TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 0907	TPA CHANGE NOTICE FORM	Date: March, 2021
Document Number, Title, and Revision: DOE/RL-2014-37, *Removal Action Work Plan for the 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*, Rev. 0		Date Document Last Issued: November, 2015
Approved Change Notices Against this Document: TPA-CN-719, TPA-CN-0809, TPA-CN-0881		
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Description of Change:
DOE/RL-2014-37 is amended to clarify that vacuum-enhanced recovery is not a requirement of the removal action and that the water extraction operation is a closed system and potential emissions are covered by Appendix C, *Air Monitoring Plan for the 200 West Operations and Maintenance Plan* (DOE/RL-2009-124).

M. W. Cline (**DOE**) and D. Goswami (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records,* and not Chapter 12.0, *Changes to the Agreement*.

Text in the main document is revised to clarify that vacuum-enhanced recovery is not a requirement of the removal action but is an option that may be added if/when the project and regulators approve its use. Text in the main document is revised to clarify that an air monitoring plan will be developed if/when the vacuum-enhanced recovery system is approved for use by the regulators.

Text in the main document is also revised to clarify that the water extraction operation is a closed system and potential emissions are covered by Appendix C, *Air Monitoring Plan for the 200 West Operations and Maintenance Plan* (DOE/RL-2009-124).

Appendix C of this document, *Air Monitoring Plan*, is no longer current and is removed along with any associated references to it in the main body of the document.

Additions are shown using <u>double underline</u>. Deletions are shown using ~~strikeout~~.

Note: Include affected page number(s): xii, 1, 11, 12, 13, 19, 21, 30, C-i through C-24

Justification and Impacts of Change:

Corrective Action, CR-2020-1115 was issued as a result of a management assessment performed on DOE/RL-2014-37, Removal Action Work Plan for the 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction. Text in DOE/RL-2014-37 inadvertently presents the use of vacuum-enhanced recovery as a requirement of the 200-DV-1 OU perched water pumping/pore water extraction removal action. Vacuum-enhanced recovery was intended to be an optional technology depending on site conditions and the progress of the removal action. To date, vacuum-enhanced recovery has not been used. The current language of the RAWP also implied the Air Monitoring Plan (Appendix C) is being implemented even though vacuum-enhanced recovery is not being implemented. The changes in this TPA-CN clarify the optional use of vacuum-enhanced recovery and remove the Air Monitoring Plan (Appendix C). In the event that vacuum-enhanced recovery is implemented, an air monitoring plan and the associated controls will be developed in coordination with the regulators.

Approvals:

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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~~by one of two means. The perched water can be transfer~~ed~~ing 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. By using a truck or pipeline, the system is closed and any air emissions are monitored and controlled through implementation of DOE/RL-2009-124, *200 West Operations and Maintenance Plan, Appendix C, Air Monitoring Plan for the 200 West Pump and Treat*. 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.

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 then will be transferred by tanker truck to the 200 West P&T, where the water then 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. By transferring the extracted waster using a truck or pipeline the system is closed and any air emissions are monitored and controlled through the implementation of the 200 West Pump and Treat Air Monitoring Plan (DOE/RL-2009-124, Appendix C). The perched water removal work activities are shown in Figure 5.

Additional perched water extraction wells and monitoring wells may be installed during implementation of this removal action to enhance the extraction rate and monitoring capability for the perched water in the deep vadose zone of the 200-DV-1 OU. The actual schedule for installation, construction, and operation of the extraction and monitoring wells will be determined based on priority of Hanford Site work activities and available funding each FY.

Two additional phases of perched water extraction were included in the treatability test plan (DOE/RL-2011-40) for potential implementation. As needed, a~~The~~ second phase ~~would~~could 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. If implemented, an air monitoring plan will be developed in consultation with the regulators. The third phase of pumping, which would occur as drainable perched water is reduced, would continue to use the vacuum system to extract soil vapor from the entrained pore water from the perched zone to maximize contaminant removal. This third 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 proposed 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.

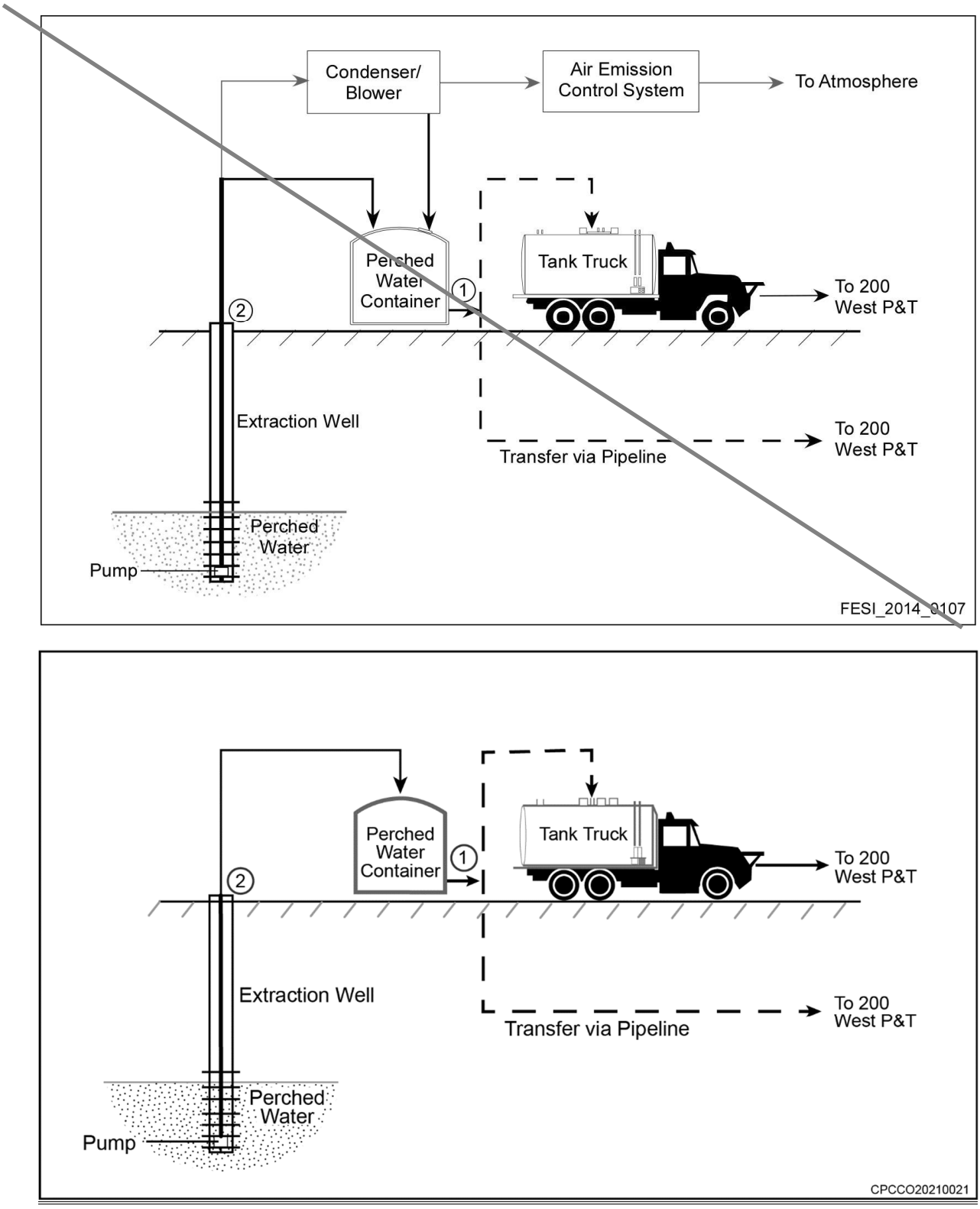

Figure 5. Perched Water Removal Activities

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 be used to remove soil vapor with entrained pore water. An air monitoring plan will be developed if /when vacuum-enhanced recovery is implemented and approved by the regulators. 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 approved for use~~used,~~ air emissions will be monitored in accordance with ~~the~~an air emission plan ~~for 200-DV-1 OU vacuum-enhanced recovery/pore water extraction (Appendix C of this RAWP)~~that will be developed in consultation with the regulators.

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 nonradionuclide COCs.

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 emissions ~~plan~~ for the 200-DV-1 OU perched water pumping/pore water extraction removal action ~~(Appendix C of this RAWP)~~ are covered by the 200 West Pump and Treat Air Monitoring Plan (DOE/RL-2009-124, Appendix C). The plan 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.

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. Purgewater 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-2016-22, *Waste Management Plan for Perched Water Pumping/Pore Water Extraction*.

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~~s plan~~ for the 200-DV-1 OU perched water pumping/pore water extraction ~~is~~are considered a closed system and are covered by ~~provided in Appendix C of this RAWP~~ the 200 West Pump and Treat Air Monitoring Plan (DOE/RL-2009-124, Appendix C). 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.

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Appendix C

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

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Terms

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

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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, tectnetium-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.

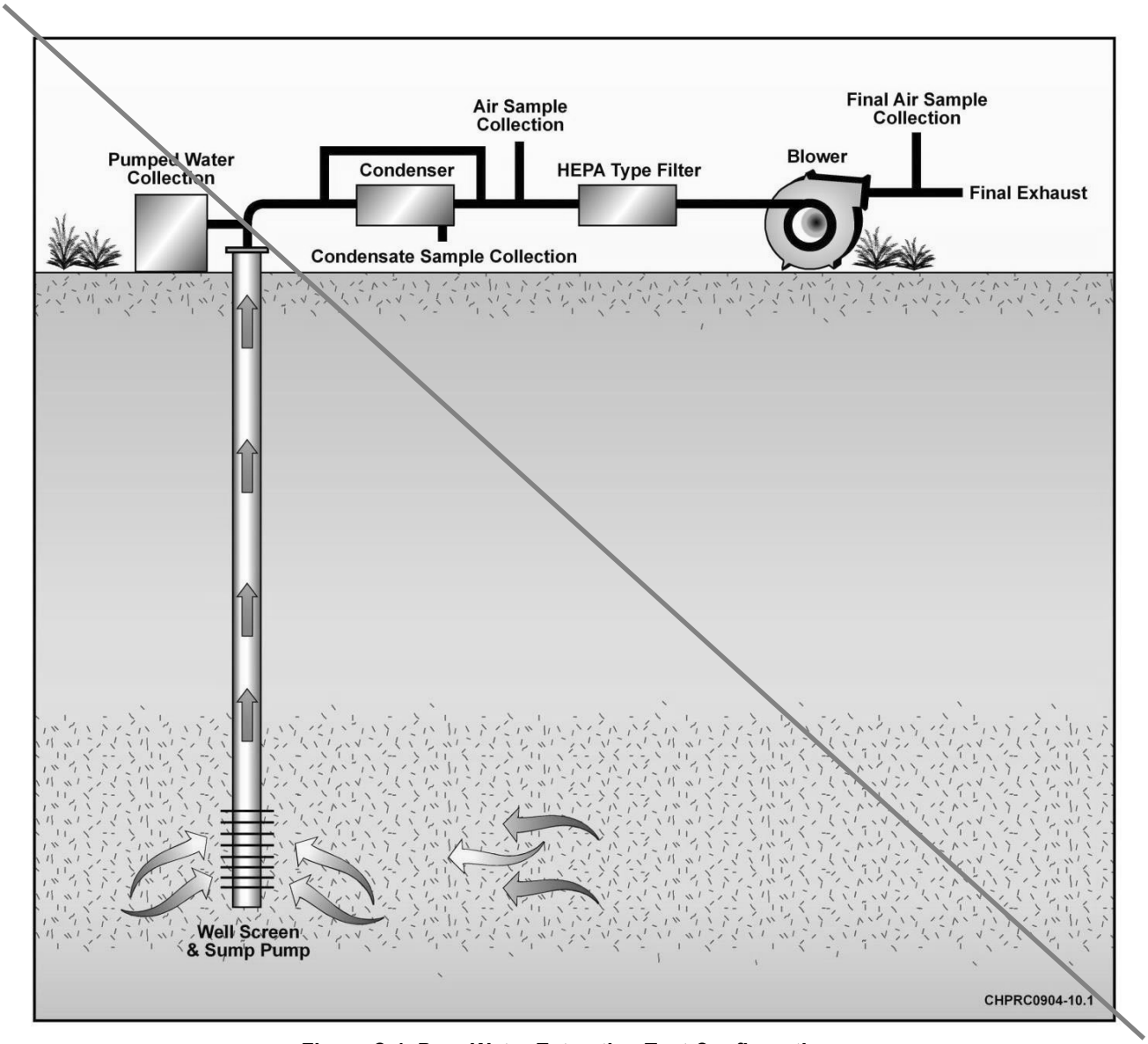


Figure C-1. Pore Water Extraction Test Configuration

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.

The radiological constituents of concern are americium-241, antimony-125, beryllium-7, carbon-14, cesium-134, cesium-137, cobalt-60, europium-152, europium-154, europium-155, gross alpha, gross beta, potassium-40, ruthenium-106, thorium-228, thorium-230, thorium-232, technetium-99, uranium, uranium-233/234, uranium-235, uranium-238, iodine-129, neptunium-237, plutonium-238, plutonium-239/240, strontium-90, and hydrogen-3. Table C-1 shows maximum detected values of these constituents in perched water samples (per the Hanford Environmental Information System [HEIS] database).

Table C-1. Radiological Constituents in 200-DV-1 OU Perched Water

Isotope	Well Name	Sample Number	Sample Date	Concentration (pCi/L)
Americium-241	299-E33-344	B21958	8/4/2009	0.16
Antimony-125	299-E33-344	B2JBT8	12/5/2011	23.6
Beryllium-7	299-E33-344	B2NC56	2/5/2013	734
Carbon-14	299-E33-344	B2VPC7	4/22/2014	1,620
Cesium-134	299-E33-344	B2KPL6	8/2/2012	590
Cesium-137	299-E33-344	B2KPL6	8/2/2012	66
Cobalt-60	299-E33-344	B2KPL6	8/2/2012	120
Europium-152	299-E33-344	B2KPL6	8/2/2012	43
Europium-154	299-E33-344	B2NC56	2/5/2013	60.9
Europium-155	299-E33-344	B2KPL6	8/2/2012	160
Gross alpha	299-E33-344	B2KPL6	8/2/2012	55,000
Gross beta	299-E33-344	B2VPD1	4/22/2014	58,000

Table C-1. Radiological Constituents in 200-DV-1 OU Perched Water

Isotope	Well Name	Sample Number	Sample Date	Concentration (pCi/L)
Iodine-129	299-E33-344	B2FL66	10/4/2011	24
Neptunium-237	299-E33-344	B21959	8/4/2009	0.812
Plutonium-238	299-E33-344	B1V7P5	7/15/2008	0.21
Plutonium-239/240	299-E33-344	B1V7P5	7/15/2008	0.15
Potassium-40	299-E33-344	B2JBT8	12/5/2011	100
Ruthenium-106	299-E33-344	B2KPL6	8/2/2012	310
Strontium-90	299-E33-344	B2FL67	10/4/2011	5.59
Technetium-99	299-E33-344	B2VPD1	4/22/2014	51,000
Thorium-228	299-E33-344	B254M4	5/24/2010	0.372
Thorium-230	299-E33-344	B22L90	11/12/2009	0.211
Thorium-232	299-E33-344	B254M4	5/24/2010	0.15
Total beta radiostrontium	299-E33-344	B21958	8/4/2009	4.3
Tritium	299-E33-344	B2J8R7	12/5/2011	43,500
Uranium	299-E33-350	B2W1W3	2/24/2014	107,000
Uranium-233/234	299-E33-350	B2W1W3	2/24/2014	34,000
Uranium-235	299-E33-344	B2VPD1	4/22/2014	2,600
Uranium-238	299-E33-350	B2W1W6	2/24/2014	35,000

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

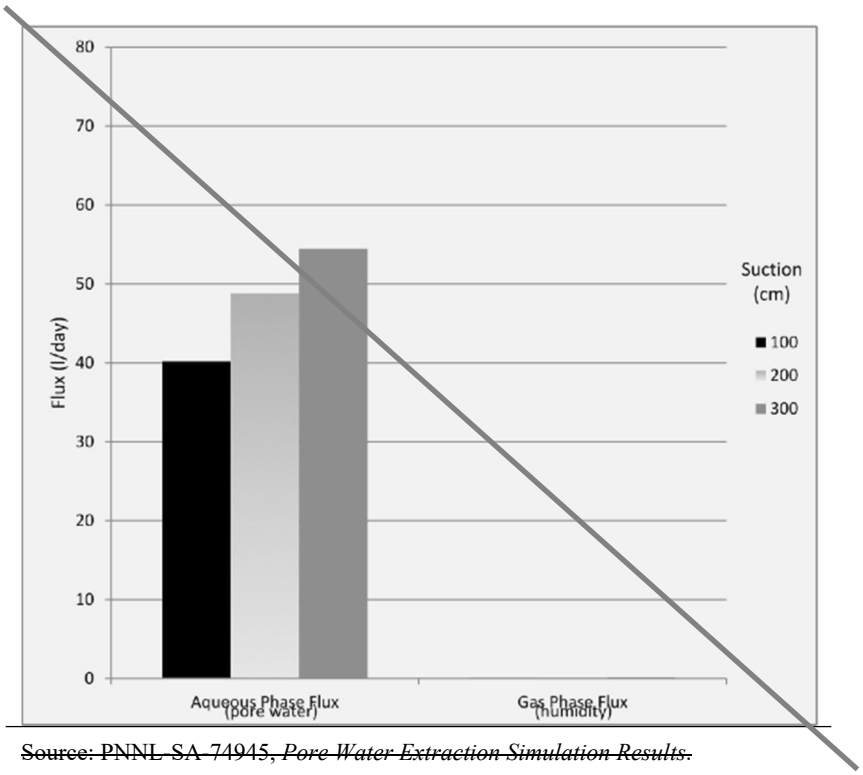
The PTE calculation is based upon the following information:

- 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:
  - APQ; liquid release fraction for americium-241, antimony-125, beryllium-7, carbon-14, cesium-134, cesium-137, cobalt-60, europium-152, europium154, europium-155, potassium-40, ruthenium-106, thorium-228, thorium-230, thorium-232, technetium-99, uranium-233/234, uranium-235, uranium-238, neptunium-237, plutonium-239/240, and strontium-90



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

- Unabated dose:

– Americium-241	= 2.38E-10 mrem/yr	– Antimony-125	= 3.74E-11 mrem/yr
– Beryllium-7	= 4.84E-11 mrem/yr	– Carbon-14	= 1.42E-10 mrem/yr
– Cesium-134	= 4.19E-09 mrem/yr	– Cesium-137	= 1.13E-10 mrem/yr
– Cobalt-60	= 1.06E-09 mrem/yr	– Europium-152	= 2.32E-10 mrem/yr
– Europium-154	= 3.72E-10 mrem/yr	– Europium-155	= 6.98E-11 mrem/yr
– Gross alpha	= 9.81E-05 mrem/yr	– Gross beta	= 2.35E-07 mrem/yr
– Iodine-129	= 3.47E-08 mrem/yr	– Neptunium-237	= 6.57E-10 mrem/yr
– Plutonium-238	= 3.46E-10 mrem/yr	– Plutonium-239/240	= 2.68E-10 mrem/yr
– Potassium-40	= 2.23E-10 mrem/yr	– Ruthenium-106	= 3.13E-10 mrem/yr
– Strontium-90	= 2.26E-11 mrem/yr	– Technetium-99	= 1.86E-05 mrem/yr
– Thorium-228	= 5.27E-10 mrem/yr	– Thorium-230	= 1.05E-10 mrem/yr
– Thorium-232	= 1.33E-10 mrem/yr	– Beta radiostrontium	= 1.74E-11 mrem/yr
– Tritium	= 4.15 E-07 mrem/yr	– Uranium	= 1.04E-10 mrem/yr
– Uranium-233/234	= 4.29E-06 mrem/yr	– Uranium-235	= 2.87E-07 mrem/yr
– Uranium-238	= 3.40E-11 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; chloroform; chloromethane; cobalt; copper; dibromochloromethane; ethylbenzene; fluoride; hexavalent chromium; lead; manganese; mercury; methylene 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 C-2. Criteria and Toxic Contaminants in 200-DV-1 OU Perched Water

Constituent[a]	CAS No.	Well Name	Sample Number	Sample Date	Concentration (µg/L)
1,1,1-Trichloroethane	71-55-6	299-E33-344	B254M2	5/24/2010	1
1,1,2,2-Tetrachloroethane	79-34-5	299-E33-344	B1T200	1/8/2008	1
1,1,2-Trichloroethane	79-00-5	299-E33-344	B254M2	5/24/2010	1
1,1-Dichloroethane	75-34-3	299-E33-344	B254M2	5/24/2010	1
1,1-Dichloroethene	75-35-4	299-E33-344	B254M2	5/24/2010	1
1,2-Dichloroethane	107-06-2	299-E33-344	B254M2	5/24/2010	1
1,2-Dichloropropane	78-87-5	299-E33-344	B1T200	1/8/2008	1
1,4-Dichlorobenzene	106-46-7	299-E33-344	B1XMD3	11/18/2008	1.3
1,4-Dioxane	123-91-1	299-E33-344	B20JC3	6/26/2009	45
2,4-Dinitrotoluene	121-14-2	299-E33-344	B22L92	11/12/2009	0.5
2-Butanone	78-93-3	299-E33-344	B254M2	5/24/2010	1
2-Methylphenol (cresol, o-)	95-48-7	299-E33-344	B20W33	6/26/2009	2
3+4 Methylphenol (cresol, m+p)	108-39-4 106-44-5	299-E33-344	B25F06	5/24/2010	2
4-Methyl-2-pentanone	108-10-1	299-E33-344	B254M2	5/24/2010	1
Arsenic	7440-38-2	299-E33-344	B20HK8	5/22/2009	28.9
Benzene	71-43-2	299-E33-344	B254M2	5/24/2010	1
Beryllium	7440-41-7	299-E33-344	B2PPB0	8/13/2013	4
Bis(2-ethylhexyl) phthalate	117-81-7	299-E33-344	B21962	8/4/2009	5.9
Bromodichloromethane	75-27-4	299-E33-344	B1T200	1/8/2008	1
Bromoform	75-25-2	299-E33-344	B1T200	1/8/2008	1
Bromomethane	74-83-9	299-E33-344	B1T200	1/8/2008	1
Cadmium	7440-43-9	299-E33-344	B2J8R8	12/5/2011	9.1
Carbon disulfide	75-15-0	299-E33-344	B254M2	5/24/2010	1
Carbon tetrachloride	56-23-5	299-E33-344	B1XMD3	11/18/2008	3.2
Chlorobenzene	108-90-7	299-E33-344	B254M2	5/24/2010	1
Chloroethane	75-00-3	299-E33-344	B1T200	1/8/2008	1
Chloroform	67-66-3	299-E33-344	B254M2	5/24/2010	1
Chloromethane	74-87-3	299-E33-344	B1T200	1/8/2008	1

Table C-2. Criteria and Toxic Contaminants in 200-DV-1 OU Perched Water

Constituent[a]	CAS No.	Well Name	Sample Number	Sample Date	Concentration (µg/L)
Cobalt	7440-48-4	299-E33-351	B2VWV2	1/30/2014	27.5
Copper	7440-50-8	299-E33-344	B2VPD1	4/22/2014	192
Dibromochloromethane	124-48-1	299-E33-344	B1T200	1/8/2008	1
Ethylbenzene	100-41-4	299-E33-344	B254M2	5/24/2010	1
Fluoride	16984-48-8	299-E33-350	B2W1W6A	2/24/2014	347
Hexavalent chromium	18540-29-9	299-E33-344	B294R0	12/19/2010	381[b]
Lead	7439-92-1	299-E33-344	B1T201	1/8/2008	0.436
Manganese	7439-96-5	299-E33-344	B2FL67	10/4/2011	255
Mercury	7439-97-6	299-E33-344	B1V7P5	7/15/2008	0.66
Methylene chloride	75-09-2	299-E33-344	B20JC3	6/26/2009	30
Naphthalene	91-20-3	299-E33-344	B1V7P5	7/15/2008	2
n-Nitrosodi-n-dipropylamine	621-64-7	299-E33-344	B1XMD3	11/18/2008	0.57
Pentachlorophenol	87-68-5	299-E33-344	B20W33	6/26/2009	2
Phenol	108-95-2	299-E33-344	B25F06	5/24/2010	2
Selenium	7782-49-2	299-E33-351	B2VWV2	1/30/2014	29.6
Styrene	100-42-5	299-E33-344	B1T200	1/8/2008	1
Tetrachloroethene	127-18-4	299-E33-344	B254M2	5/24/2010	1
Toluene	108-88-3	299-E33-344	B254M2	5/24/2010	1
trans-1,2-Dichloroethylene	156-60-5	299-E33-344	B254M2	5/24/2010	1
Trichloroethene	79-01-6	299-E33-344	B254M2	5/24/2010	1
Vanadium	7440-62-2	299-E33-344	B1T201	1/8/2008	148
Vinyl chloride	75-01-4	299-E33-344	B254M2	5/24/2010	1
Xylenes (total)	1330-20-7	299-E33-344	B254M2	5/24/2010	1

a. ECF-HANFORD-14-0039, *Air Emissions from 200-DV-1 Operable Unit Perched Water Pumping/Pore Water Extraction*, Appendix A (per HEIS database).

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:

lb/WAC 173-460-150 table time unit =
(volume water discharged in L)(contaminant concentration)

- 1,1,1-Trichloroethane:

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

- 1,1,2,2-Tetrachloroethane:

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

- 1,1,2-Trichloroethane:

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

- 1,1-Dichloroethane:

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

- 1,1-Dichloroethene:

  (972 L/day) (1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 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 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Cadmium:~~

  ~~(972 L/day)(365 day/yr)(9.1 µg/L)(g/1E+06 µg)(lb/454 g) = 7.11E-03 lb/yr~~

- ~~Carbon disulfide:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Carbon tetrachloride:~~

  ~~(972 L/day)(365 day/yr)(3.2 µg/L)(g/1E+06 µg)(lb/454 g) = 2.50E-03 lb/yr~~

- ~~Chlorobenzene:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Chloroethane:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Chloroform:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Chloromethane:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Cobalt:~~

  ~~(972 L/day)(27.5 µg/L)(g/1E+06 µg)(lb/454 g) = 5.89E-05 lb/day~~

- ~~Copper:~~

  ~~(972 L/day)(1 day/24 hr)(192 µg/L)(g/1E+06 µg)(lb/454 g) = 1.71E-05 lb/hr~~

- ~~Dibromochloromethane:~~

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

- ~~Ethylbenzene:~~

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

- ~~Fluoride:~~

  ~~(972 L/day)(347 µg/L)(g/1E+06 µg)(lb/454 g) = 7.43E-04 lb/day~~

- ~~Hexavalent chromium:~~

  ~~(972 L/day)(365 day/yr)(381 µg/L)(g/1E+06 µg)(lb/454 g) = 2.98E-01 lb/yr~~

- ~~Lead:~~

  ~~(972 L/day)(0.44 µg/L)(g/1E+06 µg)(lb/454 g) = 9.34E-07 lb/day~~

- ~~Manganese:~~

  ~~(972 L/day)(255 µg/L)(g/1E+06 µg)(lb/454 g) = 5.46E-04 lb/day~~

- ~~Mercury:~~

  ~~(972 L/day)(0.66 µg/L)(g/1E+06 µg)(lb/454 g) = 1.41E-06 lb/day~~

- ~~Methylene chloride:~~

  ~~(972 L/day)(365 day/yr)(30 µg/L)(g/1 E+06 µg)(lb/454 g) = 2.34E-02 lb/yr~~

- ~~Naphthalene:~~

  ~~(972 L/day)(365 day/yr)(2 µg/L)(g/1E+06 µg)(lb/454 g) = 1.56E-03 lb/yr~~

- ~~n-Nitrosodi-n-dipropylamine:~~

  ~~(972 L/day)(365 day/yr)(0.57 µg/L)(g/1 E+06 µg)(lb/454 g) = 4.45E-04 lb/yr~~

- ~~Pentachlorophenol:~~

  ~~(972 L/day)(365 day/yr)(2 µg/L)(g/1E+06 µg)(lb/454 g) = 1.56E-03 lb/yr~~

- ~~Phenol:~~

  ~~(972 L/day)(2 µg/L)(g/1E+06 µg)(lb/454 g) = 4.28E-06 lb/day~~

- ~~Selenium:~~

  ~~(972 L/day)(26.9 µg/L)(g/1E+06 µg)(lb/454 g) = 6.33E-05 lb/day~~

- ~~Styrene:~~

  ~~(972 L/day)(1 µg/L)(g/1 E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Tetrachloroethene:~~

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

- ~~Toluene:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~*trans*-1,2-Dichloroethylene:~~

  ~~(972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 lb/day~~

- ~~Trichloroethene:~~

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

- ~~Vanadium:~~

  ~~(972 L/day)(148 µg/L)(g/1E+06 µg)(lb/454 g) = 3.17E-04 lb/day~~

- ~~Vinyl chloride:~~

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

- Xylenes (total):

  (972 L/day)(1 µg/L)(g/1E+06 µg)(lb/454 g) = 2.14E-06 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 C-3. Comparison of Potential Release of Criteria and Toxic Chemicals from 200-DV-1 OU Perched Water with Criteria

Constituent	de minimis	Constituent PTE	PTE Exceeds de minimis?
1,1,1-Trichloroethane	6.57 lb/day	0.00000214 lb/day	No
1,1,2,2-Tetrachloroethane	0.165 lb/yr	0.000782 lb/yr	No
1,1,2-Trichloroethane	0.6 lb/yr	0.000782 lb/yr	No
1,1-Dichloroethane	6 lb/yr	0.000782 lb/yr	No
1,1-Dichloroethene	1.31 lb/day	0.00000214 lb/day	No
1,2-Dichloroethane	0.369 lb/yr	0.000782 lb/yr	No
1,2-Dichloropropane	0.959 lb/yr	0.000782 lb/yr	No
1,4-Dichlorobenzene	0.872 lb/yr	0.00102 lb/yr	No
1,4-Dioxane	1.25 lb/yr	0.0352 lb/yr	No
2,4-Dinitrotoluene	0.107 lb/yr	0.000391 lb/yr	No
2-Butanone	32.9 lb/day	0.00000214 lb/day	No
2-Methylphenol (cresol, o-)	3.94 lb/day	0.00000428 lb/day	No
3+4 Methylphenol (cresol, m+p)	3.94 lb/day	0.00000428 lb/day	No
4-Methyl-2-pentanone	19.7 lb/day	0.00000214 lb/day	No
Arsenic	0.00291 lb/yr	0.0226 lb/yr	Yes
Benzene	0.331 lb/yr	0.000782 lb/yr	No
Beryllium	0.004 lb/yr	0.00313 lb/yr	No
Bis(2-ethylhexyl) phthalate	0.4 lb/yr	0.00461 lb/yr	No
Bromodichloromethane	0.259 lb/yr	0.000782 lb/yr	No
Bromoform	8.72 lb/yr	0.000782 lb/yr	No
Bromomethane	0.0629 lb/day	0.00000214 lb/day	No
Cadmium	2.28E-03 lb/yr	0.00711 lb/yr	Yes

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

Constituent	de minimis	Constituent PTE	PTE Exceeds de minimis?
Carbon disulfide	4.26 lb/day	0.00000214 lb/day	No
Carbon tetrachloride	0.228 lb/yr	0.00250 lb/yr	No
Chlorobenzene	6.57 lb/day	0.00000214 lb/day	No
Chloroethane	197 lb/day	0.00000214 lb/day	No
Chloroform	0.417 lb/day	0.00000214 lb/day	No
Chloromethane	0.591 lb/day	0.00000214 lb/day	No
Cobalt	0.000657 lb/day	0.0000589 lb/day	No
Copper	0.011 lb/hr	0.0000171 lb/hr	No
Dibromochloromethane	0.355 lb/yr	0.000782 lb/yr	No
Ethylbenzene	3.84 lb/yr	0.000782 lb/yr	No
Fluoride	0.0854 lb/day	0.000743 lb/day	No
Hexavalent chromium	0.000064 lb/yr	0.298 lb/yr	Yes
Lead	10 lb/day	0.000000934 lb/day	No
Manganese	0.000263 lb/day	0.000546 lb/day	Yes
Mercury	0.0005.91 lb/day	0.00000141 lb/day	No
Methylene chloride	9.59 lb/yr	0.0234 lb/yr	No
Naphthalene	0.282 lb/yr	0.00156 lb/yr	No
n-Nitrosodi-n-dipropylamine	0.0048 lb/yr	.000454 lb/yr	No
Pentachlorophenol	2.08 lb/yr	0.00156 lb/yr	No
Phenol	1.31 lb/day	0.00000428 lb/day	No
Selenium	0.131 lb/day	0.0000633 lb/day	No
Styrene	5.91 lb/day	0.00000214 lb/day	No
Tetrachloroethene	1.62 lb/yr	0.000782 lb/yr	No
Toluene	32.9 lb/day	0.00000214 lb/day	No
trans-1,2-Dichloroethylene	5.3 lb/day	0.00000214 lb/day	No
Trichloroethene	4.8 lb/yr	0.000782 lb/yr	No
Vanadium	0.00131 lb/day	0.000317 lb/day	No
Vinyl chloride	0.123 lb/yr	0.000782 lb/yr	No

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

Constituent	de minimis	Constituent PTE	PTE Exceeds de minimis?
Xylenes (total)	1.45 lb/day	0.00000214 lb/day	No

OU = operable unit

PTE = potential to emit

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:

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:

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 C-4. Vapor Partition Calculation

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

a. Formula: $\ln (P_1/P_2) = -(H_{vap}/R)(1/T_1 - 1/T_2)$ [i.e., P1 = exponent(-(344.3 kJ/mol × 1,000 J/kJ) × (1/298.15 – 1/2,942.15)) ÷ 0.987]. Data obtained from New York University Physics Laboratory web page vapor pressure table and periodictable.com data provided by Mathmatica's ElementData function from Wolfram Research Inc.; accessed online June 23, 2014.

b. Formula: Hcc = ((VP × M)/S) × 41 [e.g., Hcc = ((6.30E-55 atmosphere × 51.996 g/mol). ÷ 1 mg/L) × 41].

c. Formula: $Conc_{air} = Conc_{H20} \times Hcc$ [e.g., Conc. air = 381 µg/L × 1.34E-51].

d. Formula: lb/yr = (volume water discharged in L) (contaminant concentration) [e.g., lb/yr = 972 L/day × 365 days × 5.12 E-49 µg/L × 1 g/1E+06 µg × 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 cm^2 beta-gamma or 20 dpm/100 cm^2 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

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