Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping / Pore Water Extraction

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

P.O. Box 550
Richland, Washington 99352
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Assistant Secretary for Environmental Management

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By Ashley R Jenkins at 12:56 pm, Nov 30, 2015
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Signature Sheet

Signature sheet for the Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction within the Hanford 200 Area National Priorities List (NPL) site.

M.W. Cline
U.S. Department of Energy,
Richland Operations Office

11/16/2015
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Signature Sheet

Signature sheet for the Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction within the Hanford 200 Area National Priorities List (NPL) site. This action is being conducted by the U.S. Department of Energy with the approval of the U.S. Environmental Protection Agency.


____________________
R.A. Lobos
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency

11-18-2015
Date
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Signature Sheet

Signature sheet for the Removal Action Work Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction within the Hanford 200 Area National Priorities List (NPL) site. This action is being conducted by the U.S. Department of Energy with the approval of the Washington State Department of Ecology.


[Signature]

[Date]

D. Goswami
Nuclear Waste Program
Washington State Department of Ecology
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Executive Summary

This removal action work plan (RAWP) was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and 40 CFR 300, “National Oil and Hazardous Substances Pollution Contingency Plan.” The RAWP implements DOE/RL-2014-34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction.

The 200-DV-1 Operable Unit (OU) perched water has been contaminated from past processing operations at the U.S. Department of Energy (DOE) Hanford Site. Contaminated perched water in the 200-DV-1 OU is slowly moving downward, entering the underlying 200-BP-5 OU aquifer, and could adversely impact human health and the environment (HHE). Contaminants include uranium, technetium-99, nitrate, chromium, hexavalent chromium, and tritium at concentrations above maximum contaminant levels (MCLs).

DOE, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology, collectively referred to as the Tri-Parties, have determined that a non-time-critical removal action (NTCRA) is warranted to remove the contaminated perched water. The NTCRA supports the overall cleanup objectives through the Tri-Party Agreement (Ecology et al, 1989a, Hanford Federal Facility Agreement and Consent Order), as revised. Furthermore, it promotes protection of ecological resources and restoration of the environment consistent with the goals of the Tri-Parties.

Contaminated perched water from the 200-DV-1 OU will be extracted from the perched water zone and transferred to the 200 West Pump and Treat (P&T) by truck or by

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pipeline (when the option becomes available). The extracted perched water then will be treated and injected into the aquifer below the 200 West Area. The P&T will reduce the contaminants of concern discussed in this RAWP to levels below MCLs and will be protective of HHE.

This RAWP establishes the following methods and activities required to implement the selected removal action:

- Removal action elements and how they will be implemented, including safety, health, and radiological management and controls
- Environmental management and controls, including applicable or relevant and appropriate requirements, waste management, airborne emissions, reporting for nonroutine releases, and cultural/ecological resources
- Project administration including operational criteria, cost, and schedule for the removal action, as well as post-removal action activities

This RAWP presents the optimum path forward to meet the removal action objectives regarding long-term risk, minimization of short-term worker risk and radiation exposure, provision of a cost-effective approach, and provision of a safe and stable configuration that is environmentally sound. This RAWP also identifies the basis and requirements for preparation of lower tier implementation documents.

When the 200-DV-1 OU perched water wells no longer yield sufficient amounts of water for extraction, as agreed to by the Tri-Parties, the removal action will be terminated. The perched water zone will continue to be monitored for the accumulation of contaminated water. The need for future action will be evaluated and identified in the 200-DV-1 OU Record of Decision.
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<td>as low as reasonably achievable</td>
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<td>AM</td>
<td>action memorandum</td>
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<td>ARAR</td>
<td>applicable or relevant and appropriate requirement</td>
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<td>CCU</td>
<td>Cold Creek unit</td>
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<tr>
<td>CERCLA</td>
<td><em>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</em></td>
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<tr>
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<td>contaminant of concern</td>
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<tr>
<td>CHPRC</td>
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<td>IC</td>
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<td>IX</td>
<td>ion exchange</td>
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<tr>
<td>MCL</td>
<td>maximum concentration level</td>
</tr>
<tr>
<td>NA</td>
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<td>radiological work permit</td>
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<td>S&amp;GRP</td>
<td>Soil and Groundwater Remediation Project</td>
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<td>sampling and analysis plan</td>
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<td>Sample Management and Reporting</td>
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1 Introduction

This removal action work plan (RAWP) implements the 200-DV-1 Operable Unit (OU) perched water removal action, as specified in an action memorandum (AM) (DOE/RL-2014-34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction). This RAWP was prepared in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The selected alternative was recommended in an engineering evaluation/cost analysis (DOE/RL-2013-37, Engineering Evaluation/Cost Analysis for Perched Water Pumping/Pore Water Extraction).

Specifically, this RAWP provides details for implementing a non-time-critical removal action (NTRCA) for the 200-DV-1 OU perched water underlying the B Tank Farm complex. The removal action includes extracting perched water from the 200-DV-1 OU and transferring the water by truck or pipeline to the 200 West Pump and Treat (P&T), where the water is treated and then injected into the aquifer below the 200 West Area. This removal action will minimize the release or threat of release of hazardous substances from the 200-DV-1 OU perched water. Without this removal action, contaminated perched water could adversely impact human health and the environment (HHE).

This removal action is designed to recover and treat as much perched water as practical. When the 200-DV-1 OU perched water wells no longer yield sufficient amounts of water for extraction, this removal action will be terminated. The decision to terminate removal activities will be agreed upon by the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology), collectively referred to as the Tri-Parties. Additional actions, if needed, will be identified in the 200-DV-1 OU Record of Decision (ROD).

1.1 Purpose

The purpose of this RAWP is to establish the methods and activities required to implement the selected removal action and describe the following components:

- Removal action elements and how they will be implemented, including safety, health, and radiological management and controls
- Environmental management and controls, including applicable or relevant and appropriate requirements (ARARs), waste management, airborne emissions, reporting for nonroutine releases, and cultural/ecological resources
- Project administration, including operational criteria, cost, and schedule for the removal action, as well as post-removal action activities

This RAWP identifies the basis and requirements for preparation of lower tier implementation documents.

This removal action is consistent with the overall Hanford Site cleanup initiative and will contribute to the efficient performance of anticipated long-term remedial actions, as required by 40 CFR 300, “National Oil and Hazardous Substances Pollution Contingency Plan.” To accomplish this, the following removal action objectives were identified in the AM (Section 5.1 of DOE/RL-2014-34):

- Apply institutional controls (ICs) to protect human receptors from exposure to contaminants that exceed maximum contaminant levels (MCLs) in the underlying aquifer.
- Control sources of groundwater contamination.
• Remove contaminant mass from perched water and support final remedial options for both the 200-DV-1 and 200-BP-5 OUs.

DOE is the lead agency for this removal action, with review and approval by EPA and Ecology.

1.2 Scope

The scope of this RAWP is limited to the extraction, transport, treatment, and disposal of contaminated perched water from the 200-DV-1 OU. Extracted perched water contains the following contaminants of concern (COCs): uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium. The concentrations of these COCs exceed MCLs and represent the primary risk to the underlying groundwater and HHE. The COCs, with the exception of tritium, will be treated at the 200 West P&T to concentrations below MCLs in order to meet the aquifer injection criteria. There is no treatment method for tritium; however, the resulting combined discharge concentration from the 200 West P&T is expected to be below the MCL. Removal and treatment of COCs from perched water at the 200 West P&T meet the requirements of the AM (DOE/RL-2014-34) and this RAWP.

1.3 Site Conditions and Background

The following subsections provide an overview of site conditions and background information for the Hanford Site and the 200-DV-1 OU perched water.

1.3.1 Physical Location

The Hanford Site lies within the semiarid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 1). The area is located north of the confluence of the Columbia, Yakima, and Snake Rivers and encompasses approximately 1,517 km² (586 mi²). Except for portions of the Site modified by past plutonium-production-related activities and current DOE operations and remediation, the Hanford Site is a relatively undeveloped area of shrub-steppe habitat (a drought-resistant, shrub and grassland ecosystem). The area contains a rich diversity of plant and animal species.

Elevations across the central portion of the basin and the Hanford Site range from approximately 119 m (390 ft) above mean sea level at the Columbia River to 1,060 m (3,480 ft) above mean sea level at Rattlesnake Mountain (located along the southern boundary of the Hanford Site). Public access to the Hanford Site is currently restricted and controlled at the Wye Barricade on Route 4 and the Yakima and Rattlesnake Barricades on State Highway 240.

The Hanford Site was selected for plutonium production in 1942 as part of the Manhattan Project, primarily because of the availability of water from the Columbia River and access to power from the Bonneville and Grand Coulee Dams. The remote location and weather conditions of the area, which allowed for nearly year-round construction, also contributed to the selection. Between 1943 and 1964, nine plutonium-production reactors were built along the Columbia River in six areas: 100-BC (two reactors), 100-K (two reactors), 100-N, 100-D (two reactors), 100-H, and 100-F (Figure 1).

The environmental cleanup mission at the Hanford Site began in 1989, following a plutonium-production era that lasted from 1943 to 1989. During plutonium production, the Hanford Site was divided into production areas, including the 200 East and 200 West Areas, which contain the major nuclear fuel processing, waste management, and disposal facilities. The historical designations for the 200 East and 200 West Areas are used in context throughout this RAWP, where appropriate.
The Hanford Site Central Plateau includes two principal areas (Figure 1):

- **Inner Area**: Defined as the final footprint area of the Hanford Site, the Inner Area is required for permanent waste management and control of residual contamination. The boundary of the Inner Area is defined by waste disposal decisions already in place and the anticipated future decisions that will result in the requirement for continued waste management and control of residual contamination. The Inner Area is approximately 25 km$^2$ (10 mi$^2$) in size and will remain under federal ownership and control in perpetuity.

- **Outer Area**: The Outer Area is that portion of the Central Plateau beyond the boundary of the Inner Area. Contaminated soil and debris removed as part of Outer Area cleanup will be placed within the Inner Area for final disposal. Completion of cleanup for the approximately 170 km$^2$ (65 mi$^2$) Outer Area will shrink the active footprint of cleanup for the Central Plateau to the Inner Area.

The 200-DV-1 OU is located within the Inner Area, and the 200 West P&T is located within the Outer Area (Figure 1).

Liquid wastes discharged from former Hanford Site operations are considered the most significant type of discharge to the environment in terms of volume and number of constituents. Detailed information on the historical operations and waste generation mechanisms is provided in DOE/RL-2010-89, *Long-Range Deep Vadose Zone Program Plan*.

The B, BX, and BY Tank Farm complex and associated cribs, tile fields, and unplanned releases are sources of contamination found in perched water in the 200-DV-1 OU. The location of the perched water is shown in Figure 2. A southwest-northeast sectional view of the perched water area is shown in Figure 3. Figure 3 is based on hydrologic and geologic data from wells along the section line (L1-L1') shown in Figure 2.

Contaminated perched water is contained within a localized, silty sand lens deposited in a structural low on top of a low-permeability silt layer in the Cold Creek unit (CCU). The top of the contaminated silty sand lens is between approximately 67 and 68.6 m (220 and 225 ft) below ground surface. The maximum thickness of the lens is approximately 4.6 m (15 ft). The lateral and vertical extent of the perched water is limited to the region containing the silty sand lens and underlying lower perching silt layer. The bottom of the silty sand lens is approximately 4.6 m (15 ft) above the unconfined aquifer at its lowest point.

The underlying silt layer forms a natural barrier that slows contaminant migration from the perched water within the lens to the underlying 200-BP-5 OU. The conceptual site model and detailed information for the perched water zone are provided in SGW-58147, *Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction Fiscal Year 2014*. The conceptual site model is summarized in Appendix A of this RAWP.

The areal extent of the perched water is estimated to be 19,175 m$^2$ (206,398 ft$^2$). Detailed information on the estimated extent is provided in PNNL-22499, *Perched-Water Evaluation for the Deep Vadose Zone Beneath the B, BX, and BY Tank Farms Area of the Hanford Site*.

### 1.3.2 Release or Threatened Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

The extracted perched water contains COCs (uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium) at concentrations that exceed the MCLs and that represent the primary risk to the underlying groundwater and HHE. Table 1 provides the concentrations of these COCs and other radioactive and nonradioactive constituents in perched water extracted from well 299-E33-344 from September 2011 to February 2013. Distributions of uranium, technetium-99, and nitrate in groundwater...
near the 200-DV-1 OU perched water area for 2012 are shown on Figures 4, 5, and 6 of the AM (DOE/RL-2014-34).
Figure 2. Plan View of the 200-DV-1 OU Perched Water Area
Figure 3. Southwest-Northeast Section View of the 200-DV-1 OU Perched Water Area

Table 1. Well 299-E33-344 Perched Water Sampling Data

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<tr>
<td>Uranium</td>
<td>µg/L</td>
<td>4,500</td>
<td>63,600</td>
<td>71,500</td>
<td>51,500</td>
<td>26,600</td>
<td>37,300</td>
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<tr>
<td>Technetium-99</td>
<td>pCi/L</td>
<td>5,640</td>
<td>37,800</td>
<td>45,100</td>
<td>22,100</td>
<td>12,200</td>
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<td>103</td>
<td>118</td>
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<tr>
<td>Total chromium</td>
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<td>Hexavalent chromium</td>
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<td>98.5</td>
<td>87.2</td>
<td>82.1</td>
<td>84.4</td>
<td>85</td>
<td>250</td>
</tr>
<tr>
<td>Fluoride</td>
<td>mg/L</td>
<td>60.2</td>
<td>13.1</td>
<td>9.4</td>
<td>15.1</td>
<td>12.2</td>
<td>7.9</td>
<td>4</td>
</tr>
<tr>
<td>Nitrite as N</td>
<td>µg/L</td>
<td>U</td>
<td>88.3</td>
<td>55.1</td>
<td>127.0</td>
<td>U</td>
<td>U</td>
<td>1,000</td>
</tr>
<tr>
<td>Sulfate</td>
<td>mg/L</td>
<td>483</td>
<td>603</td>
<td>627</td>
<td>529</td>
<td>540</td>
<td>600</td>
<td>250</td>
</tr>
</tbody>
</table>

b. Does not have an MCL.
c. Secondary MCL.

MCL = maximum contaminant level
NA = not analyzed
U = undetected

1.3.3 Previous Perched Water Extraction Activities

In August 2011, extraction of the contaminated 200-DV-1 OU perched water was initiated to collect information on the perched zone and reduce migration of contamination to the unconfined aquifer. Well 299-E33-344 was configured for use as the extraction well (Figure 2). Cyclical perched water pumping from this well has continued in accordance with DOE/RL-2011-40, Field Test Plan for the Perched Water Pumping/Pore Water Extraction Treatability Test.

A dedicated submersible pump installed in well 299-E33-344 has an automatic on/off pump control provided by water-level transducers (Figure 4). When the perched water level in well 299-E33-344 reaches the high-level set point of 2.1 m (7 ft) above the pump, the pump turns on and the water is pumped into an aboveground water collection container located near the wellhead (approximately 23 to 27 L [6 to 7 gal] per cycle). Once pumping lowers the water level to the low-level set point of 0.15 m (0.5 ft) above the pump, the pump shuts off to allow water from the perched zone to refill the well. The duration of this on/off cycle is typically 25 to 35 minutes. This phase of the perched water extraction is referred to as gravity drain because recharge of the well occurs naturally.

As of September 2014, approximately 882,000 L (233,000 gal) of perched water have been extracted (Chapter 2 of SGW-58147). Based on sampling data, approximately 49 kg (108 lb) of uranium, 1.7 g (0.004 lb) of technetium-99, and 471 kg (1,037 lb) of nitrate have been removed from the perched zone (Table 2).
Figure 4. Configuration of Perched Water Extraction Well 299-E33-344
### Table 2. Perched Water Extracted and Contaminants Removed from Well 299-E33-344

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Perched Water Extracted (L)</th>
<th>Uranium Removed (kg)</th>
<th>Technetium-99 Removed (g)</th>
<th>Nitrate Removed (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>08/2011 to 09/2012</td>
<td>246,657</td>
<td>12.0</td>
<td>0.37</td>
<td>131.0</td>
</tr>
<tr>
<td>2013</td>
<td>10/2012 to 09/2013</td>
<td>349,367</td>
<td>13.1</td>
<td>0.74</td>
<td>202.6</td>
</tr>
<tr>
<td>2014</td>
<td>10/2013 to 09/2014</td>
<td>286,222</td>
<td>24.1</td>
<td>0.59</td>
<td>137.2</td>
</tr>
<tr>
<td>Total</td>
<td>08/2011 to 09/2014</td>
<td>882,246</td>
<td>49.2</td>
<td>1.70</td>
<td>470.9</td>
</tr>
</tbody>
</table>
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2 Removal Action Elements

The 200-DV-1 OU perched water removal action consists of three primary elements: extraction of perched water from the subsurface, transfer of the water to the 200 West P&T, and treatment and disposal of the water at the 200 West P&T.

2.1 Removal Action Work Activities

Gravity drainage of water and cyclical pumping will be the primary method of extracting water from the perched water extraction well (299-E33-344) and the two additional perched water wells (299-E33-350 and 299-E33-351) that were installed in 2014 (Figure 2). The two new perched water extraction wells (299-E33-350 and 299-E33-351) will be configured similarly to well 299-E33-344 (Figure 4). Perched water will be removed from all three wells by using gravity to drain contaminated water into the wells and dedicated pumps to extract the water to a container on the ground surface near the wells. The water will then be transferred by tanker truck to the 200 West P&T, where the water will be treated to remove contaminants and then injected into the aquifer beneath the 200 West Area. The perched water may alternatively be transferred to the 200 West P&T by pipeline once a pipeline is constructed. The perched water removal work activities are shown in Figure 5.

Two additional phases of perched water extraction were included in the treatability test plan (DOE/RL-2011-40). The second phase would add a vacuum system to accelerate recharge into the well, thus increasing the removal capacity. This phase is referred to as vacuum-enhanced recovery of perched water. The third phase of pumping, which would occur as drainable perched water is reduced, would continue to use the vacuum system to extract pore water from the perched zone to maximize contaminant removal. This phase is referred to as pore water extraction.

With three wells in operation, the rate of perched water removal is expected to increase, and the static water level in the wells is expected to decrease. This three-well system will establish performance data to estimate the remediation time for removing a significant portion of the perched water. Assessment of these data will guide a decision regarding whether and when to implement the additional phases of extraction.

The second phase of perched water extraction (vacuum-enhanced recovery) could be implemented when levels and yields from the perched zone significantly decrease. The anticipated initial yield from all three wells is between 17,000 and 23,000 L (4,500 and 6,000 gal) per week. When the volume of perched water extracted decreases to between 4,000 and 6,000 L (1,000 and 1,500 gal) per week, consideration will be given to implementing vacuum-enhanced recovery. A vacuum would be applied to at least one extraction well.
As the perched water is removed, the perched zone will start to become unsaturated. Once the perched zone is in a mostly unsaturated condition, a higher vacuum would be applied to induce pore water extraction. Vacuum-enhanced recovery in the unsaturated zone will remove soil vapor with entrained pore water. Some pore water extraction could be initiated when vacuum-enhanced recovery of the perched water begins because parts of the well screens are above the top of the perched water. As the perched water is pumped out, the fraction of recovered water represented by pore water extraction will increase. Transition from vacuum-enhanced recovery to pore water extraction is anticipated to be gradual. Pore water extraction may be continued after vacuum-enhanced recovery of perched water has diminished to negligible amounts.

Different vacuums and operating cycles may be evaluated during the vacuum-enhanced recovery and pore water extraction phases to obtain additional information on the subsurface hydraulic conditions and perched water extent.

This removal action is designed to remove as much perched water as practical while awaiting issuance of the 200-DV-1 OU ROD. When the three perched water wells no longer yield sufficient amounts of water for extraction, as agreed upon by the Tri-Parties, the removal action will be terminated.

2.2 Field Activities

The following subsections describe the field activities associated with this removal action.
2.2.1 Perched Water Well Field Activities
Activities performed at the well field may include, but are not necessarily limited to, the following:

- Cyclical pumping of up to three wells to remove perched water
- Collecting the extracted perched water in a nearby aboveground container
- Performing water-level and electrical conductivity measurements in the collection container
- Collecting baseline samples of perched water prior to initiating extraction operations under this removal action
- Collecting samples of extracted perched water from the wells and the collection container during extraction operations

Field sampling activities are described in DOE/RL-2014-51, *Sampling and Analysis Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*. If the vacuum-enhanced recovery and/or pore water extraction phases are implemented, any additional well field activities will be described in a supplemental sampling and analysis plan (SAP) or SAP addendum. If vacuum-enhanced recovery is used, air emissions will be monitored in accordance with the air emission plan for 200-DV-1 OU vacuum-enhanced recovery/pore water extraction (Appendix C of this RAWP).

2.2.2 Perched Water Transportation Activities
The 200-DV-1 OU extracted perched water will be pumped from the collection container located in the well field into a tank truck. The truck will transport the water to the 200 West P&T, where the water will be pumped into a holding tank. When available as an alternative, 200-DV-1 OU perched water will be conveyed by pipeline to the 200 West P&T. The water will be periodically drained from the collection container to the pipeline. The pipeline from the 200-DV-1 OU perched water wells will feed into the transfer pipeline for the 200-BP-5 OU extraction wells. The tank truck route and planned pipeline route are depicted in Figure 6.

2.2.3 Perched Water Treatment and Disposal
The 200-DV-1 OU extracted perched water will be treated at the 200 West P&T to reduce COC concentrations (with the exception of tritium) to below MCLs. A treatment method is not available for tritium; however, the resulting combined discharge concentration from 200 West P&T is expected to be below the MCL. The treatment approach involves multiple steps to remove the various COCs.

The 200 West P&T treatment steps are shown in Figure 7. The treatment process is summarized in this section, and additional details are provided in DOE/RL-2009-124, *200 West Pump and Treat Operations and Maintenance Plan*.

Influent contaminated water is first filtered to remove fine particulate matter. The 200-DV-1 OU extracted perched water is blended with uranium-contaminated groundwater from the 200-UP-1 OU and 200-BP-5 OU extraction wells, and with other potential sources, in the blended water feed tank. The blended water then flows through the uranium ion exchange (IX) vessels to remove the uranium. Water from the uranium system is then combined with groundwater from the 200-ZP-1 OU and other technetium-99-contaminated groundwater that did not contain uranium contamination. This combined water then passes through another set of filters to remove fine particulates and then flows through the technetium-99 IX vessels to remove technetium-99. The water then passes through a final set of filters before being transferred to the central treatment facility for biological treatment of nonradioactive COCs.
Figure 6. Tanker Truck and Planned Pipeline Transfer Routes from the 200-DV-1 OU Perched Water Area to the 200 West P&T

Figure 7. 200 West P&T Activities

Water from the technetium-99 process is blended with groundwater without elevated radiological contamination in an equalization tank in the biotreatment facility. Water is pumped from the equalization tank to a recycle tank (used to recycle contaminated water removed downstream) and then into the bottom of the fluidized bed reactor, creating upflow to suspend the granular activated carbon bed media to which
microorganisms attach and grow. Within the fluidized bed reactor, nitrate is converted to nitrogen gas (denitrification), hexavalent chromium is converted to the trivalent form, and carbon tetrachloride (a 200-ZP-1 OU and 200-UP-1 OU contaminant) is degraded by the microorganisms under anoxic conditions (i.e., in the absence of dissolved oxygen).

Effluent from the fluidized bed reactor flows by gravity to aerobic membrane tanks for removal of total suspended solids, including precipitated chromium. The water passes through other process components to remove sludge and optimize treatment operations. The treated water is collected in an effluent holding tank and then piped to 200 West P&T injection wells and injected into the aquifer below the 200 West Area.

The anticipated blended influent concentrations will be within the design envelope for the influent to the 200 West P&T. The anticipated influent concentrations for the 200 West P&T are provided in Table 3. Periodic re-evaluation of perched water concentrations will be performed as needed. The operations and maintenance plan (DOE/RL-2009-124) was modified to incorporate operational and monitoring changes based on receiving the 200-DV-1 OU extracted water for treatment. The treated effluent will meet the treated effluent injection ARARs identified in the 200-ZP-1 OU ROD (EPA et al., 2008, Record of Decision, Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington) and 200-UP-1 OU ROD (EPA et al., 2012, Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit).

Table 3. Estimated Influent Water Quality to 200 West P&T Unit Processes

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Average Uranium Pre-Treatment</th>
<th>Average Technetium-99 Pre-Treatment</th>
<th>Average Main Treatment Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>COCs*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>79 µg/L</td>
<td>548 µg/L</td>
<td>716 µg/L</td>
</tr>
<tr>
<td>Trichloroethene</td>
<td>1.0 µg/L</td>
<td>3.1 µg/L</td>
<td>3.3 µg/L</td>
</tr>
<tr>
<td>Chromium (total)</td>
<td>24 µg/L</td>
<td>39 µg/L</td>
<td>23 µg/L</td>
</tr>
<tr>
<td>Hexavalent chromium</td>
<td>14 µg/L</td>
<td>32 µg/L</td>
<td>20 µg/L</td>
</tr>
<tr>
<td>Nitrate as nitrogen</td>
<td>101 mg/L</td>
<td>64 mg/L</td>
<td>31 mg/L</td>
</tr>
<tr>
<td>Radionuclide COCs*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iodine-129</td>
<td>1.82 pCi/L</td>
<td>0.90 pCi/L</td>
<td>0.37 pCi/L</td>
</tr>
<tr>
<td>Technetium-99</td>
<td>4,374 pCi/L</td>
<td>928 pCi/L</td>
<td>70 pCi/L</td>
</tr>
<tr>
<td>Tritium</td>
<td>8,002 pCi/L</td>
<td>6,717 pCi/L</td>
<td>2,864 pCi/L</td>
</tr>
<tr>
<td>Uranium</td>
<td>1,371 µg/L</td>
<td>5.6 µg/L</td>
<td>2.5 µg/L</td>
</tr>
<tr>
<td>Other Constituents*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkalinity (as CaCO₃)</td>
<td>132 mg/L</td>
<td>114 mg/L</td>
<td>104 mg/L</td>
</tr>
<tr>
<td>Calcium</td>
<td>104 mg/L</td>
<td>81 mg/L</td>
<td>68 mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>43 mg/L</td>
<td>28 mg/L</td>
<td>31 mg/L</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.002 mg/L</td>
<td>0.006 mg/L</td>
<td>0.009 mg/L</td>
</tr>
</tbody>
</table>
Table 3. Estimated Influent Water Quality to 200 West P&T Unit Processes

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Average Uranium Pre-Treatment</th>
<th>Average Technetium-99 Pre-Treatment</th>
<th>Average Main Treatment Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride</td>
<td>0.32 mg/L</td>
<td>0.41 mg/L</td>
<td>0.31 mg/L</td>
</tr>
<tr>
<td>Iron</td>
<td>0.11 mg/L</td>
<td>0.06 mg/L</td>
<td>0.18 mg/L</td>
</tr>
<tr>
<td>Magnesium</td>
<td>32 mg/L</td>
<td>25 mg/L</td>
<td>22 mg/L</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.01 mg/L</td>
<td>0.003 mg/L</td>
<td>0.006 mg/L</td>
</tr>
<tr>
<td>Potassium</td>
<td>8.7 mg/L</td>
<td>6.6 mg/L</td>
<td>5.2 mg/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>58 mg/L</td>
<td>41 mg/L</td>
<td>21 mg/L</td>
</tr>
<tr>
<td>Sulfate</td>
<td>129 mg/L</td>
<td>78 mg/L</td>
<td>56 mg/L</td>
</tr>
<tr>
<td>Total organic carbon</td>
<td>1.61 mg/L</td>
<td>0.99 mg/L</td>
<td>0.76 mg/L</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>2.28 mg/L</td>
<td>1.29 mg/L</td>
<td>0.35 mg/L</td>
</tr>
<tr>
<td>Total dissolved solids</td>
<td>569 mg/L</td>
<td>251 mg/L</td>
<td>68 mg/L</td>
</tr>
</tbody>
</table>


Note: The COCs listed in this table are identified in the 200-ZP-1 OU ROD (EPA et al., 2008, Record of Decision, Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington) and the 200-UP-1 OU ROD (EPA et al., 2012, Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit). The other constituents are identified as those of interest in the performance monitoring plan (DOE/RL-2009-115, Performance Monitoring Plan for the 200-ZP-1 Groundwater Operable Unit Remedial Action). Concentrations are based on estimates included in engineering design documents.

* Concentrations for COCs and other constituents are 5-year averages.

COC = contaminant of concern

ROD = Record of Decision

OU = operable unit
3 Safety and Health Management and Controls

This chapter describes safety and health management and the controls that will be performed for this removal action. These controls are necessary for worker safety, site safety, and environmental protection.

3.1 Emergency Management

The CH2M HILL Plateau Remediation Company (CHPRC) Emergency Management Program (e.g., preparedness, planning, and response) complies with DOE/RL-94-02, Hanford Emergency Management Plan, and applicable DOE orders. This program establishes a coordinated emergency response organization for planning, response, and recovery from industrial, security, and hazardous material incidents. Emergency action plans for CHPRC-managed hazardous facilities identify the capabilities necessary to respond to emergency conditions, provide guidance and instruction for initiating emergency response actions, and serve as a basis for training personnel in emergency actions for each facility.

3.2 Safeguards and Security

Access to the Hanford Site (including the removal action area and treatment area) is restricted and controlled by DOE with items such as fences, signs, and security personnel.

3.3 Health and Safety Program

The health and safety plan (HASP) is required to protect personnel from environmental hazards associated with hazardous substances (both chemical and radiological), as well as physical hazards. The HASP specifies the physical and administrative controls to protect both personnel and the environment.

3.3.1 Worker Safety Program

Work activities identified in this RAWP are regulated under 29 CFR 1910.120, “Occupational Safety and Health Standards,” “Hazardous Waste Operations and Emergency Response.” The CHPRC Health and Safety Program includes all procedures for occupational safety and industrial hygiene developed and implemented to protect the health and safety of workers. The Health and Safety Program meets the requirements of 29 CFR 1910.120 for a written safety and health program. The CHPRC Soil and Groundwater Remediation Project (S&GRP) HASP (SGW-41472, Soil and Groundwater Remediation Project Site Specific Health and Safety Plan (HASP)) is an extension of the overall CHPRC Safety and Health Program. The HASP (SGW-41472) identifies the controls necessary to mitigate general hazards that can be encountered within the project. The controls to mitigate task-specific hazards are identified and evaluated in task-specific job hazard analyses as part of the work package development process.

3.3.2 Integrated Safety Management System

The Integrated Safety Management System is incorporated into all work activities. The program includes the following elements:

- Organizational structure that specifies the official chain of command and the overall responsibilities of supervisors and employees
- Comprehensive work plan developed before work begins at a site to identify operations and objectives and to address the logistics and resources required to accomplish project goals
- Comprehensive hazard analysis when workers could be exposed to hazardous substances (both chemical and radiological), as well as physical hazards
- Worker training commensurate with individual job duties and work assignments
• Medical surveillance program administered to comply with the requirements of 29 CFR 1910.120
• CHPRC procedures, as well as project- and task-specific implementing plans and procedures
• Voluntary protection plan

3.3.3 Health and Safety Plan and Activity Hazards Analysis
Access and work activities are controlled in accordance with approved work packages, as required by established internal work requirements and procedures. The S&GRP HASP (SGW-41472) identifies how the required HASP elements are integrated into the work control process:

• Safety and health hazard analysis identifying hazards and their mitigations
• Employee training assignments
• Personal protective equipment (PPE) to be used by employees for tasks and operations
• Medical surveillance requirements
• Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques
• Site control measures
• Decontamination procedures
• Emergency response plan, including necessary PPE and other equipment
• Confined space entry procedures
• Spill containment measures

As part of work package development, a job hazards analysis is completed to identify and control hazards associated with the work tasks. Before work and activities begin, a pre-job briefing is held with the involved workers. This briefing includes a review of the hazards that may be encountered and the associated safety requirements.

3.3.4 Radiological Controls and Protection
The Radiological Controls and Protection Program is defined in DOE-approved programs and approved procedures. The Radiological Controls and Protection Program implements CHPRC policy to reduce safety and health risks to levels that are as low as reasonably achievable (ALARA) and to ensure the adequate protection of workers. The CHPRC Radiological Protection Program complies with the requirements of 10 CFR 835, “Occupational Radiation Protection.” Appropriate dosimetry, radiological work permit (RWP), PPE, ALARA planning, periodic surveys, and radiological control technician (RCT) support is also provided.

In addition to the HASP, the RWP is prepared as needed for work in areas with potential radiological hazards. The RWP extends the Radiological Protection Program to the specific work site or operation. All personnel assigned to the project and all work site visitors must strictly adhere to the provisions identified in the HASP and RWP.

Radiological control requirements are assessed as necessary. These controls will identify specific requirements for activities, such as periodic or continuous radiation monitoring by RCTs. The ALARA planning process will be used to identify contamination control requirements, radiation monitoring

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6 Worker safety and health standards are not environmental standards per se and, therefore, are not potential ARARs. Instead, compliance with applicable safety and health regulations is required external to the CERCLA ARAR process.
requirements, and other radiation control requirements for the individual tasks conducted during the removal action.

Measures also are taken to minimize the possibility of releases to the environment. The air emission plan for 200-DV-1 OU perched water pumping/pore water extraction removal action (Appendix C of this RAWP) addresses the radionuclide inventory and activities that could cause potential release of this inventory, but not to the exclusion of 10 CFR 835 requirements. Radiological worker exposure is monitored using approved occupational radiological protection methods.
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4 Environmental Management and Controls

This chapter describes the environmental management and controls necessary to conduct this removal action.

4.1 Applicable or Relevant and Appropriate Requirement Compliance

ARARs for this removal action are identified in Appendix A of the AM (DOE/RL-2014-34). The key ARARs include standards for waste management, control of releases to the environment, reporting of nonroutine releases to the environment, and protection of cultural and ecological resources. Influent acceptance criteria for the 200 West P&T were also identified as to be considered (TBC) criteria for this removal action. ARARs and TBC criteria are specified and will be implemented in lower tier work control documents and procedures. Appendix B of this RAWP provides the implementation/action strategy for ARARs and TBCs.

4.2 Waste Management Plan

Several waste streams may be generated from this removal action, such as low-level, dangerous, and mixed waste. Purge water may also be generated from well pumping, extracting, and/or sampling activities. Waste will be generated at two primary locations: the 200 West P&T, and the perched water extraction well field within the B Tank Farm complex. Waste generated from this removal action will comply with ARARs and TBC criteria. Solid waste generated through implementation of this removal action will be disposed at the Environmental Restoration Disposal Facility (ERDF) in accordance with WCH-191, Environmental Restoration Disposal Facility Waste Acceptance Criteria. Waste treatment and/or disposal may take place at other facilities on the Hanford Site or at an offsite facility that has been authorized by respective EPA regional offices in accordance with 40 CFR 300.440, “Procedures for Planning and Implementing Off-Site Response Actions.”

In accordance with Section 5.2.3 of the AM (DOE/RL-2014-34), the 200-DV-1 OU perched water pumping/pore water extraction removal action well sites and the ERDF are considered a single site for response purposes.

In accordance with Section 5.2.3 of the AM (DOE/RL-2014-34), the 200-DV-1 OU perched water pumping/pore water extraction removal action well sites and the 200 West P&T are considered to be a single site for response purposes.

Waste generated from the removal action at the well field is considered to be investigation-derived waste and will be managed in accordance with DOE/RL-2012-20, Waste Control Plan for the 200-DV-1 Operable Unit.

Waste generated from treatment of extracted perched water at the 200 West P&T will be managed in accordance with the waste management plan for the 200 West P&T (Appendix B of DOE/RL-2009-124).

4.3 Standards Controlling Releases to the Environment

For radiological and nonradiological emissions, the air emission plan for 200-DV-1 OU perched water pumping/pore water extraction is provided in Appendix C of this RAWP. The air emissions plan demonstrates compliance with the ARARs identified in WAC 246-247, “Radiation Protection—Air Emissions”; WAC 173-480; WAC 173-400, “General Regulations for Air Pollution Sources”; and WAC 173-460, “Controls for New Sources of Toxic Air Pollutants.” The air monitoring plan for the 200 West P&T (Appendix C of DOE/RL-2009-124) provides radiological requirements, criteria/toxic air emissions calculations, and control/monitoring requirements for activities at the 200 West P&T.
4.4 Reporting Requirements for Nonroutine Releases

Immediate notification to the National Response Center upon discovery of the release of a hazardous substance into the environment in excess of a reportable quantity is required in accordance with 40 CFR 302, “Designation, Reportable Quantities, and Notification.”

In accordance with 40 CFR 355, “Emergency Planning and Notification,” immediate notification to the local emergency planning committee and to the State Emergency Response Commission is required for a release of a reportable quantity of an extremely hazardous substance, comprehensive release of a reportable quantity of an extremely hazardous substance, or a CERCLA hazardous substance.

4.5 Cultural and Ecological Resources

Protection of cultural resources is addressed in the Archeological and Historic Preservation Act of 1974, National Historic Preservation Act of 1966, and Native American Graves Protection and Repatriation Act of 1990. These federal acts mandate the identification and protection of archeological objects and historical data, including human remains, funerary objects, sacred objects, and objects of cultural significance. Prior to earth-disturbing activities (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented by Mission Support Alliance (MSA). Culturally significant items will be identified and documented, if found. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report prepared by MSA.
5 Project Administration

This chapter describes the management approach for implementing the removal action, including cost and schedule summary information, and a description of the project team; change management; training and qualifications; quality assurance (QA); and post-removal action activities.

5.1 Cost

The projected cost for this removal action was documented in the environmental evaluation/cost analysis (DOE/RL-2013-37). The estimate was prepared in accordance with EPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, in which the cost for alternatives over time were calculated as present-worth costs, which are sometimes referred to as “net present value.”

The cost estimate summary was based on the best available information regarding the anticipated scope of the selected alternative. Changes in the cost elements are likely to occur based on new information and data collected during engineering design and performance of the removal action. The cost estimate is expected to be within -30 to +50 percent of the actual project cost. If actual costs are not within -30 to +50 percent of the estimated cost, the basis for the revised costs will be documented in a memorandum placed in the Administrative Record file.

Table 4 provides the present-worth cost estimate for the 200-DV-1 OU perched water removal action (based on 2013 dollars). The pipeline to the 200 West P&T is planned to support transport of groundwater from the 200-BP-5 OU and perched water from the 200-DV-1 OU to the 200 West P&T for treatment and disposal. The majority of the costs support the removal action for the 200-BP-5 OU. For this reason, pipeline costs are not included.

<table>
<thead>
<tr>
<th>Removal Action</th>
<th>Present-Worth Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extracting, transporting via tanker truck, and treating the 200-DV-1 OU perched water at the 200 West P&amp;T.</td>
<td>$1,598,450</td>
</tr>
</tbody>
</table>

Note: The accuracy range of the cost estimate is -30 percent to +50 percent.

5.2 Schedule

The removal action project is scheduled to begin in fiscal year 2016. The uranium treatment capability has been installed at the 200 West P&T, which will have the infrastructure for receiving the extracted perched water in fiscal year 2016. Until then, perched water from the 200-DV-1 OU will continue to be treated at the Effluent Treatment Facility. When the 200-DV-1 OU perched water wells no longer yield sufficient amounts of water for extraction, as described in Section 5.7 and as agreed to by the Tri-Parties, the removal action will be terminated.

5.3 Project Team

CHPRC will conduct the removal action on behalf of DOE, who has responsibility for the removal action. This section describes the management responsibilities identified for this removal action.
5.3.1 DOE-RL Project Manager
The DOE Richland Operations Office (DOE-RL) project manager is responsible for the following tasks:

- Monitoring CHPRC performance of the perched water removal action for the 200-DV-1 OU
- Obtaining EPA and Ecology approval of the RAWP
- Authorizing removal action activities
- Approving the RAWP
- Functioning as primary interface with regulators

5.3.2 DOE-RL Technical Lead
The DOE-RL technical lead is responsible for the following tasks:

- Providing day-to-day oversight of CHPRC workscope performance
- Working with CHPRC, EPA, and Ecology to identify and resolve technical issues
- Providing technical input to the DOE-RL project manager

5.3.3 200-DV-1 Operable Unit Project Manager
The 200-DV-1 OU project manager (or designee) is responsible and accountable for the following tasks:

- Project-related activities
- Coordinating with DOE-RL, regulators, and CHPRC management in support of the 200-DV-1 OU removal action activities to ensure that work is performed safely and cost effectively
- Managing documents and requirements, field activities, and subcontracted tasks and ensuring that the project file is properly maintained

5.3.4 200 West P&T Operations Manager
The 200 West P&T operations manager is responsible for all 200 West P&T operations, including managing offloading of the 200-DV-1 OU perched water tank trucks and treatment/disposal of the perched water in accordance with DOE/RL-2009-124.

5.3.5 200-DV-1 Operable Unit Technical Lead
The 200-DV-1 OU technical lead is responsible for the following tasks:

- Developing specific removal action design, analytical requirements, and quality control (QC) requirements either independently or as defined through a systematic planning process
- Ensuring that removal action activities as delegated by the 200-DV-1 OU project manager are carried out in accordance with the lower tier implementation documents
- Working closely with the environmental compliance officer (ECO), QA, Health and Safety, the field work supervisor (FWS), and the Sample Management and Reporting (SMR) organization to integrate these and other technical disciplines in planning and implementing the workscope

5.3.6 Environmental Compliance Officer
The ECO is responsible for the following tasks:

- Providing technical oversight, direction, and acceptance of project and subcontracted environmental work
• Developing appropriate mitigation measures to minimize adverse environmental impacts
• Reviewing plans, protocols, and technical documents to ensure that environmental requirements have been addressed
• Identifying environmental issues affecting operations and developing cost-effective solutions
• Responding to environmental and regulatory issues or concerns
• Overseeing project implementation for compliance with applicable internal and external environmental requirements

5.3.7 Quality Assurance
The QA point of contact is responsible for the following tasks:
• Addressing QA issues on the project
• Overseeing implementation of the project QA requirements
• Reviewing project documents (including the RAWP, data quality objective summary report, quality assurance project plan [QAP]P, SAP, and other lower tier implementation documents)
• Reviewing data validation reports from third-party data validation contractors, as appropriate
• Participating in QA assessments on removal action activities, as appropriate

5.3.8 Health and Safety
The Health and Safety organization is responsible for the following tasks:
• Coordinating industrial safety and health support within the project in accordance with the health and safety program, job hazard analyses, and other pertinent federal regulation
• Assisting project personnel in complying with the applicable health and safety program
• Coordinating with Radiological Engineering to determine PPE requirements

5.3.9 Radiological Engineering
Radiological Engineering is responsible for the following tasks:
• Providing radiological engineering and project health physics support
• Conducting ALARA reviews, exposure and release modeling, and radiological controls optimization
• Identifying radiological hazards and ensuring that appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels
• Interfacing with the project Health and Safety representative and other appropriate personnel, as needed, to plan and direct project RCT support

5.3.10 SMR Organization
The SMR organization is responsible for the following activities:
• Interfacing between the 200-DV-1 OU technical lead, Field Sampling Operations (FSO), Well Maintenance organization, and the analytical laboratories
Generating field sampling documents, labels, and instructions for field sampling personnel

Developing the Sample Authorization Form, which provides information and instructions to the analytical laboratories

Providing instructions to the FSO nuclear chemical operators (NCOs) on the collection of samples as specified in a SAP

Monitoring the entire sample and data process

Coordinating laboratory analytical work and ensuring that the laboratories conform to Hanford Site QA requirements (or their equivalent), as approved by the Tri-Parties

Resolving sample documentation deficiencies or issues associated with the FSO, laboratories, or other entities to ensure that project needs are met

Receiving analytical data from the laboratories

Ensuring that data are uploaded into the Hanford Environmental Information System database

Arranging for and overseeing data validation, as requested

Informing the 200-DV-1 OU project manager and/or the 200-DV-1 OU technical lead of any issues reported by the analytical laboratories

5.3.11 Analytical Laboratories

Analytical laboratories are responsible for the following tasks:

- Analyzing samples in accordance with established methods
- Providing data packages containing analytical and QC results
- Providing explanations in response to resolution of analytical issues
- Meeting SAP requirements
- Being on the MSA evaluated suppliers list
- Being accredited by Ecology for analyses performed for S&GRP

5.3.12 Waste Management

Waste Management is responsible for the following tasks:

- Communicating policies and protocols
- Ensuring compliance for waste storage, transportation, disposal, and tracking in a safe and cost-effective manner
- Identifying waste management sampling/characterization requirements to ensure regulatory compliance
- Interpreting data to determine waste designations and profiles
- Preparing and maintaining other documents and confirming compliance with waste acceptance criteria
5.3.13 Field Sampling Organization

The FSO is responsible for planning, coordinating, and conducting field sampling activities. Specific members of the FSO are responsible for the following tasks:

- The FWS directs the NCOs and teamsters (i.e., tank truck drivers) and ensures that they are appropriately trained and available.
- The FWS reviews the SAP for field sample collection concerns, analytical requirements, and special sampling requirements. The FWS ensures that the NCOs understand the sampling design and can perform sampling as specified by performing mock-ups and holding practice sessions with field personnel.
- NCOs collect all salient samples in accordance with sampling documentation; complete field logbook entries, chain-of-custody forms, and shipping paperwork; and ensure delivery of samples to the analytical laboratories.
- The FWS acts as a technical interface between the 200-DV-1 OU project manager and the field crew supervisors and ensures that technical aspects of the fieldwork are met. In consultation with the 200-DV-1 OU project manager and SMR, the FWS resolves issues arising from translation of technical requirements to field operations and coordinates resolution of sampling issues.

5.3.14 Well Maintenance

The Well Maintenance manager is responsible for the following activities:

- Conducting well maintenance and repair activities for the three 200-DV-1 OU pumping wells
- Coordinating with the 200-DV-1 OU technical lead to identify field constraints that could affect perched water removal actions and sampling

5.4 Change Management

If a fundamental change arises to the selected response action that is not within the workscope defined in the AM (DOE/RL-2014-34), a revised removal action will be documented in a new AM or as an amendment to the existing AM. Supporting documentation will be prepared to allow DOE to select a revised removal action.

Established configuration and change control processes ensure that proposed changes are reviewed in relation to the specified commitments. If a breach of these commitments is discovered, work will cease so stabilization and/or recovery actions may be identified and implemented, as appropriate. Change management will comply with appropriate CHPRC procedures.

Determining the significance of the change is the responsibility of DOE. CHPRC management is responsible for tracking changes and obtaining appropriate reviews. CHPRC management will discuss the change with DOE, and DOE will then discuss the type of change that is necessary with EPA and Ecology. Appropriate documentation will follow.

5.5 Personnel Training and Qualifications

During the performance of removal action activities, the experience and capabilities of the operating staff are key to maintaining worker and environmental safety. Day-to-day knowledge of ongoing operations, month-to-month understanding of conditions encountered, and lessons learned are imperative to continue safe operations.
Training requirements will ensure that personnel have been instructed in the methods and technologies to work safely in and around radiological areas and to maintain their individual radiation exposure and the radiation exposures of others ALARA. Standardized core courses and training material will be presented, and site-specific information and technologies will be discussed for adequate training of workers.

Health physics workers are required to have completed, and be current in, RCT qualification training. These training courses require successful completion of examinations to demonstrate an understanding of the training material.

Specialized training will be provided, as needed, to instruct workers in the use of nonstandard equipment, performance of abnormal operations, and hazards of specific activities. Specialized training may be provided by on-the-job training activities, classroom instruction and testing, or pre-job briefings. The depth of training in any discipline will be commensurate with the degree of the hazards involved and the knowledge required for task performance. Specialized employee training also includes pre-job safety briefings, plan-of-the-day meetings, and facility/work site orientations.

The CHPRC Training Program provides workers with the knowledge and skills necessary to execute assigned duties safely. A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable requirements.

The HASP, RWP, and hazards analysis will include specific training requirements for removal action activities conducted.

5.6 Quality Assurance Program


QA activities will use a graded approach based on the potential impact to the environment, safety, health, reliability, and continuity of operations. Other specific activities will include QA implementation, responsibilities and authorities, document control, QA records, and audits. A QAPJJP has been prepared as part of a SAP (DOE/RL-2014-51) to govern this removal action.

5.7 Post-Removal Action Activities

When the 200-DV-1 OU perched water wells no longer yield sufficient amounts of water for extraction, as agreed to by the Tri-Parties, the removal action will be terminated. The perched water zone (Figure 3) will continue to be monitored for accumulation of contaminated water. The need for future action will be evaluated and identified in the 200-DV-1 OU ROD.

At the completion of the removal action, a completion report will be issued that provides summary information, including the volume and concentration of perched water extracted, treatment results, and applicable 200-BP-5 OU monitoring data.
6 References


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Appendix A

Summary of the Conceptual Site Model
for the 200-DV-1 Operable Unit Perched Water
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Contents

A1 Summary of the Conceptual Site Model .................................................................A-1
A2 References ........................................................................................................A-3

Figure

Figure A-1. CSM of the CCU Perching Zone .............................................................A-2
Terms

<table>
<thead>
<tr>
<th>CCU</th>
<th>Cold Creek unit</th>
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<tbody>
<tr>
<td>CCU(_z)</td>
<td>Cold Creek unit silt</td>
</tr>
<tr>
<td>CSM</td>
<td>conceptual site model</td>
</tr>
<tr>
<td>OU</td>
<td>operable unit</td>
</tr>
<tr>
<td>SST</td>
<td>single-shell tank</td>
</tr>
</tbody>
</table>
A1 Summary of the Conceptual Site Model

This summary of the conceptual site model (CSM) for the 200-DV-1 Operable Unit (OU) perched water is based on the CSM presented in SGW-58147, Annual Performance Report for the 200-DV-1 Operable Unit Perched Water Extraction, Fiscal Year 2014. Borehole hydrologic, geologic, geochemical, and geophysical data sets were used to determine the nature of the perching horizon and the location and extent of the contaminated water within the perching zone. The resulting CSM indicates that the contaminated perched water is contained within a localized silty sand lens deposited in a structural low on top of a low-permeability paleosol (silt) layer (lower Cold Creek unit (CCU) silt [CCUₙₙ]) within the CCU (Figure A-1).

The top of the contaminated silty sand lens is between 67 and 68.6 m (220 and 225 ft) below ground surface based on geophysical logs. The maximum thickness of the silty sand lens is approximately 4.6 m (15 ft). The lateral and vertical extent of the perched water is limited to the region containing the silty sand lens and underlying lower perching silt zone (CCUₙₙ). The bottom of the perched sand lens is approximately 4.6 m (15 ft) above the unconfined aquifer at its lowest point. The underlying perching silt layer (CCUₙₙ) forms a natural barrier that slows contaminant migration from the saturated silty sand layer to the aquifer.

Liquid wastes containing uranium, technetium-99, and nitrate migrated vertically and laterally in the subsurface and accumulated within the CCU silty sand lens. The major sources of contaminated water are considered to be the nearby 200-DV-1 OU waste sites (216-B-7A&B Cribs and 216-B-8 Crib and Tile Field), which were used for subsurface infiltration of liquid wastes, and the single-shell tank (SST) 241-BX-102, which released liquid waste to the subsurface when it was inadvertently overfilled. Other unplanned releases near SSTs 241-B-105 and 241-B-106 also may have contributed contaminated water (DOE/RL-2012-53, Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area B-BX-BY); however, their signature contaminant (cyanide) has not been detected at perched water well 299-E33-344.

Dramatic changes in perched water chemistry and increases in contaminant concentrations occurred after the initiation of perched water extraction from well 299-E33-344. The initial extraction of perched water from this well is thought to have removed the lower concentration residual water that had accumulated from disposal operations that occurred several decades ago at the 216-B-7A&B Cribs and 216-B-8 Crib and Tile Field; these cribs and tile field are located on the eastern margin of the low-permeability perching silt layer (CCUₙₙ). The large volumes of wastewater disposed to these cribs and tile field likely saturated the perched water zone. Continued perched water extraction expanded the perched water capture area and pulled higher concentrations of contaminants from the west side of the perched zone, nearer the 241-BX-102 tank release, to the extraction well.

In addition to the increased contaminant concentrations in the perched zone samples obtained from extraction well 299-E33-344, uranium, technetium-99, and nitrate concentration increases began shortly thereafter in groundwater monitoring well 299-E33-18, followed by increases in groundwater monitoring well 299-E33-345. These groundwater monitoring wells are located less than 3.5 m (11.5 ft) laterally from perched water extraction well 299-E33-344. Technetium-99 concentrations in both groundwater monitoring wells were already higher than in the perched zone well prior to initiation of perched water extraction. However, uranium and nitrate concentrations in the groundwater monitoring wells were lower than in the perched zone extraction well prior to initiation of perched water extraction. This indicates that the unconfined aquifer beneath the perched zone was already contaminated with technetium-99 and low levels of uranium and nitrate.
Geophysical logging results for well 299-E33-18 have shown that increasing uranium concentrations occurred over time along the outside of the casing downward toward the water table. These data indicate that well 299-E33-18, an older unsealed well, may have been providing a more direct travel pathway for the perched water vadose zone contamination to migrate to the unconfined aquifer. Well 299-E33-18 was perforated, pressure-grouted, and decommissioned in 2013 to eliminate the potential for contaminant migration along the unsealed well.

The two new perched water wells (299-E33-350 and 299-E33-351) and the new groundwater monitoring well (299-E33-360) (Figure A-1) also encountered the CCU interval and the highly contaminated perched water. The characterization results confirm the existing CSM, indicating that the lateral extent of the contaminated perched water is within the region mapped (Figure 2 in the document) and supporting the conclusion that this highly contaminated perched water is slowly leaking through the CCU lower and impacting the unconfined aquifer.
A2 References


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Appendix B

Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria Implementation/Action Strategy for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction Removal Action
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Table B-2. Implementation Strategy for TBC Criteria for the 200-DV-1 OU Removal Action ..........B-12
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**Terms**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARAR</td>
<td>applicable or relevant and appropriate requirement</td>
</tr>
<tr>
<td>CERCLA</td>
<td><em>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</em></td>
</tr>
<tr>
<td>COC</td>
<td>contaminant of concern</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>Ecology</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>LDR</td>
<td>land disposal restriction</td>
</tr>
<tr>
<td>OU</td>
<td>operable unit</td>
</tr>
<tr>
<td>P&amp;T</td>
<td>pump and treat</td>
</tr>
<tr>
<td>RCRA</td>
<td><em>Resource Conservation and Recovery Act of 1976</em></td>
</tr>
<tr>
<td>TBC</td>
<td>to be considered</td>
</tr>
<tr>
<td>UTS</td>
<td>universal treatment standard</td>
</tr>
</tbody>
</table>
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B1 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria Implementation/Action Strategy

This appendix discusses how the substantive requirements from the pertinent applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBC) criteria will be implemented for the 200-DV-1 Operable Unit (OU) perched water pumping/pore water extraction removal action.

40 CFR 300, “National Oil and Hazardous Substances Pollution Contingency Plan,” requires that the removal action comply with ARARs to the extent practicable. ARARs are defined to include only substantive requirements of environmental standards incorporated in promulgated regulations that have been evaluated and determined to be pertinent to the removal action. ARARs do not include administrative requirements, including requirements to obtain any federal, state, or local permits. A TBC requirement pertains to information that consists of nonpromulgated advisories or guidance issued by federal or state governments. A TBC requirement is not legally binding and does not have the status of an ARAR. However, regulations and guidance state that, as appropriate, TBC information should be considered in determining the removal action necessary for protection of human health and the environment. The federal ARARs, state ARARs, and TBC criteria for this removal action are listed in Appendix A of the action memorandum (DOE/RL-2014-34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction).

Table B-1 presents the details of the implementation/action strategy for the ARARs. Table B-2 presents the details of the implementation/action strategy for TBC criteria.
<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC 173-160-161, “Minimum Standards for Construction and Maintenance of Wells,” “How Shall Each Water Well Be Planned and Constructed?”</td>
<td>Action-specific</td>
<td>Identifies well planning and construction requirements.</td>
<td>All monitoring, injection, and extraction wells completed for the 200-DV-1 OU removal activities will meet the substantive requirements of these regulations. Well construction will be consistent with the current work practices for well construction and decommissioning.</td>
</tr>
<tr>
<td>WAC 173-160-171, “What Are the Requirements for the Location of the Well Site and Access to the Well?”</td>
<td></td>
<td>Identifies the requirements for locating a well.</td>
<td></td>
</tr>
<tr>
<td>WAC 173-160-181, “What Are the Requirements for Preserving the Natural Barriers to Ground Water Movement Between Aquifers?”</td>
<td></td>
<td>Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.</td>
<td></td>
</tr>
<tr>
<td>WAC 173-160-450, “What Are the Well Sealing Requirements?”</td>
<td></td>
<td>Identifies the well sealing requirements.</td>
<td></td>
</tr>
<tr>
<td>ARAR Citation</td>
<td>Type</td>
<td>Regulatory Requirements</td>
<td>Implementation/Action Strategy</td>
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<tr>
<td>WAC 246-247-040(3)</td>
<td>Action-specific</td>
<td>Requires that emissions be controlled to ensure that radiation emission standards are not exceeded: - New construction and significant modifications of emission units - Existing emission units and nonsignificant modifications</td>
<td>These regulations require an evaluation of potential radiation emissions from new remedial sources by using best available radionuclide control technology or from existing sources by using as low as reasonably achievable control technology. Following evaluation of potential emissions, an air monitoring plan specifying any required monitoring for non-point and fugitive radioactive airborne emissions will be documented. The total unabated potential release (in curies) will be determined, and the annual dose to the maximally exposed individual will be calculated using the DOE guide (DOE/RL-2006-29, Calculating Potential-to-Emit Radiological Releases and Doses) or modeled using the CAP-88 PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated-modeled value of the potential to emit.</td>
</tr>
<tr>
<td>WAC 246-247-075(1), (2), (3), (4), and (8), “Monitoring, Testing and Quality Assurance”</td>
<td>Action-specific</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAC 173-480-050(1), “General Standards for Maximum Permissible Emissions”</td>
<td>Action-specific</td>
<td>Determine compliance with the public dose standard by calculating exposure at the point of maximum annual air concentration in an unrestricted area where any member of the public may be. This state regulation is as (or more) stringent than the equivalent federal program requirement.</td>
<td>The total unabated potential release (in curies) will be determined, and the annual dose to the maximally exposed individual will be calculated using the DOE guide (DOE/RL-2006-29) or modeled using the CAP-88 PC computer model. Control and monitoring requirements for potential radiological air emissions will be based on the calculated(modeled) value of the potential to emit.</td>
</tr>
</tbody>
</table>
Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
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</thead>
<tbody>
<tr>
<td>WAC 173-400-040(3) and (8) WAC 173-400-113, “General Regulations for Air Pollution”</td>
<td>Action-specific</td>
<td>Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology. This state regulation is as (or more) stringent than the equivalent federal program requirement.</td>
<td>If the 200-DV-1 OU removal action activities result in visible, particulate, fugitive, and hazardous air emissions and odors, then applicable control technology is required.</td>
</tr>
<tr>
<td>WAC 173-460, “Controls for New Sources of Toxic Air Pollutants” Specific subsections: WAC 173-460-060 WAC 173-460-150</td>
<td>Action-specific</td>
<td>Requires that new sources of air emissions meet emission requirements identified in this regulation. This state regulation is as (or more) stringent than the equivalent federal program requirement. The owner/operator of a new toxic air pollutant source that is likely to increase toxic air pollutant emissions shall demonstrate that emissions from the source are sufficiently low to protect human health and safety from potential carcinogenic and/or other toxic effects. This state regulation is as (or more) stringent than the equivalent federal program requirement.</td>
<td>If there is the potential for toxic air pollutants to become airborne as a result of remedial activities, the applicable emission standards must be met. To demonstrate compliance with applicable or relevant and appropriate requirements of WAC 173-400 and WAC 173-460, an acceptable source impact analysis will be completed. The analysis will demonstrate that, after application of toxic best available control technology, the new source’s maximum incremental ambient air impact levels do not exceed the WAC 173-460 Class A or Class B acceptable source impact levels at the nearest site boundary; or, if applicable, that the new source toxic air pollutant emission rates do not exceed the small quantity emission rates specified in WAC 173-460 at the stack.</td>
</tr>
</tbody>
</table>
### Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC 173-303-016, “Dangerous Waste Regulations,” “Identifying Solid Waste”</td>
<td>Action-specific</td>
<td>Identifies criteria for determining if materials are solid wastes.</td>
<td>Waste materials generated during the 200-DV-1 OU removal action will be compared to these criteria. Those materials that are determined to be solid waste and that are also dangerous waste will be subject to applicable and substantive waste management requirements of WAC 173-303.</td>
</tr>
<tr>
<td>WAC 173-303-017, “Recycling Processes Involving Solid Waste”</td>
<td>Action-specific</td>
<td>Identifies materials that are and are not solid wastes when recycled.</td>
<td>Waste materials generated during the 200-DV-1 OU removal action will be compared to these criteria. Those categories of wastes that are not solid wastes are not subject to these requirements. If any meet this requirement and are also solid wastes, they are subject to requirements of WAC 173-303.</td>
</tr>
<tr>
<td>WAC 173-303-070(3), “Designation of Dangerous Waste”</td>
<td>Action-specific</td>
<td>Establishes whether a solid waste is or is not a dangerous waste or an extremely hazardous waste.</td>
<td>The designation procedures to determine if a solid waste meets any dangerous waste criteria apply to remediation wastes generated from 200-DV-1 OU remediation activities. Remediation wastes including media and treatment residuals generated from the 200-DV-1 OU will be designated according to the procedures identified in WAC 173-303. The generator will determine if waste is a characteristic or listed dangerous waste by applying knowledge or by testing the material. The COCs that may be extracted/encountered during the removal action include uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium.</td>
</tr>
<tr>
<td>ARAR Citation</td>
<td>Type</td>
<td>Regulatory Requirements</td>
<td>Implementation/Action Strategy</td>
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</tr>
<tr>
<td>WAC 173-303-071, “Excluded Categories of Waste”</td>
<td>Action-specific</td>
<td>Describes those categories of wastes that are excluded from the requirements of WAC 173-303 (excluding WAC 173-303-050, “Department of Ecology Cleanup Authority”) because they are generally not dangerous or are regulated under other state and federal programs or are recycled in ways that do not threaten public health or the environment.</td>
<td>Wastes generated from the 200-DV-1 OU removal action (e.g., laboratory and treatability samples) will be reviewed against the categories identified in WAC 173-303-071.</td>
</tr>
<tr>
<td>WAC 173-303-077, “Requirements for Universal Waste”</td>
<td>Action-specific</td>
<td>Identifies those wastes exempt from regulation under WAC 173-303-140 and WAC 173-303-170 through WAC 173-303-9907, “Reserved” (excluding WAC 173-303-960, “Special Powers and Authorities of the Department”). These wastes are subject to regulation under WAC 173-303-573, “Standards for Universal Waste Management.”</td>
<td>Wastes generated from the 200-DV-1 OU removal action will be reviewed against universal waste criteria. For example, if batteries, thermostats, fluorescent lamps, and mercury-containing equipment are generated, their handling, accumulation, labeling, shipping, and management will comply with the requirements provided in WAC 173-303-573.</td>
</tr>
<tr>
<td>WAC 173-303-120, “Recycled, Reclaimed, and Recovered Wastes”</td>
<td>Action-specific</td>
<td>These regulations define the requirements for recycling materials that are solid and dangerous waste. Specifically, WAC 173-303-120(3) provides for the management of certain recyclable materials.</td>
<td>Wastes generated from the 200-DV-1 OU removal action will be reviewed against the requirements for recyclable materials. If recyclable materials (e.g., spent refrigerants, antifreeze, lead-acid batteries, or used oil) are generated, they will be managed in accordance with the requirements of WAC 173-303-120(3). Eligible recyclable materials can be recycled and/or conditionally excluded from certain dangerous waste requirements.</td>
</tr>
</tbody>
</table>
Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
</table>
| WAC 173-303-140(4), “Land Disposal Restrictions” | Action-specific | This regulation establishes state standards for land disposal of dangerous waste and incorporates, by reference, the federal restrictions of 40 CFR 268, “Land Disposal Restrictions,” that are relevant and appropriate to solid waste that is designated as dangerous or mixed waste. The requirements prohibit the placement of restricted RCRA hazardous waste in land-based units such as landfills, surface impoundments, and waste piles until treated to standards considered protective for disposal. Specific treatment standards are included in the requirements. | 200-DV-1 OU remediation dangerous waste destined for onsite land disposal will be managed in accordance with these restrictions:  
  - **Cuttings** generated as a result of well installation will be tested for indicator COCs. If soil is characterized as dangerous waste for RCRA-listed and/or characteristic criteria, it will be compared to corresponding LDRs/UTS. Soil (e.g., from borings) that are designated as listed dangerous waste must be treated to meet UTS or meet alternative treatment standards for RCRA hazardous soils. Generator certification is required to verify that the treatment standard has been achieved and the waste has not been diluted. Media with concentrations below health-based standards (i.e., WAC 173-340, “Model Toxics Control Act—Cleanup,” Method B cleanup levels) may be eligible for a contained-out determination subject to Ecology approval.  
  - **Treatment residuals** (e.g., spent resin and tank sludge) will be tested for indicator COCs and will be compared to LDR treatment standards prior to land disposal. If waste exceeds applicable LDRs/UTS, it must be treated using the technology specified in 40 CFR 268.40, “Applicability of Treatment Standards,” prior to disposal. If restricted waste is shipped to the Environmental Restoration Disposal Facility or to an offsite treatment, storage, or disposal facility, notification must accompany the waste. Generator certification is required to verify that the treatment standard has been achieved and the waste has not been diluted. |
Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAC 173-303-64620(4), “Requirements”</td>
<td>Action-specific</td>
<td>Establishes requirements for corrective action for releases of dangerous wastes and dangerous constituents, including releases from solid waste management units.</td>
<td>These requirements apply to investigation and remediation of dangerous wastes and dangerous constituents from solid waste management units and spill sites. The Washington State RCRA-authorized Hazardous Waste Management Act (RCW 70.105) and dangerous waste regulations (WAC 173-303) give Ecology corrective action jurisdiction over the 200-DV-1 OU, concurrent with CERCLA. As documented in the action memorandum DOE/RL-2014-34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction, Ecology supports and accepts the 200-DV-1 OU removal action under the Tri-Party Agreement (Ecology et al., 1989) and the CERCLA program as satisfying corrective action requirements.</td>
</tr>
<tr>
<td>ARAR Citation</td>
<td>Type</td>
<td>Regulatory Requirements</td>
<td>Implementation/Action Strategy</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Special Historic and Ecological Resources</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Endangered Species Act of 1973</em> (16 USC 1531[a], et seq., 16 USC 1536[c])</td>
<td>Location-specific</td>
<td>Prohibits actions by federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat critical to them. Mitigation measures must be applied to actions that occur within critical habitats or surrounding buffer zones of listed species in order to protect the resource.</td>
<td>Activities associated with the 200-DV-1 OU removal action shall be coordinated with available ecological site data and surveys to ensure that adverse impacts to critical habitats will not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented. The survey will look for threatened or endangered species and critical habitat and document such with respect to the areas included in this removal action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report.</td>
</tr>
<tr>
<td><strong>Native American Graves Protection and Repatriation Act of 1990</strong> (25 USC 3001, et seq.)</td>
<td>Location-specific</td>
<td>Establishes federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony. Requires Native American Tribal consultation in the event of discovery.</td>
<td>In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions. The inventory reported no significant surface archaeological sites were encountered. The 200-DV-1 OU removal action activities shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented. The survey will look for culturally significant items and document such with respect to the areas included in this removal action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report.</td>
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### Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
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<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archaeological and Historic Preservation Act of 1974 (16 USC 469a-1 through 469a-2(d))</td>
<td>Action-specific</td>
<td>Requires that removal actions at the 200-DV-1 OU do not cause the loss of any archaeological or historical data. This act mandated preservation of data and does not require protection of the actual historical sites.</td>
<td>In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions. The inventory reported no significant surface archaeological sites were encountered. The 200-DV-1 OU removal action activities shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented. The survey will look for culturally significant items and document such with respect to the areas included in this removal action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report.</td>
</tr>
<tr>
<td>National Historic Preservation Act of 1966 (16 USC 470, Section 106, et seq.)</td>
<td>Location-specific</td>
<td>Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation, and mitigation processes.</td>
<td>In 1987 and 1988, a comprehensive archaeological resources review of the Central Plateau was conducted that included an examination of samples collected from undisturbed portions. The inventory reported no significant surface archaeological sites were encountered. The 200-DV-1 OU removal action activities shall be coordinated with available site data and surveys and consultants to ensure adverse impacts do not occur. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), a survey will be completed and documented. The survey will look for culturally significant items and document such with respect to the areas included in this removal action where there would be disturbance of the earth. Any restrictions regarding disturbance of the earth or otherwise will be identified in a letter report.</td>
</tr>
</tbody>
</table>
Table B-1. Implementation Strategy for ARARs for the 200-DV-1 OU Removal Action

<table>
<thead>
<tr>
<th>ARAR Citation</th>
<th>Type</th>
<th>Regulatory Requirements</th>
<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ARAR</strong></td>
<td></td>
<td>= applicable or relevant and appropriate requirement</td>
<td></td>
</tr>
<tr>
<td>CERCLA</td>
<td></td>
<td>= Comprehensive Environmental Response, Compensation and Liability Act of 1980</td>
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</tr>
<tr>
<td>COC</td>
<td></td>
<td>= contaminant of concern</td>
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</tr>
<tr>
<td>DOE</td>
<td></td>
<td>= U.S. Department of Energy</td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td></td>
<td>= Washington State Department of Ecology</td>
<td></td>
</tr>
<tr>
<td>LDR</td>
<td></td>
<td>= land disposal restriction</td>
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</tr>
<tr>
<td>OU</td>
<td></td>
<td>= operable unit</td>
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</tr>
<tr>
<td>RCRA</td>
<td></td>
<td>= Resource Conservation and Recovery Act of 1976</td>
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</tr>
<tr>
<td>TBC</td>
<td></td>
<td>= to be considered</td>
<td></td>
</tr>
<tr>
<td>Tri-Party Agreement</td>
<td>= Hanford Federal Facility Agreement and Consent Order (Ecology et al., 1989)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UTS</td>
<td></td>
<td>= universal treatment standard</td>
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Note: The references cited in this table are included in the References chapter of this appendix.
### Table B-2. Implementation Strategy for TBC Criteria for the 200-DV-1 OU Removal Action

<table>
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<th>Type</th>
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<th>Implementation/Action Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA et al., 2008, <em>Record of Decision, Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington</em></td>
<td>TBC</td>
<td>This document provides the cleanup levels for the effluent treated at the 200 West P&amp;T.</td>
<td>Treatment capabilities at the 200 West P&amp;T will meet the cleanup levels for treated effluent.</td>
</tr>
<tr>
<td>DOE/RL-2013-07, 200-UP-1 Groundwater Operable Unit Remedial Design/Remedial Action Work Plan</td>
<td>TBC</td>
<td>This document provides the cleanup levels for the effluent treated at the 200 West P&amp;T.</td>
<td>Treatment capabilities at the 200 West P&amp;T will meet the cleanup levels for treated effluent.</td>
</tr>
<tr>
<td>DOE/RL-2009-124, 200 West Pump and Treat Operations and Maintenance Plan</td>
<td>TBC</td>
<td>This document contains the operational and monitoring changes based on receiving the 200-DV-1 OU perched water for treatment.</td>
<td>Operations and monitoring will be updated as necessary to treat the perched water at 200 West P&amp;T.</td>
</tr>
</tbody>
</table>

OU = operable unit  
P&T = pump and treat  
TBC = to be considered
B2 References


40 CFR 268.40, “Applicability of Treatment Standards.”


WAC 173-160-171, “What Are the Requirements for the Location of the Well Site and Access to the Well?”

WAC 173-160-181, “What Are the Requirements for Preserving the Natural Barriers to Ground Water Movement Between Aquifers?”


WAC 173-160-430, “What Are the Minimum Casing Standards?”

WAC 173-160-440, “What Are the Equipment Cleaning Standards?”
WAC 173-160-450, “What Are the Well Sealing Requirements?”
WAC 173-303-017, “Recycling Processes Involving Solid Waste.”
WAC 173-303-050, “Department of Ecology Cleanup Authority.”
WAC 173-303-120, “Recycled, Reclaimed, and Recovered Wastes.”
WAC 173-303-170, “Requirements for Generators of Dangerous Waste.”
WAC 173-303-630, “Use and Management of Containers.”
WAC 173-303-64620, “Requirements.”
WAC 173-303-9907, “Reserved.”
WAC 173-400-040, “General Standards for Maximum Emissions.”
WAC 173-400-113, “Requirements for New Sources in Attainment or Unclassifiable Areas.”
WAC 173-460-060, “Control Technology Requirements.”
WAC 173-460-150, “Table of ASIL, SQER and de Minimis Emission Values.”

WAC 246-247-040, “General Standards.”
Appendix C

Air Emission Plan for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction Removal Action
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## Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>action memorandum</td>
</tr>
<tr>
<td>APQ</td>
<td>annual possession quantity</td>
</tr>
<tr>
<td>CAS</td>
<td>Chemical Abstracts Service</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</td>
</tr>
<tr>
<td>dpm</td>
<td>disintegrations per minute</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>HEIS</td>
<td>Hanford Environmental Information System</td>
</tr>
<tr>
<td>HEPA</td>
<td>high-efficiency particulate air</td>
</tr>
<tr>
<td>MEI</td>
<td>maximally exposed individual</td>
</tr>
<tr>
<td>OU</td>
<td>operable unit</td>
</tr>
<tr>
<td>P&amp;T</td>
<td>pump and treat</td>
</tr>
<tr>
<td>PTE</td>
<td>potential to emit</td>
</tr>
<tr>
<td>RAWP</td>
<td>removal action work plan</td>
</tr>
<tr>
<td>SQER</td>
<td>small quantity emission rate</td>
</tr>
</tbody>
</table>
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C1 Introduction

This air emissions plan supports the removal action work plan (RAWP) that implements the 200-DV-1 Operable Unit (OU) perched water removal action as specified in DOE/RL-2014-34, Action Memorandum for 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction. The action memorandum (AM) was prepared to document the selected alternative presented in DOE/RL-2013-37, Engineering Evaluation/Cost Analysis for Perched Water Pumping/Pore Water Extraction, as required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The scope of the RAWP is limited to the extraction, transport, treatment, and disposal of contaminated perched water from the 200-DV-1 OU. The perched water contains uranium, technetium-99, nitrate, total chromium, hexavalent chromium, and tritium at concentrations that exceed the maximum concentration limits and represent the primary risk to human health and the environment. Removal and treatment of these contaminants from perched water at the 200 West Area Pump and Treat (P&T) meet the requirements of the AM (DOE/RL-2014-34) and the RAWP. There is no treatment for tritium; however, the resulting combined discharge concentration from the 200 West P&T is expected to be below the maximum contaminant level.

The potential exists for radiological and chemical releases. Maximum values for radiological and chemical constituents, as observed in underlying sediment pore water or perched water analytical results, are used to calculate the release potentials described in Chapter C2 of this appendix. The pore water extraction test configuration is shown in Figure C-1.
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C2 Air Emissions

The following discussion addresses the potential radionuclide air emissions, and the criteria and toxic air emissions. CERCLA Section 121, “Degree of Cleanup,” requires response actions to meet the substantive requirements of other promulgated environmental regulations that are either applicable, or relevant and appropriate, to the planned remedial activities. At the same time, procedural and administrative aspects of these regulations, such as permitting requirements, do not apply to onsite CERCLA actions such as this action. Federal and state ambient air quality standards require that pollution control equipment be used to control emissions from new and existing sources. Because the perched water pumping/pore water extraction removal action has the potential to discharge hazardous air pollutants, an evaluation was conducted to estimate the activity of radionuclides and the concentration or mass of toxic air pollutants that could potentially be emitted from groundwater treatment operations. The following subsections present the results of this evaluation.

C2.1 Radiological Air Emissions

RCW 70.94, “Washington Clean Air Act,” requires the regulation of radioactive air pollutants. The Washington State implementing regulation (WAC 173-480, “Ambient Air Quality Standards and Emission Limits for Radionuclides”) sets standards that are as stringent as, or more stringent than, the federal Clean Air Act of 1990 and the federal implementing regulation, 40 CFR 61, “National Emission Standards for Hazardous Air Pollutants,” Subpart H, “National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities.” U.S. Environmental Protection Agency (EPA) partial delegation of the 40 CFR 61 authority to the state of Washington includes all substantive emissions monitoring, abatement, and reporting aspects of the federal regulation. The state standards protect the public by conservatively establishing exposure standards applicable to a real or hypothetical maximally exposed individual (MEI). The standards address the point of maximum annual air concentration in an unrestricted area where any member of the public may be present. All combined radionuclide airborne emissions from the Hanford Site are not to exceed amounts that will cause exposure greater than 10 mrem/yr effective dose equivalent to any member of the public. The Washington State implementing regulation (WAC 246-247, “Radiation Protection—Air Emissions,” which adopts WAC 173-480 and 40 CFR 61, Subpart H standards) requires verification of compliance with the 10 mrem/yr standard and would be applicable or relevant and appropriate to this CERCLA removal action.
Figure C-1. Pore Water Extraction Test Configuration

WAC 246-247 addresses potential radioactive airborne emissions from point sources and fugitive or diffuse sources by requiring monitoring of these sources. Such monitoring requires physical measurement of the effluent or ambient air, as well as quality assurance measures to ensure precision, accuracy, and completeness of environmental measurements. The substantive provisions of WAC 246-247 that require monitoring of radioactive airborne emissions would be applicable or relevant and appropriate to this removal action.

These state implementing regulations further address control of radioactive airborne emissions where economically and technologically feasible (WAC 246-247-040[3] and [4], “General Standards for Maximum Emissions,” and associated definitions). To address the substantive aspect of these requirements, best or reasonably achieved control technology will be addressed by ensuring that applicable emission control technologies (i.e., those successfully operated in similar applications) will be used to the extent economically and technologically feasible (i.e., based on cost/benefit).
C2.2 Criteria and Toxic Air Emissions

Under WAC 173-400, “General Regulations for Air Pollution Sources,” and WAC 173-460 requirements are established to regulate the emission of criteria and toxic air pollutants. In accordance with WAC 173-400-040, “General Standards for Maximum Emissions,” reasonable precautions must be taken to prevent the release of air contaminants associated with point sources and fugitive emissions resulting from excavation, materials handling, or other operations if criteria and toxic emissions are expected. The use of treatment technologies for emissions of toxic air pollutants that would be subject to the substantive applicable requirements of WAC 173-460 and WAC 173-400 is anticipated to be a part of this removal action.

C2.3 Radiological Airborne Source Information

The potential to emit (PTE) is calculated by using Method 1 for annual possession quantity (APQ) in accordance with DOE/RL-2006-29, Calculating Potential-to-Emit Radiological Releases and Doses. An environmental calculation (ECF-HANFORD-14-0039, Air Emissions from 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction) was used to determine the PTE for the removal action. The basis used for the calculations is conservative in order to provide bounding cases.


<table>
<thead>
<tr>
<th>Isotope</th>
<th>Well Name</th>
<th>Sample Number</th>
<th>Sample Date</th>
<th>Concentration (pCi/L)</th>
</tr>
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<tr>
<td>Americium-241</td>
<td>299-E33-344</td>
<td>B21958</td>
<td>8/4/2009</td>
<td>0.16</td>
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<tr>
<td>Beryllium-7</td>
<td>299-E33-344</td>
<td>B2NC56</td>
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<td>734</td>
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<td>Carbon-14</td>
<td>299-E33-344</td>
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<td>Cesium-134</td>
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<td>B2KPL6</td>
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<td>590</td>
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<td>Cesium-137</td>
<td>299-E33-344</td>
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<td>8/2/2012</td>
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<td>Cobalt-60</td>
<td>299-E33-344</td>
<td>B2KPL6</td>
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<td>120</td>
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<td>Europium-152</td>
<td>299-E33-344</td>
<td>B2KPL6</td>
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<td>Gross alpha</td>
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Table C-1. Radiological Constituents in 200-DV-1 OU Perched Water

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Well Name</th>
<th>Sample Number</th>
<th>Sample Date</th>
<th>Concentration (pCi/L)</th>
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</thead>
<tbody>
<tr>
<td>Plutonium-238</td>
<td>299-E33-344</td>
<td>B1V7P5</td>
<td>7/15/2008</td>
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<tr>
<td>Plutonium-239/240</td>
<td>299-E33-344</td>
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<td>7/15/2008</td>
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<td>Potassium-40</td>
<td>299-E33-344</td>
<td>B2JBT8</td>
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<tr>
<td>Ruthenium-106</td>
<td>299-E33-344</td>
<td>B2KPL6</td>
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<td>4/22/2014</td>
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<td>Thorium-228</td>
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<td>B254M4</td>
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<td>Thorium-230</td>
<td>299-E33-344</td>
<td>B21959</td>
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<td>Thorium-232</td>
<td>299-E33-344</td>
<td>B254M4</td>
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</table>

Source: ECF-HANFORD-14-0039, Air Emissions from 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction, Appendix A (data from the HEIS database).

OU = operable unit

The PTE calculation is based upon the following information:

- Sediment water removal is perched water.
- Because the well 299-E33-344 screen is approximately 6 m (19.7 ft) long versus 1 m (3.3 ft) long, as modeled and shown in Figure C-2, the 54 L/day (14.27 gal/day) rate of pore water removal (assuming an applied vacuum of 300 cm [120 in.]) is increased by a factor of six, resulting in 324 L/day (85.6 gal/day). Wells 299-E33-350 and 299-E33-351 are presumed to be similarly configured, yielding a daily pore water removal rate of 972 L/day (256.8 gal/day).
- Release fractions are 1E-03 for liquid and 1E+00 for gas (DOE/RL-2006-29).
- No credit is taken for constituent reduction by removal of soil moisture in the chiller/condensate system.
• No credit is taken for constituent removal by high-efficiency filtration.
• Usage for 12 consecutive months is assumed.
• The highest constituent concentrations in the perched water for wells 299-E33-344, 299-E33-350, and 299-E33-351 (HEIS database) (Table C-1) are used.
• APQ:
  – (Volume of water discharged in L)(concentration in water in pCi/L)
  – (Three wells)(324 L/day)(365 days)(concentration in pCi/L)(1E-12 Ci/pCi) = Ci/yr
  – Americium-241 = 5.68E-08 Ci/yr – Antimony-125 = 8.37E-06 Ci/yr
  – Beryllium-7 = 2.60E-04 Ci/yr – Carbon-14 = 5.75E-04 Ci/yr
  – Cesium-134 = 2.09E-04 Ci/yr – Cesium-137 = 2.34E-05 Ci/yr
  – Cobalt-60 = 4.26E-05 Ci/yr – Europium-142 = 1.53E-05 Ci/yr
  – Europium-154 = 2.61E-05 Ci/yr – Europium-155 = 5.68E-05 Ci/yr
  – Gross alpha = 1.95E-02 Ci/yr – Gross beta = 2.06E-02 Ci/yr
  – Iodine-129 = 8.51E-06 Ci/yr – Neptunium-237 = 2.88E-07 Ci/yr
  – Plutonium-238 = 7.45E-08 Ci/yr – Plutonium-239/240 = 5.32E-08 Ci/yr
  – Potassium-40 = 3.55E-05 Ci/yr – Ruthenium-106 = 1.10E-04 Ci/yr
  – Strontium-90 = 1.98E-06 Ci/yr – Technetium-99 = 1.81E-02 Ci/yr
  – Thorium-228 = 1.32E-07 Ci/yr – Thorium-230 = 7.49E-08 Ci/yr
  – Thorium-232 = 5.32E-08 Ci/yr – Beta radiostrontium = 1.53E-06 Ci/yr
  – Tritium = 1.54E-02 Ci/yr – Uranium = 3.80E-02 Ci/yr
  – Uranium-233/234 = 1.21E-02 Ci/yr – Uranium-235 = 9.22E-04 Ci/yr
  – Uranium-238 = 1.24E-02 Ci/yr
• PTE quantity:
Source: PNNL-SA-74945, Pore Water Extraction Simulation Results.

Note: A 3 m (9.84 ft) thick silt lens and a 1 m (3.28 ft) long well screen are assumed.

Figure C-2. Calculated Flux

- APQ: gas release fraction for iodine-129 and tritium:
  - Americium-241 = 5.68E-11 Ci/yr
  - Beryllium-7 = 2.60E-07 Ci/yr
  - Cesium-134 = 2.09E-07 Ci/yr
  - Cobalt-60 = 4.26E-08 Ci/yr
  - Europium-154 = 2.61E-08 Ci/yr
  - Gross alpha = 1.95E-05 Ci/yr
  - Iodine-129 = 8.51E-06 Ci/yr
  - Plutonium-238 = 7.45E-11 Ci/yr
  - Potassium-40 = 3.55E-08 Ci/yr
  - Strontium-90 = 1.98E-09 Ci/yr
  - Thorium-228 = 1.32E-10 Ci/yr
  - Thorium-232 = 5.32E-11 Ci/yr
  - Tritium = 1.54E-02 Ci/yr
  - Uranium-233/234 = 1.21E-05 Ci/yr
  - Uranium-238 = 1.24E-05 Ci/yr
  - Antimony-125 = 8.37E-09 Ci/yr
  - Carbon-14 = 5.75E-07 Ci/yr
  - Cesium-137 = 2.34E-08 Ci/yr
  - Europium-152 = 1.53E-08 Ci/yr
  - Europium-155 = 5.68E-08 Ci/yr
  - Gross beta = 2.06E-05 Ci/yr
  - Neptunium-237 = 2.88E-10 Ci/yr
  - Plutonium-239/240 = 5.32E-11 Ci/yr
  - Ruthenium-106 = 1.10E-07 Ci/yr
  - Technetium-99 = 1.81E-05 Ci/yr
  - Thorium-230 = 7.49E-11 Ci/yr
  - Beta radiostrontium = 1.53E-09 Ci/yr
  - Uranium = 3.80E-05 Ci/yr
  - Uranium-235 = 9.22E-07 Ci/yr
• Unabated dose:

- Americium-241 = 2.38E-10 mrem/yr  
- Beryllium-7 = 4.84E-11 mrem/yr  
- Cesium-134 = 4.19E-09 mrem/yr  
- Cobalt-60 = 1.06E-09 mrem/yr  
- Europium-154 = 3.72E-10 mrem/yr  
- Gross alpha = 9.81E-05 mrem/yr  
- Iodine-129 = 3.47E-08 mrem/yr  
- Plutonium-238 = 3.46E-10 mrem/yr  
- Potassium-40 = 2.23E-10 mrem/yr  
- Strontium-90 = 2.26E-11 mrem/yr  
- Thorium-228 = 5.27E-10 mrem/yr  
- Thorium-232 = 1.33E-10 mrem/yr  
- Tritium = 4.15E-07 mrem/yr  
- Uranium-233/234 = 4.29E-06 mrem/yr  
- Uranium-238 = 3.40E-11 mrem/yr  
- Antimony-125 = 3.74E-11 mrem/yr  
- Carbon-14 = 1.42E-10 mrem/yr  
- Cesium-137 = 1.13E-10 mrem/yr  
- Europium-152 = 2.32E-10 mrem/yr  
- Europium-155 = 6.98E-11 mrem/yr  
- Gross beta = 2.35E-07 mrem/yr  
- Neptunium-237 = 6.57E-10 mrem/yr  
- Plutonium-239/240 = 2.68E-10 mrem/yr  
- Ruthenium-106 = 3.13E-10 mrem/yr  
- Technetium-99 = 1.86E-05 mrem/yr  
- Thorium-230 = 1.05E-10 mrem/yr  
- Beta radiostrontium = 1.74E-11 mrem/yr  
- Uranium = 1.04E-10 mrem/yr  
- Uranium-235 = 2.87E-07 mrem/yr

The total dose is 1.03E-04 mrem/yr.

The distance to the Energy Northwest receptor is approximately 18.2 km (11.3 mi) east-southeast of well 299-E33-344, located adjacent to the B Tank Farm. This is the nearest public location where the hypothetical MEI might be located. The dose per unit curie airborne release factor, used specifically for the well 299-E33-344 location, was taken from Table 4-7 of DOE/RL-2006-29. The factors are based on modeling using the EPA-approved CAP-88 PC, Clean Air Act Assessment Package for 1988. The total unabated PTE would result in a total effective dose equivalent to the MEI from the proposed deep vadose zone pore water extraction test near the B Tank Farm of 1.03E-04 mrem/yr.

### C2.4 Criteria and Toxic Airborne Source Information

ECF-HANFORD-14-0039 was used to determine the PTE for the removal action.

#### C2.4.1 Data and Calculation Methodology

In accordance with WAC 173-460-150, “Controls for New Sources of Toxic Air Pollutants,” significant chemical constituents of sediment pore water determined by analysis (per the HEIS database) are 1,1,1-trichloroethane; 1,1,2,2-tetrachloroethane; 1,1,2-trichloroethane, 1,1-dichloroethane; 1,1-dichloroethene; 1,2-dichloroethane; 1,2-dichloropropane; 1,4-dichlorobenzene, 1,4-dioxane; 2,4-dinitrotoluene; 2-butanone; 2-methylphenol (cresol, o-); 3+4 methylphenol (cresol, m+p), 4-methyl-2-pentanone; arsenic; benzene; beryllium; bis(2-ethylhexyl) phthalate; bromodichloromethane; bromoform; bromomethane; cadmium; carbon disulfide; carbon tetrachloride; chlorobenzene; chloroethane; chlorofom; chloromethane; cobalt; copper; dibromochloromethane; ethylbenzene; fluoride; hexavalent chromium; lead; manganese; mercury; methane chloride; naphthalene; n-nitrosodi-n-dipropylamine; pentachlorophenol; phenol; selenium; styrene; tetrachloroethene; toluene; trans-1,2-dichloroethylene; trichloroethene; vanadium; vinyl chloride; and xylenes (total). No other semivolatile organic analytes or volatile organic analytes were detected. Table C-2 shows maximum detected values of these constituents in perched water samples (per the HEIS database).
<table>
<thead>
<tr>
<th>Constituent*</th>
<th>CAS No.</th>
<th>Well Name</th>
<th>Sample Number</th>
<th>Sample Date</th>
<th>Concentration (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>71-55-6</td>
<td>299-E33-344</td>
<td>B25M2</td>
<td>5/24/2010</td>
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</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>79-34-5</td>
<td>299-E33-344</td>
<td>B1T200</td>
<td>1/8/2008</td>
<td>1</td>
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<tr>
<td>1,1,2-Trichloroethane</td>
<td>79-00-5</td>
<td>299-E33-344</td>
<td>B25M2</td>
<td>5/24/2010</td>
<td>1</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>75-34-3</td>
<td>299-E33-344</td>
<td>B25M2</td>
<td>5/24/2010</td>
<td>1</td>
</tr>
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<td>1,1-Dichloroethene</td>
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<td>299-E33-344</td>
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<td>1,2-Dichloroethane</td>
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<td>1,2-Dichloropropane</td>
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<td>B1T200</td>
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<td>1,4-Dichlorobenzene</td>
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<td>2-Methylphenol (cresol, o-)</td>
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<td>299-E33-344</td>
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<td>Bis(2-ethylhexyl) phthalate</td>
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<td>1/8/2008</td>
<td>1</td>
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<td>Bromoform</td>
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<td>B1T200</td>
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<td>Bromomethane</td>
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<td>Carbon tetrachloride</td>
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<td>299-E33-344</td>
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<td>299-E33-344</td>
<td>B1T200</td>
<td>1/8/2008</td>
<td>1</td>
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</table>
Table C-2. Criteria and Toxic Contaminants in 200-DV-1 OU Perched Water

<table>
<thead>
<tr>
<th>Constituenta</th>
<th>CAS No.</th>
<th>Well Name</th>
<th>Sample Number</th>
<th>Sample Date</th>
<th>Concentration (µg/L)</th>
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<tbody>
<tr>
<td>Cobalt</td>
<td>7440-48-4</td>
<td>299-E33-351</td>
<td>B2VWV2</td>
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<td>Copper</td>
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<td>299-E33-344</td>
<td>B1T200</td>
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<td>Ethylbenzene</td>
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<td>Methylene chloride</td>
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<td>299-E33-344</td>
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<td>Naphthalene</td>
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<td>299-E33-344</td>
<td>B254M2</td>
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<td><em>trans</em>-1,2-Dichloroethylene</td>
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<td>B254M2</td>
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</tbody>
</table>


b. Converted HEIS data from mg/L to µg/L.

CAS = Chemical Abstracts Service

HEIS = Hanford Environmental Information System

OU = operable unit
The PTE calculation uses a graded approach for each constituent detected above the method detection limit, based upon the following:

- Sediment water removal is perched water.
- Because the screen for well 299-E33-344 is approximately 6 m (19.7 ft) long versus 1 m (3.3 ft) long, as modeled and shown in Figure C-2, the 54 L/day (14.3 gal/day) rate of pore water removal (assuming an applied vacuum of 300 cm [120 in.]) is increased by a factor of six, resulting in 324 L/day (85.6 gal/day). Wells 299-E33-350 and 299-E33-351 are presumed to be similarly configured, yielding a daily pore water removal rate of 972 L/day (256.8 gal/day).
- For the initial step, the entire inventory is assumed to be released to the atmosphere regardless of the partial pressures associated with each constituent. No credit is taken for reduction of constituents by removal of soil moisture in the chiller/condensate system. No credit is taken for constituent removal by high-efficiency filtration.
- For those constituents with liquid concentrations exceeding the airborne concentration limit at the de minimis value, an additional calculation (second step) is performed based on the partial pressure. The vapor pressures are corrected to 25°C (77°F) using the Clausius-Clapeyon equation. For elemental metals described as insoluble, a factor of 1 mg/L (1 part per million) is assigned. The entire inventory is assumed to be subject to release. No credit is taken for reduction of constituents by removal of soil moisture in the chiller/condensate system. No credit is taken for constituent removal by high-efficiency filtration.
- For those constituents where the vapor correction results in a contaminant level above the de minimis value (third step), a 99 percent removal efficiency is credited to the chiller and high-efficiency particulate air (HEPA) filter as best available control technology for toxics.
- Usage for 12 consecutive months is assumed.

### C2.4.2 Potential-to-Emit Quantities

For the step one formula:

\[
\text{lb/WAC 173-460-150 table time unit} = \frac{(\text{volume water discharged in L})(\text{contaminant concentration})}{(\text{volume water discharged in L})(\text{contaminant concentration})}
\]

- 1,1,1-Trichloroethane:
  \[(972 \text{ L/day})(1 \mu\text{g/L})(g/1\times10^6 \mu\text{g})(lb/454 \text{ g}) = 2.14\times10^{-6} \text{ lb/day}\]
- 1,1,2,2-Tetrachloroethane:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu\text{g/L})(g/1\times10^6 \mu\text{g})(lb/454 \text{ g}) = 7.82\times10^{-4} \text{ lb/yr}\]
- 1,1,2-Trichloroethane:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu\text{g/L})(g/1\times10^6 \mu\text{g})(lb/454 \text{ g}) = 7.82\times10^{-4} \text{ lb/yr}\]
- 1,1-Dichloroethane:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu\text{g/L})(g/1\times10^6 \mu\text{g})(lb/454 \text{ g}) = 7.82\times10^{-4} \text{ lb/yr}\]
- 1,1-Dichloroethene:
  \[(972 \text{ L/day})(1 \mu\text{g/L})(g/1\times10^6 \mu\text{g})(lb/454 \text{ g}) = 2.14\times10^{-6} \text{ lb/day}\]
• 1,2-Dichloroethane:
  (972 L/day)(365 day/yr)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 7.82E-04 lb/yr

• 1,2-Dichloropropane:
  (972 L/day)(365 day/yr)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 7.82E-04 lb/yr

• 1,4-Dichlorobenzene:
  (972 L/day)(365 day/yr)(1.3 μg/L)(g/1E+06 μg)(lb/454 g) = 1.02E-03 lb/yr

• 1,4-Dioxane:
  (972 L/day)(365 day/yr)(45 μg/L)(g/1E+06 μg)(lb/454 g) = 3.52E-02 lb/yr

• 2,4-Dinitrotoluene:
  (972 L/day)(365 day/yr)(0.5 μg/L)(g/1 E+06 μg)(lb/454 g) = 3.91E-04 lb/yr

• 2-Butanone:
  (972 L/day)(1 μg/L)(g/E+06 μg)(lb/454 g) = 2.14E-06 lb/day

• 2-Methylphenol (cresol, o-):
  (972 L/day)(2 μg/L)(g/1E+06 μg)(lb/454 g) = 2.14E-06 lb/day

• 3+4 Methylphenol (cresol, m+p):
  (972 L/day)(2 μg/L)(g/1E+06 μg)(lb/454 g) = 2.14E-06 lb/day

• 4-Methyl-2-pentanone:
  (972 L/day)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 2.14E-06 lb/day

• Arsenic:
  (972 L/day)(365 day/yr)(28.9 μg/L)(g/1E+06 μg)(lb/454 g) = 2.26E-02 lb/yr

• Benzene:
  (972 L/day)(365 day/yr)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 7.82E-04 lb/yr

• Beryllium:
  (972 L/day)(365 day/yr)(4 μg/L)(g/1E+06 μg)(lb/454 g) = 3.13E-03 lb/yr

• Bis(2-ethylhexyl) phthalate:
  (972 L/day)(365 day/yr)(5.9 μg/L)(g/1E+06 μg)(lb/454 g) = 4.61E-03 lb/yr

• Bromodichloromethane:
  (972 L/day)(365 day/yr)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 7.82E-04 lb/yr

• Bromoform:
  (972 L/day)(365 day/yr)(1 μg/L)(g/1E+06 μg)(lb/454 g) = 7.82E-04 lb/yr
• Bromomethane:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Cadmium:
  \( (972 \text{ L/day})(365 \text{ day/yr})(9.1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 7.11E-03 \text{ lb/yr} \)
• Carbon disulfide:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Carbon tetrachloride:
  \( (972 \text{ L/day})(365 \text{ day/yr})(3.2 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.50E-03 \text{ lb/yr} \)
• Chlorobenzene:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Chloroethane:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Chloroform:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Chloromethane:
  \( (972 \text{ L/day})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day} \)
• Cobalt:
  \( (972 \text{ L/day})(27.5 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 5.89E-05 \text{ lb/day} \)
• Copper:
  \( (972 \text{ L/day})(1 \text{ day/24 hr})(192 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 1.71E-05 \text{ lb/hr} \)
• Dibromochloromethane:
  \( (972 \text{ L/day})(365 \text{ day/yr})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 7.82E-04 \text{ lb/yr} \)
• Ethylbenzene:
  \( (972 \text{ L/day})(365 \text{ day/yr})(1 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 7.82E-04 \text{ lb/yr} \)
• Fluoride:
  \( (972 \text{ L/day})(347 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 7.43E-04 \text{ lb/day} \)
• Hexavalent chromium:
  \( (972 \text{ L/day})(365 \text{ day/yr})(381 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 2.98E-01 \text{ lb/yr} \)
• Lead:
  \( (972 \text{ L/day})(0.44 \mu\text{g/L})(g/1E+06 \mu\text{g})(lb/454 \text{ g}) = 9.34E-07 \text{ lb/day} \)
- Manganese:
  \[(972 \text{ L/day})(255 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 5.46E-04 \text{ lb/day}\]

- Mercury:
  \[(972 \text{ L/day})(0.66 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 1.41E-06 \text{ lb/day}\]

- Methylene chloride:
  \[(972 \text{ L/day})(365 \text{ day/yr})(30 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 2.34E-02 \text{ lb/yr}\]

- Naphthalene:
  \[(972 \text{ L/day})(365 \text{ day/yr})(2 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 1.56E-03 \text{ lb/yr}\]

- n-Nitrosodi-n-dipropylamine:
  \[(972 \text{ L/day})(365 \text{ day/yr})(0.57 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 4.45E-04 \text{ lb/yr}\]

- Pentachlorophenol:
  \[(972 \text{ L/day})(365 \text{ day/yr})(2 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 1.56E-03 \text{ lb/yr}\]

- Phenol:
  \[(972 \text{ L/day})(2 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 4.28E-06 \text{ lb/day}\]

- Selenium:
  \[(972 \text{ L/day})(26.9 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 6.33E-05 \text{ lb/day}\]

- Styrene:
  \[(972 \text{ L/day})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day}\]

- Tetrachloroethene:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 7.82E-04 \text{ lb/yr}\]

- Toluene:
  \[(972 \text{ L/day})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day}\]

- trans-1,2-Dichloroethylene:
  \[(972 \text{ L/day})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 2.14E-06 \text{ lb/day}\]

- Trichloroethene:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 7.82E-04 \text{ lb/yr}\]

- Vanadium:
  \[(972 \text{ L/day})(148 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 3.17E-04 \text{ lb/day}\]

- Vinyl chloride:
  \[(972 \text{ L/day})(365 \text{ day/yr})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 \text{ g}) = 7.82E-04 \text{ lb/yr}\]
• Xylenes (total):

\[(972 \text{ L/day})(1 \mu g/L)(g/1E+06 \mu g)(lb/454 g) = 2.14E-06 \text{ lb/day}\]

**C2.4.3 Comparison with WAC 173-460-150 Criteria**

The small quantity emission rate (SQER) and de minimis values for toxic air pollutants, tabulated in WAC 173-460-150, represent values that require controls to limit potential emissions. Table C-3 compares these values with calculated emissions.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>de minimis</th>
<th>Constituent PTE</th>
<th>PTE Exceeds de minimis?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,1-Trichloroethane</td>
<td>6.57 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>0.165 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,1,2-Trichloroethene</td>
<td>0.6 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>6 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>1.31 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>0.369 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>0.959 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,4-Dichlorobenzene</td>
<td>0.872 lb/yr</td>
<td>0.00102 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>1,4-Dioxane</td>
<td>1.25 lb/yr</td>
<td>0.0352 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>2,4-Dinitrotoluene</td>
<td>0.107 lb/yr</td>
<td>0.000391 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>2-Butanone</td>
<td>32.9 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>2-Methylphenol (cresol, o-)</td>
<td>3.94 lb/day</td>
<td>0.00000428 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>3+4 Methylphenol (cresol, m+p)</td>
<td>3.94 lb/day</td>
<td>0.00000428 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>4-Methyl-2-pentanone</td>
<td>19.7 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Arsenic</td>
<td>0.00291 lb/yr</td>
<td>0.0226 lb/yr</td>
<td>Yes</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.331 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Beryllium</td>
<td>0.004 lb/yr</td>
<td>0.00313 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Bis(2-ethylhexyl) phthalate</td>
<td>0.4 lb/yr</td>
<td>0.00461 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>0.259 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Bromoform</td>
<td>8.72 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>0.0629 lb/day</td>
<td>0.0000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Cadmium</td>
<td>2.28E-03 lb/yr</td>
<td>0.00711 lb/yr</td>
<td>Yes</td>
</tr>
</tbody>
</table>
## Table C-3. Comparison of Potential Release of Criteria and Toxic Chemicals from 200-DV-1 OU Perched Water with Criteria

<table>
<thead>
<tr>
<th>Constituent</th>
<th>de minimis</th>
<th>Constituent PTE</th>
<th>PTE Exceeds de minimis?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon disulfide</td>
<td>4.26 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>0.228 lb/yr</td>
<td>0.00250 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>6.57 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>197 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.417 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.591 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Cobalt</td>
<td>0.000657 lb/day</td>
<td>0.0000589 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Copper</td>
<td>0.011 lb/hr</td>
<td>0.0000171 lb/hr</td>
<td>No</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td>0.355 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>3.84 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Fluoride</td>
<td>0.0854 lb/day</td>
<td>0.000743 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Hexavalent chromium</td>
<td>0.000064 lb/yr</td>
<td>0.298 lb/yr</td>
<td>Yes</td>
</tr>
<tr>
<td>Lead</td>
<td>10 lb/day</td>
<td>0.00000934 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.000263 lb/day</td>
<td>0.000546 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Mercury</td>
<td>0.0005.91 lb/day</td>
<td>0.0000141 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>9.59 lb/yr</td>
<td>0.0234 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>0.282 lb/yr</td>
<td>0.00156 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>n-Nitrosodi-n-dipropylamine</td>
<td>0.0048 lb/yr</td>
<td>0.000454 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>2.08 lb/yr</td>
<td>0.00156 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Phenol</td>
<td>1.31 lb/day</td>
<td>0.00000428 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Selenium</td>
<td>0.131 lb/day</td>
<td>0.0000633 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Styrene</td>
<td>5.91 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Tetrachloroethene</td>
<td>1.62 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Toluene</td>
<td>32.9 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>trans-1,2-Dichloroethylene</td>
<td>5.3 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Trichloroethene</td>
<td>4.8 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
<tr>
<td>Vanadium</td>
<td>0.00131 lb/day</td>
<td>0.000317 lb/day</td>
<td>No</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>0.123 lb/yr</td>
<td>0.000782 lb/yr</td>
<td>No</td>
</tr>
</tbody>
</table>
Four metals (arsenic, cadmium, hexavalent chromium, and manganese) were the only constituents to exceed their de minimis value. To determine the concentration of vapor released to the atmosphere (vapor partition) from each metal, Henry’s law is applied using a calculated Henry’s law constant. The PTE is recalculated for the vapor concentration using the formula:

\[
\text{lb/WAC 173-460-150 Table time unit = (volume water discharged in L)(contaminant concentration)}
\]

The results of the step two process are summarized in Table C-4 assigned to the HEPA filter and the abated PTE is calculated using the following formula:

\[
\text{Abated PTE (lb/yr) = (vapor partition PTE [lb/yr])(0.01)}
\]

The abated arsenic vapor partition is 0.000128 lb/yr and is below the 0.05811 lb/yr SQER contained in WAC 173-460-150. HEPA filtration is considered adequate as best available control technology for toxics for arsenic.

<table>
<thead>
<tr>
<th>Constituent</th>
<th>de minimis</th>
<th>Constituent PTE</th>
<th>PTE Exceeds de minimis?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylenes (total)</td>
<td>1.45 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
</tbody>
</table>

OU = operable unit
PTE = potential to emit

---

**Table C-3. Comparison of Potential Release of Criteria and Toxic Chemicals from 200-DV-1 OU Perched Water with Criteria**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>de minimis</th>
<th>Constituent PTE</th>
<th>PTE Exceeds de minimis?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylenes (total)</td>
<td>1.45 lb/day</td>
<td>0.00000214 lb/day</td>
<td>No</td>
</tr>
</tbody>
</table>

---

**Table C-4. Vapor Partition Calculation**

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Liquid Concentration (µg/L)</th>
<th>Vapor Pressure (Calculated Atmosphere) (a)</th>
<th>Henry’s Law Constant (Calculated Dimensionless) (b)</th>
<th>Vapor Partition Concentration (µg/L) (c)</th>
<th>PTE (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>28.9</td>
<td>1.84E-04</td>
<td>5.65E-01</td>
<td>1.63E+01</td>
<td>1.28E-02 lb/yr</td>
</tr>
<tr>
<td>Cadmium</td>
<td>9.1</td>
<td>3.22E-13</td>
<td>1.49E-09</td>
<td>1.35E-08</td>
<td>1.06E-11 lb/yr</td>
</tr>
<tr>
<td>Hexavalent chromium</td>
<td>381</td>
<td>4.30E-54</td>
<td>9.18E-51</td>
<td>3.50E-48</td>
<td>2.73E-51 lb/yr</td>
</tr>
<tr>
<td>Manganese</td>
<td>255</td>
<td>2.45E-34</td>
<td>5.51E-31</td>
<td>1.41E-28</td>
<td>3.01E-34 lb/day</td>
</tr>
</tbody>
</table>

\(a\) Formula: \(\ln (P_1/P_2) = -(H_{vap}/R) (1/T_1-1/T_2)\) [i.e., \(P_1 = \exp(-344.3 \text{ kJ/mol} \times 1000 \text{ J/kJ}) \times (1/298.15 - 1/2,942.15)) \div 0.987\]. Data obtained from New York University Physics Laboratory web page vapor pressure table and periodictable.com data provided by Mathematica’s ElementData function from Wolfram Research Inc.; accessed online June 23, 2014.

\(b\) Formula: \(Hcc = ((VP \times M)/S) \times 41\) [e.g., \(Hcc = ((6.30E-55 \text{ atmosphere} \times 51.996 \text{ g/mol}) \div 1 \text{ mg/L}) \times 41\)].

\(c\) Formula: Conc. air = Conc. H\(_{2}\)O \times Hcc [e.g., Conc. air = 381 µg/L \times 1.34E-51].

\(d\) Formula: lb/yr = (volume water discharged in L) (contaminant concentration) [e.g., lb/yr = 972 L/day \times 365 days \times 5.12 E-49 µg/L \times 1 g/1E+06 µg \times 1 lb/454 g].

PTE = potential to emit
C3 Emission Controls

Based on analysis of the potential radiological emissions, and criteria and toxic emissions, to the atmosphere and available control technologies, the following controls have been selected for use during the remedial action:

- The aboveground air-handling systems will employ a chiller/condenser to remove a portion of the water vapor (for the purposes of collecting samples and protecting the blower and filter) and to reduce potential air emissions.

- One stage of HEPA type filtration will remove potential particulates. The HEPA type is intended to reflect nonstandard application of HEPA abatement, not meeting engineered specifications of the applicable standards. The filter will be replaced at least annually (±6 months of the previous installation date) because of the high water vapor content of the well vent effluent.
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C4 Monitoring

Based on an analysis of the unabated release potential for radiological emissions, the emission unit has a PTE of less than 0.1 mrem/yr total effective dose equivalent to the MEI (minor source). Specifically, the calculated unabated annual total effective dose equivalent to the MEI for the deep vadose zone perched water pumping/pore water extraction removal action at well 299-E33-344 is 1.03E-04 mrem/yr. This activity is considered a minor source that requires only periodic confirmatory measurement.

In the context of as low as reasonably achievable and worker protection, the following actions will be required based on radiological monitoring:

- If contamination surveys in the ventilation exhaust port exceed 1,000 disintegrations per minute (dpm)/100 cm² beta-gamma or 20 dpm/100 cm² alpha, then suspend work, secure ventilation, and investigate the source of the contamination.

- If the low-volume air sample results at the ventilation exhaust exceed 0.3 derived air concentration after allowing for decay of naturally occurring radionuclides, then suspend work, secure ventilation, and investigate the source of the contamination.

Based on an analysis of the unabated release potential for criteria and toxic emissions, the emission units at wells 299-E33-344, 299-E33-350, and 299-E33-351 will have the potential to exceed the de minimis limit for arsenic (2.91E-03 lb/yr); specifically, the calculated unabated release of arsenic is 2.26E-02 lb/yr. Application of the controls defined in Section C3, particularly the HEPA filter, will reduce emissions by at least a factor of 10, which is less than the SQER.
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C5 References


Subpart H, “National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities.”


WAC 173-400-040, “General Standards for Maximum Emissions.”

WAC 173-460-150, “Controls for New Sources of Toxic Air Pollutants.”


WAC 246-247-040, “General Standards.”