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

11-AMCP-0213

SEP 19 2011

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

Dear Mr. Faulk:

WASTE SITE RECLASSIFICATION FORM (CONTROL NUMBER 2011-049), AND RESPONSE ACTION REPORT FOR THE 200-MG-1 OPERABLE UNIT WASTE SITE 600-218, DOE/RL-2011-64, REVISION 0

This letter transmits signed copies of the Waste Site Reclassification Form (Control Number 2011-049), and the approved Response Action Report for the 200-MG-1 Operable Unit Waste Site 600-218, DOE/RL-2011-64, Revision 0.

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

Sincerely,

Jonathan Dowell

Jonathan A. Dowell, Assistant Manager
for the Central Plateau

AMCP:FMR

Attachments

cc: See Page 2

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

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

# WASTE SITE RECLASSIFICATION FORM

| | | |
|---|---|---|
| Date Submitted: 7/20/11 | Operable Unit(s): 200-MG-1 | Control Number: 2011-049 |
| Originator: N. Chandran | Waste Site Code: 600-218 | |
| Phone: 373-4716 | Type of Reclassification Action:<br>Closed Out ☐ Interim Closed Out ☒ No Action ☐<br>RCRA Postclosure ☐ Rejected ☐ Consolidated ☐ | |

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:
(Summarize status of investigation/remediation of the waste sites.)

The 600-218 waste site is located northwest of the 200 West Area, and is comprised of two areas separated by land not designated as a waste site. Observations made during the site walk down included transite debris scattered across the larger, southern portion of the 600-218 waste site; however, no visible indicators of potential contamination were observed. The selected alternative authorized by DOE/RL-2009-48, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit* (Action Memorandum) was confirmatory sampling/no further action. Initial sampling indicated contaminants of potential concern (COPCs) in excess of the established removal action levels (RALs) for the waste site, resulting in the implementation of the removal, treatment, and disposal (RTD) alternative in accordance with DOE/RL-2009-53, Rev. 1, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit* (RAWP). Following RTD, verification sampling was performed in accordance with DOE/RL-2009-60, Rev. 1, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, which demonstrated the waste site had achieved compliance with the RALs and corresponding removal action objectives (RAOs).

The results show that residual soil concentrations of COPCs less than or equal to the RALs supports a reclassification of this site to interim closed out. The current site conditions achieve the RALs and the corresponding RAOs established in the RAWP. The results of waste site sampling are used to make reclassification decisions for the 600-218 waste site in accordance with the TPA-MP-14 (DOE-RL 2007) process. Debris removal, along with underlying soil, was conducted at the areas of impact, as well as the remainder of the larger, southern portion of the 600-218 waste site. RAOs were achieved without requiring additional excavation; therefore, backfill was not required at the 600-218 waste site.

Basis for reclassification:
(For interim closeout, reference supporting documentation, as listed in Table 3.)

The current site conditions meet RALs and the corresponding RAOs specified in the Action Memorandum. The results show that the residual soil concentrations support reasonably anticipated future land uses recognized in DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, and the Action Memorandum. The results also demonstrate that residual concentrations of COPCs in soil support unrestricted future use of shallow zone soil [i.e., surface to 4.6 meters (15 feet)] and that COPC concentrations remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 600-218 waste site therefore no institutional controls are required. The basis for reclassification to interim closed out is described in detail in DOE/RL-2011-64, *Response Action Report for 200-MG-1 Operable Unit Waste Site 600-218*, U.S. Department of Energy, Richland Operation Office, Richland, Washington.

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.

| | | |
|---|---|---|
| D. A. Farabee<br>DOE Federal Project Director (printed) | Signature | 7/20/11<br>Date |
| DENNIS Faulk<br>EPA Project Manager (printed) | Signature | 7/21/11<br>Date |

DOE/RL-2011-64
Revision 0

# Response Action Report for the 200-MG-1 Operable Unit Waste Site 600-218

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

DOE/RL-2011-64
Revision 0

# Response Action Report for the 200-MG-1 Operable Unit Waste Site 600-218

Date Published
July 2011

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Assistant Secretary for Environmental Management

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P.O. Box 1600
Richland, Washington

Release Approval 07/20/2011
Date

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# Approval Page

**Title:** *Response Action Report for 200-MG-1 Operable Unit Waste Site 600-218*

O. A. Farabee
U.S. Department of Energy, Richland Operations Office

Signature

7/20/11
Date

# Executive Summary

This response action report documents the successful completion of the removal action conducted at the 600-218 waste site, also known as the H-51 Anti-Aircraft Artillery Site Dumping Area. The alternative proposed in DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*[1] (EE/CA) and selected in DOE/RL-2009-48, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*[2] (Action Memorandum), was confirmatory sampling/no further action (CS/NFA).

The 600-218 waste site was investigated between August 2009 and May 2011 through field observations and sampling to determine the nature and extent of contaminants of potential concern (COPCs) present in the waste site soils as part of the selected removal action alternative of CS/NFA, as prescribed in the Action Memorandum. Visual inspections of the waste site area were conducted, and soil samples were collected between December 2009 and April 2011. This investigation was performed in accordance with DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*[3] and DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit.*[4] Through the investigation summarized in this report, it was found that analytical results from initial sampling demonstrated that soil conditions at the waste site did not comply with established removal action levels (RALs). Therefore, in accordance with the methodology prescribed in the Action Memorandum, the alternative was changed to removal, treatment, and disposal (RTD). Verification sampling conducted after RTD activities confirmed that the waste site achieved compliance with RALs and, therefore, met the established removal action objectives.

---

[1] DOE/RL-2008-44, 2009, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=0096350

[2] DOE/RL-2009-48, 2009, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=0096131

[3] DOE/RL-2009-60, 2011, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1003290272

[4] DOE/RL-2009-53, 2010, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=1010180132

The analytical results demonstrate that the residual soil concentrations of COPCs support reasonably anticipated future land use described in the EE/CA and Action Memorandum. The analytical results also support reclassification to "interim closed out" status in accordance with the process described in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System."[5] No institutional controls are required because there is no deep vadose zone contamination associated with the 600-218 waste site.

This waste site and the data obtained from the subject sampling evolutions will be included in the risk assessment and remedial investigation/feasibility study for final remedial decisions for the Outer Area.

[5] *RL-TPA-90-0001, 2007, Tri-Party Agreement Handbook Management Procedures, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS),"* Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/hanford/files/TPA-MP14.pdf.

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# Terms

| | |
|---|---|
| bgs | below ground surface |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| COPC | contaminant of potential concern |
| CS/NFA | confirmatory sampling/no further action |
| DOE | U.S. Department of Energy |
| DQA | data quality assessment |
| Ecology | Washington State Department of Ecology |
| EE/CA | *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites* |
| EPA | U.S. Environmental Protection Agency |
| HEIS | Hanford Environmental Information System |
| N/A | not available |
| NPL | National Priorities List |
| O&M | operations and maintenance |
| OU | Operable Unit |
| PAH | polynuclear aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| QA | quality assurance |
| QC | quality control |
| RAL | removal action level |
| RAO | removal action objective |
| RAWP | *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit* |
| RDL | required detection limit |
| RI/FS | remedial investigation/feasibility study |
| ROD | record of decision |
| RTD | removal, treatment, and disposal |
| SAP | *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites* |
| TPH | total petroleum hydrocarbon |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |

| | |
|---|---|
| VSP | Visual Sample Plan |
| WIDS | Waste Identification Data System |

# 1 Introduction

This report documents the successful completion of a non-time-critical removal action conducted at the 600-218 waste site. The removal action alternative selected for this waste site was confirmatory sampling/no further action (CS/NFA), as proposed in the *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites* (EE/CA, DOE/RL-2008-44), and authorized by the *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit* (Action Memorandum, DOE/RL-2009-48). Analytical results from samples collected during the CS/NFA evolution indicated that the waste site did not achieve compliance with the removal action levels (RALs). Using the methodology prescribed in the Action Memorandum, and based on the CS/NFA sampling results, the alternative was changed to removal, treatment, and disposal (RTD). This report provides the basis for the successful completion of the RTD action performed at the 600-218 waste site. This documentation has been prepared based on U.S. Environmental Protection Agency (EPA) guidance provided in *Close Out Procedures For National Priorities List Sites* (EPA/540/R-98/016).

This report provides a summary of the actions taken and resulting data to support a determination that, through performance of the RTD alternative, conditions remaining at the 600-218 waste site have achieved the established RALs and have met the removal action objectives (RAOs) provided in the Action Memorandum for the 600-218 waste site. The documentation process is consistent with the U.S. Department of Energy (DOE) *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) *Remedial Action Site Closure Guidance* (DOE, 2010).

Statutory authority for the action taken is in accordance with CERCLA (as amended by the *Superfund Amendments and Reauthorization Act of 1986*); *Superfund Implementation* (Executive Order 12580); the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989), also known as the Tri-Party Agreement; and 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

The non-time-critical removal action for the 600-218 waste site was completed in May 2011 in accordance with the *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit* (RAWP, DOE/RL-2009-53). This report provides the following information relative to the completion of the subject removal action:

- Background, historical information, regulatory enforcement history, and environmental setting pertinent to this removal action
- A description of the selected alternative, RAOs, and exposure and land use assumptions provided in the related regulatory documents
- A summary of the completed actions, the resulting data collected in support of completion of that removal action, a comparison of data against objectives, and demonstration that RAOs have been met

## 1.1 Site Description

This section provides general information on the Hanford Site and the 200-MG-1 Operable Unit (OU) and provides a background of the development of the removal action for the 600-218 waste site.

### 1.1.1 Hanford General Site Information

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

### 1.1.2 200-MG-1 Operable Unit

The Washington State Department of Ecology (Ecology), DOE, and EPA created the 200-MG-1 OU through the Tri-Party Agreement Milestone M-015-06-02 and Tri-Party Agreement Change Request C-06-02 (Ecology et al., 2006). The 200-MG-1 OU is made up of waste sites in the 200 East and 200 West Areas, and the 600 Area of the Hanford Site. The 600 Area encompasses those areas south of the Columbia River that are not part of another designated area (i.e., 300 Area, 200 East Area, and 100-K) and are not specifically identified (Figure 1-1). The 200-MG-1 OU waste sites consist of French drains, trenches, cribs, ditches, and retention basins with shallow contamination (generally less than 4.6 m [15 ft] deep), and areas where chemical and radioactive contaminants were released during material transfers (i.e., unplanned release sites). Additionally, some 200-MG-1 OU sites were produced by airborne dissemination of radioactive particles, or biodegradation and dispersion of plant or animal matter. For those sites containing radionuclides, the radionuclide inventory for this conceptual model group does not include transuranic isotopes greater than or equal to 100 nCi/g.

All of the waste sites contained in the 200-MG-1 OU are located within the Central Plateau, as described in the EE/CA and Action Memorandum. The 600-218 waste site, also known as the H-51 Anti-Aircraft Artillery Site Dumping Area, is located approximately one mile west of the 200 West Area, and east of State Route 240, as shown in Figure 1-2.

## 1.2 Regulatory and Enforcement History

As discussed in Chapter 1, statutory authority for this removal action is taken in accordance with CERCLA. Further governing requirements for compliance with CERCLA and the *Resource Conservation and Recovery Act of 1976* activities at Hanford are in accordance with the Tri-Party Agreement.
The Hanford Site was proposed for inclusion in 53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites – Update 7," and was placed on the National Priorities List (NPL) on November 3, 1989 (54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites – Final Rule 10/04/89," October 4, 1989) by EPA. EPA placed the four aggregate areas (i.e., the 100, 200, 300, and 1100 Areas) on the NPL. The 200 Area NPL site consists of the 200 West and 200 East Areas, which contain waste management facilities and inactive irradiated-fuel reprocessing facilities. The site also includes the 200 North Area, formerly used for interim storage and staging of irradiated fuel, and the waste sites assigned to the 200-MG-1 OU.

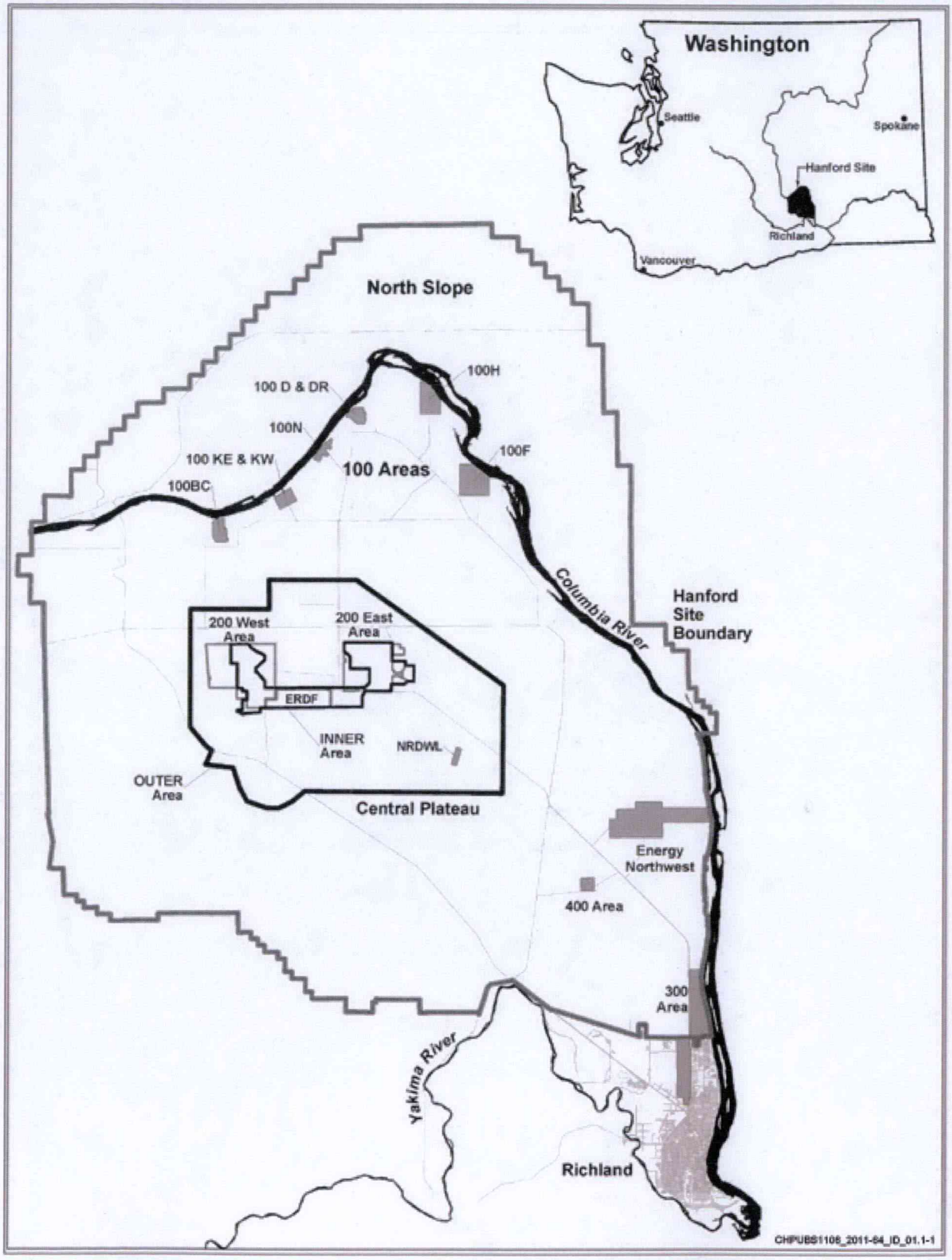


**Figure 1-1. Location of the Hanford Site in Washington State**

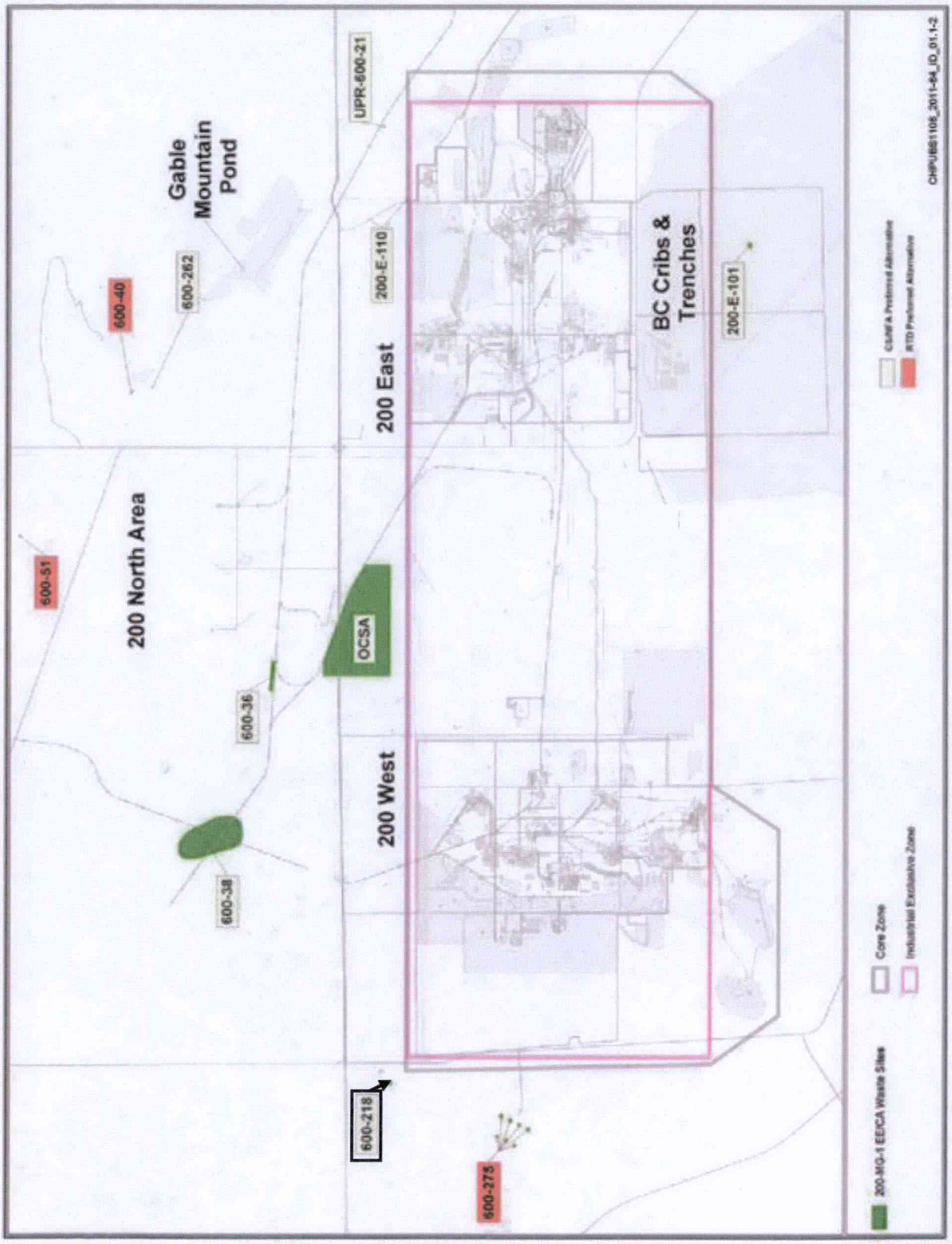


Figure 1-2. 200-MG-1 Operable Unit and Waste Site 600-218

## 1.3 Environmental Setting

The Hanford Site is located within the semiarid Pasco Basin in the northern portion of the Columbia Plateau. Normal annual precipitation is 17.7 cm (7 in.). According to *Estimated Recharge Rates at the Hanford Site* (PNL-10285), there is an estimated 2.6 to 17.3 mm (0.1 to 0.7 in.) per year of recharge in the 100 Area. Bedrock beneath the site is basalt of the Columbia River Basalt Group.

The Ringold Formation and the Hanford formation cover the basalt throughout the Central Plateau. Poorly consolidated, river-deposited, well-drained sands, gravels, cobbles, and boulders dominate these units. The Ringold Formation is an interstratified sequence of unconsolidated clay, silt, sand, and gravel-to-cobble sediment deposited by the ancestral Columbia River. The Hanford formation consists of uncemented gravels, sands, and silts deposited by Pleistocene cataclysmic floodwaters. Groundwater from the Hanford Site discharges to the Columbia River, the dominant surface-water body of the Hanford Site. The direction of groundwater flow beneath the Central Plateau is toward the east-northeast. The uses of the Columbia River include the production of hydroelectric power, irrigation, drinking water, recreation, and natural resources.

The average depth from ground surface to groundwater beneath the 200 Area ranges from 50 m (164 ft) to greater than 100 m (328 ft). Additional details about the geology and hydrogeology underlying the 200 Area and the 200-MG-1 OU are not provided in the base response action documents because the 200-MG-1 OU was created for shallow zone (less than 4.6 m [15 ft] in depth) waste sites, which are assumed not to be a threat to groundwater quality. This assumption is based on historical and process knowledge regarding volumes of liquids discharged, lack of mobility of contaminants, and shallow depth of the discharge(s).

The nearest natural surface water body to the 600-218 waste site is the Columbia River, located approximately 7.3 km (4.5 mi) north of the waste site. The potential for natural groundwater recharge within the 200 Area is limited to precipitation infiltration. Estimates of recharge from precipitation at the Hanford Site range from 0 to 10 cm (0 to 4 in.) per year.

# 2 Waste Site Background

This chapter provides a description of the 600-218 waste site, information on process and background, describes the selected alternative, and delineates the RAOs and cleanup standards applicable to this removal action as prescribed in the Action Memorandum.

## 2.1 600-218 Site Background

The 600-218 waste site is located northwest of the 200 West Area. The site is described in the Waste Information Data System (WIDS) as a dumping area for inert debris generated from the construction of a nearby anti-aircraft site. The 600-218 waste site is irregularly shaped and is comprised of two areas separated by land not designated as a waste site (Figure 2-1). According to WIDS, the larger portion of the waste site is approximately 74 m (243 ft) at the longest point by 20.4 m (67 ft) at the widest point with an area of approximately 1,513 $m^2$ (16,280 $ft^2$). The smaller portion of the site lies approximately 48 m (157 ft) northeast of the larger portion, and is recorded as being generally rectangular in shape, approximately 1.5 m (5 ft) by 1.8 m (6 ft), with an area of approximately 2.8 $m^2$ (30 $ft^2$). No documentary evidence was found suggesting that stabilizing material has ever been added to this site, and no structures exist at this site.

In March 1997, a site investigation team mapped and photographed the waste site. The WIDS listing describes debris in the waste site area including empty metal cans (oil, paint, and food), wood, concrete rubble, pipe, sheet metal, barbed wire, and metal fence posts. No evidence exists identifying a potential for radioactive material at this site. WIDS lists the waste site category as "nondangerous/nonradioactive."

The release mechanism for this site was miscellaneous dumping of debris. The waste matrix was primarily solid in nature, and no chemical or radiological processes have been associated with this site.

## 2.2 Description of the Selected Alternative

As stated in the EE/CA and Action Memorandum, the selected alternative for the subject waste site was CS/NFA. This alternative was selected because, due to historical activity and process knowledge, concentrations of contaminants of potential concern (COPCs) were not expected to exceed the RALs. Initial sampling and analysis did not confirm that concentrations of COPCs in soil were less than or equal to the RALs without the need for further action. As a result, in accordance with the Action Memorandum, the alternative was changed to RTD. Activities involved in the RTD action set forth in the RAWP and *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites* (SAP, DOE/RL-2009-60) include soil excavation and verification sampling to demonstrate that the remaining residual soil COPC concentrations are less than or equal to the established RALs, and that no additional removal action is required.

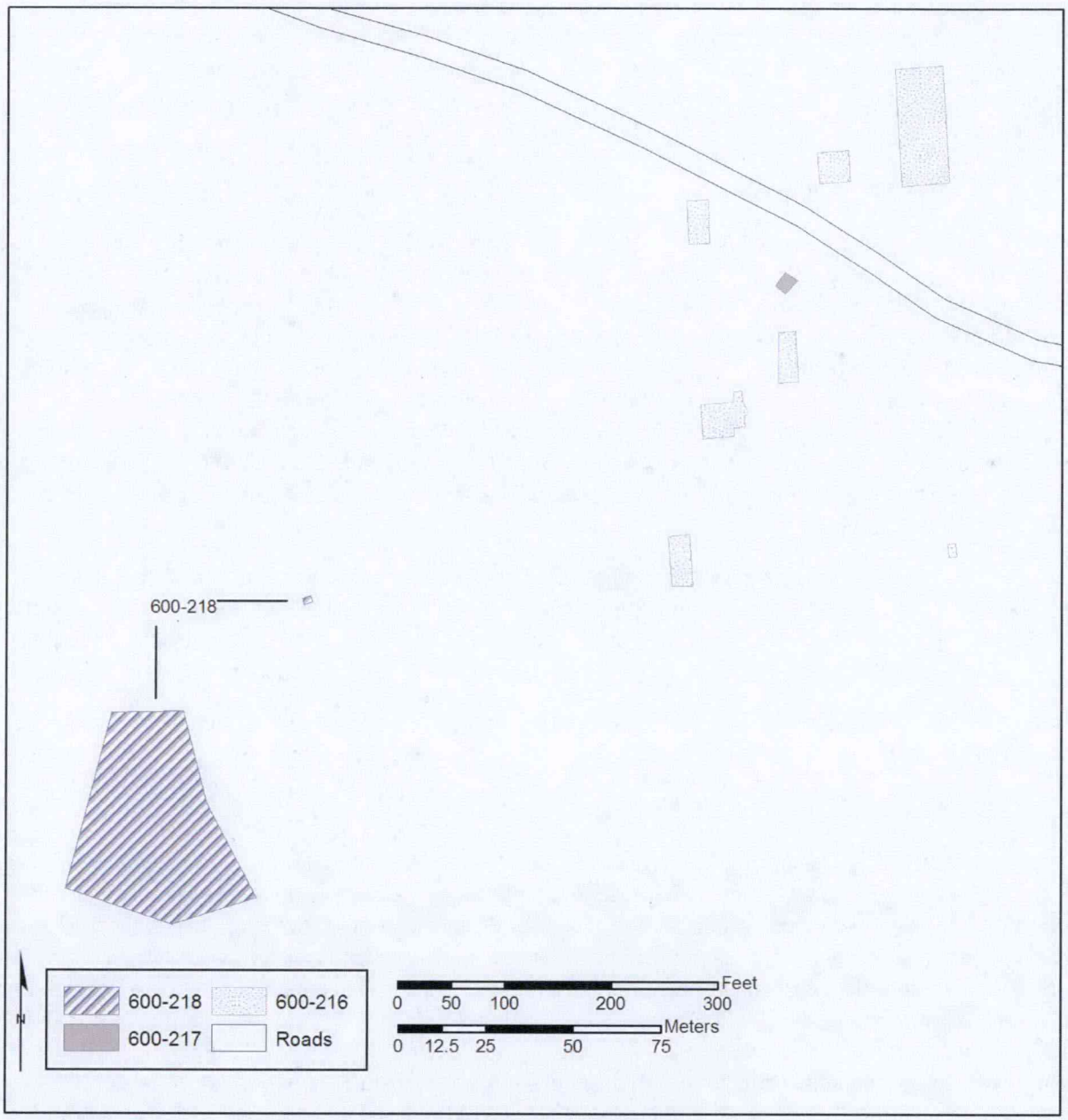


**Figure 2-1. 600-218 Waste Site**

The general removal action sampling design criteria are provided in this section followed by a summary of removal action history, specific sampling design and methodology, and analytical results for the 600-218 waste site.

The following key features relevant to the 600-218 waste site were considered during the development of a sample design:

- Direct visual inspection of the waste site surface was performed, using available site information as a guide for visual cues such as soil staining, absence of vegetation, presence of debris, and other anomalies.

- Radiological field screening was performed at the surface of the waste site to provide an indication of the presence of radiological COPCs.
- Both random and focused sampling were performed per the methodology prescribed in the SAP. The use of a random sampling methodology was considered appropriate for the initial sampling evolution. Focused and random samples collected from areas of excavation were considered appropriate for the in process and verification sampling evolution.

Based on these key design features, soil samples were collected from the 600-218 waste site and analyzed for COPC concentrations. Evaluation of analytical results from the initial sampling evolution demonstrated that, for specific areas, concentrations of COPCs were greater than the RALs, resulting in the implementation of the RTD alternative. Under this alternative, soil was removed from the impacted areas, and a verification sampling evolution was conducted, the results of which confirmed that remaining residual COPC concentrations in soil were less than or equal to the RALs. Table 5-2 provides the maximum concentrations for each COPC from the verification sampling analytical data. Tables A-1 through A-3 (Appendix A) provide a detailed summary of all analytical data results for sampling conducted at the 600-218 waste site.

Personnel with current training and qualifications performed field radiological surveying of the waste site during site evaluation and during the sampling evolutions, surveying both the samples and sampling locations. Survey methods and practices were performed in accordance with established contractor methods and protocols. Radiological surveys performed for the 600-218 waste site resulted in no radiological dose readings greater than the measured background, and no radiological contamination was found.

### 2.2.1 Removal Action Objectives

The removal action alternatives for the 200-MG-1 OU waste sites were evaluated based on their overall ability to protect human health and the environment and their effectiveness in maintaining both short-term and long-term protection. The selected alternative must meet the following RAOs established in the Action Memorandum:

- **RAO 1**: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with nonradiological constituents to 4.6 m (15 ft) below ground surface (bgs) at concentrations above the appropriate RALs.
- **RAO 2**: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with radiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs.
- **RAO 3**: Control the sources of groundwater contamination to minimize impacts to groundwater resources, protect the Columbia River from adverse impacts, and reduce the degree of groundwater cleanup that may be required under future action.
- **RAO 4**: Prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption.

The RALs for the waste sites identified in the Action Memorandum are based on the RAOs noted above. These RALs are based on attainment of acceptable levels of human health, ecological risk, and protection of groundwater, but are not less than background levels or detection limits for waste sites. Attainment of RALs is intended to meet the first three RAOs and is expected to satisfy the remedial action objectives established in the final record of decision (ROD). The fourth RAO is met through cultural and ecological

reviews performed before starting removal action activities. Table 2-1 lists the COPCs identified for the 200-MG-1 OU. The attainment of established RALs and corresponding RAOs is described in Chapter 5 of this report.

**Table 2-1. Nonradiological Removal Action Levels**

| Contaminant of Concern | Background Concentration[a] (mg/kg) | Direct Exposure[b] (mg/kg) | Groundwater Protection[c] (mg/kg) | Required Detection Limit (mg/kg) | Removal Action Levels (mg/kg) | Ecological Risk Screening Values (mg/kg) |
|---|---|---|---|---|---|---|
| Antimony | 5 | 32 | 5.4 | 0.6 | 5.4 | 5 |
| Arsenic | 6.5 | 6.5[d] | 6.5[d] | 1.0 | 6.5[d] | 7 |
| Barium | 132 | 16,000 | 1,650 | 2 | 1,650 | 102 |
| Beryllium | 1.51 | 160 | 63.2 | 0.5 | 63.2 | 10 |
| Boron | N/A | 16,000 | 210 | 2 | 210 | 0.5 |
| Cadmium | 0.81 | 80 | 0.81[d] | 0.5 | 0.81[d] | 4 |
| Chromium Total | 18.5 | 120,000 | 2,000 | 1 | 2,000 | 42 |
| Chromium (VI) | N/A | 240 | --[e] | 0.5 | --[e] | N/A |
| Cobalt | 15.7 | 24 | 15.7[d] | 2 | 15.7[d] | 20 |
| Copper | 22.0 | 3,200 | 284 | 1 | 284 | 50 |
| Lead | 10.2 | 250 | 3,000 | 5.0 | 250 | 50 |
| Lithium | 33.5 | 160 | 192 | 2.5 | 160 | 35 |
| Manganese | 512 | 3,760 | 512[d] | 5 | 512[d] | 1,100 |
| Mercury | 0.33 | 24 | 2.09 | 0.2 | 2.09 | 0.1 |
| Nickel | 19.1 | 1,600 | 130 | 4 | 130 | 30 |
| Selenium | 0.78 | 400 | 5.2 | 1 | 5.2 | 0.3 |
| Silver | 0.73 | 400 | 13.6 | 0.2 | 13.6 | 2 |
| Strontium | N/A | 48,000 | 2,920 | 1 | 2,920 | N/A |
| Tin | N/A | 48,000 | 48,000 | 10 | 48,000 | 1 |
| Uranium (Soluble Salts) | 3.21 | 240 | 3.21[d] | 1 | 3.21[d] | 50 |
| Vanadium | 85.1 | 560 | 2,240 | 2.5 | 560 | 5 |
| Zinc | 67.8 | 24,000 | 5,970 | 1 | 5,970 | 2 |
| PCB Aroclor 1016 | N/A | 0.5 | 0.094 | 0.017 | 0.094 | 86 |
| PCB Aroclor 1221 | N/A | 0.5 | 0.017[d] | 0.017 | 0.017[d] | 0.65 |
| PCB Aroclor 1232 | N/A | 0.5 | 0.017[d] | 0.017 | 0.017[d] | 0.65 |
| PCB Aroclor 1242 | N/A | 0.5 | 0.039 | 0.017 | 0.039 | 0.65 |
| PCB Aroclor 1248 | N/A | 0.5 | 0.039 | 0.017 | 0.039 | 0.65 |
| PCB Aroclor 1254 | N/A | 0.5 | 0.066 | 0.017 | 0.066 | 0.65 |

**Table 2-1. Nonradiological Removal Action Levels**

| Contaminant of Concern | Background Concentration[a] (mg/kg) | Direct Exposure[b] (mg/kg) | Groundwater Protection[c] (mg/kg) | Required Detection Limit (mg/kg) | Removal Action Levels (mg/kg) | Ecological Risk Screening Values (mg/kg) |
|---|---|---|---|---|---|---|
| PCB Aroclor 1260 | N/A | 0.5 | 0.72 | 0.017 | 0.5 | 0.65 |
| Acenaphthene | N/A | 4,800 | 98 | 0.33 | 98 | 0.65 |
| Acenaphthylene | N/A | 4,800 | 98 | 0.33 | 98 | 20 |
| Anthracene | N/A | 24,000 | 2,270 | 0.33 | 2,270 | N/A |
| Benzo(a)anthracene | N/A | 1.37 | 0.86 | 0.33 | 0.86 | N/A |
| Benzo(a)pyrene | N/A | 0.137 | 0.233[f] | 0.33 | 0.33[d] | N/A |
| Benzo(b)fluoranthene | N/A | 1.37 | 2.95 | 0.33 | 1.37 | 12 |
| Benzo(g,h,i)perylene | N/A | 2,400 | 25,700 | 0.33 | 2,400 | N/A |
| Benzo(k)fluoranthene | N/A | 1.37 | 2.95[f] | 0.33 | 1.37 | N/A |
| Chrysene | N/A | 13.7 | 9.56 | 0.33 | 9.56 | N/A |
| Dibenz(a,h)anthracene | N/A | 1.37 | 4.29 | 0.33 | 1.37 | N/A |
| Fluoranthene | N/A | 3,200 | 631 | 0.33 | 631 | N/A |
| Fluorene | N/A | 3,200 | 101 | 0.33 | 101 | N/A |
| Indeno(1,2,3-cd)pyrene | N/A | 1.37 | 8.33 | 0.33 | 1.37 | 30 |
| Naphthalene | N/A | 1,600 | 4.46 | 0.33 | 4.46 | N/A |
| Phenanthrene | N/A | 24,000 | 1,140 | 0.33 | 1,140 | N/A |
| Pyrene | N/A | 2,400 | 655 | 0.33 | 655 | N/A |
| Carbon Tetrachloride[g] | N/A | 7.69 | 0.0031 | 0.005 | 0.005 | N/A |
| Xylene[h] | N/A | 16,000 | 14.6 | 0.01 | 14.6 | N/A |
| Nitrate (as Nitrogen) | 11.8 | 128,000 | 40 | 0.75 | 40 | N/A |
| TPH-Diesel | N/A | 2,000 | 2,000 | 5 | 2,000 | N/A |
| TPH-Kerosene | N/A | 2,000 | 2,000 | 5 | 2,000 | 200 |
| Fluoride[i] | N/A | 4,800 | 16 | 5 | 16 | 200 |
| Asbestos | N/A | N/A[j] | N/A[j] | N/A[j] | 1%[j] | N/A |

**Table 2-1. Nonradiological Removal Action Levels**

| Contaminant of Concern | Background Concentration[a] (mg/kg) | Direct Exposure[b] (mg/kg) | Groundwater Protection[c] (mg/kg) | Required Detection Limit (mg/kg) | Removal Action Levels (mg/kg) | Ecological Risk Screening Values (mg/kg) |
|---|---|---|---|---|---|---|

a. If Hanford Site-specific background data are not available, values are then taken from Ecology Publication No. 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available from nonradiological background data in DOE/RL-92-24, Rev. 4, *Hanford Site Soil Background: Part 1, Soil Background for Nonradioactive Analytes*, Table D9-2.

b. Direct contact values were calculated based on WAC 173-340-740, "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Cleanup Standards," using Method B methodology and assumptions.

c. The groundwater protection values were obtained using equations provided in WAC 173-340-747(4), "Deriving Soil Concentrations for Groundwater Protection," with the physical parameters obtained from http://www.ecy.wa.gov/.

d. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits in accordance with WAC 173-340-700(6)(d), "Overview of Cleanup Standards," and WAC 173-340-707(2), "Analytical Considerations," respectively.

e. Based on process knowledge, chromium (VI) is not expected to be present at 200-MG-1 OU waste sites. The following values are given to help guide cleanup:

- 0.2 mg/kg—calculated value using $K_d = 0$, based on PNNL-13895, *Hanford Contamination Distribution Coefficient Database and Users Guide*, and WAC 173-340-747, equation 747-1.
- 2.1 mg/kg—based on DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area.*
- 18.4 mg/kg—based on Ecology, 2007, Cleanup Levels & Risk Calculations (CLARC) database.

f. The soil concentrations for protection of groundwater values for benzo(a)pyrene and benzo(k)fluoranthene were incorrectly reported in DOE/RL-2009-48, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*, and have been corrected.

g. Carbon tetrachloride is applicable to the 11 waste sites authorized by DOE/RL-2009-48.

h. Xylene is applicable only to 200-W-3, 216-S-19, and 216-S-26.

i. Fluoride is added as a contaminant of potential concern for select sites, such as 216-S-19 and 216-S-26, based on process history.

j. The removal action level for asbestos in soil is 1 percent by weight (measured using polarized light microscopy). EPA has used this value for determining if response actions for asbestos should be undertaken (Cook, 2004, "Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups"). Further evaluation of removal actions for asbestos will be conducted as needed on a site-specific basis in the Outer Area RI/FS.

N/A = Not available

Ecological screening values, which are based on "Model Toxics Control Act—Cleanup," "Tables," (WAC 173-340-900), Table 749-3, are used for screening purposes only and are not considered cleanup levels for this CERCLA removal action (described more fully in Section 5 of the Action Memorandum). If analytical results exceed the ecological values, the results will be further evaluated during the final ecological risk assessment in accordance with the remedial investigation/feasibility study (RI/FS) for the Central Plateau to make final cleanup decisions.

### 2.2.2 Exposure and Land-Use Assumptions

The 600-218 waste site is located within the Central Plateau, as discussed in more detail in the EE/CA and Action Memorandum for the 200-MG-1 OU. Land use for the Central Plateau is designated for reasonably anticipated future land uses recognized in the EE/CA and Action Memorandum (for the purposes of this interim action, RAOs were selected that would support unrestricted land use).

### 2.2.3 Design Summary

The CS/NFA action alternative was the selected alternative for the 600-218 waste site. Sampling and analysis indicated that concentrations of COPCs in the waste site soils were greater than the RALs. Based on those analytical results, and per the methodology prescribed in the Action Memorandum, the alternative progressed to RTD. Following the removal of impacted soil, verification sampling was conducted to confirm that residual concentrations of COPCs in soil were less than or equal to the RALs. The sampling objectives for the 600-218 waste site included visual inspection and the collection of discrete soil samples from the waste site as described in Section 3.1 of this report. The following key features of the site-specific sampling design included:

- Direct visual inspection of the waste site surface was performed, using available site information as a guide for visual cues such as soil staining, absence of vegetation, presence of debris, and other anomalies.
- Radiological field screening was performed at the surface of the waste site to provide an indication of the presence of radiological COPCs.
- Both random and focused sampling were performed per the methodology prescribed in the SAP. The use of a random sampling methodology was considered appropriate for the initial sampling evolution. Focused and random samples collected from areas of excavation were considered appropriate for the in process and verification sampling evolution.

## 2.3 Decision Document Amendments, Significant Differences, or Waivers

No amendments to the EE/CA or Action Memorandum, or technical impracticability waivers were associated with this removal action.

# 3 Response Activity Summary

As stated in the EE/CA and Action Memorandum, the selected alternative for the 600-218 waste site was CS/NFA. The results of initial sampling indicated COPC concentrations greater than the RALs in two of the twenty locations sampled at the 600-218 waste site. Per the provisions of the Action Memorandum, the removal action activities progressed to implementation of the RTD alternative. Upon completion of RTD activities, verification sampling was conducted to demonstrate that concentrations of COPCs in soil at the 600-218 waste site were less than or equal to the RALs, thus demonstrating that the RAOs were met.

## 3.1 Summary of Activities

The removal action at the 600-218 waste site was conducted between August 2009 and May 2011, and included the collection of statistically based random and focused samples from locations within the boundaries of the waste site, as specified in Section 2.2 and per the methodologies prescribed in the SAP. The sampling process, as described in the SAP, was based on the use of an observational approach and included visual inspections, field screening for radiological COPCs, and collection of soil samples from areas identified during site evaluation. Key activities pertinent to the removal action at the 600-218 waste site are listed as follows:

- Collection of samples from locations selected utilizing a statistical grid with a random start, based on limited historical and process knowledge, and the lack of visual indicators observed during site evaluation.
- Excavation of soil under the RTD alternative in the R3 and R14 areas of the 600-218 waste site, which were identified as containing COPCs at concentrations greater than the RALs as a result of initial sampling (Figure 3-1).
- Collection of focused in process samples from locations surrounding the R3 area to determine the lateral and vertical extent of impact, and surrounding the R14 area to determine lateral extent. Randomly selected samples were collected from the excavated areas for verification purposes. Samples were submitted for laboratory analysis for COPCs, and an evaluation of analytical results was performed to demonstrate achievement of RALs.

### 3.1.1 Waste Site 600-218 Initial Sampling

A site evaluation was performed in August 2009 prior to performance of the initial sampling evolution. This evaluation served to support job planning as well as completion of the visual inspection component of the sampling activities described in the SAP. The visual inspection incorporated observational indicators and historical information to identify areas of concern within the waste site boundary. Observations made during the site walk down did not identify any visible indicators of potential contamination, such as soil staining or devegetation within the larger, southern portion of the 600-218 waste site. The condition of the vegetation and scattered wood and metal debris in this portion of the waste site suggested involvement in the 2000 range fire. Transite debris was observed to be scattered across the southern portion of the waste site. Ground penetrating radar survey of the 600-218 waste site identified metallic material and debris to a depth of approximately 0.6 m (2 ft).

Observations made at the smaller, northern portion of the waste site (Figure 3-1) during site evaluation included fencing materials and empty containers; however, there were no visual indicators of potential contamination such as soil staining or devegetation.

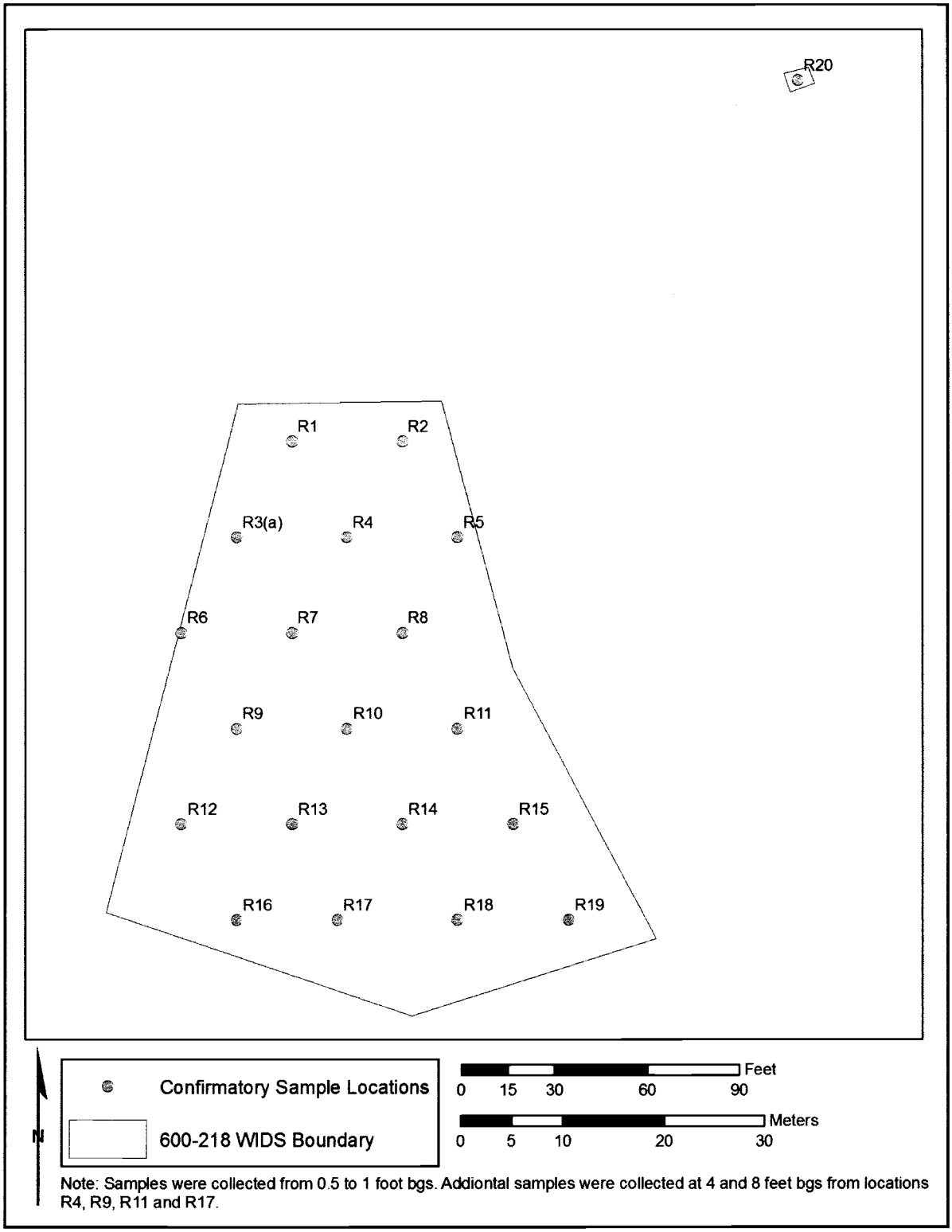


**Figure 3-1. Initial Sample Locations at the 600-218 Waste Site**

For radiological field screening at the 600-218 waste site, survey methods and practices were performed in accordance with established contractor methods and protocols by personnel with current training and

qualifications. No radiological postings were present at the waste site. Of the radiological surveys performed during removal action activities, no radiological readings were greater than the measured background, and no radiological contamination was found. The site was confirmed to be a nonradiological site and the radiological COPCs were eliminated from the list of analytes to be included in laboratory analysis.

Initial soil sampling was conducted on December 30 and 31, 2009 and February 12, 2010 at the 600-218 waste site. Twenty surface samples (0 to 0.3 m [0 to 1 ft] bgs) were placed across the 600-218 waste site on a statistically based grid with a random start, utilizing Visual Sample Plan© (VSP) software. Additionally, four of the sample locations, R4, R9, R11, and R17, were selected for the collection of depth samples at 1.2 m (4 ft) and 2.4 ft (8 ft) bgs from each location (Figure 3-1). The samples were analyzed for the full suite of COPCs (metals, polynuclear aromatic hydrocarbons [PAHs], volatile organic analytes, anions, and total petroleum hydrocarbons) in accordance with Revision 0 of the SAP. Analytical results from the initial sampling evolution indicated concentrations of PAHs and nickel greater than the RALs at sample locations R3 and R14, respectively, and are summarized in Table 3-1. Analytical results from samples collected from the remainder of the 600-218 waste site indicated concentrations of COPCs less than the RALs.

### 3.1.2 Waste Site Excavation

The results of the initial sampling indicated that concentrations of COPCs were greater than the RALs at sample locations R3 and R14. Excavation of impacted soils from these areas commenced in March 2011. In process sampling was conducted at the areas surrounding sample locations R3 and R14 prior to excavation activities to determine lateral and vertical extent of contamination in those areas. Results from the in process sampling further refined the vertical extent of excavation to approximately 1 m (3 ft) bgs at location R3 and approximately 1.2 m (4 ft) bgs at location R14. Analytical results from in process sampling indicating concentrations of COPCs were less than established RALs were also used to laterally delineate the area of impact surrounding locations R3 and R14. In addition to the removal of impacted soil at sample locations R3 and R14, debris was removed throughout the southern portion of the 600-218 waste site, along with approximately 0.6 m (2 ft) of underlying soil.

### 3.1.3 Waste Site Verification Sampling

Analytical results of soil samples collected from the 600-218 waste site indicated that COPC concentrations were greater than the RALs at sample locations R3 and R14. These locations became areas of excavation during the implementation of the RTD alternative. The lateral and vertical extent of excavation in each area was determined utilizing in process samples, which were collected from locations surrounding R3 and R14 prior to RTD activities. Upon completion of RTD activities, a verification sampling design was developed utilizing random sampling within each area of impact as delineated laterally by the in process sample locations. Samples were collected from the excavated areas as described in the following subsections. A detailed summary of verification sampling analytical results can be found in Table A-3 (Appendix A).

© Visual Sample Plan, Pacific Northwest National Laboratory, Richland, Washington.

**Table 3-1. COPC Concentrations Greater Than RALs**

| Contaminants of Potential Concern | Removal Action Levels (mg/kg) | Background Activity (mg/kg) | Required Detection Limit (mg/kg) | HEIS #B23C37 #R3 (mg/kg) | HEIS #B23C48 #R14 (mg/kg) |
|---|---|---|---|---|---|
| Nickel | 130 | 19.1 | 4 | 6.88 | 268 |
| Benzo(a)anthracene | 0.86 | N/A | 0.33 | 1.9 | U |
| Benzo(a)pyrene | 0.33 | N/A | 0.33 | 1.6 | U |
| Benzo(k)fluoranthene | 1.37 | N/A | 0.33 | 1.6 | U |

HEIS = Hanford Environmental Information System
N/A = not available
U = result is less than laboratory detection limit

#### *3.1.3.1 Sample Location R3*

The area of excavation at sample location R3 was approximately 44 $m^2$ (475 $ft^2$); therefore, two samples, selected randomly utilizing VSP, were collected from the base of the impacted area surrounding sample location R3. Implementation of Revision 1 of the SAP allowed for the refinement of the list of COPCs targeted during verification sampling to include PAHs only (Figure 3-2).

#### *3.1.3.2 Sample Location R14*

The area of impact at sample location R14 was approximately 0.8 $m^2$ (8.5 $ft^2$) as determined by analytical results of in process samples indicating COPC concentrations less than established RALs; therefore, one random sample was collected from the base of the impacted area surrounding sample location R14 (Figure 3-2). Implementation of Revision 1 of the SAP allowed for the refinement of the list of COPCs targeted during verification sampling to include metals analysis only. Manganese, mercury, and hexavalent chromium were excluded from analysis because they are not considered COPCs for the 600-218 waste site, and because analytical results from confirmatory and in process sampling confirmed concentrations were less than the respective RALs for those analytes.

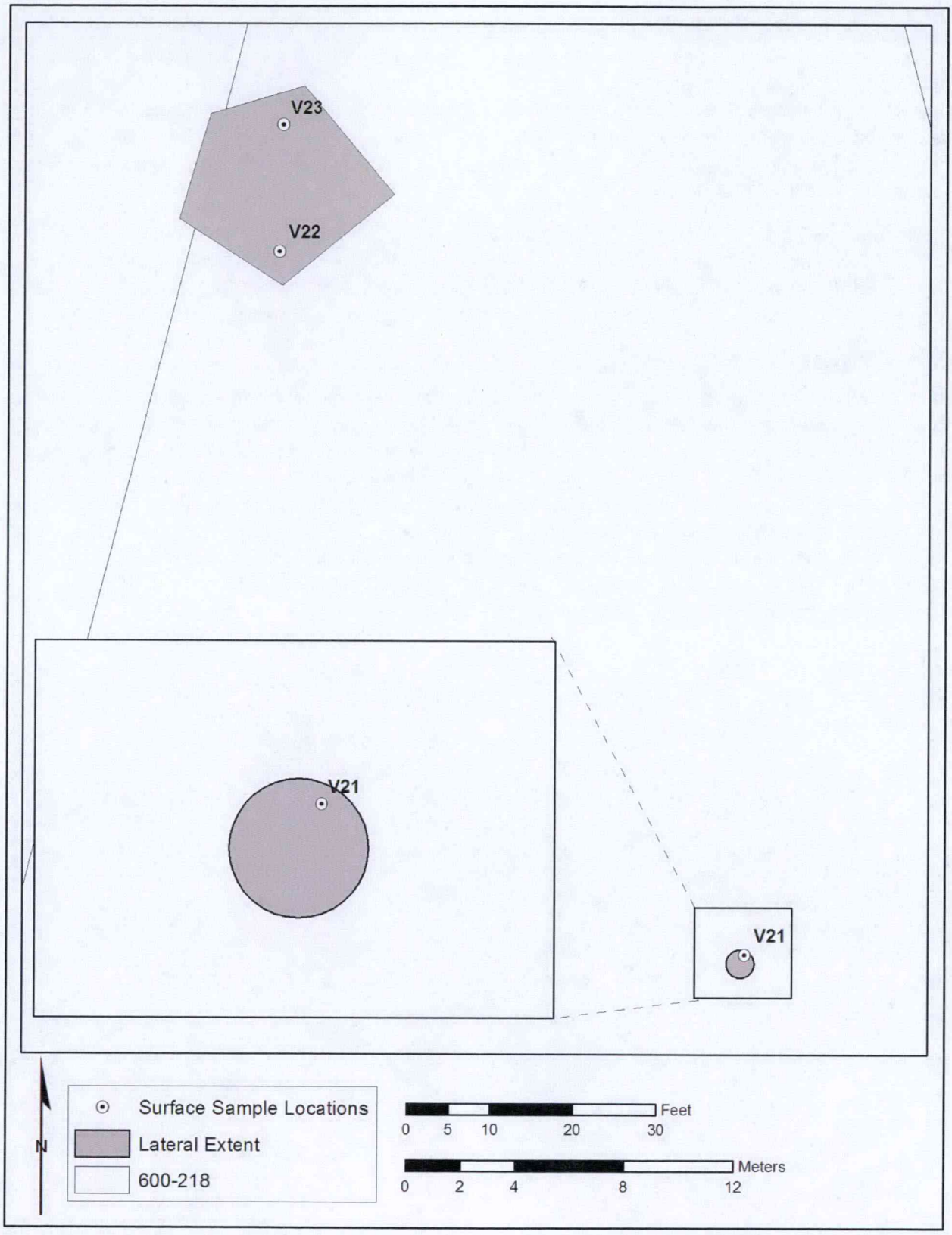


**Figure 3-2. Verification Sample Locations at the 600-218 Waste Site**

### 3.1.4 Backfill and Revegetation

As described in Sections 2.1 and 5.5.1 of the RAWP, backfill and/or contouring may take place at the 600-218 waste site upon concurrence by the signing parties that the RAOs have been attained. Surface debris, along with approximately 0.6 m (2 ft) of underlying soil, was removed from the areas of impact, as well as the remainder of the larger, southern portion of the 600-218 waste site. Since RTD activities were limited in depth to less than 0.6 m (2 ft) (i.e., surface debris removal at the waste site), backfill was not required at the 600-218 waste site.

In accordance with the ecological compliance review conducted for the 600-218 waste site, this area does not meet the requirements of a Level III or Level IV designation as described in *Hanford Site Biological Resources Management Plan* (DOE/RL-96-32); therefore, revegetation at the 600-218 waste site is not required. The area has not yet been reseeded, DOE anticipates reseeding to occur in Fall 2011.

### 3.1.5 Statement of Protectiveness

In accordance with the SAP, the soil at the 600-218 waste site has been sampled, analyzed, and evaluated. The results obtained through the implementation of the RTD alternative demonstrate that concentrations of COPCs in the soil at the 600-218 waste site are less than established RALs (discussed in further detail in Chapter 5). These results also indicate that residual concentrations will support reasonably anticipated future land use recognized in the EE/CA and Action Memorandum, and demonstrate that residual concentrations of COPCs in soil throughout the site are unlikely to affect groundwater or the Columbia River. As summarized in Chapter 5, a review of the sampling results showed that the removal action at the 600-218 waste site has demonstrated achievement of the RAOs established in the Action Memorandum and identified in the RAWP.

# 4 Chronology of Events

Table 4-1 presents a chronology of major events associated with sampling the subject waste site. The chronology includes approval of the regulatory documents that form the basis of the removal action and key fieldwork activities associated with the removal action.

**Table 4-1. Removal Action Chronology**

| Date | Event |
|---|---|
| June 5, 2009 | DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, approved |
| July 31, 2009 | DOE/RL-2009-48, Revision 0, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*, approved |
| August 2009 | Site evaluation |
| September 1, 2009 | DOE/RL-2009-60, Revision 0, *Sampling and Analysis Plan for Selected Sites 200-MG-1 Operable Unit Waste Sites*, approved |
| November 25, 2009 | DOE/RL-2009-53, Revision 0, *Removal Action Work Plan for 11 Waste Sites in the 200-MG-1 Operable Unit*, approved |
| December 30, 2009 | Initial sampling commenced |
| February 12, 2010 | Initial sampling completed and in process sampling commenced |
| March 1, 2010 | Laboratory analytical data evaluation of initial sampling completed |
| October 7. 2010 | DOE/RL-2009-53, Revision 1, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit,* approved |
| January 10, 2011 | DOE/RL-2009-60, Revision 1, approved |
| February 18, 2011 | In process sampling completed |
| March 15, 2011 | Laboratory analytical data evaluation of in process sampling completed |
| March 21, 2011 | RTD of the 600-218 waste site commenced |
| April 8, 2011 | RTD of the 600-218 waste site completed |
| April 14, 2011 | Verification sampling of the 600-218 waste site completed |
| May 9, 2011 | Laboratory analytical data evaluation completed |

# 5 Performance Standards and Construction Quality Control

This chapter addresses the process for demonstrating achievement of performance standards, which include the attainment of RALs and RAOs and maintaining the required quality control (QC) during removal activities.

## 5.1 Attainment of Performance Standards

Soil sampling, laboratory analysis, and data evaluation conducted after RTD activities confirm that the 600-218 waste site meets the RAOs identified in the Action Memorandum, and residual levels of COPCs remaining in the soil are less than or equal to the RALs. As shown in Table 5-1, RAOs 1 and 2 are achieved by preventing unacceptable risk to human health and the environment through direct exposure to soils and debris by reducing the soil concentration of COPCs to less than or equal to the RALs. RAO 3 is achieved by preventing migration and/or leaching of radiological and nonradiological contamination to groundwater by reducing the soil concentration of COPCs to less than or equal to the RALs. RAO 4 is met through cultural and ecological evaluation, performed in May 2010 and August 2009, respectively, and by the implementation of considerations and recommendations during work activities. Demonstration that the soil concentration of COPCs is less than or equal to RALs (Table 5-2) meets RAOs 1, 2, and 3.

Per the methodology prescribed in the RAWP and SAP, initial sampling of the 600-218 waste site consisted of visual inspection, radiological survey, and soil sampling performed in September 2010. Resulting data from the sampling evolution indicating concentrations of COPCs greater than the RALs initiated the removal of impacted soils, performed between August 2009 and April 2011, followed by verification sampling performed in April 2011. The results, provided in Tables A-1 through A-3 (Appendix A), demonstrate that there are no chemical COPC concentrations greater than the RALs remaining in soil at the 600-218 waste site, thus meeting RAOs 1, 2, and 3.

This waste site and the data obtained from the subject sampling evolutions will be included in the risk assessment and RI/FS for final remedial decisions for the Outer Area.

**Table 5-1. Summary of Attainment of Cleanup Objectives**

| Removal Action Objective | Compliance Methods | Removal Action Objectives Attained? |
|---|---|---|
| **RAO 1**: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with nonradiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs. | Achieved through verification soil sampling, performed upon completion of RTD activities, which demonstrated that all individual COPC concentrations are less than the RALs. | Yes |
| **RAO 2**: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with radiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs. | Achieved through the radiological survey of soil, conducted during site evaluation and sampling evolutions, which resulted in no measured dose rates greater than background established for the waste site and no detectable radiological contamination. This demonstrates that all individual radiological COPC concentrations are less than or equal to the RALs. | Yes |
| **RAO 3**: Control the sources of groundwater contamination to minimize impacts to groundwater resources, protect the Columbia River from adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions. | Achieved through verification soil sampling, performed upon completion of RTD activities, which demonstrated that concentrations of COPCs in soil were less than established RALs. | Yes |
| **RAO 4**: Prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption. | Achieved through cultural and ecological evaluations and the implementation of considerations during removal activities to minimize wildlife habitat and cultural artifact disruption. | Yes |

### 5.1.1 Performance Standard Documentation

This report addresses the individual 600-218 waste site and not an OU; therefore, this section is not applicable.

### 5.1.2 Response Action Objectives Verification

RAO performance standard attainment involves comparison of soil analytical data to RALs. The RALs, identified in the Action Memorandum and RAWP, are a direct comparison to the maximum results from the analytical data (Table 5-2). The full set of analytical results from all samples collected is provided in Appendix A.

### 5.1.3 Contaminant Identification

Table 5-2 provides a direct comparison of verification sample analytical results for each nonradiological COPC, as determined from process knowledge and historical information, against the established RALs for the 600-218 waste site.

**Table 5-2. Comparison of Verification Sample Results Against Removal Action Levels for Nonradiological Contaminants of Potential Concern**

| Contaminant of Potential Concern | Background Concentration[a] (mg/kg) | Removal Action Levels (mg/kg) | Maximum Concentration in Soil (mg/kg) | Does the Maximum Exceed Removal Action Levels? |
|---|---|---|---|---|
| **Metals** | | | | |
| Antimony | 5 | 5.4 | U | No |
| Arsenic | 6.5 | 6.5[b] | 5.15 | No |
| Barium | 132 | 1,650 | 103 | No |
| Beryllium | 1.51 | 63.2 | 0.451 | No |
| Boron | N/A | 210 | 5.97 | No |
| Cadmium | 0.81 | 0.81[b] | 0.101 | No |
| Chromium (Total) | 18.5 | 2,000 | 12.1 | No |
| Cobalt | 15.7 | 15.7[b] | 8.72 | No |
| Copper | 22.0 | 284 | 13.4 | No |
| Lead | 10.2 | 250 | 7.11 | No |
| Lithium | 33.5 | 160 | 10.9 | No |
| Nickel | 19.1 | 130 | 12.1 | No |
| Selenium | 0.78 | 5.2 | 1.54 | No |
| Silver | 0.73 | 13.6 | U | No |
| Strontium | N/A | 2,920 | 52.8 | No |
| Thallium | 0.1 | 1.59 | .0129 | No |
| Tin | N/A | 48,000 | 0.467 | No |
| Uranium (Soluble Salts) | 3.21 | 3.21[b] | 0.595 | No |
| Vanadium | 85.1 | 560 | 52.7 | No |
| Zinc | 67.8 | 5,970 | 44.1 | No |
| **Polynuclear Aromatic Hydrocarbons** | | | | |
| Acenaphthene | N/A | 98 | U | No |
| Acenaphthylene | N/A | 98 | U | No |
| Anthracene | N/A | 2,270 | U | No |
| Benzo(a)anthracene | N/A | 0.86 | U | No |
| Benzo(a)pyrene | N/A | 0.33[b] | U | No |
| Benzo(b)fluoranthene | N/A | 1.37 | U | No |

**Table 5-2. Comparison of Verification Sample Results Against Removal Action Levels for Nonradiological Contaminants of Potential Concern**

| Contaminant of Potential Concern | Background Concentration[a] (mg/kg) | Removal Action Levels (mg/kg) | Maximum Concentration in Soil (mg/kg) | Does the Maximum Exceed Removal Action Levels? |
|---|---|---|---|---|
| Benzo(g,h,i)perylene | N/A | 2,400 | U | No |
| Benzo(k)fluoranthene | N/A | 1.37 | U | No |
| Chrysene | N/A | 9.56 | U | No |
| Dibenz(a,h)anthracene | N/A | 1.37 | U | No |
| Fluoranthene | N/A | 631 | U | No |
| Fluorene | N/A | 101 | U | No |
| Indeno(1,2,3-cd)pyrene | N/A | 1.37 | U | No |
| Naphthalene | N/A | 4.46 | U | No |
| Phenanthrene | N/A | 1,140 | U | No |
| Pyrene | N/A | 655 | U | No |
| **Asbestos** | | | | |
| Asbestos[c] | N/A | 1% | None | No |

a. If Hanford Site-specific background data are not available, values are then taken from *Natural Background Soil Metals Concentrations in Washington State* (Ecology Publication 94-115). Hanford Site background values are available from nonradiological background data in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE/RL-92-24), Table D9-2.

b. Where cleanup levels are less than background or RDLs, cleanup levels default to background or RDLs in accordance with "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards" (WAC 173-340-700(6)(d)), and "Analytical Considerations" (WAC 173-340-707(2)), respectively.

c. Because of the nonhomogeneous nature of soils, results are reported using the following terms rather than percentages (as provided by analytical laboratory report narrative):

- None—No asbestos fibers found.
- Trace detectable—With extensive searching a few fibers of the type indicated were found; concentration very low, well below 1%.
- Obvious presence—Fibers easily found but overall concentration still low.
- Significant presence—Fibers readily found; overall concentration may approach or exceed 1% level.

N/A = not available

U = result is below laboratory detection limit

## 5.2 Construction Quality Assurance/Quality Control

No construction-related aspects were implemented as part of the selected alternative for the 600-218 waste site; therefore, this section is not applicable.

## 5.3 Cleanup Verification Quality Assurance/Quality Control

A data quality assessment (DQA) review was performed to compare the sampling approach and analytical data with the sampling and data requirements specified by the SAP. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (EPA/540-R-00-007, *Soil Screening Guidance for Radionuclides: User's Guide*). The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality process.

Level C data validation as defined in the contractors' validation procedures, which are based on EPA functional guidelines (for example, Bleyler, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), was performed for the entire sampling and analysis data package for the samples collected for the 600-218 waste site. Level C validation is a review of the QC data and specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on: analytical holding times; method blank results; matrix spikes/matrix spike duplicates; surrogate recoveries; duplicates; and analytical method blanks.

Specific data quality objectives for the site are found in the SAP.

All of the sampling and analysis data generated from the initial, in process, and verification sampling of the 600-218 waste site are tracked through Hanford Environmental Information System (HEIS) identification numbers. All of the sampling and analysis data for the 600-218 waste site were found to be useable for decision-making purposes as provided in the following summary:

**HEIS Identification Numbers:** B23BY2/B23C34, B23BY4/B23C36, B23BY5/B23C37, B23BY6/B23C38, B23BY7/B23C39, B23BY8/B23C40, B23BY9/B23C41, B23C00/B23C42, B23C01/B23C43, B23C02/B23C44, B23C03/B23C45, B23C04/B23C46, B23C05/B23C47, B23C06/B23C48, B23C07/B23C49, B23C08/B23C50, B23C09/B23C51, B23C10/B23C52, B23C11/B23C53, B23C12/B23C54, B23NB6, B23NB7, B23NB8, B23NB9, B23NC0, B23NC1, B23NC2, B23NC3, B241H5, B241H7, B241H8, B241H9, B241J0, B241J1, B2BV77, B2BV78, B2BV80, B2BV81, B2BV83, B2BV84, B2BV85, B2BV86, B2BV87, B2BVN0, B2BVN1, B2D0K3/B2D1F1, B2D0K4, and B2D0K5.

**Blanks:** Equipment blanks (B23C55/B23K81, B23ND9/B23ND6, and B2D0L4), field trip blanks (B23K84, and B241J3), and field transfer blanks (B23C56/B23K82, B23C57, and B241J5) were received intact to the laboratory and holding times were acceptable.

**Field Duplicates:** The duplicate (B23BY3/B23C35, B241H6, B2BV79, and B2D0K6/B2D1F2) results were acceptable.

**Data Completeness:** Analytical reports submitted for validation and verified for completeness based on the percentage of data determined to be valid (i.e., not rejected). The completion percentage was 100 percent. The data has been determined to be useable for decision-making purposes. The final results, narrative supporting the sampling analysis activities and findings, and copies of chains of custody were transmitted in letter reports from the laboratory.

**Field Screening:** Relative to analytical data in sample media, physical data, and/or field screening results are of lesser importance in making inferences of risk. Because of the secondary importance of such data, no validation for physical property data and/or field screening results was performed. However, field quality assurance (QA)/QC was reviewed to ensure that the data are useable. Field instrumentation, calibration, and QA checks were performed in accordance with the following.

- Calibration of radiological field instruments (such as Geiger-Mueller and portable alpha meters) on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.
- Daily calibration checks are performed and documented for each instrument used in support of waste site sampling and investigation. These checks are made on standard materials that are sufficiently like the matrix under consideration that direct comparison of data can be made. Daily calibration checks of radiological field instruments were performed by trained and qualified radiological control technicians in accordance with established program requirements.

The review and approval of completed field radiation surveys by the radiological controls organization represents the data validation and usability review for handheld field radiological measurements.

The DQA review for the 600-218 waste site found the analytical results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The data are of the correct type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected because of QA/QC deficiencies. All analytical data were found acceptable for decision-making purposes. All of the sampling analytical data are stored in HEIS.

## 5.4 Regulatory Oversight

This document provides a summary of the removal action taken at the 600-218 waste site; it shows a comparison of the data collected to RALs authorized in approved regulatory documents, and provides the basis to reclassify the waste site status (see Chapter 9). Though this report does not require approval by Ecology or EPA, concurrence of those agencies is necessary under CERCLA Section 120 and the Tri-Party Agreement, for determinations concerning follow-on remedial actions. This report is therefore provided to the agency (or agencies) for review, in accordance with the approval process for waste site reclassification, as supporting documentation. Upon approval of the waste site reclassification, a copy of this report shall be maintained in the Administrative Record. No additional regulatory oversight was required for the sampling at the 600-218 waste site.

# 6 Final Inspection and Certifications

There were no final inspections or certification required in the implementation of the selected alternative for the 600-218 waste site; therefore, this section is not applicable.

# 7 Operation & Maintenance Activities

This chapter discusses the operations and maintenance (O&M) activities for the 600-218 waste site.

## 7.1 Remedy-Related Operations and Maintenance or Monitoring

There are no O&M activities or monitoring requirements for the 600-218 waste site; therefore, this section is not applicable.

## 7.2 Institutional Controls

Based on the analyses performed and presented in this report, there are no waste site specific institutional controls required at the 600-218 waste site.

## 7.3 Five-Year Reviews

Five-year reviews are required by CERCLA for post-ROD remedial actions, but do not apply to the 600-218 waste site. This waste site and the data obtained from the subject sampling evolution will be included in the risk assessment and RI/FS for final remedial decision for the Outer Area.

# 8 Summary of Project Costs

For the purposes of reporting costs of removal action for the 600-218 waste site, costs are prorated utilizing an activity/schedule-based methodology. This method is not considered to be audit quality data. Actual costs for waste site cleanup will continue to be collected for each OU or closure area in accordance with the current cost tracking methodology (Table 8-1). These costs will then be included, in accordance with CERCLA requirements, in the response action report for the final remedial action of the OU or closure area.

**Table 8-1. Cost Summary**

| Cost Item | Actual Cost Fiscal Year 2009 ($) | Actual Cost Fiscal Year 2010 ($) | Actual Cost Fiscal Year 2011 ($) | Actual Total Cost ($) |
|---|---|---|---|---|
| Removal Action Capital (Construction) Costs | 0 | 0 | 0 | 0 |
| Removal Action Operating Costs | 22,300 | 61,500 | 144,400 | 228,200 |
| Total Removal Action Cost | 22,300 | 61,500 | 144,400 | 228,200 |
| Projected Yearly Operations and Maintenance Costs | 0 | 0 | 0 | 0 |

# 9 Waste Site Reclassification

The waste site reclassification form for the subject waste site is proposed and processed in accordance with the methods and definitions described in *Tri-Party Agreement Handbook Management Procedures* (RL-TPA-90-0001), TPA-MP-14, "Maintenance of the WIDS." Reclassification form 2011-049 for the 600-218 waste site proposes the status of this waste site be changed to "interim closed out." Per TPA-MP-14, "interim closed out" status indicates that a site meets the cleanup standards specified in the approved Action Memorandum (i.e., the interim response action decision document). This site will be evaluated under the cleanup standards established for the final ROD for the Outer Area.

# 10 Observations and Lessons Learned

There were no observations or lessons learned applicable for inclusion in this report.

# 11 Contact Information

**The DOE Contractor:**

R.L. Cathel
Geographic Closure, Environmental, Waste, and Quality Assurance Director
CH2M HILL Plateau Remediation Company
P.O. Box 1600, MSIN R3-60
Richland, WA 99352
Telephone: 509-373-9171

**The Project Manager for DOE:**

F.M. Roddy
200-MG-1 Operable Unit Project Manager
Department of Energy, Richland Operations Office
P.O. Box 550, MSIN A5-11
Richland, WA 99352
Telephone: 509-372-0945

**The Project Manager for the Lead Regulatory Agency:**

L. Buelow
Environmental Scientist
U.S. Environmental Protection Agency
Hanford Project Office
309 Bradley Boulevard, Suite 115, MSIN B1-46
Richland, WA 99352
Telephone: 509-376-5466

# 12 References

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_09/40cfr300_09.html.

Appendix B, "National Priorities List."

53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites – Update 7," *Federal Register*, Vol. 53, No. 122, pp. 23988 – 23998, June 24, 1988. Available at: http://www.epa.gov/superfund/sites/npl/p880624.htm#23988.

54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites – Final Rule 10/04/89," *Federal Register*, Vol. 54, No. 191, pp. 41015 – 41025, October 4, 1989. Available at: http://www.epa.gov/superfund/sites/npl/f891004.htm#41015.

Bleyler, Ruth, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*, Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.hanford.gov/ARPIR/index.cfm?content=findpage&AKey=D196013784.

Bleyler, Ruth, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*, Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.hanford.gov/ARPIR/index.cfm?content=findpage&AKey=D196013785.

*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*, 42 USC 9601, et seq. Available at: http://uscode.house.gov/download/pls/42C103.txt.

Cook, Michael B., 2004, "Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups" (memorandum to Superfund National Policy Managers, Regions 1-10), OSWER 9345.4-05, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., August 10. Available at: http://www.epa.gov/region9/toxic/noa/eldorado/pdf/memo722b.pdf.

DOE, 2010, *CERCLA Remedial Action Site Closure Guidance*, Draft, Office of Nuclear Safety and Environmental Assistance, U.S. Department of Energy, Washington, D.C. Available at: http://homer.ornl.gov/nuclearsafety/env/guidance/cercla/siteclosure/index.cfm.

DOE/EIS-0222-F, 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Washington, D.C. Available at:
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158842.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158843.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158844.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158845.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158846.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158847.

DOE/EIS-0222-SA-01, 2008, *Supplemental Analysis Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, Draft, U.S. Department of Energy, Washington, D.C. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=DA06917281.

DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, 2 vols., U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=0096062. http://www2.hanford.gov/arpir/?content=findpage&AKey=0096061.

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. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0095436.

DOE/RL-96-32, 2001, *Hanford Site Biological Resources Management Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.pnl.gov/ecomon/docs/brmap/BRMaP.pdf.

DOE/RL-2008-44, 2009, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0096350.

DOE/RL-2009-48, 2009, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0096131.

DOE/RL-2009-53, 2010, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit,* Revision 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=1010180132

DOE/RL-2009-60, 2009, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites,* Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 2007, Cleanup Levels and Risk Calculations (CLARC) database, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.

Ecology Publication No. 94-115, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/94115.pdf.

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. Available at: http://www.hanford.gov/?page=90&parent=91.

Ecology, EPA, and DOE, 2006, *Hanford Federal Facility Agreement and Consent Order Changes to Central Plateau Waste Site and Groundwater Remediation Milestones (including Tentative Agreement on Negotiations, Introduction, Federal Facilities Agreement and Consent Order Change Control Form M-15-16-02, M-13-06-01, P-11-06-01, C-06-02, September 14*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Richland Washington.

EPA/540-R-00-007, 2000, *Soil Screening Guidance for Radionuclides: User's Guide,* OSWER 9355.4-16A, Office of Waste Programs Enforcement and Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/superfund/health/contaminants/radiation/radssg.htm.

EPA 540-R-98-016, 2000, *Close Out Procedures for National Priorities List Sites*, OSWER Directive 9320.2-09A-P, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/superfund/programs/npl_hrs/closeout/pdf/guidance.pdf.

Executive Order 12580, 1987, *Superfund Implementation*, Ronald W. Reagan, January 23. Available at: http://www.archives.gov/federal-register/codification/executive-order/12580.html.

Lindsey, K.A., 1996, The *Miocene to Pliocene Ringold Formation and Associated Deposits of the Ancestral Columbia River System, South-Central Washington and North-Central Oregon,* Washington Department of Natural Resources, Washington Division of Geology and Earth Resources, Open File Report 96-8, Olympia, Washington. Available at: http://www.dnr.wa.gov/Publications/ger_ofr96-8_ringold_formation.pdf.

PNL-10285, 1995, *Estimated Recharge Rates at the Hanford Site*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/energycitations/servlets/purl/10122247-XORHkt/webviewable/10122247.pdf.

PNNL-13895, 2003, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0911300341.

PNNL-16939, 2007, *Visual Sample Plan, Version 5.0 User's Guide*, Pacific Northwest National Laboratory, Richland, Washington. Available at: www.pnl.gov/main/publications/external/technical_reports/PNNL-16939.pdf.

*Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at: http://www.epa.gov/epawaste/inforesources/online/index.htm.

RL-TPA-90-0001, 2007, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/TPA-MP14.pdf.

*Superfund Amendments and Reauthorization Act of 1986*, 42 USC 103, et seq. Available at: http://www.epa.gov/superfund/policy/sara.htm.

WAC 173-340-700, "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards," *Washington Administrative Code,* Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-700.

WAC 173-340-707, "Model Toxics Control Act—Cleanup," "Analytical Considerations," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-707.

WAC 173-340-747, "Model Toxics Control Act—Cleanup," "Deriving Soil Concentrations for Groundwater Protection," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/wac/default.aspx?cite=173-340-747.

WAC 173-340-900, "Model Toxics Control Act—Cleanup," "Tables," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340-900.

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# Appendix A

## Sampling Results for the 600-218 Waste Site

This appendix contains laboratory analytical results, provided in Tables A-1 through A-3, from the sampling conducted at the 600-218 waste site. The following information is provided in the table headings: Hanford Environmental Information System identification numbers, field sample identifier, and sample depth. Depths provided in the tables are below ground surface.

- Tables A-1a and A-1b provide analytical results for nonradiological contaminants from samples collected during the initial phase of sampling. Analytical results from two sample locations did not meet the established removal action levels (RALs). Therefore, removal, treatment, and disposal (RTD) at the waste site was implemented.
- Tables A-2a and A-2b provide analytical results from in process samples collected from locations surrounding areas R3 and R14. The analytical results from these in-process samples were used to delineate the vertical and lateral extents of contamination prior to RTD activities.
- Table A-3 includes final verification sampling results for nonradiological contaminants of potential concern, which were further refined based on the results of initial and in process sampling to target polynuclear aromatic hydrocarbon and metals analysis only. Analytical results of the verification sampling evolution at the 600-218 waste site demonstrate achievement of the established RALs.

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**Table A-1a. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23BY2 B23C34 R1 Surface | B23BY4 B23C36 R2 Surface | B23BY5 B23C37 R3 Surface | B23BY6 B23C38 R4 Surface | B23NB6 R4 (1.2 m [4 ft]) | B23NB7 R4 (2.4 m [8 ft]) | B23BY7 B23C39 R5 Surface | B23BY8 B23C40 R6 Surface | B23BY9 B23C41 R7 Surface | B23C00 B23C42 R8 Surface | B23C01 B23C43 R9 Surface | B23NB8 R9 (1.2 m [4 ft]) | B23NB9 R9 (2.4 m [8 ft]) | B23C02 B23C44 R10 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Antimony | 5.4 | 0.6 | 0.304 | 5 | U | U | U | 1.91 | 0.31 | U | U | U | U | U | U | U | U | U |
| Arsenic | 6.5[c] | 1 | 0.0399 | 6.5 | 1.43 | 1.95 | 1.93 | 1.92 | 5.77 | 3.01 | 1.71 | 2.06 | 2.06 | 1.73 | 2.17 | 3.23 | 5.82 | 2.08 |
| Barium | 1,650 | 2 | 0.2 | 132 | 57.4 | 54.5 | 76.3 | 88.3 | 62.5 | 58.4 | 59.1 | 69.9 | 72.3 | 66.3 | 67.7 | 64.2 | 111 | 56.8 |
| Beryllium | 63.2 | 0.5 | 0.405 | 1.51 | U | U | U | U | U | U | U | U | U | U | U | U | 0.447 | U |
| Boron | 210 | 2 | 1.9 | N/A | 6.26 | 8.07 | 7.80 | 8.74 | 10.2 | 10.3 | 9.0 | 9.08 | 5.6 | 7.36 | 5.20 | 9.78 | 12.4 | 8.9 |
| Cadmium | 0.81[c] | 0.5 | 0.1 | 0.81 | U | 0.15 | 0.11 | 0.12 | U | U | U | U | 0.1 | U | U | 0.11 | 0.1 | U |
| Chromium Total | 2000 | 1 | 0.499 | 18.5 | 5.65 | 14.2 | 7.11 | 6.47 | 8.66 | 11.9 | 8.25 | 6.13 | 7.01 | 5.82 | 5.17 | 7.68 | 8.24 | 14.3 |
| Chromium (VI) | N/A | 0.5 | 0.1 | N/A | NA | NA | NA | NA | U | U | NA | NA | NA | NA | NA | U | U | NA |
| Cobalt | 15.7[c] | 2 | 0.0499 | 15.7 | 4.16 | 5.1 | 4.9 | 6.01 | 7.83 | 8.38 | 5.52 | 5.02 | 5.09 | 4.6 | 5.11 | 7.7 | 10.4 | 5.68 |
| Copper | 284 | 1 | 0.0998 | 22 | 7.26 | 11 | 8.56 | 10.5 | 15.6 | 16.9 | 10 | 11.7 | 8 | 7.58 | 8.65 | 12.9 | 13.8 | 10.7 |
| Lead | 250 | 5 | 0.0998 | 10.2 | 7.35 | 26.3 | 7.95 | 45.4 | 4.63 | 3.17 | 6.2 | 9.67 | 6.53 | 17.9 | 8.03 | 5.76 | 5.71 | 6.12 |
| Lithium | 160 | 2.5 | 0.41 | 33.5 | 3.61 | 4.36 | 4.58 | 5.75 | 5.62 | 6.1 | 6.67 | 5.59 | 3.82 | 4.48 | 3.12 | 5.62 | 8.28 | 5.26 |
| Manganese | 512[c] | 5 | 0.0998 | 512 | 264 | 249 | 263 | 315 | 288 | 283 | 258 | 257 | 268 | 244 | 261 | 286 | 417 | 265 |
| Mercury | 2.09 | 0.2 | 0.0506 | 0.33 | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Nickel | 130 | 4 | 0.2 | 19.1 | 6.57 | 10 | 6.88 | 7.98 | 8.51 | 11.2 | 9.81 | 6.61 | 7.43 | 6.42 | 6.35 | 7.77 | 10 | 10.5 |
| Selenium | 5.2 | 1 | 0.0304 | 0.78 | 0.51 | 0.88 | 0.61 | 0.73 | 0.939 | U | 0.98 | 0.59 | 0.65 | 0.82 | 0.69 | 1.07 | 1.08 | 1.06 |
| Silver | 13.6 | 0.2 | 0.101 | 0.73 | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Strontium | 2,920 | 1 | 0.0998 | N/A | 20.3 | 19.6 | 25.2 | 25.9 | 58.3 | 41.2 | 27.8 | 20.8 | 19.8 | 23.2 | 22.5 | 35.9 | 46.1 | 20.9 |
| Thallium | 1.59 | 1 | 0.101 | 0.1 | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Tin | 48,000 | 10 | 0.0499 | N/A | 0.33 | 1.28 | 0.45 | 0.33 | 2.02 | 1.77 | 0.32 | 0.27 | 0.29 | 0.24 | 0.27 | 1.78 | 1.83 | 0.3 |
| Uranium | 3.21[c] | 1 | 0.0506 | 3.21 | 0.22 | 0.19 | 0.22 | 0.27 | 0.98 | 0.48 | 0.28 | 0.23 | 0.18 | 0.16 | 0.29 | 0.44 | 0.62 | 0.27 |
| Vanadium | 560 | 2.5 | 0.2 | 85.1 | 17.6 | 15.4 | 17.5 | 17 | 62.8 | 70.8 | 18.4 | 17.3 | 18.1 | 15.4 | 19.9 | 58.9 | 67.8 | 33 |
| Zinc | 5970 | 1 | 0.798 | 67.8 | 24.8 | 31.2 | 28.9 | 66.5 | 41.2 | 48.6 | 26.8 | 26.2 | 25.1 | 33.3 | 26.9 | 43.4 | 50.4 | 32.1 |
| **Anions** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Nitrate-N | 40 | 0.75 | 1.6[d] | 11.8 | NA | NA | NA | NA | U | U | NA | NA | NA | NA | NA | U | U | NA |

**Table A-1a. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23BY2 B23C34 R1 Surface | B23BY4 B23C36 R2 Surface | B23BY5 B23C37 R3 Surface | B23BY6 B23C38 R4 Surface | B23NB6 R4 (1.2 m [4 ft]) | B23NB7 R4 (2.4 m [8 ft]) | B23BY7 B23C39 R5 Surface | B23BY8 B23C40 R6 Surface | B23BY9 B23C41 R7 Surface | B23C00 B23C42 R8 Surface | B23C01 B23C43 R9 Surface | B23NB8 R9 (1.2 m [4 ft]) | B23NB9 R9 (2.4 m [8 ft]) | B23C02 B23C44 R10 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatic Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Acenaphthene | 98 | 0.33 | 0.17 | N/A | U | U | 0.56 | U | U | U | U | U | U | U | U | U | U | U |
| Acenaphthylene | 98 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Anthracene | 2,270 | 0.33 | 0.17 | N/A | U | U | 0.49 | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(a)anthracene | 0.86 | 0.33 | 0.17 | N/A | U | U | 1.90 | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(a)pyrene | 0.33[c] | 0.33 | 0.25 | N/A | U | U | 1.60 | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(b)fluoranthene | 1.37 | 0.33 | 0.22 | N/A | U | U | 1.20 | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(k)fluoranthene | 1.37 | 0.33 | 0.23 | N/A | U | U | 1.60 | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(g,h,i)perylene | 2,400 | 0.33 | 0.36[d] | N/A | U | U | 0.7 | U | U | U | U | U | U | U | U | U | U | U |
| Chrysene | 9.56 | 0.33 | 0.17 | N/A | U | U | 2.60 | U | U | U | U | U | U | U | U | U | U | U |
| Dibenzo(a,h)anthracene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | 0.5 | U | U | U | U | U | U | U | U | U | U | U |
| Fluoranthene | 631 | 0.33 | 0.017 | N/A | U | U | 5.3 | U | U | U | U | U | U | U | U | U | U | U |
| Fluorene | 101 | 0.33 | 0.17 | N/A | U | U | 0.240 | U | U | U | U | U | U | U | U | U | U | U |
| Indeno(1,2,3-cd)pyrene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | 0.79 | U | U | U | U | U | U | U | U | U | U | U |
| Naphthalene | 4.46 | 0.33 | 0.17 | N/A | U | U | 0.19 | U | U | U | U | U | U | U | U | U | U | U |
| Phenanthrene | 1,140 | 0.33 | 0.17 | N/A | U | U | 4.80 | U | U | U | U | U | U | U | U | U | U | U |
| Pyrene | 655 | 0.5 | 0.17 | N/A | U | U | 4.80 | U | U | U | U | U | U | U | U | U | U | U |
| **Polychlorinated Biphenyls** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Aroclor 1016 | 0.094 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1221 | 0.017[c] | 0.017 | 0.0089 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1232 | 0.017[c] | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1242 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1248 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1254 | 0.066 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1260 | 0.5 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |

**Table A-1a. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23BY2 B23C34 R1 Surface | B23BY4 B23C36 R2 Surface | B23BY5 B23C37 R3 Surface | B23BY6 B23C38 R4 Surface | B23NB6 R4 (1.2 m [4 ft]) | B23NB7 R4 (2.4 m [8 ft]) | B23BY7 B23C39 R5 Surface | B23BY8 B23C40 R6 Surface | B23BY9 B23C41 R7 Surface | B23C00 B23C42 R8 Surface | B23C01 B23C43 R9 Surface | B23NB8 R9 (1.2 m [4 ft]) | B23NB9 R9 (2.4 m [8 ft]) | B23C02 B23C44 R10 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Analytes** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Carbon Tetrachloride | 0.005 | 0.005 | 0.0013 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| **Total Petroleum Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Diesel | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Kerosene | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |

a. Removal action levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1 (RAWP).

b. If Hanford Site-specific background data is not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available in nonradiological background data from DOE/RL-92-24, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology (1996), WAC 173-340-700(6)(d), and WAC 173 340 707(2), respectively.

d. Maximum reported laboratory method detection limits were greater than the required detection limit per the RAWP; however, analytical results are below the established removal action levels and meet the corresponding removal action objectives.

N/A = not available

NA = not applicable

U = result is less than laboratory method detection limit

**Table A-1b. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23C03 B23C45 R11 Surface | B23NC0 R11 (1.2 m [4 ft]) | B23NC1 R11 (2.4 m [8 ft]) | B23BY4 B23C36 R12 Surface | B23C05 B23C47 R13 Surface | B23C06 B23C48 R14 Surface | B23C07 B23C49 R15 Surface | B23C08 B23C50 R16 Surface | B23C09 B23C51 R17 Surface | B23NC2 R17 (1.2 m [4 ft]) | B23NC3 R17 (2.4 m [8 ft]) | B23C10 B23C52 R18 Surface | B23C11 B23C53 R19 Surface | B23C12 B23C54 R20 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Antimony | 5.4 | 0.6 | 0.304 | 5 | 0.7 | U | U | 0.37 | U | 0.34 | U | U | U | U | U | U | U | U |
| Arsenic | 6.5[c] | 1 | 0.0399 | 6.5 | 2.16 | 2.77 | 3.79 | 2.66 | 2.7 | 2.89 | 2.68 | 2.07 | 1.92 | 2.92 | 2.37 | 2.99 | 2.25 | 2.39 |
| Barium | 1,650 | 2 | 0.2 | 132 | 112 | 77.8 | 106 | 60.9 | 66.7 | 73.2 | 71.2 | 66 | 59.6 | 72.7 | 91.5 | 77.4 | 71.4 | 66.8 |
| Beryllium | 63.2 | 0.5 | 0.405 | 1.51 | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Boron | 210 | 2 | 1.9 | N/A | 9.03 | 11.1 | 8.6 | 8.74 | 8.47 | 9.38 | 9.0 | 8.38 | 8.77 | 9.36 | 8.51 | 9.63 | 9.77 | 8.82 |
| Cadmium | 0.81[c] | 0.5 | 0.1 | 0.81 | 0.3 | 0.14 | 0.14 | 0.13 | 0.11 | 0.26 | 0.12 | U | 0.11 | 0.13 | U | 0.12 | U | 0.1 |
| Chromium Total | 2000 | 1 | 0.499 | 18.5 | 21 | 10.8 | 11.4 | 8.86 | 12.5 | 600 | 8.59 | 9.93 | 8 | 7.41 | 8.46 | 7.9 | 7.65 | 7.05 |
| Chromium (VI) | N/A | 0.5 | 0.1 | N/A | NA | 0.23 | U | NA | NA | NA | NA | NA | NA | U | U | NA | NA | NA |
| Cobalt | 15.7[c] | 2 | 0.0499 | 15.7 | 5.75 | 6.71 | 6.98 | 6.62 | 6.24 | 11 | 6.8 | 6.95 | 6.09 | 6.65 | 6.12 | 6.73 | 6.26 | 6.09 |
| Copper | 284 | 1 | 0.0998 | 22 | 9.59 | 11.6 | 11.5 | 13.3 | 12 | 21.5 | 11.8 | 11.4 | 9.21 | 11.4 | 10.8 | 11.4 | 9.56 | 8.75 |
| Lead | 250 | 5 | 0.0998 | 10.2 | 109 | 17.5 | 4.17 | 22 | 6.66 | 10.1 | 32.8 | 5.44 | 5.43 | 5.06 | 3.5 | 8.03 | 12.2 | 5.77 |
| Lithium | 160 | 2.5 | 0.41 | 33.5 | 6.19 | 5.68 | 9.16 | 6.44 | 5.81 | 5.98 | 6.46 | 5.49 | 5.74 | 5.77 | 6.32 | 6.62 | 6.47 | 6.15 |
| Manganese | 512[c] | 5 | 0.0998 | 512 | 274 | 264 | 360 | 298 | 281 | 388 | 304 | 328 | 293 | 287 | 271 | 321 | 301 | 286 |
| Mercury | 2.09 | 0.2 | 0.0506 | 0.33 | 0.09 | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Nickel | 130 | 4 | 0.2 | 19.1 | 6.95 | 9.66 | 9.71 | 8.77 | 10.5 | 268 | 8.42 | 9.95 | 7.79 | 7.71 | 7.19 | 8.73 | 7.9 | 7.54 |
| Selenium | 5.2 | 1 | 0.0304 | 0.78 | 0.61 | U | U | 0.65 | 0.85 | 0.84 | 0.73 | 0.76 | 0.71 | U | 0.837 | 0.5 | 0.9 | 0.97 |
| Silver | 13.6 | 0.2 | 0.101 | 0.73 | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Strontium | 2,920 | 1 | 0.0998 | N/A | 128 | 31.5 | 49.4 | 20.5 | 19.2 | 22.1 | 21 | 21.6 | 18.1 | 32.2 | 31.6 | 21.4 | 18.6 | 20.1 |
| Thallium | 1.59 | 1 | 0.101 | 0.1 | 0.11 | U | 0.12 | U | U | U | U | U | U | U | U | U | U | U |
| Tin | 48,000 | 10 | 0.0499 | N/A | 0.37 | 0.37 | 1.82 | 0.39 | 0.31 | 0.83 | 0.35 | 0.32 | 0.29 | 1.86 | 1.75 | 0.36 | 0.32 | 0.28 |
| Uranium | 3.21[c] | 1 | 0.0506 | 3.21 | 0.27 | 0.42 | 1.11 | 0.38 | 0.32 | 0.34 | 0.56 | 0.3 | 0.25 | 0.59 | 0.47 | 0.3 | 0.25 | 0.35 |
| Vanadium | 560 | 2.5 | 0.2 | 85.1 | 35.2 | 43.3 | 41 | 41.3 | 36.9 | 42.2 | 40.6 | 35.4 | 38.3 | 58.9 | 46.7 | 39.8 | 38.3 | 39.6 |
| Zinc | 5970 | 1 | 0.798 | 67.8 | 71.9 | 60.8 | 37.3 | 37.6 | 34.8 | 39.3 | 52.7 | 31 | 34.6 | 40.8 | 38.4 | 38.3 | 43.9 | 33.4 |
| **Anions** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Nitrate-N | 40 | 0.75 | 1.6[d] | 11.8 | NA | U | U | NA | NA | NA | NA | NA | NA | U | U | NA | NA | NA |

**Table A-1b. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23C03 B23C45 R11 Surface | B23NC0 R11 (1.2 m [4 ft]) | B23NC1 R11 (2.4 m [8 ft]) | B23BY4 B23C36 R12 Surface | B23C05 B23C47 R13 Surface | B23C06 B23C48 R14 Surface | B23C07 B23C49 R15 Surface | B23C08 B23C50 R16 Surface | B23C09 B23C51 R17 Surface | B23NC2 R17 (1.2 m [4 ft]) | B23NC3 R17 (2.4 m [8 ft]) | B23C10 B23C52 R18 Surface | B23C11 B23C53 R19 Surface | B23C12 B23C54 R20 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatic Hydrocarbons** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Acenaphthene | 98 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Acenaphthylene | 98 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Anthracene | 2,270 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(a)anthracene | 0.86 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(a)pyrene | 0.33[c] | 0.33 | 0.25 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Benzo(b)fluoranthene | 1.37 | 0.33 | 0.22 | N/A | U | U | U | 0.23 | U | U | U | U | 0.32 | U | U | U | U | U |
| Benzo(k)fluoranthene | 1.37 | 0.33 | 0.23 | N/A | U | U | U | U | U | U | U | U | 0.27 | U | U | U | U | U |
| Benzo(g,h,i)perylene | 2,400 | 0.33 | 0.36[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Chrysene | 9.56 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | 0.23 | U | U | U | U | U |
| Dibenzo(a,h)anthracene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Fluoranthene | 631 | 0.33 | 0.017 | N/A | U | U | U | 0.19 | U | U | U | U | 0.3 | U | U | U | U | U |
| Fluorene | 101 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Indeno(1,2,3-cd)pyrene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Naphthalene | 4.46 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Phenanthrene | 1,140 | 0.33 | 0.17 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Pyrene | 655 | 0.5 | 0.17 | N/A | U | U | U | U | U | U | U | U | 0.24 | U | U | U | U | U |
| **Polychlorinated Biphenyls** | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Aroclor 1016 | 0.094 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1221 | 0.017[c] | 0.017 | 0.0089 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1232 | 0.017[c] | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1242 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1248 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Aroclor 1254 | 0.066 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | 0.025 | U | U | U | U | U | U | U |
| Aroclor 1260 | 0.5 | 0.017 | 0.011 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |

**Table A-1b. Analytical Results for Initial Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B23C03 B23C45 R11 Surface | B23NC0 R11 (1.2 m [4 ft]) | B23NC1 R11 (2.4 m [8 ft]) | B23BY4 B23C36 R12 Surface | B23C05 B23C47 R13 Surface | B23C06 B23C48 R14 Surface | B23C07 B23C49 R15 Surface | B23C08 B23C50 R16 Surface | B23C09 B23C51 R17 Surface | B23NC2 R17 (1.2 m [4 ft]) | B23NC3 R17 (2.4 m [8 ft]) | B23C10 B23C52 R18 Surface | B23C11 B23C53 R19 Surface | B23C12 B23C54 R20 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Analytes** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Carbon Tetrachloride | 0.005 | 0.005 | 0.0013 | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| **Total Petroleum Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Diesel | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |
| Kerosene | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U | U | U | U | U | U | U | U | U |

a. Removal action levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1 (RAWP).

b. If Hanford Site-specific background data is not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available in nonradiological background data from DOE/RL-92-24, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology (1996), WAC 173-340-700(6)(d), and WAC 173 340 707(2), respectively.

d. Maximum reported laboratory method detection limits were greater than the required detection limit per the RAWP; however, analytical results are below the established removal action levels and meet the corresponding removal action objectives.

N/A = not available

NA = not applicable

U = analyzed for but not detected above laboratory method detection limit

**Table A-2a. Analytical Results for In Process Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B241H5 R3a 1 m (3 ft) bgs | B241H7 R3b Surface | B241H8 R3c Surface | B241H9 R3d Surface | B241J0 R3e Surface | B241J1 R3f Surface |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Antimony | 5.4 | 0.6 | 0.304 | 5 | U | U | 0.36 | U | U | U |
| Arsenic | 6.5[c] | 1 | 0.0399 | 6.5 | 5.3 | 2.88 | 4.7 | 2.79 | 3.08 | 2.85 |
| Barium | 1,650 | 2 | 0.2 | 132 | 94.8 | 82.2 | 78.4 | 74.2 | 65.7 | 71.2 |
| Beryllium | 63.2 | 0.5 | 0.405 | 1.51 | 0.445 | U | U | U | U | U |
| Boron | 210 | 2 | 1.9 | N/A | 10.2 | 10.1 | 10.6 | 10.3 | 9.41 | 9.61 |
| Cadmium | 0.81[c] | 0.5 | 0.1 | 0.81 | U | 0.11 | 0.56 | 0.15 | U | U |
| Chromium Total | 2000 | 1 | 0.499 | 18.5 | 8.34 | 8.64 | 11.8 | 7.97 | 6.92 | 7.89 |
| Chromium (VI) | N/A | 0.5 | 0.1 | N/A | U | U | 0.72 | U | U | U |
| Cobalt | 15.7[c] | 2 | 0.0499 | 15.7 | 7.96 | 6.96 | 8.2 | 6.63 | 6.86 | 6.78 |
| Copper | 284 | 1 | 0.0998 | 22 | 14.5 | 11 | 14.5 | 11.8 | 13.1 | 11.9 |
| Lead | 250 | 5 | 0.0998 | 10.2 | 5.29 | 6.68 | 124 | 6.71 | 5.11 | 6.72 |
| Lithium | 160 | 2.5 | 0.41 | 33.5 | 6.79 | 6.76 | 6.18 | 6.23 | 6.38 | 6.39 |
| Manganese | 512[c] | 5 | 0.0998 | 512 | 300 | 321 | 324 | 296 | 309 | 280 |
| Mercury | 2.09 | 0.2 | 0.0506 | 0.33 | U | U | U | U | U | 0.35 |
| Nickel | 130 | 4 | 0.2 | 19.1 | 8.84 | 8.86 | 8.18 | 7.93 | 8.89 | 8.32 |
| Selenium | 5.2 | 1 | 0.0304 | 0.78 | 1.17 | 0.959 | 1.14 | 0.819 | 0.666 | U |
| Silver | 13.6 | 0.2 | 0.101 | 0.73 | U | U | U | U | U | U |

Table A-2a. Analytical Results for In Process Sampling for Nonradiological Contaminants

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B241H5 R3a 1 m (3 ft) bgs | B241H7 R3b Surface | B241H8 R3c Surface | B241H9 R3d Surface | B241J0 R3e Surface | B241J1 R3f Surface |
|---|---|---|---|---|---|---|---|---|---|---|
| Strontium | 2,920 | 1 | 0.0998 | N/A | 58.2 | 27 | 29.7 | 32.2 | 36.6 | 32.4 |
| Thallium | 1.59 | 1 | 0.101 | 0.1 | U | U | U | U | U | U |
| Tin | 48,000 | 10 | 0.0499 | N/A | 1.85 | 1.78 | 2.21 | 1.75 | 1.7 | 1.71 |
| Uranium | 3.21[c] | 1 | 0.0506 | 3.21 | 0.48 | 0.35 | 0.36 | 0.34 | 0.37 | 0.35 |
| Vanadium | 560 | 2.5 | 0.2 | 85.1 | 66.4 | 50 | 47.6 | 50.5 | 49 | 48.6 |
| Zinc | 5970 | 1 | 0.798 | 67.8 | 40.4 | 39 | 138 | 38.7 | 36.2 | 36 |
| **Anions** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | |
| Nitrate-N | 40 | 0.75 | 1.6[d] | 11.8 | 0.178 | U | 3.09 | 2.36 | 2.29 | U |
| **Polynuclear Aromatic Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Acenaphthene | 98 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Acenaphthylene | 98 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Anthracene | 2,270 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Benzo(a)anthracene | 0.86 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Benzo(a)pyrene | 0.33[c] | 0.33 | 0.25 | N/A | U | U | U | U | U | U |
| Benzo(b)fluoranthene | 1.37 | 0.33 | 0.22 | N/A | U | U | U | U | U | U |
| Benzo(k)fluoranthene | 1.37 | 0.33 | 0.23 | N/A | U | U | U | U | U | U |
| Benzo(g,h,i)perylene | 2,400 | 0.33 | 0.36[d] | N/A | U | U | U | U | U | U |

Table A-2a. Analytical Results for In Process Sampling for Nonradiological Contaminants

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B241H5 R3a 1 m (3 ft) bgs | B241H7 R3b Surface | B241H8 R3c Surface | B241H9 R3d Surface | B241J0 R3e Surface | B241J1 R3f Surface |
|---|---|---|---|---|---|---|---|---|---|---|
| Chrysene | 9.56 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Dibenzo(a,h)anthracene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | U | U | U | U |
| Fluoranthene | 631 | 0.33 | 0.017 | N/A | U | U | U | U | U | U |
| Fluorene | 101 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Indeno(1,2,3-cd)pyrene | 1.37 | 0.33 | 0.37[d] | N/A | U | U | U | U | U | U |
| Naphthalene | 4.46 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Phenanthrene | 1,140 | 0.33 | 0.17 | N/A | U | U | U | U | U | U |
| Pyrene | 655 | 0.5 | 0.17 | N/A | U | U | U | U | U | U |
| **Polychlorinated Biphenyls** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Aroclor 1016 | 0.094 | 0.017 | 0.011 | N/A | U | U | U | U | U | U |
| Aroclor 1221 | 0.017[c] | 0.017 | 0.0089 | N/A | U | U | U | U | U | U |
| Aroclor 1232 | 0.017[c] | 0.017 | 0.011 | N/A | U | U | U | U | U | U |
| Aroclor 1242 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U |
| Aroclor 1248 | 0.039 | 0.017 | 0.011 | N/A | U | U | U | U | U | U |
| Aroclor 1254 | 0.066 | 0.017 | 0.011 | N/A | U | U | 0.047 | U | U | U |
| Aroclor 1260 | 0.5 | 0.017 | 0.011 | N/A | U | U | U | U | U | U |

## Table A-2a. Analytical Results for In Process Sampling for Nonradiological Contaminants

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B241H5 R3a 1 m (3 ft) bgs | B241H7 R3b Surface | B241H8 R3c Surface | B241H9 R3d Surface | B241J0 R3e Surface | B241J1 R3f Surface |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Analytes** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Carbon Tetrachloride | 0.005 | 0.005 | 0.0013 | N/A | U | U | U | U | U | U |
| **Total Petroleum Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Diesel | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U |
| Kerosene | 2,000 | 5 | 5.7[d] | N/A | U | U | U | U | U | U |

a. Removal action levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1 (RAWP).

b. If Hanford Site-specific background data is not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available in nonradiological background data from DOE/RL-92-24, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology (1996), WAC 173-340-700(6)(d), and WAC 173 340 707(2), respectively.

d. Maximum reported laboratory method detection limits were greater than the required detection limit per the RAWP; however, analytical results are below the established removal action levels and meet the corresponding removal action objectives.

N/A = not available

U = analyzed for but not detected above laboratory method detection limit

**Table A-2b. Analytical Results for In Process Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2BV77 T1-1 Surface | B2BV78 T1-2 Surface | B2BV80 T1-3 Surface | B2BV81 T1-4 Surface | B2BV83 T2-1 Surface | B2BV84 T2-2 Surface | B2BV85 T2-3 Surface | B2BV86 T2-4 Surface | B2BV87 T2-5 Surface | B2BVN0 C-2 Surface | B2BVN1 C-3 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Antimony | 5.4 | 0.6 | 0.33 | 5 | U | U | U | 0.47 | U | U | 0.489 | U | U | 0.459 | U |
| Arsenic | 6.5[c] | 1 | 0.43 | 6.5 | 3.22 | 3.13 | 3.29 | 4.14 | 3.55 | 3.62 | 3.09 | 3.66 | 3.34 | 3.2 | 3.1 |
| Barium | 1,650 | 2 | 0.22 | 132 | 89.1 | 95 | 86.8 | 90.8 | 95.4 | 95.1 | 83 | 93.6 | 95.6 | 98.3 | 91.3 |
| Beryllium | 63.2 | 0.5 | 0.11 | 1.51 | 0.376 | 0.329 | 0.3 | 0.406 | 0.32 | 0.312 | 0.269 | 0.372 | 0.414 | 0.387 | 0.344 |
| Boron | 210 | 2 | 4.5[d] | N/A | 25.1 | 20.1 | 23.4 | 24 | 22.2 | 17.1 | 20.9 | 19.7 | 20.9 | 23.1 | 18.9 |
| Cadmium | 0.81[c] | 0.5 | 0.11 | 0.81 | 0.155 | 0.113 | U | 0.112 | 0.112 | 0.184 | 0.13 | U | 0.133 | U | U |
| Chromium Total | 2000 | 1 | 0.54 | 18.5 | 9.96 | 10.3 | 9.59 | 11.1 | 10.3 | 10.7 | 10 | 9.95 | 11.2 | 16.7 | 11.3 |
| Chromium (VI) | N/A | 0.5 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Cobalt | 15.7[c] | 2 | 0.11 | 15.7 | 8.37 | 9.4 | 8.23 | 9.07 | 8.62 | 8.83 | 8.02 | 8.52 | 8.51 | 9.76 | 8.86 |
| Copper | 284 | 1 | 0.11 | 22 | 12.4 | 12.4 | 14.8 | 15.7 | 14.1 | 14.5 | 15.4 | 15.1 | 14.4 | 14.7 | 14.5 |
| Lead | 250 | 5 | 0.11 | 10.2 | 6.08 | 6.46 | 6.87 | 8.37 | 9.84 | 29.8 | 22.9 | 10.1 | 12.4 | 18.2 | 9.97 |
| Lithium | 160 | 2.5 | NA | 33.5 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Manganese | 512[c] | 5 | 0.11 | 512 | 384 | 381 | 364 | 400 | 380 | 398 | 351 | 379 | 387 | 436 | 405 |
| Mercury | 2.09 | 0.2 | 0.054 | 0.33 | U | U | 0.0847 | U | U | U | U | U | U | U | U |
| Nickel | 130 | 4 | 0.22 | 19.1 | 10.1 | 10.8 | 9.73 | 11.6 | 11.9 | 11.4 | 9.93 | 10.6 | 10.7 | 12.5 | 11.9 |
| Selenium | 5.2 | 1 | 0.33 | 0.78 | 1.28 | 1.21 | 1.51 | 1.28 | 1.51 | 1.29 | 0.781 | 1.38 | 1.24 | 1.25 | 0.914 |
| Silver | 13.6 | 0.2 | 0.11 | 0.73 | U | U | U | U | U | U | U | U | U | U | U |
| Strontium | 2,920 | 1 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Thallium | 1.59 | 1 | 0.11 | 0.1 | 0.13 | 0.131 | U | U | U | U | U | U | U | U | U |
| Tin | 48,000 | 10 | 0.11 | N/A | 0.438 | 0.567 | 0.387 | 0.446 | 0.434 | 0.436 | 0.436 | 0.451 | 0.409 | 0.484 | 0.429 |
| Uranium | 3.21[c] | 1 | 0.11 | 3.21 | 0.411 | 1.16 | 0.376 | 0.514 | 0.487 | 0.385 | 0.407 | 0.517 | 0.408 | 0.543 | 0.462 |
| Vanadium | 560 | 2.5 | 0.22 | 85.1 | 58.4 | 57.5 | 56.2 | 60 | 58.6 | 58.6 | 52.2 | 54 | 54.4 | 65.1 | 57.8 |
| Zinc | 5970 | 1 | 0.87 | 67.8 | 44.8 | 44.7 | 44 | 50 | 47.6 | 73.9 | 56 | 57.4 | 46.3 | 52.5 | 47.3 |
| **Anion** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Nitrate-N | 40 | 0.75 | NA | 11.8 | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**Table A-2b. Analytical Results for In Process Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2BV77 T1-1 Surface | B2BV78 T1-2 Surface | B2BV80 T1-3 Surface | B2BV81 T1-4 Surface | B2BV83 T2-1 Surface | B2BV84 T2-2 Surface | B2BV85 T2-3 Surface | B2BV86 T2-4 Surface | B2BV87 T2-5 Surface | B2BVN0 C-2 Surface | B2BVN1 C-3 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polynuclear Aromatic Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Acenaphthene | 98 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthylene | 98 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Anthracene | 2,270 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(a)anthracene | 0.86 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | 0.33[c] | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | 1.37 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(k)fluoranthene | 1.37 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzo(g,h,i)perylene | 2,400 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Chrysene | 9.56 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dibenzo(a,h)anthracene | 1.37 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Fluoranthene | 631 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Fluorene | 101 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | 1.37 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Naphthalene | 4.46 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Phenanthrene | 1,140 | 0.33 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pyrene | 655 | 0.5 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Polychlorinated Biphenyls** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Aroclor 1016 | 0.094 | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1221 | 0.017[c] | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1232 | 0.017[c] | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1242 | 0.039 | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1248 | 0.039 | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1254 | 0.066 | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1260 | 0.5 | 0.017 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

**Table A-2b. Analytical Results for In Process Sampling for Nonradiological Contaminants**

| Contaminant | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2BV77 T1-1 Surface | B2BV78 T1-2 Surface | B2BV80 T1-3 Surface | B2BV81 T1-4 Surface | B2BV83 T2-1 Surface | B2BV84 T2-2 Surface | B2BV85 T2-3 Surface | B2BV86 T2-4 Surface | B2BV87 T2-5 Surface | B2BVN0 C-2 Surface | B2BVN1 C-3 Surface |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Analytes** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Carbon Tetrachloride | 0.005 | 0.005 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| **Total Petroleum Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Diesel | 2,000 | 5 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Kerosene | 2,000 | 5 | NA | N/A | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

a. Removal Action Levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1 (RAWP).

b. If Hanford Site-specific background data is not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available in nonradiological background data from DOE/RL-92-24, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology (1996), WAC 173-340-700(6)(d), and WAC 173 340 707(2), respectively.

d. Maximum reported laboratory method detection limits were greater than the required detection limit per the RAWP; however, analytical results are below the established removal action levels and meet the corresponding removal action objectives.

NA = not applicable

N/A = not available

U = analyzed for but not detected above laboratory method detection limit

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Table A-3. Analytical Results for Verification Sampling for Nonradiological Contaminants of Potential Concern

| Contaminant of Potential Concern | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2D0K3 R14-V21 1.2 m (4 ft) bgs | B2D0K4 R3-V22 1 m (3 ft) bgs | B2D0K5 R3-V23 1 m (3 ft) bgs |
|---|---|---|---|---|---|---|---|
| Metals | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) | (mg/kg) |
| Antimony | 5.4 | 0.6 | 0.3 | 5 | U | NA | NA |
| Arsenic | 6.5[c] | 1 | 0.39 | 6.5 | 5.15 | NA | NA |
| Barium | 1,650 | 2 | 0.2 | 132 | 103 | NA | NA |
| Beryllium | 63.2 | 0.5 | 0.099 | 1.51 | 0.451 | NA | NA |
| Boron | 210 | 2 | 4.3[d] | N/A | 5.97 | NA | NA |
| Cadmium | 0.81[c] | 0.5 | 0.099 | 0.81 | 0.101 | NA | NA |
| Chromium Total | 2,000 | 1 | 0.099 | 18.5 | 12.1 | NA | NA |
| Cobalt | 15.7[c] | 2 | 0.099 | 15.7 | 8.72 | NA | NA |
| Copper | 284 | 1 | 0.099 | 22 | 13.4 | NA | NA |
| Lead | 250 | 5 | 0.099 | 10.2 | 7.11 | NA | NA |
| Lithium | 160 | 2.5 | 0.42 | 33.5 | 10.9 | NA | NA |
| Nickel | 130 | 4 | 0.2 | 19.1 | 12.1 | NA | NA |
| Selenium | 5.2 | 1 | 0.3 | 0.78 | 1.54 | NA | NA |
| Silver | 13.6 | 0.2 | 0.099 | 0.73 | U | NA | NA |
| Strontium | 2,920 | 1 | 0.099 | N/A | 52.8 | NA | NA |
| Thallium | 1.59 | 1 | 0.099 | 0.1 | 0.129 | NA | NA |
| Tin | 48,000 | 10 | 0.099 | N/A | 0.467 | NA | NA |

Table A-3. Analytical Results for Verification Sampling for Nonradiological Contaminants of Potential Concern

| Contaminant of Potential Concern | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2D0K3 R14-V21 1.2 m (4 ft) bgs | B2D0K4 R3-V22 1 m (3 ft) bgs | B2D0K5 R3-V23 1 m (3 ft) bgs |
|---|---|---|---|---|---|---|---|
| Uranium | 3.21[c] | 1 | 0.099 | 3.21 | 0.595 | NA | NA |
| Vanadium | 560 | 2.5 | 0.2 | 85.1 | 52.7 | NA | NA |
| Zinc | 5,970 | 1 | 0.79 | 67.8 | 44.1 | NA | NA |
| **Polynuclear Aromatic Hydrocarbons** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** | **(mg/kg)** |
| Acenaphthene | 98 | 0.33 | 0.2 | N/A | NA | U | U |
| Acenaphthylene | 98 | 0.33 | 0.2 | N/A | NA | U | U |
| Anthracene | 2,270 | 0.33 | 0.2 | N/A | NA | U | U |
| Benzo(a)anthracene | 0.86 | 0.33 | 0.2 | N/A | NA | U | U |
| Benzo(a)pyrene | 0.33[c] | 0.33 | 0.2 | N/A | NA | U | U |
| Benzo(b)fluoranthene | 1.37 | 0.33 | 0.2 | N/A | NA | U | U |
| Benzo(k)fluoranthene | 1.37 | 0.33 | 0.2 | N/A | NA | U | U |
| Benzo(g,h,i)perylene | 2,400 | 0.33 | 0.2 | N/A | NA | U | U |
| Chrysene | 9.56 | 0.33 | 0.2 | N/A | NA | U | U |
| Dibenzo(a,h)anthracene | 1.37 | 0.33 | 0.2 | N/A | NA | U | U |
| Fluoranthene | 631 | 0.33 | 0.2 | N/A | NA | U | U |
| Fluorene | 101 | 0.33 | 0.2 | N/A | NA | U | U |
| Indeno(1,2,3-cd)pyrene | 1.37 | 0.33 | 0.2 | N/A | NA | U | U |
| Naphthalene | 4.46 | 0.33 | 0.2 | N/A | NA | U | U |

**Table A-3. Analytical Results for Verification Sampling for Nonradiological Contaminants of Potential Concern**

| Contaminant of Potential Concern | Removal Action Levels[a] | Required Detection Limit | Maximum Reported Laboratory Method Detection Limit | Background Concentration[b] | B2D0K3 R14-V21 1.2 m (4 ft) bgs | B2D0K4 R3-V22 1 m (3 ft) bgs | B2D0K5 R3-V23 1 m (3 ft) bgs |
|---|---|---|---|---|---|---|---|
| Phenanthrene | 1,140 | 0.33 | 0.2 | N/A | NA | U | U |
| Pyrene | 655 | 0.5 | 0.2 | N/A | NA | U | U |
| **Asbestos** | **(% by weight)** | **(% by weight)** | **(% by weight)** | **(% by weight)** | **(% by weight)** | **(% by weight)** | **(% by weight)** |
| Asbestos[e] | 40 | N/A | N/A | 11.8 | None | NA | NA |

a. Removal Action Levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1 (RAWP).

b. If Hanford Site-specific background data is not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values available in nonradiological background data from DOE/RL-92-24, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology (1996), WAC 173-340-700(6)(d), and WAC 173 340 707(2), respectively.

d. Maximum reported laboratory method detection limits were greater than the required detection limit per the RAWP; however, analytical results are below the established removal action levels and meet the corresponding removal action objectives.

e. Because of the nonhomogeneous nature of soils, results are reported using the following terms rather than percentages (as provided by analytical laboratory report narrative):

- None—No asbestos fibers found
- Trace detectable—With extensive searching a few fibers of the type indicated were found; concentration very low, well below 1%
- Obvious presence—Fibers easily found but overall concentration still low
- Significant presence—Fibers readily found; overall concentration may approach or exceed 1% level

NA = not applicable

N/A = not available

U = result is less than laboratory method detection limit