Phosphate Infiltration and Injection Operations

Phosphate Solution Delivery and Storage. Phosphate chemicals will be delivered to the site in concentrated and pH-buffered liquid form. Buffered to a pH of 7, the concentrated phosphate solutions will be prepared at concentrations of 103,208 mg/L monosodium phosphate, and 20,012 mg/L pyrophosphate. At these concentrations, the estimated volumes of concentrated phosphate solutions required for Stage A are 501,344 L (132,441 gal) of monosodium phosphate, and 301,595 L (79,673 gal) of pyrophosphate. Concentrated phosphate solutions will be delivered to the 300 Area in tanker trucks. The concentrate concentrated solutions will either be temporarily stored in holding tanks, or fed directly from the tanker trucks to the remediation skids during the infiltration and injection operations.

Chemical Blending for Infiltration and Injection. The planned mix proportions and blending ratios for preparing the infiltration and injection phosphate solutions are summarized in Tables 4-1 and 4-2.

Table 4-1. Stage A Chemical Blending for Phosphate Infiltration

Reagents	Concentration in Buffered Concentrate (mg/L)	Target Infiltration Concentration (mg/L)	Total Infiltration Rate (0.3 hectare; 0.75 acre) (lpm/gpm)	Concentrate Feed Rate (lpm/gpm)	Makeup Water Feed Rate (lpm/gpm)	Concentrate: Makeup Water Ratio
NaH_2PO_4 (Monosodium phosphate)	103,208	5,699	511/135	38/10	621/164	1:17
$Na_4P_2O_7$ (Pyrophosphate)	20,012	665	511/135	23/6	621/164	1:27

Table 4-2. Stage A Chemical Blending for Phosphate Injection

Reagents	Concentration in Buffered Concentrate (mg/L)	Target Injection Concentration (mg/L)	Total Injection Rate (6 Wells) (lpm/gpm)	Concentrate Feed Rate (lpm/gpm)	Makeup Water Feed Rate (lpm/gpm)	Concentrate: Makeup Water Ratio
NaH_2PO_4 (Monosodium Phosphate)	103,208	9,409	1,135/300	102/27	969/256	1:9
$Na_4P_2O_7$ (Pyrophosphate)	20,012	1,097	1,135/300	61/16	969/256	1:16

gpm = gallons per minute
lpm = liters per minutes

Stage A Infiltration and Injection Schedule. The planned Stage A infiltration and injection schedule and flow rates are summarized in Table 4-3. Infiltration and injection will be performed during the time of year when the river stage is low and when the groundwater flow direction at the EAA will be to the south or southwest (September). Figure 4-1 presents the hydrographs from 2009 through 2013 from the wells in the vicinity of the EAA.

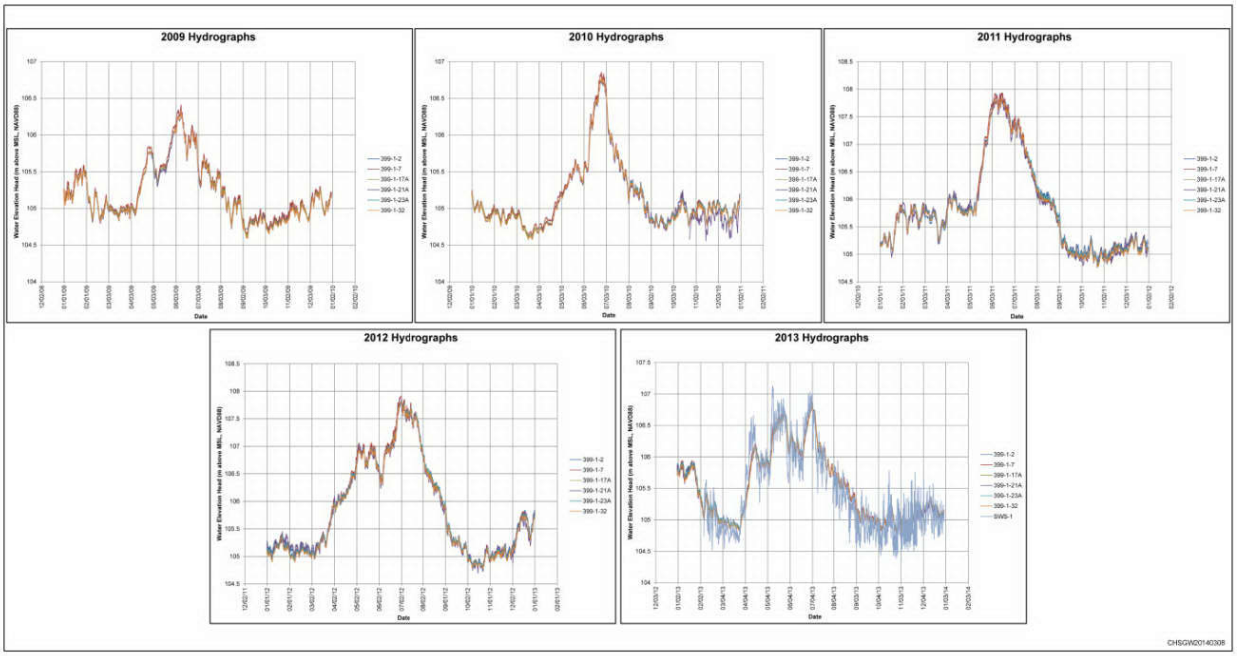


Figure 4-1. Hydrographs from 2009 to 2013

Both remediation skids will be utilized during Stage A: one for mixing and pumping phosphate solution for infiltration, and the other for mixing and pumping phosphate solution for injection.

The estimated Stage A operation period is 10 days (7 days of intermittent aquifer injection with 5 days of simultaneous infiltration, followed by 3 days of PRZ injection). The infiltration duration of 5 days was based on an estimated wetting front advancement rate of 1 m/day (3.4 ft/day) and a wetting distance of 5.8 m (19 ft) from the application depth of 1.8 m (6 ft) to the top of the PRZ at a depth of 7.6 m (25 ft). The estimated wetting front advancement rate was based on the advancement rate observed during infiltration studies at 100-NR-2 (PNNL-20322), scaled up to account for a proposed Stage A infiltration rate of 1 cm/hr (0.39 in./hr) versus what was performed at 100-NR-2 (0.7 cm/hr [0.28 in./hr]). The estimated Stage A aquifer injection duration of 7 days was estimated based on the objective of injecting phosphate into the aquifer at least 1 day before, during, and after the phosphate infiltration period.

Phosphate infiltration will be conducted continuously (24 hour per day operation) over the 0.3 ha (0.75 ac) Stage A treatment area (Figure 4-2) for approximately 5 days. The advancement of the infiltration wetting front will be monitored real-time using ERT, as further described in the "Stage A Operation Testing, Monitoring, Sampling and Analysis" section. Infiltration rates will be adjusted as needed to maximize the contact time of phosphate solution in the vadose zone during the estimated 5 day infiltration period, while minimizing the potential for flushing phosphate solution too quickly through the vadose zone and PRZ, potentially mobilizing uranium to groundwater.

Phosphate injections into the 9 Stage A aquifer injection well screens (Figure 4-2) will be conducted intermittently over approximately 7 days. Injections will be initiated the day before the start of phosphate infiltration, resume during infiltration, and conclude the day after completion of phosphate infiltration, in order to establish a layer of phosphate in groundwater below the infiltration area to remediate uranium that may be flushed to groundwater during infiltration operations. Injections will be conducted into at least 6 wells at a time during daytime hours, while varying the location of the 6 wells being injected during the 7 day period to maximize the distribution of phosphate in groundwater below the infiltration area.

Phosphate injections into the 9 Stage A PRZ injection well screens (Figure 4-2) will be conducted over approximately 3 days after the completion of infiltration, when moisture content in the PRZ will be maximized from infiltration activities. Injecting into the PRZ when moisture content is highest will maximize the injection ROI in the PRZ during low river stage. Injections will be conducted into at least 6 wells at a time during daytime hours.

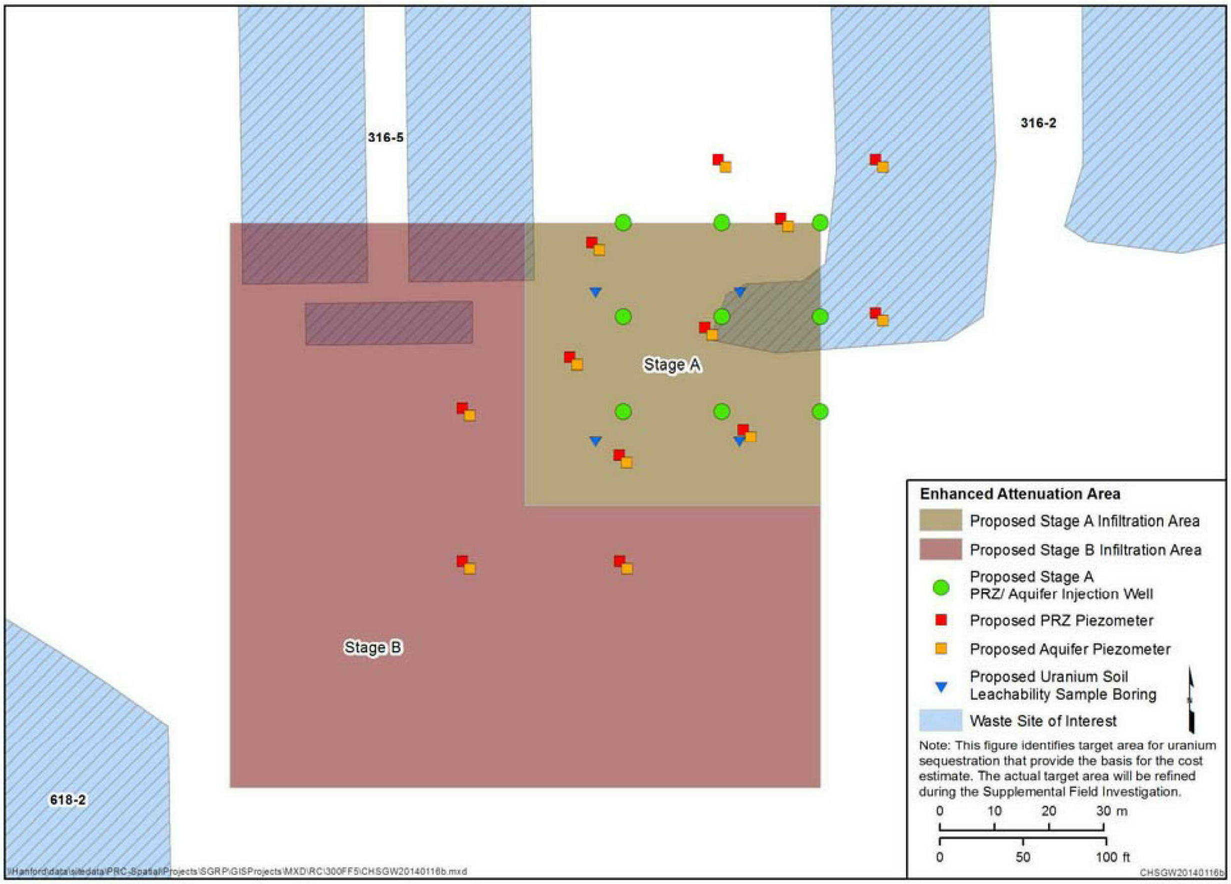


Figure 4-2. Proposed Injection Wells and Performance Monitoring Piezometers for Stage A

Table 4-3. Stage A Phosphate Infiltration and Injection Schedule

Day	Aquifer Injection (wells)	PRZ Injection (wells)	Infiltration (hectares/ acres)	Injection Flow Rate 8 hours/day (lpm/gpm)	Infiltration Flow Rate 24 hours/day (lpm/gpm)	Injection Volume (L/gal)	Infiltration Volume (L/gal)	Total Volume (L/gal)
1	6	--	--	1135/300	--	545,000/144,000	--	545,000/144,000
2	--	--	0.3/0.75	--	511/135	--	736,000/194,400	736,000/194,400
3	--	--	0.3/0.75	--	511/135	--	736,000/194,400	736,000/194,400
4	6	--	0.3/0.75	1135/300	511/135	545,000/144,000	736,000/194,400	1,281,000/338,400
5	--	--	0.3/0.75	--	511/135	--	736,000/194,400	736,000/194,400
6	--	--	0.3/0.75	--	511/135	--	736,000/194,400	736,000/194,400
7	6	--	--	1135/300	--	545,000/144,000	--	545,000/144,000
8	--	6	--	1135/300	--	545,000/144,000	--	545,000/144,000
9	--	6	--	1135/300	--	545,000/144,000	--	545,000/144,000
10	--	6	--	1135/300	--	545,000/144,000	--	545,000/144,000

Stage A Operation Testing, Monitoring, Sampling and Analysis. Operations testing, monitoring, sampling, and analysis for the uranium sequestration infiltration and injection will be described in the O&M Plan.

Operational testing involves sampling the injection solution prior to the start of infiltration and injection, and once near the end of the infiltration and injection to ensure that the phosphate is being applied at the correct concentrations in the vadose zone and PRZ/aquifer, respectively. During infiltration and injection, flow rates and volumes will be monitored to test and optimize operation of the remediation skids and to verify that the systems are delivering the solutions as designed. Field parameters will be measured in adjacent piezometers at least every four hours during daytime hours to monitor the rate of solution distribution in the aquifer.

ERT has been successfully used to characterize wetting front advancement and distribution of soil moisture during tracer infiltration studied performed at 100-NR-2 (PNNL-20322). ERT will be used to monitor the advancement of the phosphate infiltration wetting front at the 300 Area. Phosphate infiltration is expected to increase vadose zone electrical conductivity significantly by increasing both saturation and pore fluid specific conductance, thereby enabling the use of time-lapse ERT to remotely monitor polyphosphate transport. The 0.3 ha (0.75 ac) Stage A EAA will be monitored along a 2-dimensional section spanning between the upgradient (northeast) and downgradient (southwest) corners. This section will be monitored with a line of 64 electrodes at 1.5 m (5 ft) spacing (96 m [315 ft] in total). The electrodes will be buried in a shallow 0.2 to 0.3 m (8 to 12 in.) deep trench for safety purposes. Baseline surveys will be collected prior to phosphate infiltration. Time lapse imaging with be performed at approximately 30 minute intervals during infiltration to monitor the advancement of the infiltration wetting front.

As part of the Stage A delivery performance monitoring, the following sampling program will be implemented:

- Uranium leachability testing will be conducted before and after phosphate application. Installation of borings, soil sampling, and soil leachability testing procedures are described in Remedy Implementation SAP.
- Installation of 24 mini piezometers consisting of 12 well pairs screened within the PRZ (approximately 9 to 10.7 m [30 to 35 ft] bgs) and within the top of the aquifer (approximately 12 to 13.7 m [40 to 45 ft] bgs). Piezometer installations will include 3 piezometer pairs upgradient of the Stage A treatment area, 6 piezometer pairs within the Stage A treatment area, and 3 piezometer pairs downgradient of the Stage A treatment area (Figure 4-2). Piezometers will be installed using sonic drilling equipment or a hydraulic hammer direct push rig as described in the Remedy Implementation SAP.
- Groundwater samples will be collected at the 24 mini piezometers for uranium and phosphate analyses before application of phosphate to establish a baseline during phosphate application, 1 week after phosphate application, and 1 month after phosphate application. Field parameters including conductivity, oxidation reduction potential, pH, and temperature will also be collected. The procedures for sampling will be described in the O&M Plan for the injection program.

Results of the Stage A delivery performance monitoring will be used to refine the delivery performance monitoring program for Stage B. For costing purposes, a similar delivery performance monitoring scope (4 soil boring locations for uranium leachability testing, and sampling of 24 piezometers) is assumed to be implemented over the 3 quadrants of the Stage B EAA.

4.1.2.2 Stage B Phosphate Infiltration and Injection

The results of the Stage A phosphate infiltration/injections, operational testing, and delivery performance monitoring will be used to refine the design of the Stage B phosphate infiltration/injections. For costing purposes, it is assumed that the infiltration and injection design for Stage A will be repeated at the remaining 3 quadrants of the EAA.

4.1.3 Project Status Reporting

Progress will be communicated in the Unit Managers Meetings, including sample and analyses results, operations, and general project status/timelines.

A Stage A Delivery Performance Report will be completed for the Stage A implementation to document the results of pre and post-injection sampling, injection rates achieved, and other lessons learned that may influence the Stage B injections. A Stage B Delivery Performance Report will be completed for the Stage B implementation to document the results of pre and post-injection sampling, injection rates achieved, and other lessons learned. Groundwater monitoring results will be summarized as described in the Performance Monitoring Plan as part of the Remedy Implementation SAP.

5 Environmental Management and Controls

This chapter describes the environmental management and controls associated with implementation of the 300 Area remedies. A Waste Management Plan documenting the processes for handling waste from infiltration network, well, and piezometer installations; sampling; and phosphate infiltration/injection activities will be prepared under separate cover as part of the Remedy Implementation SAP. Quality assurance (QA) for the groundwater remedy implementation will be discussed in the Remedy Implementation SAP and O&M Plan.

5.1 Air Emissions

5.1.1 Radiological Air Emissions

Radiological air emissions associated with deployment of the phosphate for uranium sequestration are not anticipated.

5.1.2 Nonradiological Air Emissions

Nonradiological air emissions associated with deployment of the phosphate for uranium sequestration are not anticipated.

5.2 Reporting Requirements for Non-Routine Releases

40 CFR 302 "Designation, Reportable Quantities, and Notification," requires immediate notification to the National Response Center on discovery of a release of a hazardous substance into the environment in excess of a reportable quantity in a 24 hour period. 40 CFR 355 "Emergency Planning and Notification," requires immediate notification to the community emergency coordinator for the local emergency planning committee and to the State Emergency Response Commission for a release of a reportable quantity of an extremely hazardous substance or a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) hazardous substance in a 24 hour period, except for releases exempted from reporting under 40 CFR 355.31, "What Types of Releases are Exempt from the Emergency Release Notification Requirements of this Subpart?".

5.3 Waste Management

Waste management requirements for project waste streams, waste characterization, designation and disposal, waste generation management, management of waste containers, final disposal/storage, waste disposal records, waste transportation, waste treatment, and waste minimization and recycling are specific to uranium sequestration activities. Activities associated with waste management are included in the Remedy Implementation SAP.

5.4 Cultural/Ecological Resources

Protection of cultural resources is addressed, in part, during the ARAR identification process based on CERCLA and 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan." The lead and non-lead agencies identify requirements that are applicable or relevant and appropriate to the release or RA at a CERCLA site (40 CFR 300.400[g], "General"). ARARs for the 300 Area RA are provided in Appendix A of the Integrated RDR/RAWP (DOE/RL-2014-13). As identified in Appendix A, the following ARAR protects ecological, cultural, historic, and Native American sites and artifacts (resources) for work within the 300-FF-5 OU:

- *Endangered Species Act of 1973*: 300-FF-5 OU groundwater discharges into the Hanford Reach of the Columbia River which contains the Upper Columbia River spring-run Chinook salmon and the steelhead which are endangered. The spring-run Chinook salmon do not spawn in the Hanford Reach but use it as a migration corridor. Steelhead spawning has been observed in the Hanford Reach. The bull trout is listed as a threatened species but is not considered a resident species and is rarely observed in the Hanford Reach. Remediation actions and investigation activities will be managed to avoid jeopardy and/or adversely affect a listed species or critical habitat.

Prior to disturbing the earth (e.g., drilling and excavation), the DOE Richland Operations Office will initiate discussion with the affected parties, and an analysis of cultural and ecological resource impacts will be undertaken. This will include an assessment of the resources present and a qualitative comparison to the risk posed by the contaminants present in the OU.

A cultural resources review is part of work planning activities, and the project will involve cultural resources staff early in the planning stage to address potential concerns and consider the effects that the planned project activities could have.

5.5 Safety and Health Program

A health and safety plan (HASP) addresses routine job site hazards and physical hazards and specifies general controls and requirements for work activities. Access and work activities are controlled in accordance with approved work packages, as required by established internal work requirements and processes. The HASP includes the requirements for hazardous waste operations and/or construction activities, as specified in 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response." Depending on the specific hazards present, one or more HASPs could be written for this RA. As part of work package development, a job or activity hazards analysis will be written to identify the hazards associated with specific tasks in addition to the HASP.

In addition to the HASP, radiological work permits (RWPs) will be prepared, as needed, for work in areas with potential radiological hazards in accordance with contractor-level procedures and programs. The RWP extends the Radiological Protection Program to the specific work site or operation. All personnel assigned to the project and all work site visitors strictly shall adhere to the provisions identified in the HASP and RWP. Before work and before each activity begins, a pre-job briefing will be held with the involved workers. This briefing will include reviews of the hazards that could be encountered and the associated requirements. Throughout an activity, daily briefings also could be held, as well as special briefings before major evolutions.

5.6 Emergency Response

During construction and operations, emergency response for project activities will be covered by the project-specific HASP, and related health and safety procedures and work instructions. The HASP, health and safety procedures, and work instructions contain primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan, and emergency equipment at each task site, as well as emergency coordinators, emergency response procedures, and spill containment. A copy of the HASP will be kept in the construction field office. When emergencies arise that are beyond the limitations of the project-specific HASP, DOE-0223, *Emergency Plan Implementing Procedures*, will govern project staff response, as specified in the HASP.

5.7 Quality Assurance Program

Overall QA for the RDR/RAWP will be planned and implemented in accordance with 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements;" EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5); EPA/240/R-02/009, *Guidance* *for Quality Assurance Project Plans* (EPA QA/G-5); and EPA/240/B-05/001, *Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation* (EPA QA/G-11). QA activities will use a graded approach based on potential impact to the environment, safety, health, reliability, and continuity of operations. QA for the groundwater remedy implementation will be discussed in the Remedy Implementation SAP and O&M Plan/Field Instructions and will comply with the following requirements:

- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*
- DOE O 414.1D, *Quality Assurance*

All SAPs and groundwater monitoring plans prepared to support the 300 Area RA will contain a QA project plan, which establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis.

This page intentionally left blank.

6 Remedial Action Completion

The enhanced attenuation RA for the 300 Area is considered complete upon implementation of the Stage A and Stage B infiltration and injection in the EAA. Upon completion of both stages, an Infiltration/Injection Completion Report will be prepared and submitted to the regulatory agencies. Groundwater monitoring to evaluate the uranium sequestration will continue for approximately 5 years as described in the Performance Monitoring Plan as part of the Remedy Implementation SAP. Ongoing groundwater monitoring for MNA and 300 Area groundwater monitoring will continue until CULs are met as described in the Performance Monitoring Plan as part of the Remedy Implementation SAP.

Seven waste sites are associated with the enhanced attenuation remedy within the 300 Area ROD and will be reclassified based on implementation of both stages of infiltration and injection. The three 300-FF-1 OU waste sites (316-1, 316-2, and 316-5) associated with the enhanced attenuation remedy have previously received a final reclassification status of "closed out" based on remediation performed under the 300-FF-1 ROD. No further reclassification will be performed for these sites, but waste site reclassification forms and/or the Waste Information Data System summary reports may be revised as necessary to identify implementation of enhanced attenuation. The four 300-FF-2 OU waste sites (316-3, 618-1, 618-2, and 618-3) have previously received interim reclassification statuses under the 300-FF-2 interim action ROD. Final reclassification of the 618-1, 618-2, and 618-3 sites will be based upon implementation of the infiltration/injection components described in this addendum. Final reclassification of the 316-3 site will be based upon implementation of the infiltration/injection components described in this addendum, as well as a demonstration that the site meets industrial CULs for COCs other than deep zone uranium.

This page intentionally left blank.

7 Cost and Schedule

The cost and schedule for the 300 Area groundwater remedy components are presented in this chapter.

7.1 Cost Summary

Costs for the 300-FF-5 uranium sequestration and groundwater monitoring were updated, based on the design presented in the addendum, and are estimated at $23,585,000 with an accuracy of -30% to +50 percent and include 25 years of O&M (ECE-300FF514-00001, *Remedial Design/Remedial Action Work Plan Cost Estimate Documentation*). Table 7-1 summarizes the costs for the selected groundwater remedy.

Table 7-1. Summary of Costs for Selected Groundwater Remedy

Activity	Total Costs
Capital Costs	
Validation Effort	$964.000
Stage A	$4,425,000
Stage B	$6,159,000
Capital Subtotal	$11,548,000
Operations and Maintenance	
Annual O&M (25 Years)	12,037,000
Total of Capital and O&M	**$23,585,000**

7.2 Schedule

Figure 7-1 provides a projected schedule through implementation and remedy completion report.

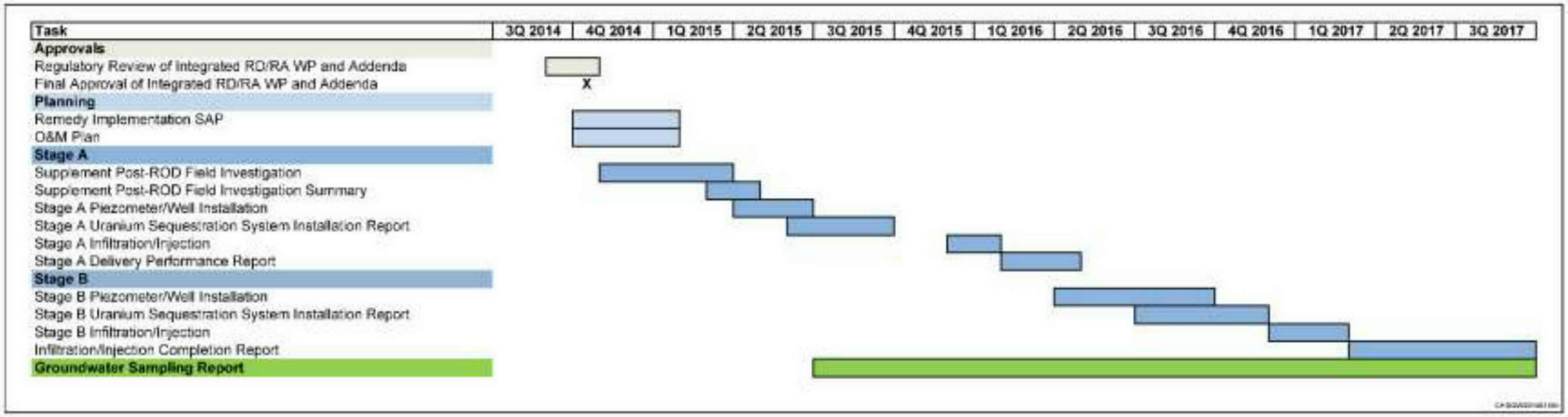


Figure 7-1. Schedule for Groundwater Remedy Implementation

8 References

10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title10-vol4/xml/CFR-2010-title10-vol4-part830-subpartA.xml.

29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*. Available at: http://edocket.access.gpo.gov/cfr_2005/julqtr/pdf/29cfr1910.120.pdf.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part300.xml.

40 CFR 302, "Designation, Reportable Quantities, and Notification," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part302.xml.

40 CFR 355, "Emergency Planning and Notification," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol27/xml/CFR-2010-title40-vol27-part355.xml.

40 CFR 355.31, "Emergency Planning and Notification," "What Types of Releases are Exempt from the Emergency Release Notification Requirements of this Subpart?" *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2009-title40-vol27/pdf/CFR-2009-title40-vol27-sec355-31.pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE O 414.1D, 2011, *Quality Assurance*, U.S. Department of Energy, Washington, D.C. Available at: https://www.directives.doe.gov/directives/0414.1-BOrder-d/view.

DOE-0223, *Emergency Plan Implementing Procedures*, U.S. Department of Energy, Washington, D.C.

DOE/RL-96-68, 2007, *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD), Rev. 3, *Volume 1, Administrative Requirements*; *Volume 2, Sampling Technical Requirements*; *Volume 3, Field Analytical Technical Requirements*; and *Volume 4, Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/HASQARD_Vol_1.pdf.
http://www.hanford.gov/files.cfm/HASQARD_Vol_2.pdf.
http://www.hanford.gov/files.cfm/HASQARD_Vol_3.pdf.
http://www.hanford.gov/files.cfm/HASQARD_Vol_4.pdf.

DOE/RL-2014-13, 2014, *Integrated Remedial Design Report/Remedial Action Work Plan for the 300 Area*, Decisional Draft, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECE-300FF514-00001, 2014, *Remedial Design/Remedial Action Work Plan Cost Estimate Documentation*, Draft, CH2M HILL Plateau Remediation Company, Richland, Washington.

ECF-300FF5-14-0030, 2014, *Preliminary Evaluation of Extent of Polyphosphate Injection to Support the 300 Area Remediation at Hanford Site, Washington*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

Endangered Species Act of 1973, Pub. L. 93-205, as amended, 7 USC 136, 16 USC 1531, et seq. Available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esa.pdf.

EPA, 2010, *U.S. Department of Energy 100-NR-1 and NR-2 Operable Units Hanford Site – 100 Area Benton Country, Washington Amended Record of Decision, Decision Summary and Responsiveness Summary*, U.S. Environmental Protection Agency, Seattle, Washington. Available at: http://www.epa.gov/region10/pdf/sites/hanford/100/rod-amend-092810.pdf.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/r5-final.pdf.

EPA/240/B-05/001, 2005, *Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation*, EPA QA/G-11, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/g11-final-05.pdf.

EPA/240/R-02/009, 2002, *Guidance for Quality Assurance Project Plans*, EPA QA/G-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/QUALITY/qs-docs/g5-final.pdf.

PNNL-17480, 2008, *Challenges Associated with Apatite Remediation of Uranium in the 300 Area Aquifer*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17480.pdf.

PNNL-18529, 2009, *300 Area Uranium Stabilization Through Polyphosphate Injection: Final Report,* Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-18529.pdf.

PNNL-20322, 2011, *100-NR-2 Apatite Treatability Test: Fall 2010 Tracer Infiltration Test*, White Paper, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-20322.pdf.

PNNL-21733, 2012, *Use of Polyphosphate to Decrease Uranium Leaching in Hanford 300 Area Smear Zone Sediment*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-21733.pdf.

PNNL-22886, 2014, *System-Scale Model of Aquifer, Vadose Zone, and River Interactions for the Hanford 300 Area –Application to Uranium Reactive Transport*, Draft, Pacific Northwest National Laboratory, Richland, Washington.

SGW-56993, 2014, *Sampling Instruction for the 300-FF-5 Operable Unit Supplemental Post-ROD Field Investigation*, Draft A, CH2M HILL Plateau Remediation Company, Richland, Washington.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160.

WAC 173-218-040, "Underground Injection Control Program," "UIC Well Classification Including Allowed and Prohibited Wells," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-218-040.

Appendix A

ECF-300FF5-14-0030, Preliminary Evaluation of Extent of Polyphosphate Injection to Support the 300 Area Remediation at Hanford Site, Washington

This page intentionally left blank.

ENVIRONMENTAL CALCULATION COVER PAGE

Part 1: Completed by the Responsible Manager

Project: 300-FF-5 RDRA **Date:** 04/28/2014

Calculation Title & Description: Preliminary Evaluation of Extent of Polyphosphate Injection to Support the 300 Area Remediation at Hanford Site, Washington

Preparer: W Linderfelt	**Basis of Qualification:** Education & experience
Checker: J Jayne	**Basis of Qualification:** Education & experience
Senior Reviewer: S Mehta	**Basis of Qualification:** Education & experience

Part 2: Completed by Preparer

Calculation No.: ECF-300FF5-14-0030 **Revision No.:** 0

Revision History:

Revision No.	Description	Date	Affected Pages ADD ROW
Revision 0			All

Part 3: Document Review & Approval:

Preparer: W Linderfelt / Senior Groundwater Modeler (INTERA, Inc.)
NAME/POSITION
William R Linderfelt 4-28-2014
SIGNATURE DATE

Checker: J Jayne / Hydrogeologist (INTERA, Inc.)
NAME/POSITION
Josh Jayne 4-28-2014
SIGNATURE DATE

Senior Reviewer: S Mehta / Senior Scientist (CHPRC)
NAME/POSITION
[signature] 4/28/2014
SIGNATURE DATE

Risk/Modeling Integration Manager: N/A
NAME/POSITION
APPLICABLE IF CALCULATION IS A RISK ASSESSMENT OR USES AN ENVIRONMENTAL MODEL
SIGNATURE DATE

Responsible Manager: AH Aly / Risk & Modeling Integration Manager (CHPRC)
NAME/POSITION
A Aly 4/29/2014
SIGNATURE DATE

Environmental Calculation File

Preliminary Evaluation of Extent of Polyphosphate Injection to Support the 300 Area Remediation at Hanford Site, Washington

Contents

Attachments

Figures

Tables

Terms

2-D	two-dimensional
3-D	three-dimensional
amsl	above mean sea level
CHPRC	CH2M HILL Plateau Remediation Company
DOE	U.S. Department of Energy
ECF	environmental calculation file
EPA	U.S. Environmental Protection Agency
gpm	gallons per minute
HISI	Hanford Information System Inventory (software database)
OU	Operable Unit
PNNL	Pacific Northwest National Laboratory
PRZ	periodically rewetted zone
ROD	Record of Decision
STOMP	Subsurface Transport Over Multiple Phases (software)

1 Purpose

The remedy for uranium contamination in 300-FF-5 Groundwater Operable Unit (OU) located in the 300 Area of the Department of Energy's Hanford Site is injection of phosphate (mixture of orthophosphate and polyphosphate) into the groundwater as identified in the *Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site 300 Area* (hereafter referred to as the 300 Area Record of Decision (ROD)/ROD Amendment) (EPA, 2013). The injected phosphate solution acts to sequester, or bind, residual uranium to form insoluble minerals. The purpose of this environmental calculation file (ECF) is to simulate injection of water-soluble phosphate compounds into the unconfined groundwater aquifer associated with the 300-FF-5 OU to support the design basis discussed in the (DOE/RL-2014-13-ADD, *Remedial Design Report/Remedial Action Work Plan Addendum for the 300 Area Groundwater*). Results of the simulations provide a preliminary evaluation of phosphate injection in the 300 Area and will be used in continued development of the overall remedy and evaluation of enhanced attenuation of uranium using phosphate injection. Specifically, the model results will be used to determine if design parameters for injection of the phosphate compounds (PNNL 2008; DOE/RL-2014-13-ADD) produce spatial distributions and residence times that are adequate for uranium sequestration in the 300 Area.

2 Methodology

Simulation of phosphate injection and the resulting effects on uranium transport are based on previous models of the vadose zone, PRZ, and aquifer at the 300-FF-5 Groundwater OU (ECF-300FF5-11-0151, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document*). These models were constructed to evaluate the dynamics of uranium transport in the 300 Area and to test various remedial alternatives that could be used to reduce uranium loading to the Columbia River (ECF-300FF5-11-0151). The models were based on a two-dimensional (2-D) cross section flow and transport model that extended from beneath the Columbia River inland through the Phase 1 and 2 treatment area (ECF-300FF5-11-0151; DOE/RL-2014-13).

The steps used in development of the phosphate injection model include:

1. Construct a three-dimensional (3-D) flow model of the 300-FF-5 Groundwater OU encompassing the Phase 1 and 2 treatment areas (DOE/RL-2014-13-ADD).
    a. Modify and adapt the 2-D model, previously used to evaluate uranium remedial alternatives (ECF-300FF5-11-0151), to a simplified 3-D model.
    b. Conduct simulations to compare 2-D and 3-D model results as verification that the 3-D model accurately reproduces the 2-D model results.
2. Conduct phosphate injection simulations with the 3-D model
    a. Assign injection wells in the 3-D model to simulate phosphate injection at locations identified in the Phase 1 and 2 treatment area (DOE/RL-2014-13-ADD) for 9-well and 36-well injection patterns.
    b. Run simulations for injection and post-injection periods and evaluate resulting phosphate distributions within the aquifer both spatially and in time.

3 Assumptions and Inputs

3.1 Development of 3-D Phosphate Injection Model

The 3-D model was constructed by adapting the 2-D model previously used to evaluate remedial alternatives (ECF-300FF5-11-0151). The hydrogeology represented in the 2-D model was assumed to represent the hydrogeology of the 300-FF-5 Groundwater OU.

3.1.1 Model Domain

The original 2-D transect model was oriented along a groundwater pathway extending from beneath the western side of the Columbia River inland through the treatment area and terminating up-gradient of the 300-FF-5 OU (Figure 3-1). Even though the model transect is curvilinear, the curvilinear transect is represented as a linear pathway in model coordinates. The linear extent of the 2-D model is overlain on the map of the 300 Area in Figure 3-1 and is aligned with the portion of the 2-D transect that extends through the Phase 1 and 2 treatment area.

The 2-D model grid consists of 269 cells horizontally along the 2-D transect (*i* dimension), 1 cell wide (*j* dimension) and 45 layers (*k* dimension). The 3-D model was constructed by first expanding the 2-D model from one cell to 111 cells in *j* (Figure 3-1). A uniform 2 m grid spacing was applied to all columns in *j*. The model was trimmed at both ends (in *i*) making the model shorter in order to reduce computation time (Figure 3-1).

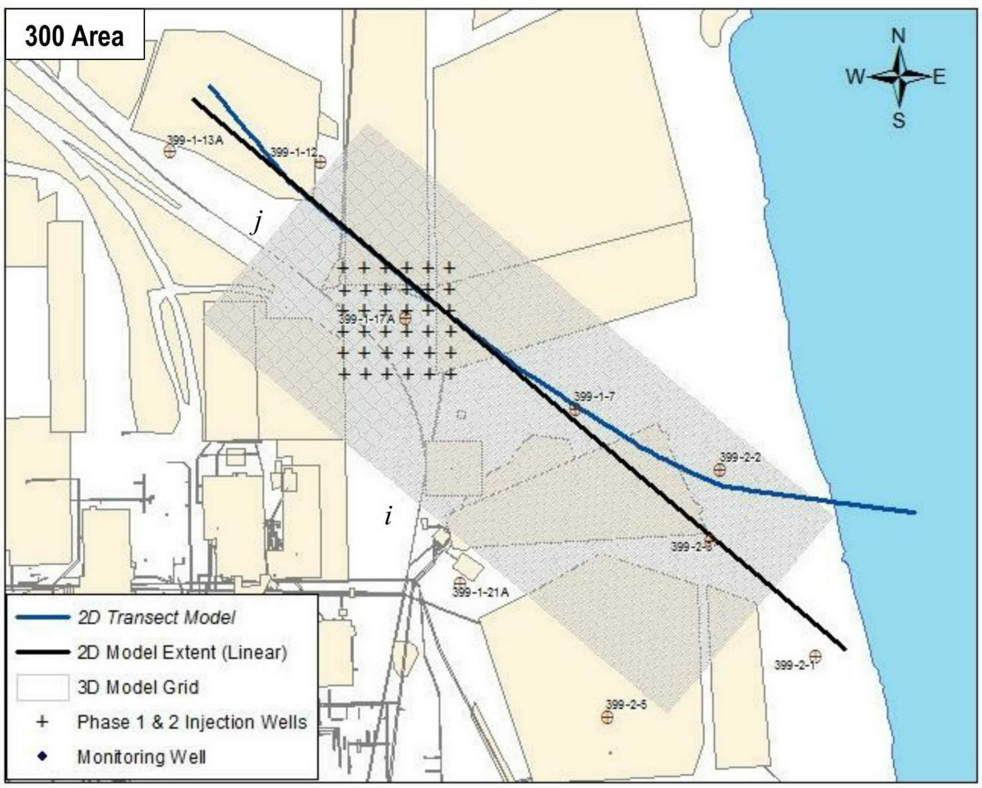


Figure 3-1. 300 Area Phosphate Injection Well Locations and 2-D and 3-D Model Grids

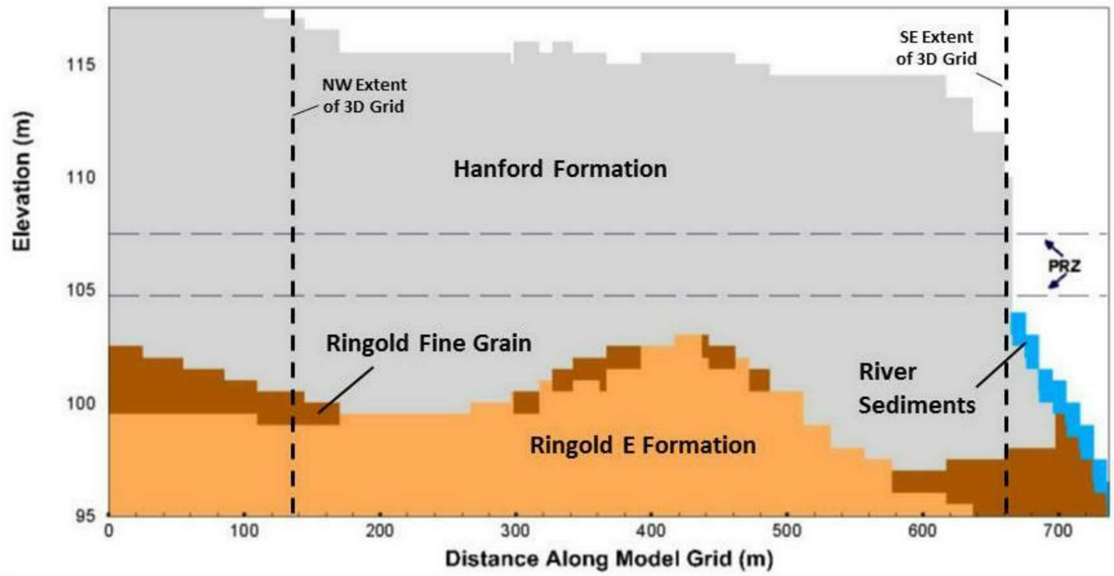


Figure 3-2. Hydrogeology of 300 Area Model

3.1.2 Model Parameters

Flow and transport parameters in the 3-D model were identical to those in the 2-D model (Figure 3-2, Table 3-1). The water-soluble phosphate compounds include ortho-, pyro-, and tripolyphosphate. Sorption and precipitation processes for the phosphate compounds in the Hanford groundwater are represented by a single distribution coefficient, K_d, in the model. The K_d used in the model was 0.02 ml/g and is a field-scale transport parameter derived from laboratory-experiments (PNNL-17818). For all cells in *j* in the 3-D model, the geologic description and model parameters are uniform.

Table 3-1. Model Parameters

Parameter	Hanford SZ/PRZ	Hanford VZ	Ringold E	Ringold Fine Grain	River Alluvium
Horizontal K (m/d)	9,000	9,000	42	1	10
K Anisotropy (K_z/K_x)	0.01	0.01	0.01	0.01	1.0
Diffusive Porosity (cm^3/cm^3)	0.167	0.167	0.177	0.177	0.177
Longitudinal Dispersivity, α_L (m)	8.75	0.875	1	1	1
Dispersivity Anisotropy, α_T/α_L	0.01	0.1	0.01	0.01	0.01
van Genuchten α (1/cm)	0.1	0.1	-	-	-
van Genuchten n (-)	1.725	1.725	-	-	-
Residual saturation (cm^3/cm^3)	0.132	0.132	-	-	-
Particle Density, ρ_s(g/cm^3)	2.68	2.68	2.65	2.65	2.76
Bulk Density, ρ_b (g/cm^3)	2.23	2.23	2.18	2.18	2.27

3.1.3 Initial and Boundary Conditions

The two-year period from 2008 through 2009 was assumed representative of the transient nature of the Hanford aquifer and the Columbia River that bounds the aquifer (ECF-300FF5-11-0151). The 2-D model was run for five 2-year cycles (2008 through 2009) to establish quasi-equilibrium conditions for use as initial head conditions in that model. The initial heads for the 3-D model were taken from the sixth 2-year simulation cycle in the 2-D model for the specific 3-D model start times (see Section 5).

Since the model was trimmed at both ends, transient head boundary conditions were assigned to each boundary cell at the inland and river ends of the model that were taken from daily output files for the 2-D model heads. For each boundary cell, boundary conditions were copied to each of the 111 cells in *j*.

3.1.4 Phosphate Injection Wells

Phosphate was injected in the model at the Phase 1 and 2 injection locations (DOE/RL-2014-13-ADD) (Figure 3-3). Two injection patterns were simulated. One pattern represented the 9 wells identified as Phase 1 wells; the second pattern was for the 36 wells representing both Phase 1 and 2 injection wells (Figure 3-4). All 36 wells were included as one of the scenarios in order to fully test how the injection rates and the total number of wells would affect water levels and interact with model boundaries.

Phosphate injection was applied to the model using the ~Source input card in STOMP. Each well screen was 5 m, or 10 cells vertically (Figure 3-5). For both scenarios, the wells extended from 103 m above mean sea level (amsl) to 108 m amsl with each well extending above and below the PRZ (Figure 3-5). The injection rate was 100 gallons per minute (gpm) for each well. The total injection rate was evenly divided into the 10 nodes representing each well vertically. Solute injection was specified at each well node such that the resulting injection concentration was 1.0, representing a maximum relative phosphate concentration.

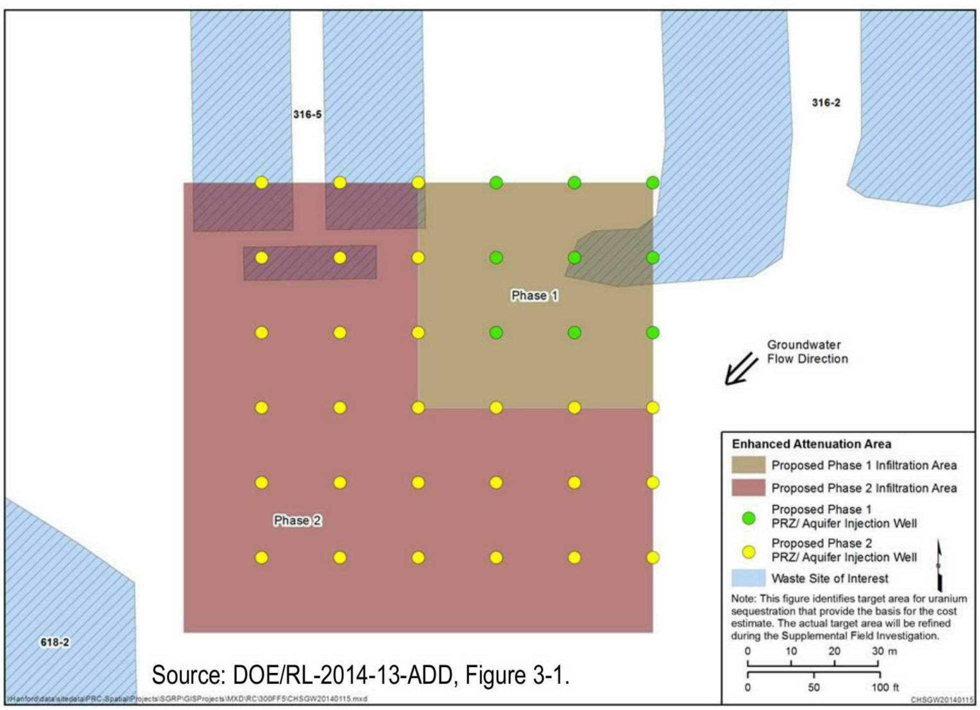


Figure 3-3. Proposed Phase 1 and 2 Injection Well Locations (DOE/RL-2014-13-ADD)

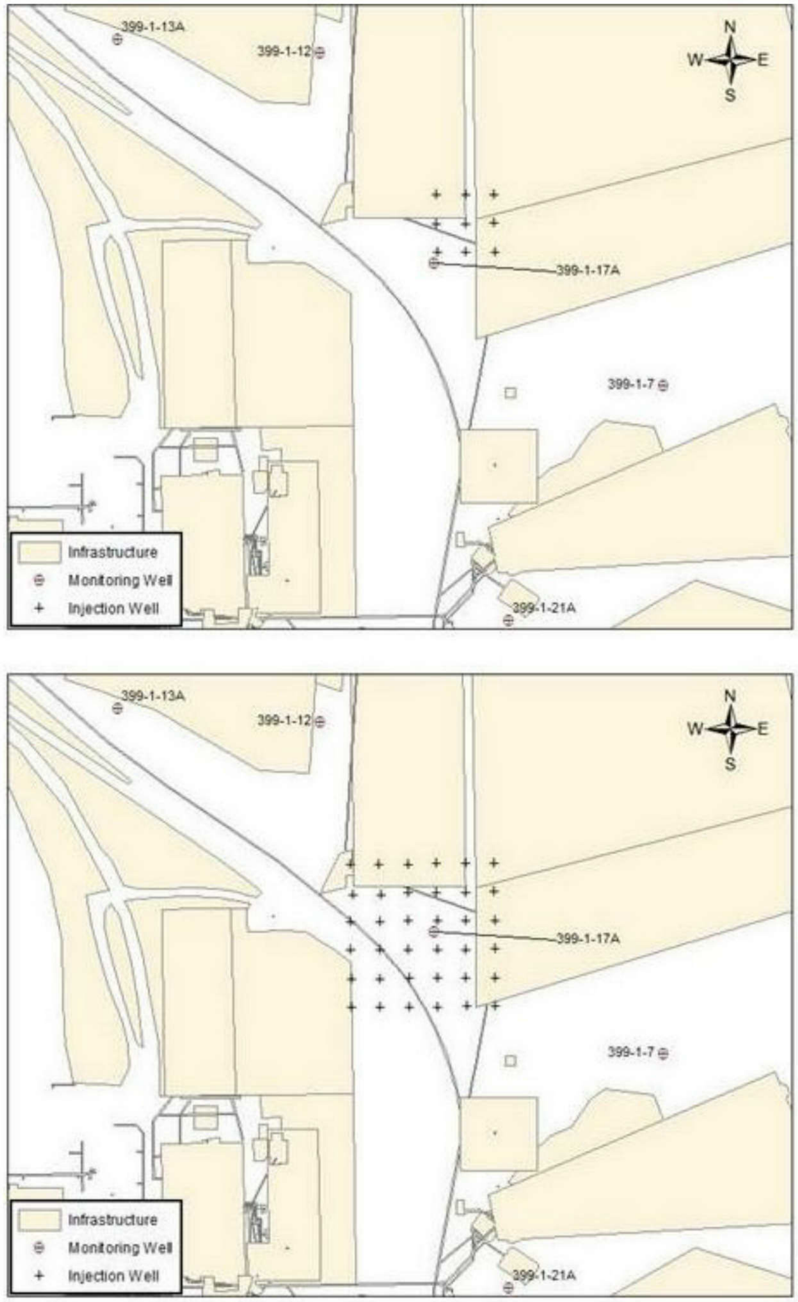


Figure 3-4. Injection Well Locations for 9-well (top) and 36-well (bottom) Models

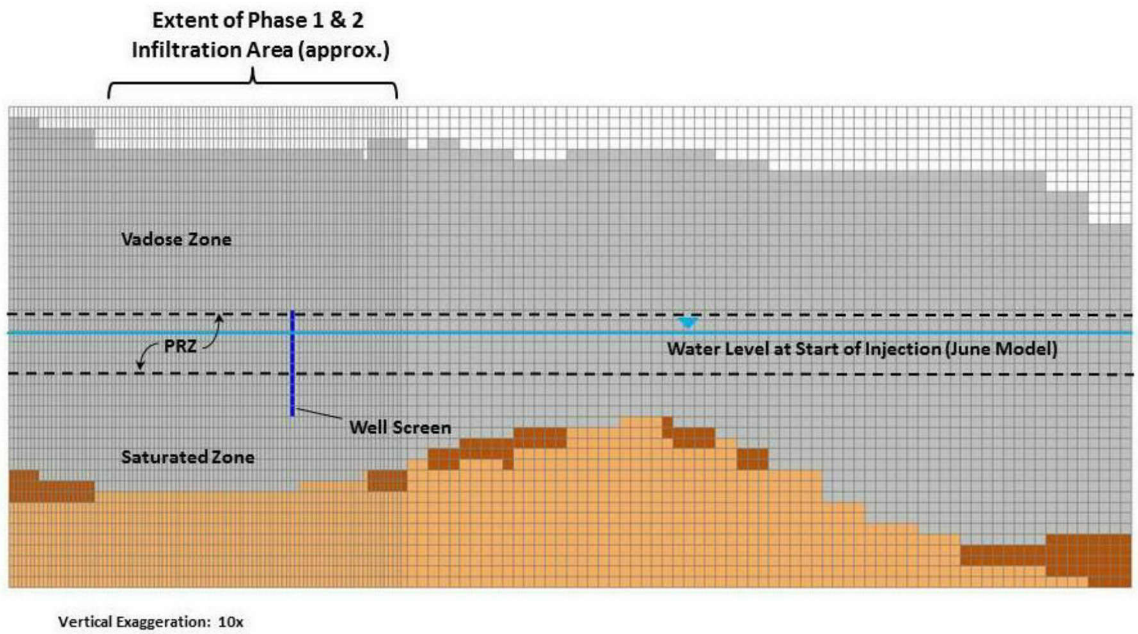


Figure 3-5. Location of Well Screen in Models

4 Software Applications

4.1 Approved Software

The groundwater flow and phosphate transport calculations were performed using the STOMP (Subsurface Transport Over Multiple Phases) (CHPRC Build 4) code with Hanford Information System Inventory (HISI) identification number 2471. The STOMP operational mode STOMP-W was utilized for the calculations. The software was approved and controlled in accordance with PRC-PRO-IRM-309 *Controlled Software Management* and managed for controlled use under CHPRC-00176, *STOMP Software Management Plan*.

CHPRC Build 4 of the STOMP Water operational mode (STOMP-W) was used with executable file 'stomp-w-bcg-chprc04l.x'. This executable file was compiled with Lahey-Fujitsu®[1] Fortran 64 Compiler for Linux®[2] and linked with the SPLIB bi-conjugate gradient solver. This executable was installed and tested for use on 'Green' Linux® cluster that is owned and managed by INTERA, Inc. and located at INTERA's Richland, Washington office. A copy of the software installation and checkout form is included in Attachment A to this ECF. The Green cluster is equipped with the following hardware: two Intel® Xeon®[3] 2.8GHz 6-core processors, 48GB RAM, two 300GB drives in RAID-1 (operating system and /home), six 2TB drives in RAID-6 with dedicated hot-swap, and six 2TB drives in RAID-5.

As given by the command name "uname –a", the operating system details are

```
Linux green 3.2.0-60-generic #91-Ubuntu SMP Wed Feb 19 03:54:44
UTC 2014 x86_64 x86_64 x86_64 GNU/Linux.
```

[1] Lahey® is a registered trademark of Lahey Computer Systems; Fujitsu is a registered trademark of Fujitsu Limited.
[2] Linux® is a registered trademark of Linux Torvalds in the United States and other countries.
[3] Intel® and Xeon® are registered trademarks of Intel in the United States and other countries.

The results of CHPRC acceptance testing (CHPRC-00515, *STOMP Acceptance Test Report*) demonstrate that the STOMP software is acceptable for its intended use by the CHPRC. Installations of the software are operating correctly, as demonstrated by the INTERA's Green Linux® cluster system producing the same results as those presented for selected problems from the STOMP Application Guide (PNNL-11216, *STOMP Subsurface Transport Over Multiple Phases: Application Guide*) in accordance with CHPRC-00211, *STOMP Software Test Plan*. The use of this software was consistent with its purpose, used within its limitations, and was a valid application of STOMP consistent with the functional requirements.

Linux®-based scripts were utilized for pre- and post-processing of the model inputs and outputs. Scripts used were both provided with the STOMP software and developed for this specific calculation. Scripts developed for this calculation were checked for correctness as part of this ECF.

Microsoft Excel®[4] 2007 spreadsheets were used to perform various routine calculations and for selected plotting. This use of Excel® is in the spreadsheet category and all calculations were subjected to checking as part of checking of this ECF.

Groundwater Vistas™ (*Guide to Using Groundwater Vistas* [Rumbaugh and Rumbaugh, 2007]) Version 6.58 Build 17 provided graphical tools used for model quality assurance and model input/output review.

Fortran code, compiled with Intel® Fortran 64 Compiler for Linux®, converted STOMP output into MODFLOW output format for import into Groundwater Vistas™ for visualization purposes (MODFLOW itself was not used in this calculation). The Fortran code developed and used for post-processing for this calculation was checked for correctness as part of the checking of this ECF.

ArcGIS®[5] (The ESRI Guide to GIS Analysis, Volume 1: Geographic Patterns and Relationships [Mitchell, 1999]) provided visualization tool for assessing simulated plume distributions, identifying extraction/injection well coordinates and mapping auxiliary data.

5 Calculation

5.1 Verification of 3-D Model

The 3-D model was verified by comparing heads for a single node in the3-D model within the saturated zone of the Hanford formation with heads at the node at the same (*i,k*) location in the 2-D model. This was done for June through August and September through November transient periods.

5.2 Phosphate Injection

Two injection patterns (9 wells and 36 wells) were simulated, and two injection periods were simulated for each injection pattern for a total of four phosphate injection scenarios. One injection period started at the beginning of high water levels, June 1, 2008 (Figure 5-1). During this time groundwater is flowing inland due to the increased Columbia River stage. Water levels remain high with flow inland for approximately 30 days at which time the river stage decreases and groundwater flow direction reverses toward the river. The second injection period was during low river stage when groundwater flow is always towards the river, starting September 1, 2008 (Figure 5-1).

[4] Excel® is a registered trademark of Microsoft Corporation in the United States and other countries.

[5] ArcGIS is a registered trademark of Esri in the United States and other countries.

The time for injection for both scenarios was 15 hours, at which time the injection wells were turned off in the model. Each simulation was run for 3 months to ensure that all of the important dynamics following phosphate injection were observed.

Injection concentrations represent a maximum relative phosphate concentration of 1. Depending on the level of precipitation of phosphate compounds desired, the concentration of phosphate compounds to be injected in the field can be determined. Resulting phosphate concentrations in groundwater following injection are a function of injected concentration, volumetric injection rate, groundwater flow velocity and associated phosphate residence times, and aquifer dispersivity.

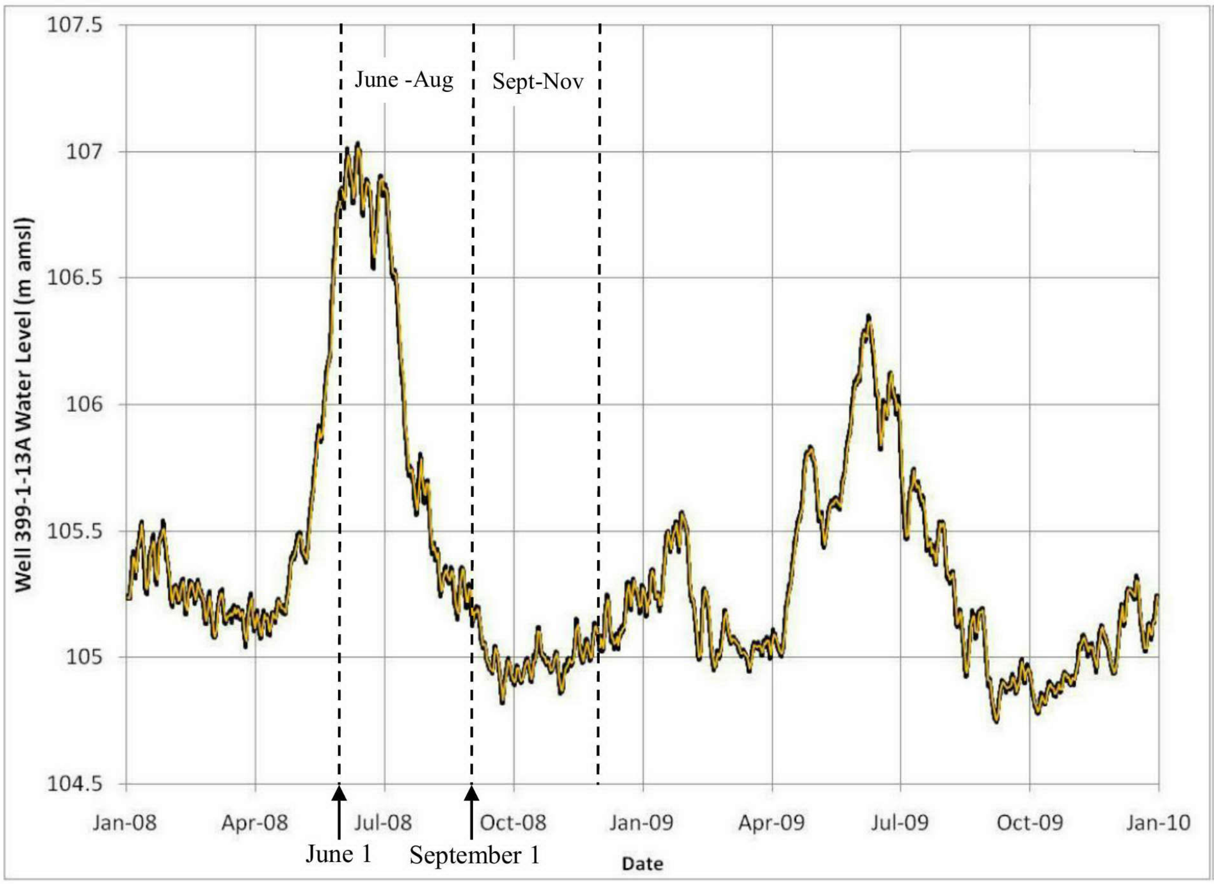


Figure 5-1. Water Levels at Well 399-1-13A for 2008 and 2009

6 Results and Conclusions

6.1 Results

6.1.1 Verification of 3-D Model

Heads in the 2-D and 3-D models were compared for a node within the Hanford formation for both the June through August and September through November models (Figure 6-1). Results show close agreement between the two models for the flow calculation verifying that the 3-D models accurately represent the flow simulated in the 2-D model.

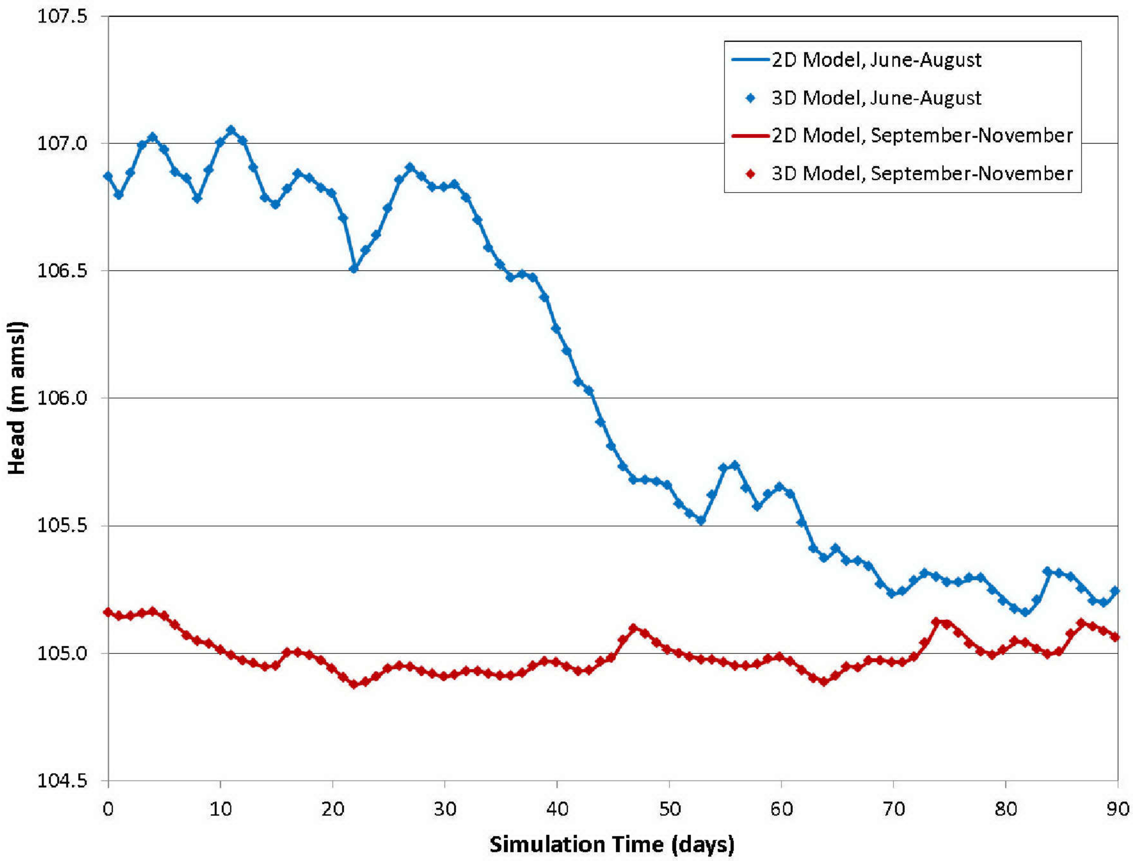


Figure 6-1. Comparison of Heads in 2-D and 3-D Models

6.1.2 Phosphate Injection

Water levels for the 36-well model for high and low water level injection periods indicate that only a small amount of mounding occurs, on the order of 0.1 m (Figure 6-2). This is due to the high hydraulic conductivity exhibited by the Hanford formation. Even though the mounding extends laterally to the edge of the model domain, this effect is small and short-lived and dissipates rapidly once injection is turned off.

Aqueous phosphate concentrations at the water table and in cross section are shown for the 9-well and 36-well models for the June (Figures 6-3 through 6-6; note that later times are in 10-day intervals) and September (Figures 6-7 through 6-10; note that later times are in 5-day intervals) injection scenarios for times following the start of injection. For phosphate injected at the beginning of the high water levels starting in June 2008, the phosphate plume first migrates a short distance inland for approximately 30 days, then reverses direction and migrates back towards the river as the river stage and groundwater levels decrease around the beginning of July 2008 (Figure 5-1; Figures 6-11 and 6-12, left-most plots). Residence times and concentrations within the saturated zone (105.75 m amsl) are relatively high during this period. The concentration in the vadose zone just above the water table near the top of the PRZ (107.25 m amsl) follows similar behavior as for the saturated zone out to approximately 35 days at which time the saturated zone concentration continues to decrease while the vadose zone concentration remains relatively constant at 0.2 to 0.3 (Figures 6-11 and 6-12, left-most plots). The higher concentrations maintained in the vadose zone results from the lower pore water velocities and slower migration of phosphate solutions from the injection zone once water levels decline, effectively stranding the phosphate solution in the upper part of the PRZ.

For phosphate injection at the beginning of September 2008, groundwater is flowing towards the river for the entire simulation period such that the phosphate injected into the saturated zone is swept away from the treatment area at higher flow rates that are always towards the river (Figures 6-7 through 6-10;Figures 6-11 and 6-12, right-most plots, 104.75 m amsl). Note that the phosphate plume is still in the vicinity of the well field after 30 days for the June injection scenario (Figures 6-3 through 6-6) whereas after 15 days the phosphate has already migrated to the southeast of the well field for the September injection simulation (Figures 6-7 through 6-10). As a result, residence times and concentrations in the saturated zone are lower for the September injection scenario than for the June injection scenario. Concentrations in the vadose zone near the top of the PRZ (Figures 6-11 and 6-12, right-most plots, 107.25 m amsl) remain much higher for the September injection than for the June injection. This is due to the location of the water table approximately 2 m lower for the September injection such that the phosphate injected in the upper portion of the PRZ is neither diluted nor displaced by saturated-zone flow.

The 9-well and 36-well model results are similar with the main difference being that the phosphate concentrations remain higher longer for the 36-well model. This is clear in Figures 6-11 and 6-12 for the June injection results (left-most plots) where both saturated zone and vadose zone concentrations are approximately 0.1 higher for the 36-well model for 5 to 40 days following injection . This effect is also evident in the cross section figures (Figures 6-4 and 6-6) and is due to the reduced effects of dispersion and mixing in the center of the phosphate plume for the larger volumes injected in the 36-well model. The effect is also evident, although less pronounced, for the September injection (Figures 6-11 and 6-12, right-most plots, and Figures 6-7 through 6-10) due to the more rapid decrease in concentrations in the vicinity of the well field resulting from groundwater flowing towards the river during the entire time period.

6.2 Conclusions

Based on model results, the well spacing and injection rates tested in the 3-D phosphate injection model appear to be reasonable and effective with respect to the coverage and relative concentrations of phosphate in the saturated and vadose zones in the 300 Area. Both groundwater flow direction and water level strongly influence phosphate residence times in the Phase 1 and 2 treatment area. Injecting at the beginning of the high-water levels in early summer allows for larger residence times in the saturated zone as the injected phosphate first migrates further inland, then back through the treatment area once the flow direction reverses back towards the river. Phosphate residence times in the saturate zone are lower for injection during low water levels since groundwater is flowing at a higher and more continuous rate towards the river to the southeast.

Injection into the vadose zone shows different behavior. Following injection during high water levels, vadose-zone concentrations decrease in a similar fashion to concentrations in the saturated zone. However, once the water levels drop, the phosphate injected at the top of the injection wells is out of the influence of saturated-zone flow resulting in residual phosphate at relatively higher concentrations compared to saturated-zone concentrations. This is compared to the phosphate injection during low water levels where phosphate injected in the vadose zone in the upper part of the injection well shows no influence from saturated-zone flow resulting in much higher residual phosphate concentrations. This effect is not diminished due to groundwater mounding in the vicinity of the injection wells due to the very high hydraulic conductivity of the Hanford formation.

A planned supplemental post-ROD field investigation for the 300-FF-5 Operable Unit will provide useful information on the distribution and potential mobility of uranium within the vadose zone and PRZ and will be helpful in refining the location of the enhanced attenuation treatment area. Field data combined with insights of phosphate injection provided by the 3-D model will guide the design of the final remedy at the 300 Area.

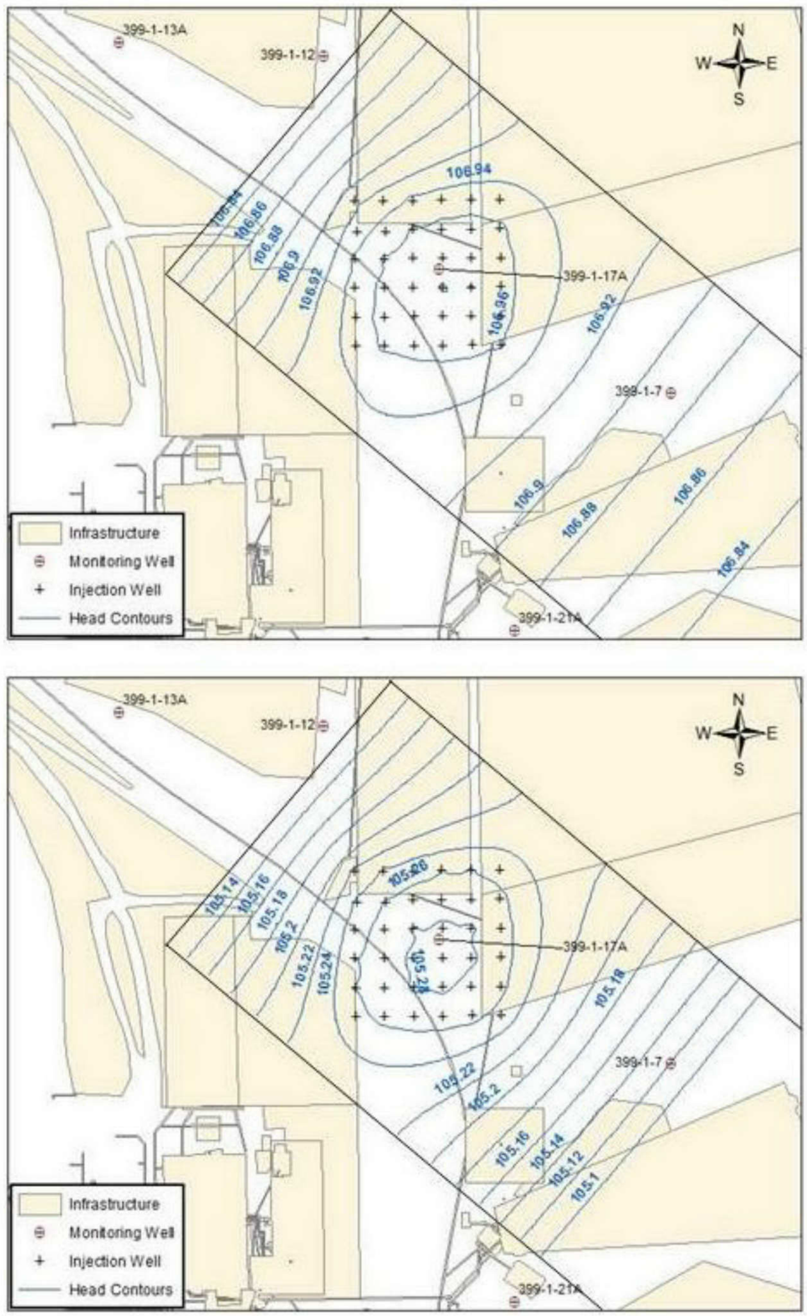


Figure 6-2. Water Level Contours at the End of the 15-hour Phosphate Injection Period for June 1st (top) and September 1st (bottom) Injection Periods (contour interval = 0.02 m)

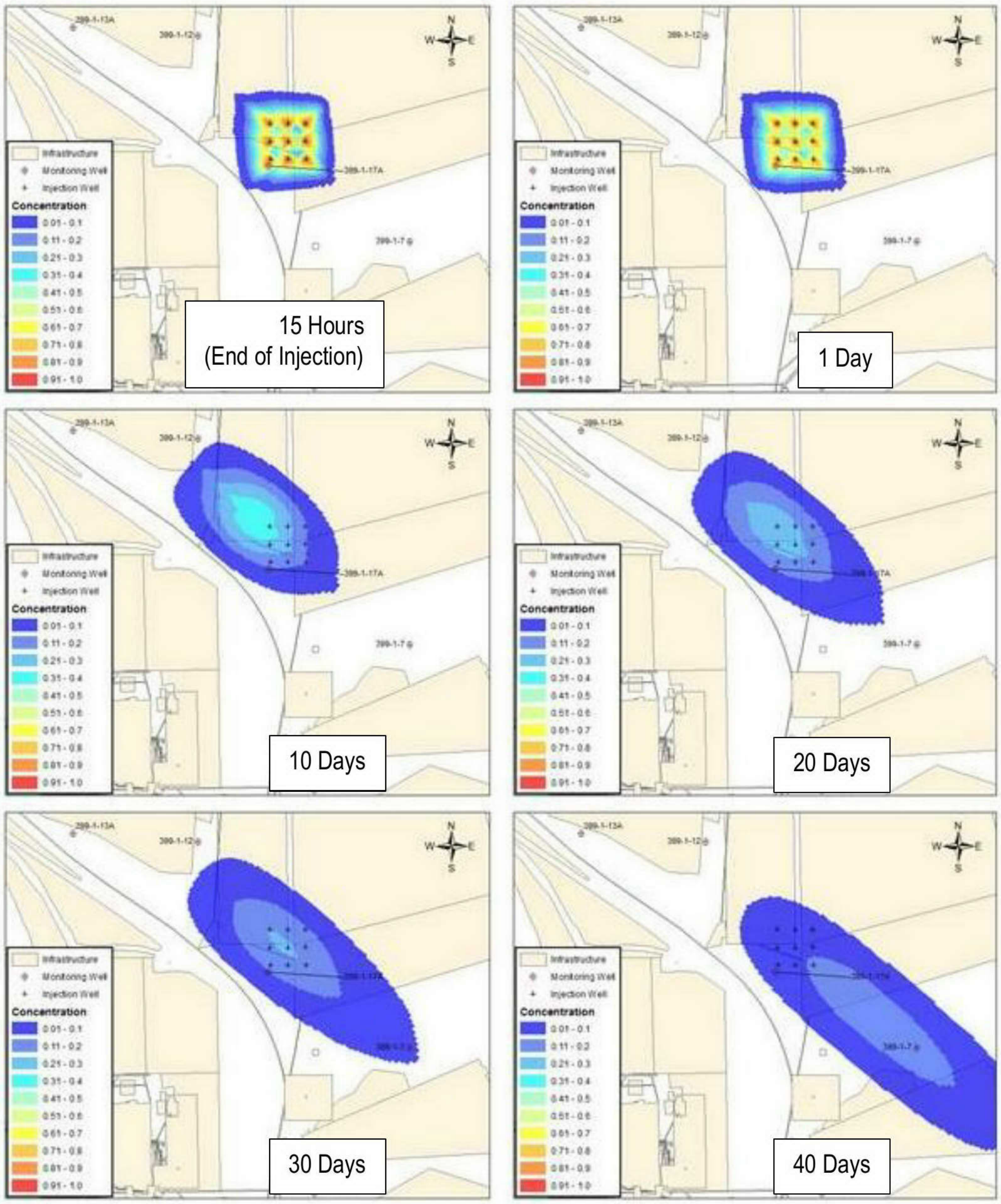


Figure 6-3. Aqueous Concentrations at the Water Table following Phosphate Injection at the 9 Phase 1 Wells during High Water Levels (June 1, 2008)

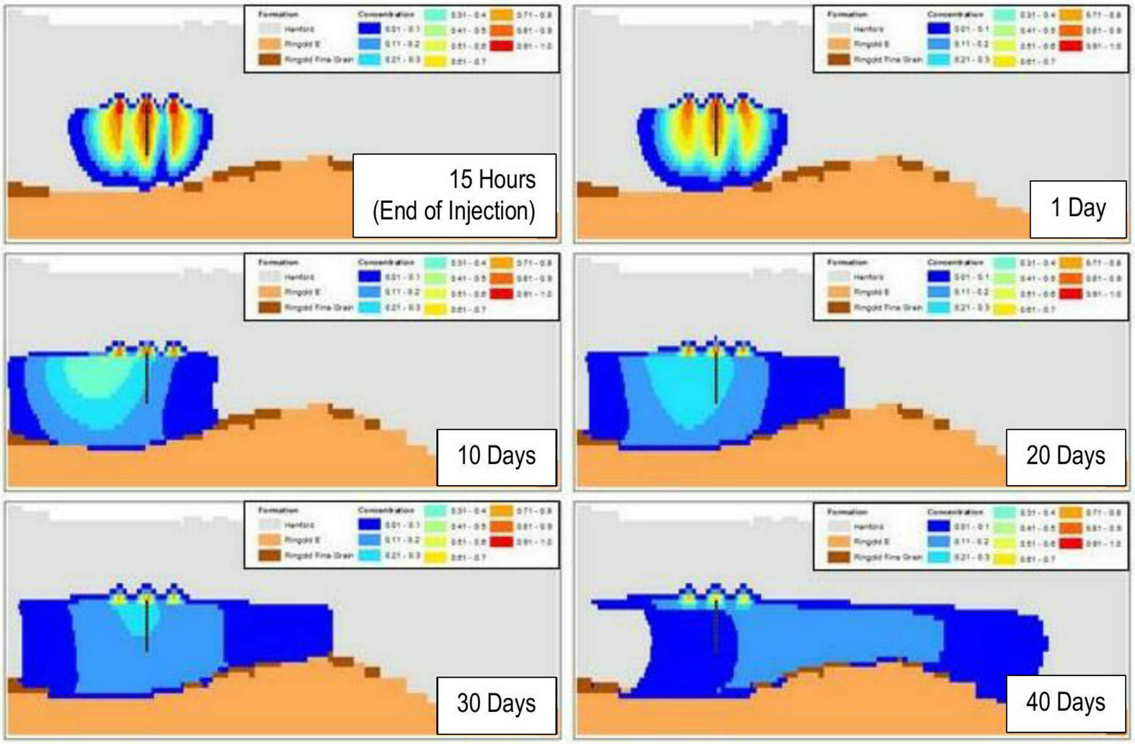


Figure 6-4. Aqueous Concentrations in Section through Center of Well Field Following Phosphate Injection at the 9 Phase 1 Wells during High Water Levels (June 1, 2008) (Columbia River is to the right)

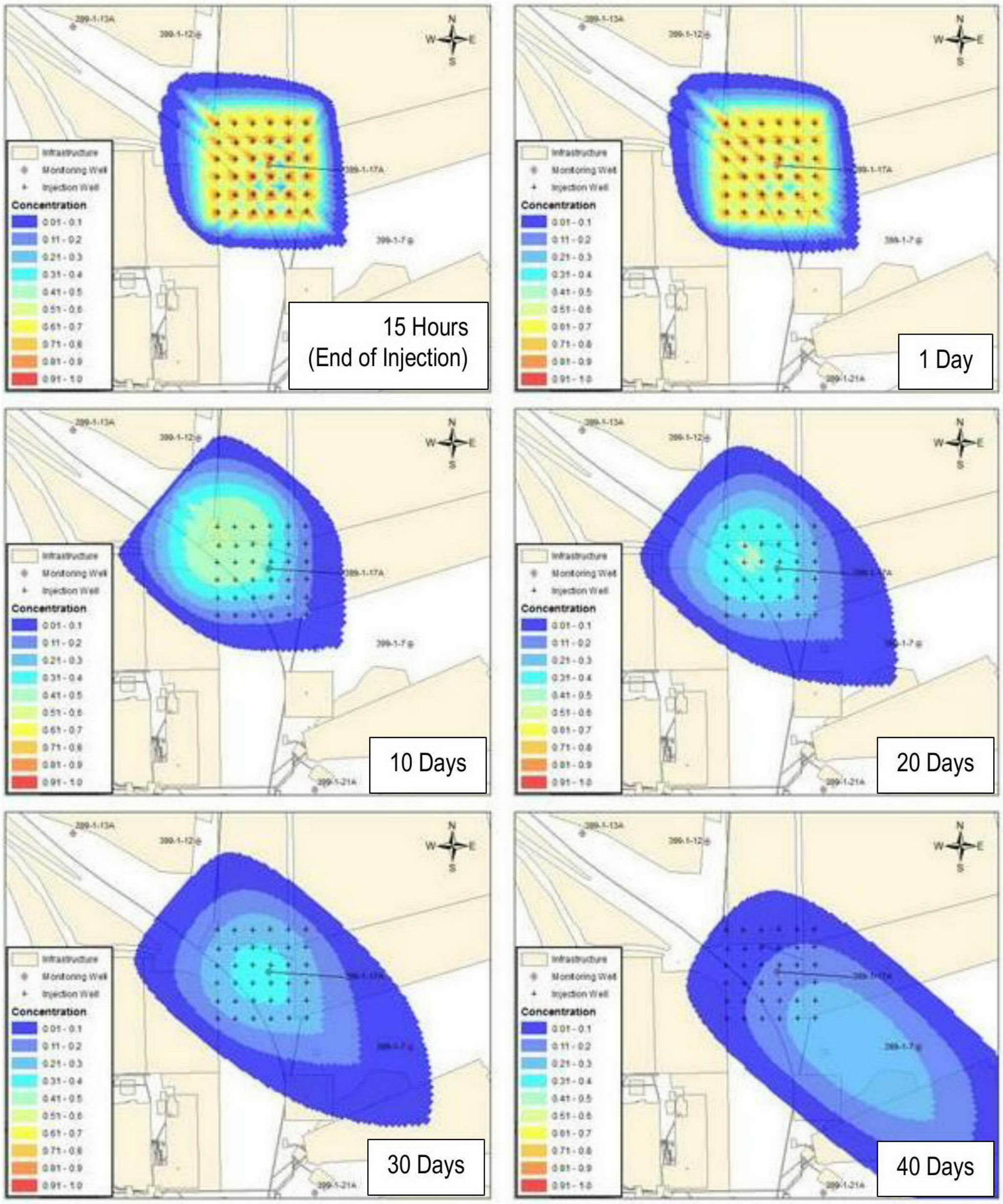


Figure 6-5. Aqueous Concentrations at the Water Table following Phosphate Injection at the 36 Phase 1 and 2 Wells during High Water Levels (June 1, 2008)

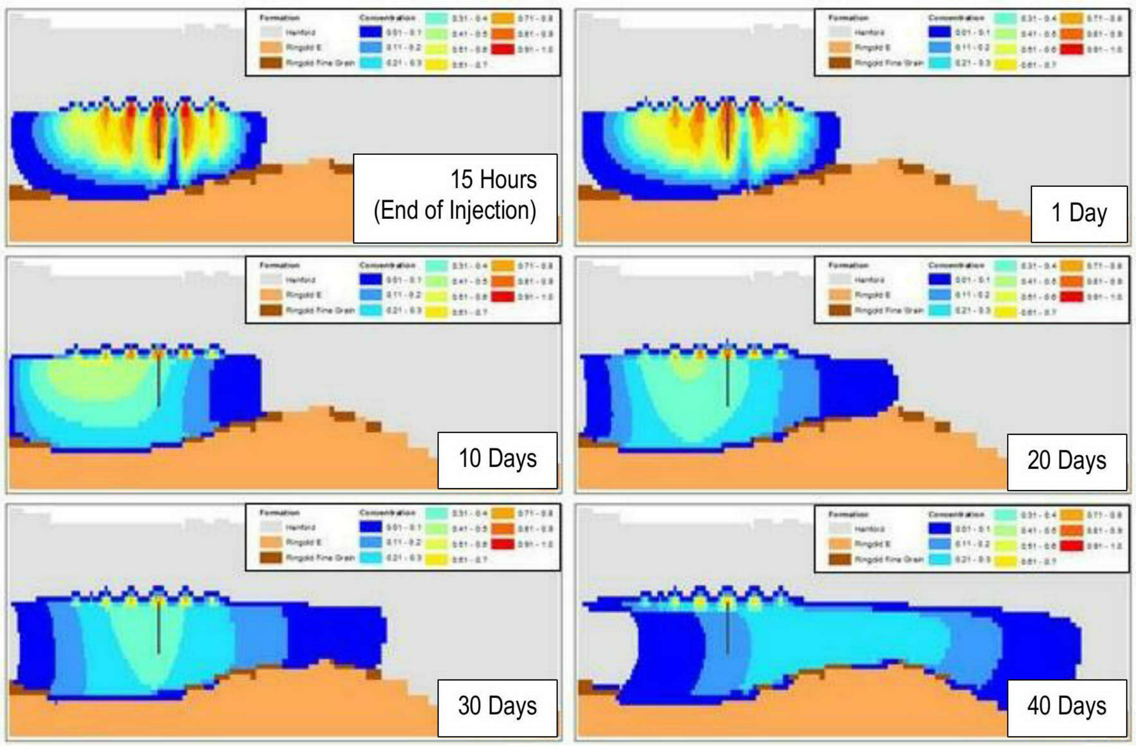


Figure 6-6. Aqueous Concentrations in Section through Center of Well Field following Phosphate Injection at the 36 Phase 1 and 2 wells during High Water Levels (June 1, 2008) (Columbia River at right)

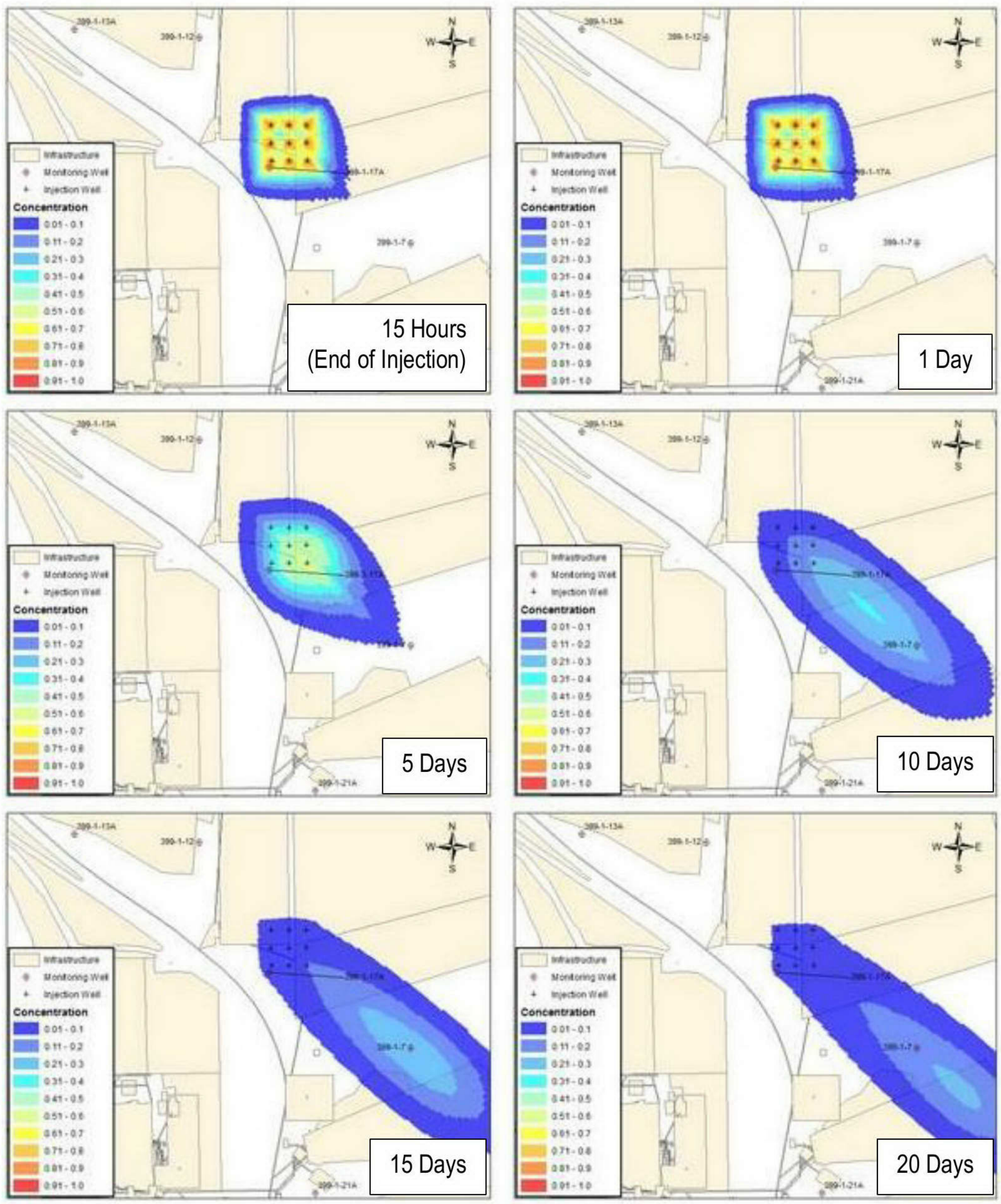


Figure 6-7. Aqueous Concentrations at the Water Table following phosphate Injection at the 9 Phase 1 Wells during Low Water Levels (September 1, 2008)

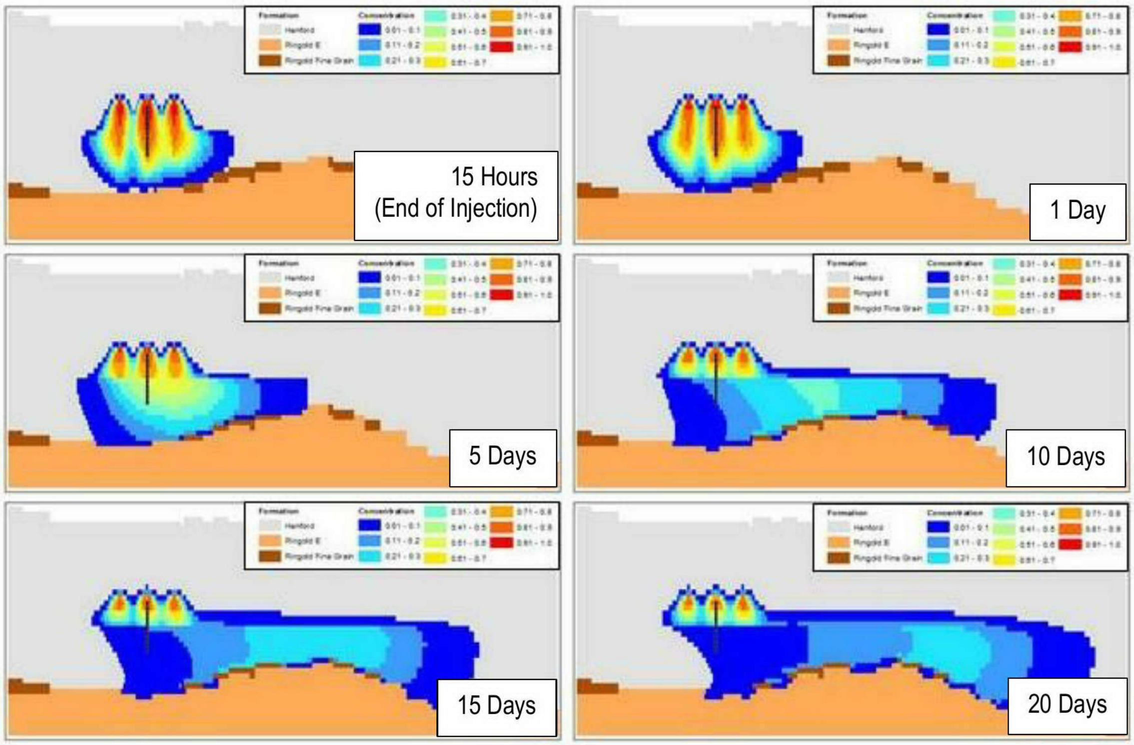


Figure 6-8. Aqueous Concentrations in Section through Center of Well Field following Phosphate Injection at the 9 Phase 1 Wells during Low Water Levels (September 1, 2008) (Columbia River at right)

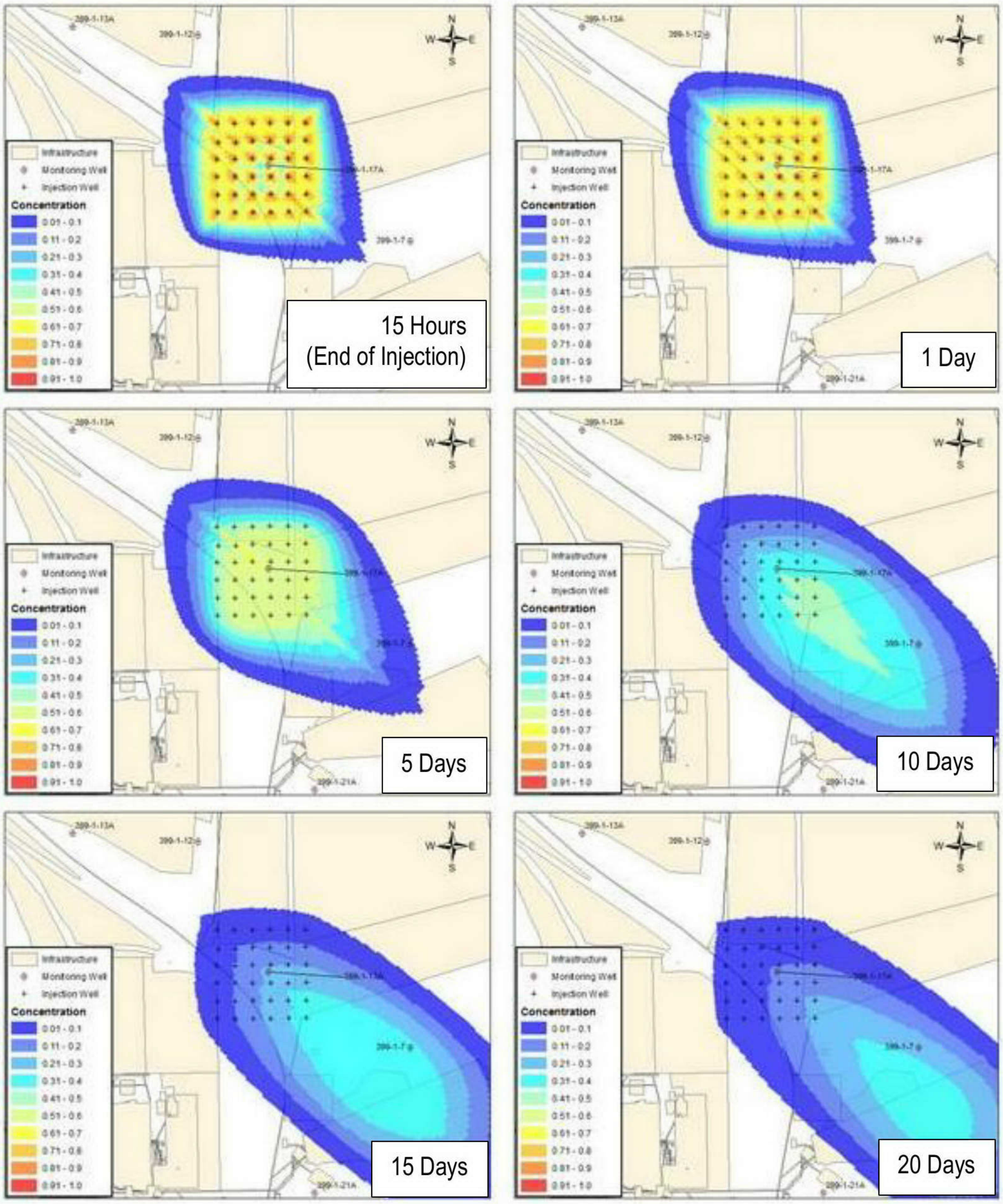


Figure 6-9. Aqueous Concentrations at the Water Table following Phosphate Injection at the 36 Phase 1 and 2 Wells during Low Water Levels (September 1, 2008)

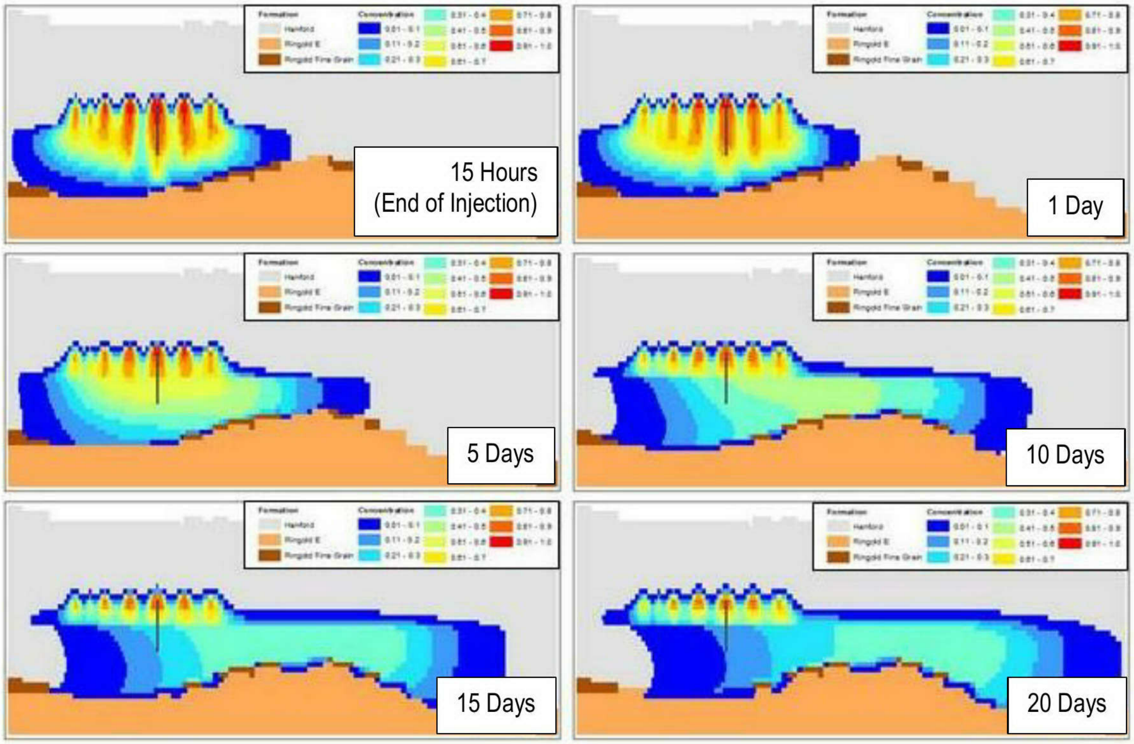


Figure 6-10. Aqueous Concentrations in Section through Center of Well Field following Phosphate Injection at the 36 Phase 1 and 2 Wells during Low Water Levels (September 1, 2008) (Columbia River at right)

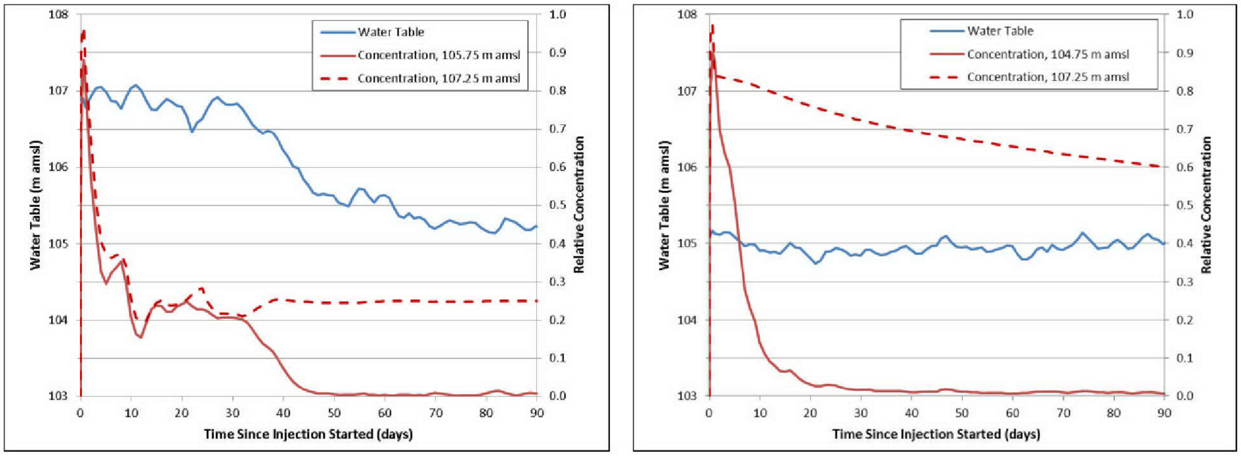


Figure 6-11. Saturated zone head and aqueous concentration time series at the center of well field for the 9-well model for June (L) and September (R) injection periods.

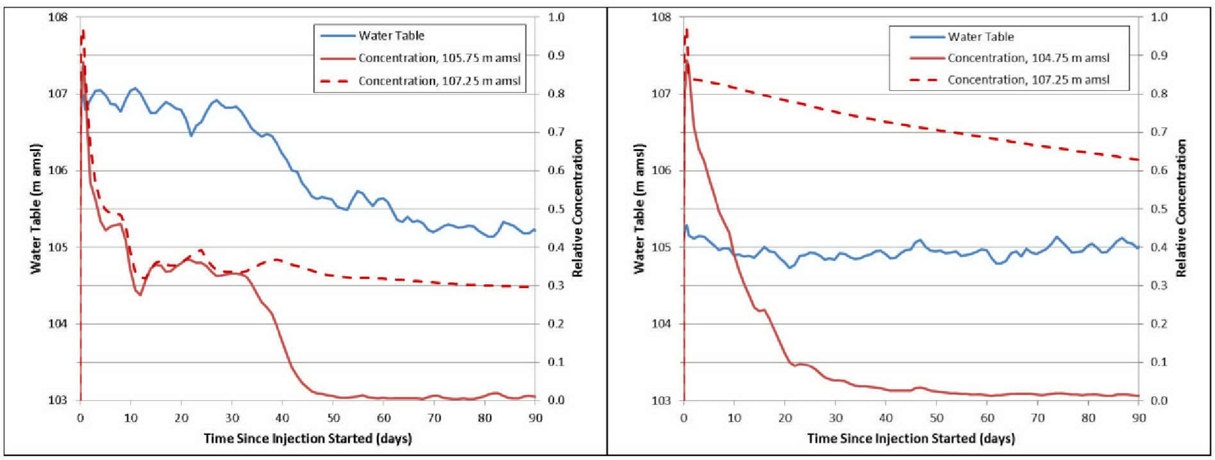


Figure 6-12. Saturated Zone Head and Aqueous Concentration Time Series at the Center of Well Field for the 36-well Model for June (L) and September (R) Injection Periods

7 References

CHPRC-00176, 2011, *STOMP Software Management Plan*, Rev. 2, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-00211, 2011, *STOMP Software Test Plan*, Rev. 1, CH2M HILL Plateau Remediation Company, Richland, Washington.

CHPRC-00515, 2013, *STOMP Acceptance Test Report (CHPRC Build 4)*, Rev. 3, CH2M HILL Plateau Remediation Company, Richland, Washington.

DOE/RL-2014-13-ADD, 2014, *Remedial Design Report/Remedial Action Work Plan Addendum for the 300 Area Groundwater*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

ECF-300FF5-11-0151, 2012, *Groundwater Flow and Uranium Transport Modeling in Support of the 300 Area FF-5 RI/FS Document*, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 2013, *Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1, Hanford Site 300 Area*. U.S. Environmental Protection Agency, Region 10 and U.S. Department of Energy, Richland Operations Office, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0087180.

Mitchell, A. 1999, The ESRI Guide to GIS Analysis, Volume 1: Geographic Patterns and Relationships, Environmental Systems Research Institute, Inc., Redlands, California.

PNNL-11216, 1997, *STOMP Subsurface Transport Over Multiple Phases Application Guide*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://stomp.pnnl.gov/documentation/guides/application.pdf.

PNNL-17818, 2008, *300 Area Treatability Test: Laboratory Development of Polyphosphate Remediation Technology for In Situ Treatment of Uranium Contamination in the Vadose Zone and Capillary Fringe*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17818.pdf.

PRC-PRO-IRM-309, 2013, *Controlled Software Management*, Rev. 4, CH2M HILL Plateau Remediation Company, Richland, Washington.

Rumbaugh and Rumbaugh, 2007, *Guide to Using Groundwater Vistas.* Online guide is available at: http://www.groundwatermodels.com/Groundwater_Vistas.php.

Attachment A

Software Installation and Checkout Forms for Controlled Use Software

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM

Software Owner Instructions:

Complete Fields 1-13, then run test cases in Field 14. Compare test case results listed in Field 15 to corresponding Test Report outputs. If results are the same, sign and date Field 19. If not, resolve differences and repeat above steps.

Software Subject Matter Expert Instructions:

Assign test personnel. Approve the installation of the code by signing and dating Field 21, then maintain form as part of the software support documentation.

GENERAL INFORMATION:

1. Software Name: STOMP (Subsurface Transport Over Multiple Phases) Software Version No.: Bld 4

EXECUTABLE INFORMATION:

2. Executable Name (include path):

```
All executable files installed in directory /srv/samba/saved_data/bin
--------------------------------  ---------------------------
MD5 File Signature                Executable File Name
--------------------------------  ---------------------------
6536b8e12d8c5b83dca76f2c947b6153  stomp-wae-bcg-chprc04i.x
e0cdf04bc1a2f6c55c5a1b499939f663  stomp-wae-bcg-chprc04l.x
6e72340bb39f6056e232fe5ff241c4d4  stomp-wae-bd-chprc04i.x
3f837a0fb8d9f47dbcada686f542d7fc  stomp-wae-bd-chprc04l.x
7e5b4cc36a8991b3d5a8ea2ed155ce47  stomp-wae-cgsq-chprc04i.x
00a898c0c3ec06817485781ad1c9ec46  stomp-wae-cgsq-chprc04l.x
f18ff5ab5667065d8ab12657344fb6a0  stomp-wae-cgst-chprc04i.x
061af86cf21ad8435b046d0efabe971b  stomp-wae-cgst-chprc04l.x
3c8111a9855dc0e430bf3c8a7abcf37e  stomp-w-bcg-chprc04i.x
20436d615a94955a2ce8eecdb8cba546  stomp-w-bcg-chprc04l.x
8b3df29df21d040189c3e2a50ef823bb  stomp-w-bd-chprc04i.x
066a289a75aedb933eb2536da5d7d1ff  stomp-w-bd-chprc04l.x
c8e62ad7a0d9b6fca39d8a8952ef5d8e  stomp-w-cgsq-chprc04i.x
28ad16806e1307aca51fd7bf89793e75  stomp-w-cgsq-chprc04l.x
6c25051016db2fe1f883a7caaaab1e97  stomp-w-cgst-chprc04i.x
ff9ff6f29b3469419ffaece87d7e772b  stomp-w-cgst-chprc04l.x
0c3e3fba40f5b93e71bcf9586432fd27  stomp-w-r-bcg-chprc04i.x
78492aee80a8c2d0a4e82aabf4a9c213  stomp-w-r-bcg-chprc04l.x
84b129786aba9c4be884e15e45a67389  stomp-w-r-bd-chprc04i.x
e990f1566c8099a8d54508de3da9cd88  stomp-w-r-bd-chprc04l.x
18a589a2b55aab2db290efea19b39351  stomp-w-r-cgsq-chprc04i.x
6569959476772a137df35ce874821889  stomp-w-r-cgsq-chprc04l.x
```

3. Executable Size (bytes): MD5 signatures above uniquely identify each executable file

COMPILATION INFORMATION:

4. Hardware System (i.e., property number or ID):

   Tellus Subsurface Modeling Platform

5. Operating System (include version number):

   Linux tellusmgmt.rl.gov 2.6.18-308.4.1.el5 #1 SMP Tue Apr 17 17:08:00 EDT 2012 x86_64 x86 64 x86 64 GNU/Linux

INSTALLATION AND CHECKOUT INFORMATION:

6. Hardware System (i.e., property number or ID):

   Green Linux Cluster

7. Operating System (include version number):

   Linux green 3.2.0-35-generic #55-Ubuntu SMP Wed Dec 5 17:42:16 UTC 2012 x86_64 x86_64 x86 64 GNU/Linux

Page 1 of 2 A-6005-149 (REV 0)

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM (continued)

1. Software Name: STOMP (Subsurface Transport Over Multiple Phases) Software Version No.: Bld 4

8. Open Problem Report? (●) No ( ) Yes PR/CR No.

TEST CASE INFORMATION:

9. Directory/Path:

/srv/samba/saved data/test/stomp/build-04/itc

10. Procedure(s):

CHPRC-00211 Rev 1, STOMP Software Test Plan

11. Libraries:

N/A (static linking)

12. Input Files:

Input files for ITC-STOMP-1, ITC-STOMP-2, and ITC-STOMP-2
(Baseline for comparison are results files from ATC-STOMP-1, ATC-STOMP-2, and ATC-STOMP-3 prepared on Tellus during acceptance testing)

13. Output Files:

plot.* files produced by STOMP in testing

14. Test Cases:

ITC-STOMP-1, ITC-STOMP-2, and ITC-STOMP-3

15. Test Case Results:

Pass for all executable files listed above.

16. Test Performed By: WE Nichols

17. Test Results: (●) Satisfactory, Accepted for Use ( ) Unsatisfactory

18. Disposition (include HISI update):

Accepted; Installation noted in HISI for users TJ Budge, N Hasan, A Mayenna, WJ McMahon, WE Nichols, S Mehta, H Rashid.

Prepared By:

19.	[signature]	WE Nichols	25 APRIL 2013
	Software Owner (Signature)	Print	Date

20. Test Personnel:

[signature]	WE Nichols	25 APRIL 2013
Sign	Print	Date
Sign	Print	Date
Sign	Print	Date

Approved By:

21.		N/R (per CHPRC-00211 Rev 1)	
	Software SME (Signature)	Print	Date

Page 2 of 2 A-6005-149 (REV 0)