DOE/RL-2010-05
Revision 0

Proposed Plan for Remediation of the 200-UP-1 Groundwater Operable Unit

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office
P.O. Box 550
Richland, Washington 99352

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APPROVED
By Janis D. Aardal at 11:30 am, Jul 13, 2012

Release Approval   Date

Proposed Plan for Remediation of the 200-UP-1 Groundwater Operable Unit

U.S. Department of Energy, Richland Operations Office
U.S. Environmental Protection Agency
Washington State Department of Ecology

Central Plateau Remediation at the Department of Energy Hanford Site July 2012

Public Comment Period
July 17 – August 16, 2012

How You Can Participate in this Decision-Making Process:

Read this Proposed Plan and review documents in the Administrative Record.

Send Comment on the cleanup alternatives presented in this Proposed Plan by mail or e-mail on or before August 16, 2012 to:

Tifany Nguyen, U.S. Department of Energy, Richland Operations Office, at the following addresses:

Mail: P.O. Box 550, A7-75
Richland, WA 99352
Phone: (509) 376-8230
Email: 200UP1PP@rl.gov

See page 28 for more information about public involvement and contact information.

Inside this Plan

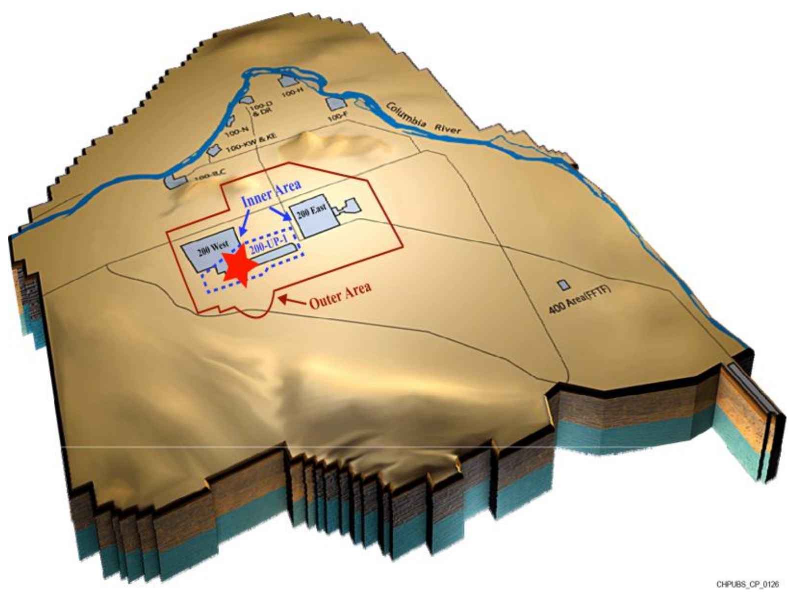


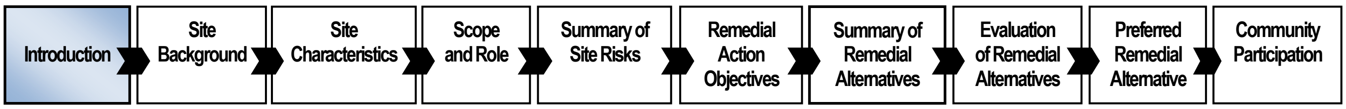
Figure 1. Hanford Site

The U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) invite the public and Tribal Nations to comment on this ***Proposed Plan***[1] for an interim remedial action cleanup of contaminated ***groundwater*** in the 200 UP-1 Groundwater ***Operable Unit (OU)*** located under the central part of the Hanford Site, about 20 miles north of Richland, Washington. DOE has completed an investigation and evaluation of this OU, through the ***remedial investigation (RI)*** and ***feasibility study (FS)*** process. The RI/FS concluded that without ***remedial action***, ***contaminants*** in the OU would present an unacceptable level of risk to human health if the groundwater was used for domestic/drinking water purposes. This Proposed Plan is being issued to summarize the information the Parties relied on to select a Preferred Alternative and seek public and Tribal Nations input on the Preferred Alternative and the other cleanup alternatives considered. Input from the public and Tribal Nations on the Proposed Plan will help DOE and EPA select a cleanup alternative for this contaminated groundwater. The selected cleanup alternative may differ from the Preferred Alternative

[1] Important terms are used in this Proposed Plan. When these terms are first used, they appear in ***bold italics***. Explanation of these terms are provided in the Glossary.

described herein based on comments received during the public comment period. Comments will be accepted during the 30-day public comment period (see sidebar on left of page 1). Following consideration of public input on the cleanup alternatives presented in the Proposed Plan, an interim action ***Record of Decision (ROD)*** will be issued by DOE and EPA, identifying the alternative selected for implementation. The ROD will include a ***responsiveness summary*** which will present a summary of significant comments received, and DOE and EPA responses to those comments. The responsiveness summary will also identify where public comments resulted in changes to the Preferred Alternative.

The following graphic is included to illustrate where the next section fits within the overall document.



Introduction

The DOE, the lead agency and the party responsible for conducting the selected cleanup, is issuing this Proposed Plan as part of the public participation requirements under Section 117(a), "Public Participation," "Proposed Plan," of the ***Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)*** (commonly known as "Superfund") and Section 300.430(f)(2), "Remedial Investigation/Feasibility Study and Selection of Remedy," of the ***National Oil and Hazardous Substances Pollution Contingency Plan*** (commonly known as the "National Contingency Plan," or NCP) (40 *Code of Federal Regulations* [CFR] Part 300). CERCLA establishes the broad federal authority for conducting cleanup at Superfund sites, and the NCP (40 CFR 300) includes requirements and expectations for the cleanup.

The EPA is the lead regulatory agency for this OU and the Washington State Department of Ecology (Ecology) is the non-lead regulatory agency and provides input to EPA on this cleanup decision. Together with DOE, the three organizations are referred to as the ***Tri-Party agencies*** under the *Hanford Federal Facility Agreement and Consent Order* ***(Tri-Party Agreement)*** (Ecology et al., 1989).

The DOE has completed the following:

- *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit* (DOE/RL-2009-122)
- 200- UP-1 RI/FS Appendices A, B, C, and E (DOE/RL-2009-122)
- 200-UP-1 RI/FS Appendix D (DOE/RL-2009-122)

This Proposed Plan has also been prepared to highlight key information about the cleanup alternatives considered and the Preferred Alternative proposed for remediation. Interested parties may review the RI/FS Report for more comprehensive information. This report and other supporting information used to develop and evaluate cleanup alternatives are available in the ***Administrative Record*** (***200-UP-1***), which can be viewed at the various information repositories identified in the Community Participation section.

The RI/FS Report concluded that without remedial action, contaminants in groundwater would present an unacceptable level of risk to human health, if that groundwater was used for domestic purposes such as for drinking, cooking, or bathing. The following remedial action technologies were evaluated in the FS to remediate the contamination:

- No action
- Active remediation through pump-and-treat technology
- ***Monitored natural attenuation (MNA)***
- ***Institutional Controls (ICs)***
- Hydraulic containment

For groundwater response actions, the NCP (40 CFR 300) specifies development of a limited number of cleanup alternatives that attain cleanup levels within varying timeframes. For the active remediation technology of pump-and-treat, increasing pumping rates and increasing numbers of extraction wells at varied locations were evaluated to define the variability and sensitivity in remediation timeframes and to optimize a pumping strategy. After evaluating seven different pumping scenarios, three alternatives were carried forward for further evaluation (in addition to the no action alternative). These alternatives are:

- *No Action Alternative*. Under 40 CFR 300.430(e)(6), a No Action Alternative is required to provide a baseline for comparison against the other alternatives. A No Action Alternative means no further action is taken to protect human health and the environment. Under this alternative, no remedial actions would be taken and all groundwater interim actions including monitoring and ICs would be discontinued.
- *Alternative 2* – *45 Years Active Remediation, MNA, Hydraulic Containment, and ICs*. Groundwater restoration through 45 years of pump-and-treat, MNA for the portions of the contaminated groundwater remaining after pumping, hydraulic containment for Iodine-129 (I-129) and ICs until cleanup levels for unrestricted use are met.
- *Alternative 3* – 35 years *Active Remediation, MNA, Hydraulic Containment, and ICs*. Groundwater restoration through 35 years of pump-and-treat, MNA for the portions of the contaminated groundwater remaining after pumping, hydraulic containment for I-129 and ICs until cleanup levels for unrestricted use are met.
- *Alternative 4* – *25 Years Active Remediation, MNA, Hydraulic Containment, and ICs*. Groundwater restoration through 25 years of pump-and-treat, MNA for the portions of the contaminated groundwater remaining after pumping, hydraulic containment for I-129 and ICs until cleanup levels for unrestricted use are met.

The Preferred Alternative

Based on the results of the detailed and comparative evaluation of the remedial alternatives, the Preferred Alternative is *Alternative 3—35 Years Active Remediation, MNA, Hydraulic Containment, and ICs*. This alternative would clean up contaminated groundwater using moderately aggressive pump-and-treat for 35 years. The contaminated groundwater not addressed through pump-and-treat would be addressed through MNA for a total of 125 years. The I-129 plume would be hydraulically contained in the aquifer until a treatment technology can be identified. ICs would be used to restrict access and use of the groundwater until the cleanup levels for unrestricted use are achieved. ICs are expected to be required for 125 years, as is the case for the adjacent 200-ZP-1 OU's remedy. Alternative 3 will be protective of human health and the environment and meet the statutory and regulatory requirements for remedy selection.

Proposed Plan Organization

The subsequent sections of this Proposed Plan provide:

- **Site Background** – facts about the Site contamination, investigations, interim remediation and past community involvement
- **Site Characteristics** – physical and hydrogeologic characteristics, and a description of the nature and extent of the groundwater contamination
- **Scope and Role** – how the groundwater remedial action fits into the overall Site cleanup strategy; describes prior and planned cleanup actions
- **Summary of Site Risks** – summarizes results of the baseline risk assessment and land and groundwater use assumptions; identifies major contaminants of concern
- **Remedial Action Objectives** – describes what the proposed Site cleanup is expected to accomplish

- **Summary of Remedial Alternatives** – identifies options for attaining the identified ***remedial action objectives (RAOs)***
- **Evaluation of Remedial Alternatives** – compares the options using the CERCLA criteria
- **Preferred Remedial Alternative** – explains rationale for selecting Preferred Alternative
- **Community Participation –** provides information on how the Tribal Nations and public can provide input to the remedy selection process.
- **Glossary –** a list of the terms and definitions used in this document
- **References –** titles and direct links to important documents referenced in this Proposed Plan

Introduction → Site Background → Site Characteristics → Scope and Role → Summary of Site Risks → Remedial Action Objectives → Summary of Remedial Alternatives → Evaluation of Remedial Alternatives → Preferred Remedial Alternative → Community Participation

Site Background

Hanford Site Background

In 1942, during World War II, the Hanford Site was selected by the leaders of the Manhattan Project as the site for building the first production-scale nuclear reactors to produce plutonium for nuclear weapons. The Site manufactured nuclear materials for the nation's defense from 1943 through 1988. Forty-five years of production activities in the center of the Site, known as the Central Plateau, produced large-scale contamination of the groundwater. In 1989, EPA placed the 100, 200, 300, and 1100 Areas of the Hanford Site on its "***National Priorities List" (NPL)*** (40 CFR 300, Appendix B), which is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. Also in 1989, DOE, EPA, and Ecology entered into the Tri-Party Agreement (Ecology et al., 1989), which governs cleanup of the Hanford Site. Since that time, the Hanford Site's mission has focused on environmental cleanup.

200-UP-1 Groundwater OU Background

For the Central Plateau's groundwater cleanup, the Tri-Party agencies divided the groundwater in the 200 East and 200 West Areas into four OUs (200-ZP-1, 200-UP-1, 200-BP-5, and 200-PO-1) as identified in Figure 2. Collectively, the four OUs and their RODs will define the necessary groundwater cleanup actions across the Central Plateau. The 200-UP-1 OU is made up of contaminated groundwater beneath the southern portion of the 200 West Area. To the north of 200-UP-1 lies the 200-ZP-1 Groundwater OU, for which a ROD was issued in 2008. The DOE is currently in the process of implementing the selected groundwater remedy identified in that ROD. The 200-UP-1 OU is located about 8 km (5 mi) south of the Columbia River and 11 km (7 mi) from the nearest site boundary and is bounded on the eastern side by the 200-PO-1 Groundwater OU (Figure 2).

The contamination consists mainly of plumes of carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), I-129, Tc-99, and tritium. From the 1940s through the early 1990s, liquid wastes from materials used and produced at the Hanford Site were disposed to the ground through cribs, ditches, ponds, and trenches. Some of these waste disposal sites are located in the 200 West Area and overlie the groundwater in the 200-UP-1 OU.

Sources of Contamination

The major waste streams that contributed to groundwater contamination in 200-UP-1 were associated with plutonium-separation and uranium recovery operations at the S Plant and U Plant facilities. Their locations are shown in Figure 3. Groundwater contamination has also migrated from 200-ZP-1 into the 200-UP-1 which resulted from liquid waste disposal associated with plutonium concentration and recovery operations at Z Plant facilities.

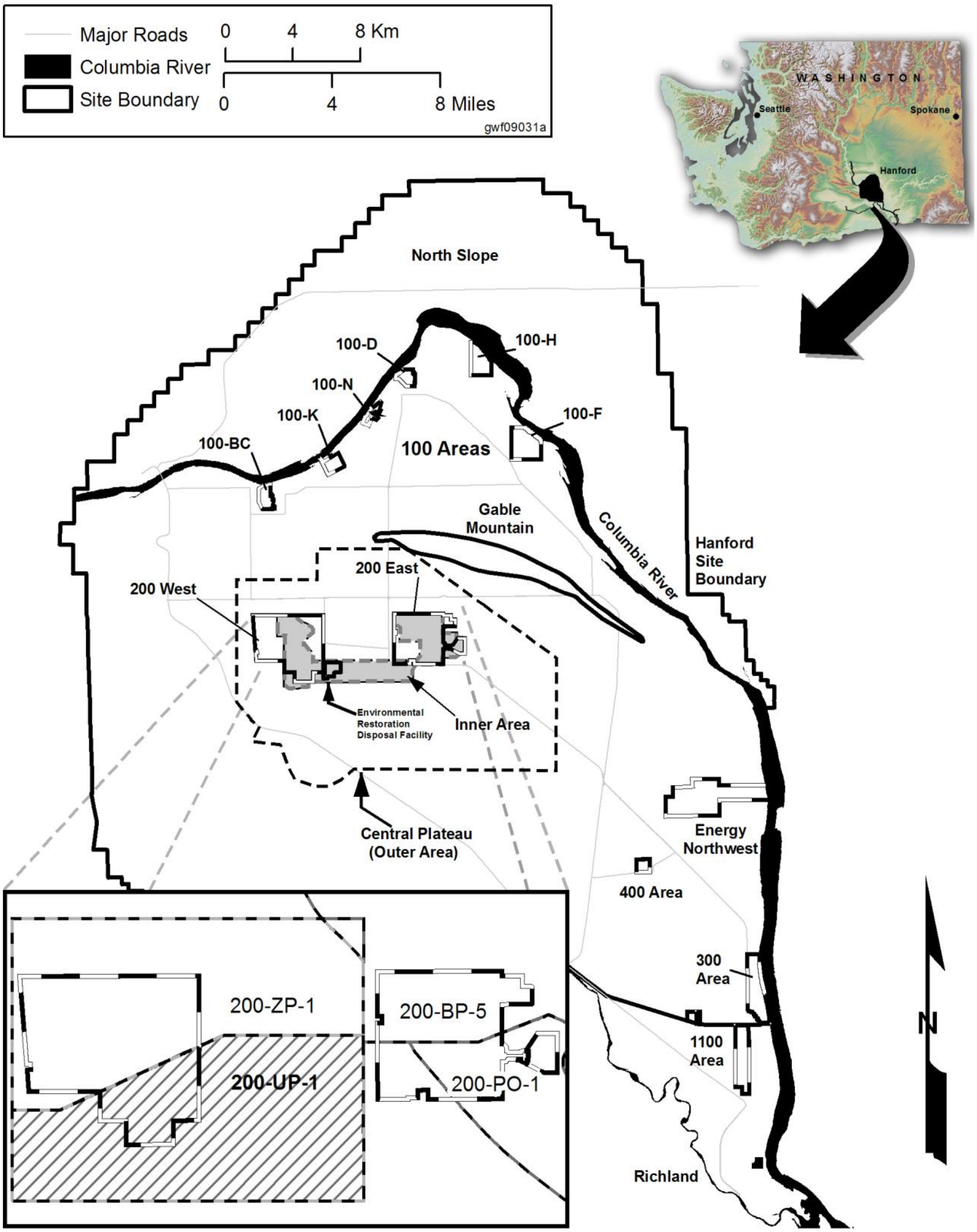


Figure 2. Hanford Site Map Illustrating the Location of the Inner and Outer Areas, 200 West Area and the Four Groundwater OUs on the Central Plateau

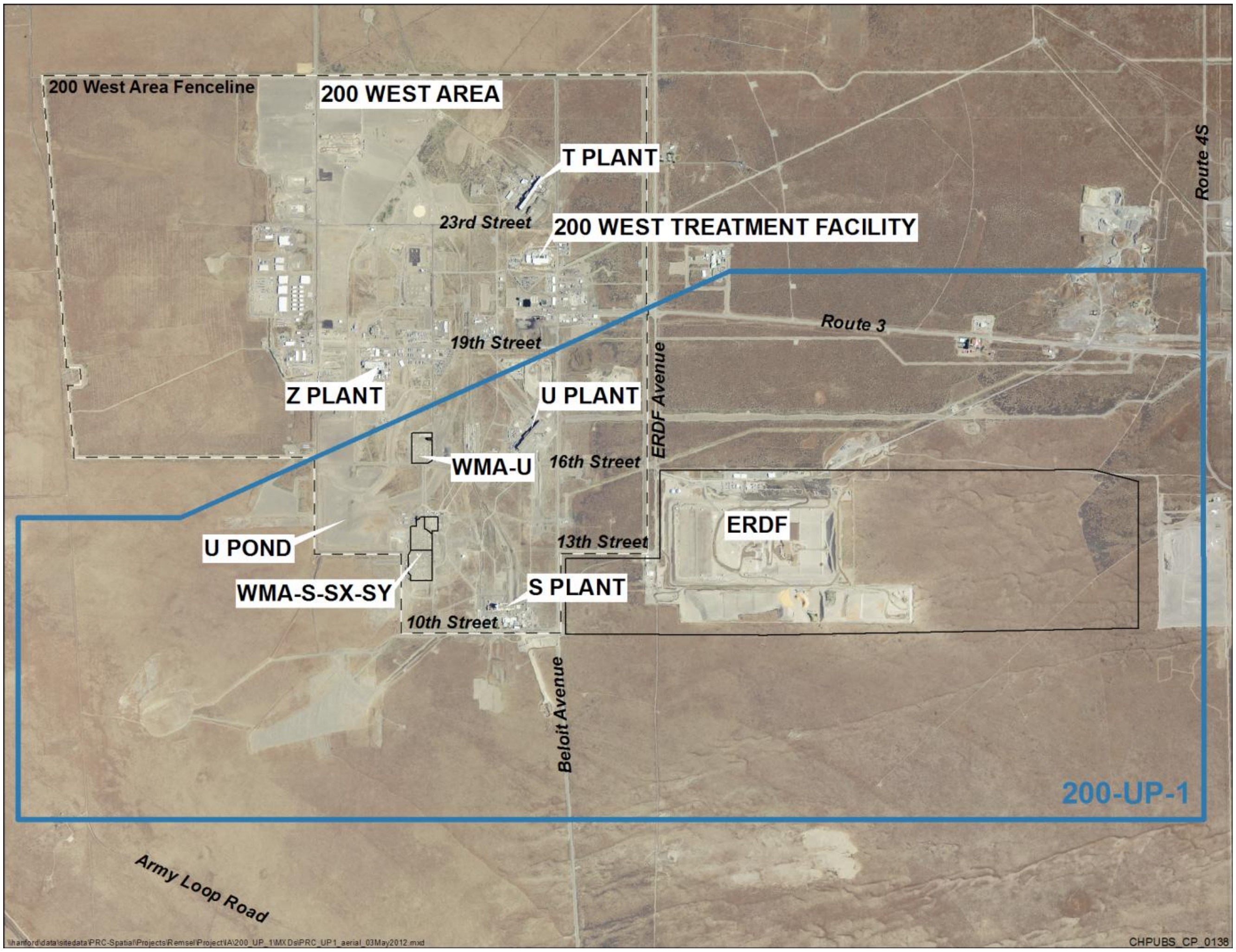


Figure 3. Primary Site Features for the 200-UP-1 OU

The S and U Plant chemical separation and recovery processes generated liquid waste streams, such as process condensate, cooling water and laboratory waste, that were discharged to the ground using ponds, cribs, ditches, and trenches. As effluents were discharged to these sites, mobile contaminants migrated through the soil/***vadose zone*** to the groundwater some 76 m (250 ft) below ground surface. These past discharges occurred from 1944 to the early 1990s. The U Pond received the largest quantity of liquid waste, which was sufficient to form a water table mound, the remnants of which can be measured today.

Some groundwater contamination has also resulted from single-shell storage tank leaks, particularly associated with Waste Management Area (WMA) S-SX. Single-shell tanks were built between 1944 and 1964 in 12 tank farms on the Hanford Site. DOE stopped sending waste to these tanks in 1980. The Single-Shell Tank Interim Stabilization and Intrusion Prevention project was completed to minimize the amount of hazardous liquid released from the tanks and included removal of pumpable liquid with transfer to the double-shelled tanks, disconnecting and capping pipelines, and installing storm water run-on controls to avoid inadvertent liquid addition. Currently, there are no liquid waste streams being discharged to the ground above the OU (with the exception of septic drain fields).

Previous Investigations

CERCLA requires an RI be conducted to determine the nature and extent of contamination and to assess any actual or potential risks to human health and the environment from the contamination. Part of the RI, known as the baseline risk assessment, estimates what risks the OU contamination would pose if no remedial action was taken. This provides a basis for taking action and identifies contaminants and the exposure pathways that need to be addressed by the remedial action. During the RI for the 200-UP-1 OU, data were collected in accordance with DOE/RL-92-76, *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit*, to characterize the nature and extent of chemical and radiological contamination and to define the hydrogeologic conditions. The results of the RI determined that contaminants in the groundwater pose a threat to human health and that an evaluation of CERCLA remedial action alternatives is warranted. This is documented in an RI/FS Report that is available for public review as part of the Administrative Record for 200-UP-1 (DOE/RL-2009-122).

Previous Cleanup Actions

A ROD for a 200-UP-1 OU Interim Remedial Action was issued in 1997 to remediate high concentrations (10 times the DWS) of uranium and Tc-99 in groundwater using pump-and-treat technology. This remediation system extracted groundwater down gradient from the disposal sites in the U Plant area (Figure 3) where uranium and Tc-99 had contaminated the groundwater. Extracted groundwater was treated at the Effluent Treatment Facility to remove the contaminants and the treated water injected back to the aquifer. The system was shut down in the spring of 2011 after successfully achieving its interim remedial action objectives. A total of 886 million liters (234 million gallons) of groundwater was pumped removing 220 kg of uranium and 127 g (2 Curies) of Tc-99 from the aquifer, along with 41 kg (90 lb) of carbon tetrachloride and 49,000 kg (108,026 lb) of nitrate.

High concentrations of Tc-99 in groundwater also occur near WMA S-SX. In 2003, an interim remedial action was initiated to extract Tc-99 contamination using a single well (299-W23-19). In 2009, the Tri-Parties agreed to expand the interim remedial action at WMA S-SX with a new groundwater extraction system designed to capture a larger portion of the contamination (contamination exceeding 10 times the DWS for Tc-99). The new system consists of three extractions wells located downgradient of WMA S-SX, pipelines and a transfer building to pump extracted groundwater to the 200 West groundwater treatment facility for treatment and reinjection. Construction of the system was recently completed and startup is expected to occur later in 2012. Operation of this interim remedial system would continue under Alternatives 2, 3, and 4 and the cleanup level would be updated to reflect the DWS of 900 pCi/L.

Previous Public Involvement

Hanford Site Tri-Party Agreement Public Involvement Community Relations Plan (Ecology et al., 2002) outlines stakeholder and public involvement processes and opportunities, including interactions with the State of Oregon, the Hanford Advisory Board and the public. The Tribal Nations, the State of Oregon, the Hanford Advisory Board (comprising representatives of stakeholders in the community concerned with Hanford Site cleanup), and the public, are routinely informed on the progress of Hanford cleanup.

The first Interim Action ROD (EPA/ROD/R10-97/048, *Interim Remedial Action Record of Decision for the 200-UP-1 Operable Unit, Hanford Site, Benton County, Washington*) was issued on February 25, 1997 and updated in 2009. Public involvement activities included presentations at HAB meetings (which are open to the public), a public comment period on the Proposed Plan, and a public meeting to receive comments and suggestions.

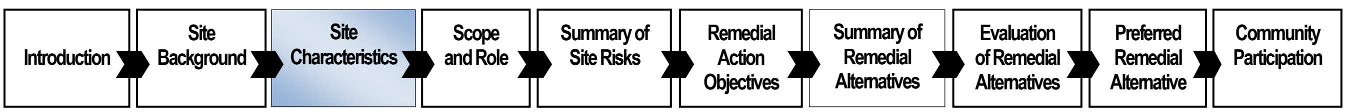
Previous draft versions of the RI/FS Report and of this Proposed Plan for the 200-UP-1 OU were shared with the Tribal Nations, Oregon DOE and the HAB for their consideration and input. The input and advice from all parties relative to groundwater cleanup and this OU was reviewed in the development of this Proposed Plan to ensure it reflects consideration of stakeholder values, principles, and issues.

Tribal Involvement

The Hanford Site is located on land at one time ceded to the United States under separate treaties with the Confederated Tribes and Bands of the Yakama Nation and the Confederated Tribes of the Umatilla Indian Reservation. The Nez Perce Tribe has treaty rights on the Columbia River. Each of these tribes has been deemed “affected” by Hanford Site operations under the *Nuclear Waste Policy Act of 1982*. In addition, DOE consults with the Wanapum Band of Indians who once resided on Hanford lands.

The DOE American Indian & Alaska Native Tribal Government Policy sets forth the principles to be followed by the DOE to ensure an effective implementation of a government-to-government relationship with tribes. The most important doctrine derived from this relationship is the trust responsibility of the United States to protect tribal sovereignty and self-determination, tribal lands, assets resources, and treaty and other federally recognized and reserved rights. The DOE consults with tribal governments before taking action, making decisions, or implementing programs that may impact tribal traditional, cultural and religious values and practices; natural resources; treaty and other federally recognized and reserved rights.

The Tri-Parties take a proactive approach to soliciting input from tribal governments on Tri-Party Agreement (Ecology et al., 1989) policies and issues. Specifically, the Tri-Parties conduct periodic briefings for the affected tribal governments. DOE routinely provides copies of Tri-Party Agreement (Ecology et al., 1989) documents concurrently to tribal governments, Ecology, and EPA.



Site Characteristics

The following subsection presents information on physical characteristics, surface features, and the extent of groundwater contamination in 200-UP-1.

Physical Characteristics

The Hanford Site lies within the semiarid shrub-steppe Pasco Basin of the Columbia Plateau in south-central Washington State. Over the last 16 million years, the basin filled with materials that form bedrock (volcanic lava flows) and unconsolidated sediments (silt, sand, and gravel). The 200 Area of the Hanford Site is located on a broad, relatively flat area that constitutes a local topographic high, which is why it is commonly referred to as the Central Plateau.

The water table is relatively deep, averaging approximately 75 m (250 ft) below the ground surface. Groundwater contamination is largely contained within the uppermost unconfined aquifer, which ranges in thickness from approximately 10 m (33 ft) to 100 m (330 ft), and lies within a geologic layer composed of silty sandy gravel. The unconfined aquifer controls the lateral movement of groundwater contaminants across the OU and is bounded by a lower geologic unit that has a texture similar to mud, which acts as a barrier and limits vertical groundwater flow into the confined aquifer.

Site Features and Land-Uses

Features visible on the ground surface include the four main uranium separations and plutonium recovery process canyon buildings (U Plant, S Plant, T Plant and Z Plant), the active ***Environmental Restoration Disposal Facility (ERDF)*** which is a lined landfill used to dispose of CERCLA wastes, WMA U and S-SX where underground single-shell tanks are located, U Pond and several active streets including 10^{th}, 13^{th}, 16^{th}, 23^{rd}, Beloit Avenue and ERDF Avenue. Figure 3 (presented in Site Background) shows the locations of these current landmarks.

All current land-use activities associated with the Inner Area of the Central Plateau (Figure 2) are industrial in nature. Groundwater from the 200-UP-1 OU is currently contaminated and not withdrawn from the aquifer for beneficial use (drinking water or industrial use). An alternate source of water derived from the Columbia River is provided to current Hanford site Central Plateau workers. However, the Tri-Party agencies share a goal to return groundwater to its highest beneficial use, which is a potential source of drinking water.

Extent of Groundwater Contamination

The ***contaminants of concern (COCs)*** are carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), I-129, Tc-99, and tritium. Figure 4 is a map of the 200-UP-1 groundwater plumes (locations and size). The 200-ZP-1 plumes to the north are shown, as well.

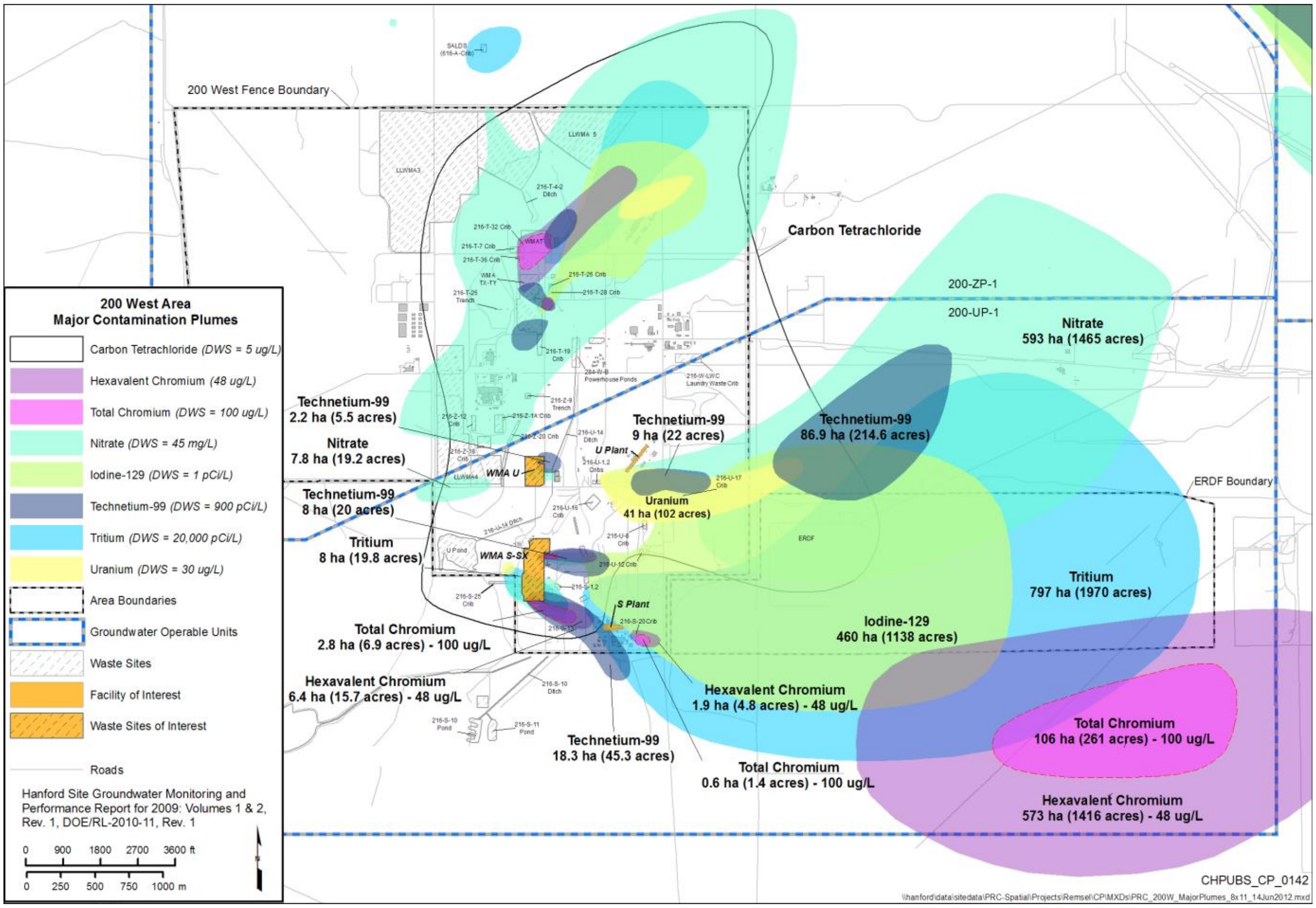


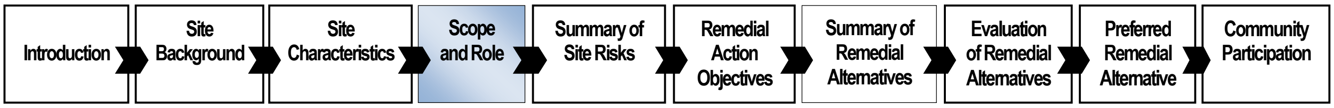
Figure 4. 200 West (200-UP-1 OU and 200-ZP-1 OU) Groundwater Plume Map

The 200-UP-1 plumes include:

- A uranium plume originating from U Plant cribs
- A widespread nitrate plume originating from U Plant and S Plant cribs and WMA S-SX
- A chromium (total and hexavalent) plume associated with WMA S-SX and a dispersed chromium (total and hexavalent) plume in the southeast corner of the OU that originated from an S Plant crib
- A widespread I-129 plume originating from U Plant and S Plant cribs

- Five separate Tc-99 plumes associated with WMA U, U Plant cribs and WMA S-SX
- A widespread tritium plume originating from S Plant cribs

In addition to the plumes that formed within 200-UP-1, a widespread carbon tetrachloride plume exists over a large portion of the 200 West Area. This plume originated from operation of Plutonium Finishing Plant (Z Plant) facilities and has extended south and east from 200-ZP-1 into 200-UP-1.



Scope and Role

The process for characterization and remediation of waste sites at Hanford is addressed by the Tri-Party Agreement (Ecology et al., 1989). Cleanup of the Hanford site contamination in the Central Plateau is being accomplished by dividing it into a number of OUs. Under the Tri-Party Agreement (Ecology et al., 1989), OUs within the Central Plateau are addressed under CERCLA, and in some cases in conjunction with ***Hazardous Waste Management Act (HWMA)*** (RCW 70.105) corrective action authority**.** Dangerous waste treatment, storage, and/or disposal (TSD) units subject to HWMA closure requirements are addressed under approved HWMA closure plans. The TSD units on the Central Plateau include the Single Shell Tank Systems; 222-S Dangerous and Mixed Waste TSD Unit; and the 216-S-10 Pond and Ditch.

The OUs with soil contamination include: four canyon facility OUs; three Central Plateau OUs (two inner area, one outer area); deep vadose zone OU; burial grounds OU; and the 200-PW-1/3/6 and 200-CW-5 OUs which have key plutonium bearing waste sites in the Inner Area. The groundwater OUs on the Central Plateau include: 200-UP-1, 200-ZP-1, 200-PO-1, and 200-BP-5. The RI/FS process will be completed for each of the OUs within the Central Plateau that could serve as a source of groundwater contamination. As part of this process, contaminant sources and associated vadose zone contamination will be characterized to assess possible future impacts to groundwater from the overlying contamination and to determine the need for remedial actions to protect groundwater. Remedial action decisions for soil contamination will be made under separate OU RODs that will include provisions to define and incorporate future groundwater protection requirements into remedial actions.

The 200-UP-1 alternatives presented in this proposed plan address contamination that has already reached groundwater and would be implemented as an interim action. A final ROD for 200-UP-1 will be pursued when future impacts to groundwater from vadose zone contributions are understood, taking into account remedial actions for OUs that can serve as sources of groundwater contamination. The schedule for completing the RI/FS reports for these OUs is established in the Tri-Party Agreement (Ecology et al., 1989).

The DOE's overall proposed strategy for cleaning up the Central Plateau is identified in DOE/RL-2009-81, *Central Plateau Cleanup Completion Strategy*. The document is a planning document and provides a context for the DOE's proposed cleanup approach for structures, soil, debris, and groundwater from a plateau-wide perspective.

The Completion Strategy organizes the Central Plateau cleanup into three major components:

- ***The Inner Area*** is approximately 26 km^2 (10 mi^2) in the middle of the Central Plateau encompassing the region where chemical processing and waste management activities occurred.
- ***The Outer Area*** is greater than 168 km^2 (65 mi^2) and includes much of the open area on the Central Plateau where limited processing activity occurred. Cleanup levels in the outer area are expected to be comparable to those being used for OUs along the Columbia River (River Corridor).

- ***Groundwater Remediation*** is necessary for approximately 207 km^2 (80 mi^2) of groundwater beneath the Central Plateau which is contaminated above DWSs because of past processing and waste disposal activities. Cleanup actions started in 1995 and are currently being expanded to hydraulically contain contaminant plumes within the Central Plateau, remove contaminants, and restore groundwater to beneficial use conditions.

Figure 2 shows the location of the Inner and Outer Area with the four related groundwater OUs.

Early Cleanup Actions

The following groundwater interim remedial actions have been conducted in the 200-UP-1 OU:

216-U-1 Crib and 216-U-2 Crib Groundwater Interim Remedial Action (1985): An interim remedial action was designed to pump-and-treat groundwater below these cribs. Pumping commenced in June 1985 and continued until November 1985. DOE completed this action under their own non-CERCLA authority. The 200 Area was not placed on the NPL (40 CFR 300, Appendix B) until 1989. About 30×10^6 L (8 million gal) of groundwater were pumped and treated to remove 687 kg (1,514 lb) of uranium via ion exchange treatment. The maximum uranium concentration was reduced from about 72,000 pCi/L to about 17,000 pCi/L.

200-UP-1 Groundwater OU Interim Remedial Action (1997, amended in 2009 and 2010): A pilot-scale treatability test (DOE/RL-95-02, *Treatability Report for the 200-UP-1 Operable Unit – Hanford Site*) consisting of an onsite pump-and-treat system plus single extraction and injection wells was constructed adjacent to the 216-U-17 Crib. Phase I pump-and-treat operations commenced September 25, 1995, and continued until February 7, 1997. The treatability test demonstrated that the ion exchange resin and granular activated carbon were effective at removing Tc-99, uranium and carbon tetrachloride from groundwater.

On February 25, 1997, an interim ROD was issued (EPA/ROD/R10-97/048, *Interim Remedial Action Record of Decision for the 200-UP-1 Operable Unit, Hanford Site, Benton County, Washington*). A work plan (DOE/RL-97-36, *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan*) was prepared to describe the detailed design of the treatment system. This cleanup action started in 1997 and has since met its remedial action objectives (shut down in 2012). This ROD was amended through an Explanation of Significant Difference (ESD) in 2009 (Ecology et al., 2009, *Explanation of Significant Differences for the Interim Action Record of Decision for the 200-UP-1 Groundwater Operable Unit Hanford Site Benton County, Washington*), which updated the uranium cleanup level from 48 µg/L to 30 µg/L and modified pumping rates and approach due to a drop in the water table. This system removed nearly 886×10^6 L (234×10^6 gal) of contaminated groundwater with 220 kg of uranium, 127 g (2 Curies) of Tc-99, 41 kg of carbon tetrachloride and 49,000 kg of nitrate. This remedial action also identified ICs for the 200-UP-1 OU to prevent exposure to contaminated groundwater. The following links are provided for the ROD, the associated ESD, and the Work Plan:

- *Interim Remedial Action Record of Decision for the 200-UP-1 Operable Unit Hanford Site, Benton County, Washington* (February 25, 1997)
- *Explanation of Significant Differences for The Interim Action Record of Decision for the 200-UP-1 Groundwater Operable Unit Hanford Site Benton County, Washington* (March 11, 2009)
- *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan*, DOE/RL-97-36, Revision 3 (June 23, 2010)

In addition to actions taken to address groundwater in 200-UP-1, the following actions have been or are being taken to address groundwater contamination in the 200-ZP-1 OU that have implications for 200-UP-1:

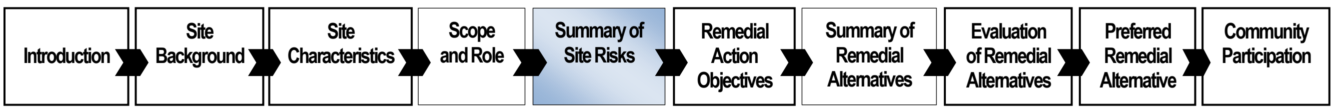
200-ZP-1 OU Interim Remedial Action (1995): In 1996, a pump-and-treat system was implemented to reduce the mass of carbon tetrachloride in the groundwater and to contain the plume where concentrations exceed

2 mg/L. This action was completed and the interim pump-and-treat system was deactivated in May 2012. The ROD title and link is below:

- *Record of Decision for the USDOE Hanford 200-ZP-1 Operable Unit, 200 Area NPL Site Interim Remedial Measure* (June 5, 1995)

200-ZP-1 Record of Decision (2008): *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site Benton County, Washington* (EPA et al., 2008) identifies the use of pump-and-treat technology, MNA, and ICs to remediate contaminated groundwater and prevent exposure during remediation. Groundwater pumping from this activity will impact the direction of groundwater flow and the levels of carbon tetrachloride present in 200-UP-1. A large pump-and-treat facility, known as the 200 West Pump-and-Treat began operation in 2012. The ROD title and link is below:

- *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site Benton County, Washington* (September 29, 2008)



Summary of Site Risks

A baseline risk assessment was conducted to evaluate current and potential future risks to human health and the environment from contaminated 200-UP-1 groundwater and to provide information that can be used in the development and evaluation of remedial alternatives. Sampling results from monitoring 93 wells within the OU from 2004 to 2009 were used to perform the baseline risk assessment. The assessment demonstrated that the contaminants in the groundwater would pose an unacceptable threat to human health if it were used as a source of drinking water. The baseline risk assessment identified thirteen ***contaminants of potential concern (COPCs)***. The COPCs are: carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), I-129, Tc-99, tritium, chloroform, 1,4-dioxane, tetrachloroethene (PCE), trichloroethene (TCE), and strontium-90 (Sr-90).

All current land-use activities associated with the Inner Area of the Central Plateau are industrial in nature. The reasonably anticipated future land use is also industrial use. Groundwater from 200-UP-1 is currently contaminated and is not withdrawn from the aquifer for beneficial use; however, the potential beneficial use of the groundwater is as a drinking water source. The Tri-Party agencies goal for Hanford groundwater is to return it to this highest beneficial use.

Exposure Assessment

The exposure assessment component of the risk assessment identifies actual or potential exposure pathways, characterizes the potentially exposed populations, and determines the potential extent of exposure. There are currently no known actual exposures of either human or ecological receptors to groundwater within 200-UP-1. Based on fate and transport model simulations, it is not expected that groundwater contaminants will migrate beyond the boundaries of the Central Plateau, discharge to ground surface or to surface water at concentrations that pose a risk; thus, only exposure to humans who might draw water from the groundwater was considered.

The following potentially complete exposure pathways were identified:

- Ingestion of contaminated water by drinking or in food preparation
- Inhalation of contaminant vapors during showering or other household activities
- Dermal contact exposure to contaminants in groundwater
- External radiation exposure from radioactive contaminants in groundwater (this is not a significant pathway)

Summary of Human Health Risks

A calculated cancer risk estimates the probability that additional cases of cancer may develop within a population if the people are exposed to contamination over the course of a lifetime. This risk estimate is referred to as the **excess lifetime cancer risk (ELCR)**. To evaluate health risks, EPA has developed the following acceptable exposure values under CERCLA. For contaminants that are known or suspected to cause cancer, acceptable exposure levels are generally concentration levels that represent an ELCR range for an individual of one in a million (referred to as 1×10^{-6}) to one in ten thousand (referred to as 1×10^{-4}).

The ELCR values were calculated for ***contaminants of potential concern (COPCs)*** from 200-UP-1. The number of COPCs is larger than the final number of COCs to allow for a more conservative calculation of risk. A ***90th percentile value*** was used to express the current groundwater concentrations for each contaminant. The 90th percentile value means that 90 percent of all the data for that contaminant fall below that value. It is used to conservatively represent contaminant concentrations throughout the aquifer.

A ***hazard quotient (HQ)*** is used to express the risk for contaminants that are non-cancer causing due to exposure to chemicals. An HQ is a numerical expression that indicates whether the concentration of an individual specific chemical is likely to result in adverse health effects. A ***hazard index (HI)*** is the summation of the HQ for all chemicals to which an individual is exposed. An HI value of 1.0 or less indicates that no adverse human health effects to the non-cancerous contaminants are expected to occur.

The results of the 200-UP-1 risk assessment indicate the potential cumulative ELCR from all nonradiological carcinogenic COPCs is 5.8×10^{-4}, meaning 5.8 additional people out of 10,000 could develop cancer if exposed over a life-time to nonradiological contaminants in the 200-UP-1 groundwater, This value is greater than the WAC 173-340, "Model Toxics Control Act—Cleanup" (MTCA) risk threshold of 1×10^{-5} for multiple hazardous substances and the upper CERCLA NCP (40 CFR 300.430) threshold of 1×10^{-4}. The HI from non-carcinogenic hazards is 41, which is greater than the EPA and the WAC target HI of 1 (WAC 173-340-708, "Human Health Risk Assessment Procedures"), meaning adverse human health effects could occur if exposed over a life-time to non-cancer causing contaminants in the 200-UP-1 groundwater. Table 1 and Table 2 present the quantified results of the baseline risk assessment. Table 1 shows each contaminant's individual contribution to risk with carbon tetrachloride being the major cancer and non-cancer risk contributor. Other noncancer HI risk contributors are uranium, nitrate, and hexavalent chromium. The primary noncancer health effects associated with exposure to the primary HI contributors are carbon tetrachloride—liver toxicity, nitrate—methemaglobenemia, uranium—kidney toxicity, and hexavalent chromium—nasal septum atrophy.

Risk from radionuclides is estimated by the types and amount of radiation they emit. To protect public health, EPA has established DWSs for several types of radioactive contaminants: beta emitters (4 mrem/yr); gross alpha standard (15 pCi/L); and uranium (30 µg/L). Cancer risk factors were estimated for the radionuclide COPCs and are presented in Table 2 as individual fractions of the federal DWS (90th percentile groundwater concentration divided by the federal DWS), the sum of the fractions, the individual contaminant dose, and the cumulative annual dose (sum of fractions multiplied by the 4-mrem standard). The total ELCR for radiological COPCs is 2.76×10^{-4}, meaning 2.76 additional people out of 10,000 could develop cancer if exposed over a lifetime to radiological contaminants in the 200-UP-1 groundwater. This value also exceeds the CERCLA NCP (40 CFR 300.430) risk threshold of 1×10^{-4}.

Ecological Risks

Ecological exposure is not expected because of a lack of direct or indirect exposure by ecological receptors to 200-UP-1 contaminated groundwater, both now and in the future. Groundwater contaminants are not expected to disperse beyond the boundaries of the Central Plateau at levels that could pose a risk to these receptors and it will not discharge to the ground surface or to surface water. Therefore, a quantitative baseline ecological risk evaluation was not conducted.

Risk Summary

It is DOE's and EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one/some of the other active measures considered in this Proposed Plan, are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances or pollutants or contaminants into the environment which may present an imminent and substantial endangerment to public health or welfare.

Table 1. 90th Percentile Current Groundwater Concentrations of Nonradiological COPCs, MTCA B Non-Cancer Cleanup Levels and HQs, and Associated MTCA B Cleanup Level and Cancer ELCRs

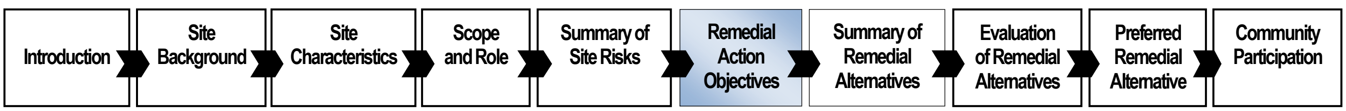
			Non Carcinogen Hazard			Cancer Risk		
Final COPC	Units	90th Percentile Concentration	MTCA B Cleanup Level Noncarcinogens at HQ=1*	90^{th} Percentile HQ	Percent Contribution to HI	MTCA B Cleanup Level Carcinogens at 10^{-6} ELCR Risk Level*	90^{th} Percentile ELCR	Percent Contribution to ELCR
Carbon Tetrachloride	µg/L	189	5.6	34	83%	0.34	5.6×10^{-4}	95.6%
Chloroform	µg/L	7.2	80	0.09	0%	1.4	5.1×10^{-6}	0.9%
1,4-Dioxane	µg/L	6.0	800	<0.01	0%	4.0	1.5×10^{-6}	0.3%
Tetrachloroethene (PCE)	µg/L	1.0	80	0.01	0%	0.081	1.2×10^{-5}	2.1%
Trichloroethene (TCE)	µg/L	3.3	--	--		0.49	6.7×10^{-6}	1.2%
Total ELCR						--	5.8×10^{-4}	100%
Total Chromium	µg/L	99	24,000	<0.01	0%	--	--	
Hexavalent Chromium	µg/L	52	48	1.1	3%	--	--	
Nitrate as NO_3	mg/L	133	113.6	1.2	3%	--	--	
Nitrate as N	mg/L	30.1	25.6	1.2	3%			
Uranium (total)	µg/L	206	48	4.3	11%	--	- -	
Hazard Index				41	100%			

* Source: WAC 173-340-720, "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards" (Washington State cleanup levels for unrestricted use).

Table 2. 90th Percentile Current Groundwater Concentrations for Radiological COPCs, Associated ELCR and Federal DWS

Final COPC	90th Percentile Concentration (pCi/L)	Federal DWS (pCi/L)	Federal DWS ELCR	Individual Dose Fraction of DWS	Individual Dose for Radiological Contaminants	90th Percentile ELCR	% Contribution to ELCR
I-129	3.5	1	2.8×10^{-6}	3.5	14	9.80×10^{-6}	4%
Strontium-90	0.66	8	8.5×10^{-6}	0.08	0.32	6.80×10^{-7}	0%
Tc-99	4,150	900	4.7×10^{-5}	4.6	18.4	2.16×10^{-4}	78%
Tritium*	51,150	20,000	1.9×10^{-5}*	2.6	10.4	4.94×10^{-5}	18%
Sum of Fractions				**10.8**			-
Cumulative Annual Dose (mrem)				-	**43.1**		-
Cumulative ELCR for Radioactive COPCs				-		**2.76×10^{-4}**	**100%**

* An excess lifetime cancer risk for tritium, which includes the ingestion and inhalation exposure routes, would be 1.3×10^{-4}. The ELCR for tritium would be 1.9×10^{-5} for the ingestion exposure route only.



Remedial Action Objectives

This section presents the RAOs for the remediation of the contaminated groundwater to address risks presented above. Under CERCLA and the NCP (40 CFR 300), a groundwater remedy must; (1) be protective of human health and the environment, and (2) meet ARARs (or satisfy criteria for an ARAR to be waived).

Based on these requirements and NCP (40 CFR 300) expectations for groundwater restoration, the RAOs are as summarized below:

- **RAO 1:** Return the 200-UP-1 OU groundwater to beneficial use as a potential drinking water source.
- **RAO 2:** Prevent human exposure to contaminated 200-UP-1 OU groundwater that exceeds acceptable risk levels for drinking water.

Preliminary Remediation Goals

The current groundwater 90th percentile concentrations, federal DWSs, the MTCA (WAC 173-340) Method B cleanup levels, and the 200-UP-1 PRGs are shown in Table 3. The final cleanup levels and remediation goals will be developed from these PRGs and will be specified in a ROD with the selected remedial alternative.

Table 3. 200-UP-1 OU COCs, 90th Percentile Concentrations Federal DWSs, State Cleanup Levels, and PRGs

COCs	Units	90th Percentile Groundwater Concentrations	Federal Drinking Water Standard[a]	Model Toxics Control Act Method B Cleanup Levels		200-UP-1 OU PRGs
				Non-Carcinogens at HQ = 1	Carcinogens at 1×10^{-5} Risk Level	
I-129	pCi/L	3.5	1	–	–	1[d]
Tc-99	pCi/L	4,150	900	–	–	900
Tritium	pCi/L	51,150	20,000	–	–	20,000
Uranium	µg/L	206	30	–	–	30
Nitrate[b] (as NO3)	mg/L	133	45	113.6	–	45
Nitrate[b] (as N)	mg/L	30.1	10	25.6	–	10
Total Chromium	µg/L	99	100	24,000	–	100
Hexavalent Chromium	µg/L	52	-[c]	48	–	48
Carbon Tetrachloride	µg/L	189	5	5.6	3.4	3.4[e]

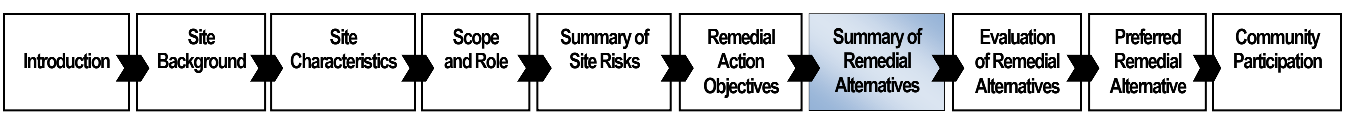
a. Federal DWS from 40 CFR 141, "National Primary Drinking Water Regulations," with I-129 and Tc-99 values from EPA 816-F-00-002, *Implementation Guide for Radionuclides*.

b. Nitrate (NO3) may be expressed as the ion NO3 (NO3- NO_3) or as nitrogen (NO_3-N). The federal DWS for nitrate is 10 mg/L expressed as N and 45 mg/L expressed as NO_3^-. The state cleanup level is 25.6 mg/L, as nitrogen.

c. There is no federal DWS for hexavalent chromium.

d. Current groundwater treatment technology is insufficient to reach the 1 pCi/L DWS.

e. This cleanup level is a risk-based calculation used for the carbon tetrachloride located in the 200-ZP-1 OU, which is located in the same aquifer as 200-UP-1.



Summary of Remedial Alternatives

This section describes the remedial alternatives that were developed and evaluated in the FS. The FS considered a range of remedial technologies and process options based on their effectiveness, implementability, and relative costs for attaining RAOs. Seven process options were considered in assembling four potential remedial alternatives. Three viable alternatives were retained for detailed analysis.

These three alternatives (numbered Alternatives 2 through 4), along with the EPA required "No Action" alternative, are:

- No Action Alternative
- Alternative 2 - 45 Years Active Remediation, MNA, hydraulic containment and ICs
- Alternative 3 - 35 Years Active Remediation, MNA, hydraulic containment and ICs (*Preferred Alternative*)
- Alternative 4 - 25 Years Active Remediation, MNA, hydraulic containment and ICs

Common Components to Remedial Alternatives 2 through 4

Alternatives 2 through 4 share several common components, including ICs, MNA, remedy performance monitoring, groundwater pump-and-treat, hydraulic containment, and an I-129 treatment technology evaluation. Each of these common components is described below. Alternatives 2 through 4 also incorporate the Tc-99 interim remedial action constructed at WMA S-SX in 2012.

Institutional Controls Component

ICs are instruments, such as administrative and/or legal restrictions, that are designed to control or eliminate specific pathways of exposure to contaminants until remedial goals are achieved. DOE is responsible for implementing, maintaining, reporting on, and enforcing ICs for the Hanford Site and for current CERCLA response actions. The *Sitewide Institutional Controls Plan* (DOE/RL-2001-41) describes how ICs are implemented and maintained, and how they would be modified to incorporate additional requirements upon selection of future remedies that include ICs. Alternatives 2, 3 and 4 described in this Proposed Plan would require ICs for preventing groundwater use until remediation goals are achieved. It is estimated that it will take up to 125 years to achieve the PRGs presented in this Proposed Plan for all COCs.

Monitored Natural Attenuation Component

MNA relies on natural processes within the aquifer to achieve reductions in the toxicity, mobility, volume, concentration, and/or bioavailability of the COCs. These natural processes include physical, chemical, and biological transformations that occur without human intervention. MNA is a viable component for the 200-UP-1 remedial alternatives; especially for tritium because of its short radioactive half-life (12.3 years) and because there is no groundwater treatment technology for this constituent. Chapter 7 of the RI/FS Report documents information supporting the conclusion that MNA will occur in combination with pump-and-treat activities to achieve the remediation goals.

Alternatives 2 and 3 rely upon MNA for the diffuse (low-concentration) nitrate plume areas not captured by the extraction wells that target the uranium plume and the high-concentration portion of the nitrate plume located near the U Plant area. MNA for tritium and carbon tetrachloride is a common component of each alternative except the No Action Alternative. MNA will address that portion of the carbon tetrachloride plume that remains after the active pumping period. Carbon tetrachloride will require the longest MNA time frame estimated to be 125 years, consistent with the 200-ZP-1 OU ROD.

Remedy Performance Monitoring Component

Remedy performance monitoring of the groundwater will be conducted to evaluate the overall effectiveness of the selected remedy over time. Performance monitoring for the extraction well network will include; groundwater sampling and analysis for the final COPCs, extraction well flow rates and water level measurements. This will allow evaluation of each contaminants mass removal rate and determination of the effectiveness of the injection well network to hydraulically contain the I-129 plume.

Performance monitoring of the 200 West groundwater treatment facility will include sampling and analysis to evaluate the efficiency of COPC and COC removal from extracted groundwater and to ensure the groundwater meets the injection requirements before being returned to the aquifer. Performance monitoring will also be used to confirm that the natural attenuation processes for carbon tetrachloride, tritium and nitrate are performing as planned. The performance monitoring plan will be prepared as part of the remedial design/remedial action work plan.

Groundwater Pump-and-Treat Component

Each of the alternatives, except the No Action Alternative, includes using groundwater pump-and-treat systems. These systems consist of a network of groundwater extraction wells, conveyance piping (with transfer pump stations), and use of the existing groundwater treatment facility in the 200 West Area. Figure 5 provides a conceptual overview of a groundwater pump-and-treat system. Extraction wells would be designed and installed to remove contaminated groundwater from the aquifer and to reduce or prevent further plume migration.

Injection wells are used to inject treated water back into the aquifer and to control groundwater flow. The placement of injection wells near the plume margins or downgradient of the plume provides flow path (gradient) control to prevent migration and slow COC travel times.

The 200 West groundwater treatment system includes various chemical, physical, and biological treatment processes designed specifically to treat the COCs, carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), and Tc-99. The facility consists of two main processes and includes a separate radiological pretreatment process for groundwater containing Tc-99 and uranium using ion-exchange resins, and a central treatment process that utilizes anaerobic and aerobic biodegradation for organic contaminants, membrane filtration for removal of particulate matter, and air stripping for removal of volatile organic contaminants. The treated effluent will meet federal DWSs and will be returned to the aquifer using vertical injection wells.

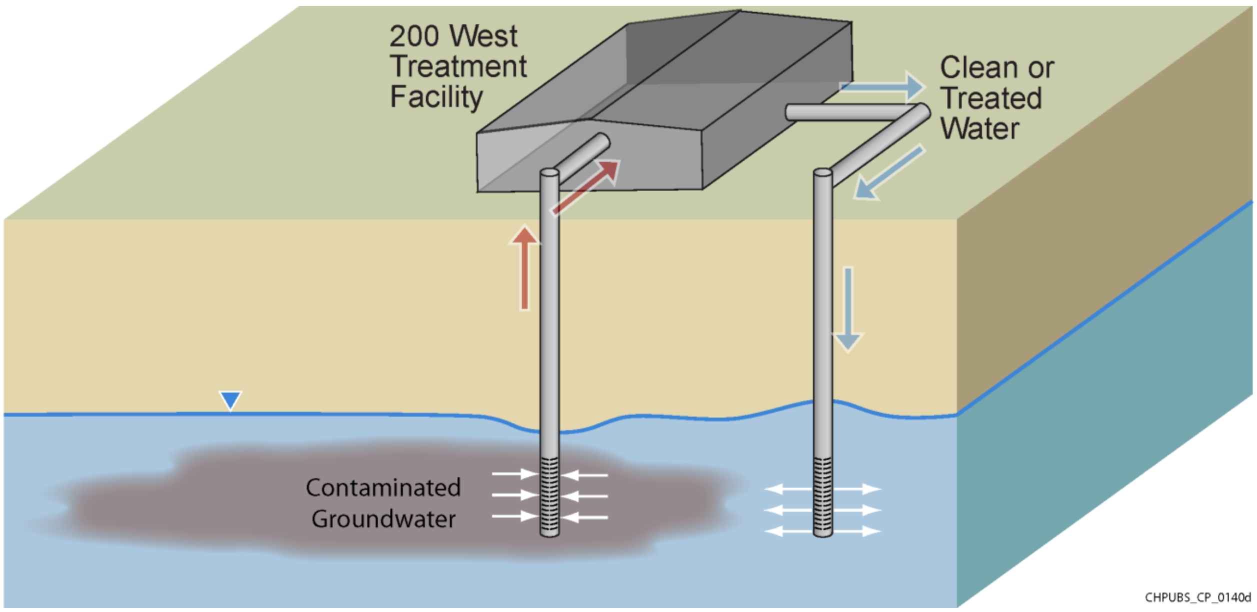


Figure 5. Conceptual Overview of Groundwater Pump-and-Treat

I-129 Hydraulic Containment and Treatment Technology Evaluation Component

There is currently no groundwater treatment technology that can reduce the 200-UP-1 I-129 concentrations to the 1pCi/L DWS. Therefore, pump-and-treat is not a viable remedy for this contaminant. A technology evaluation to identify potential treatment options will be completed as part of Alternatives 2 through 4. The evaluation will include a feasibility analysis of treatment options. Alternatives 2 through 4 also include hydraulic containment of the I-129 plume while technologies are evaluated. Hydraulic containment will be performed using injection wells placed at the leading edge of the plume.

Figure 8 presented later in this document illustrates this approach to hydraulic containment. Treated water from the 200 West groundwater treatment facility will be pumped to the injection wells. It is estimated that three injections wells with a flow rate of 50 gpm per well (150 gpm total) will be needed to contain the plume. Hydraulic containment of the plume will prevent further migration.

The NCP (40 CFR 300) requires that the Proposed Plan include a summary explanation of any proposed waivers of Applicable or Relevant and Appropriate Requirements (ARARs). Alternatives 2 through 4 include a waiver of the federal DWS of 1 pCi/L for I-129 which is an ARAR. Alternatives 2 through 4 are for an interim remedial action which will only be part of the total remedial action for 200 UP-1 OU that will attain or otherwise waive the ARAR for I-129 upon completion of remedial action as required by CERCLA Section 121(d)(4), "Cleanup Standards," "Degree of Cleanup." A subsequent ROD will be needed to complete the total remedial action for 200-UP-1.

A technology evaluation for I-129 was completed in the FS, which identified no current treatment technology that can achieve the federal DWS. DOE will continue to evaluate potential treatment options for I-129. In the event a viable treatment technology is not available, the use of a technical impracticable waiver under 40 CFR 300.430(f)(l)(ii)(c) may need to be considered as part of the final remedy.

Remedial Alternatives

The "No Action" alternative is included for comparison purposes, as required by the NCP (40 CFR 300). Remedial Alternatives 2 through 4 focus on achieving restoration of the groundwater to meet the RAOs and the PRGs identified in Table 3 above.

Each remediation alternative was developed around the core groundwater remedial technologies of pump-and-treat and hydraulic containment, because these technologies are robust and proven for the conditions present at the Hanford Site and within the 200-UP-1. MNA and ICs supplement these active remediation components for each alternative. Each alternative is summarized below in Table 4.

Table 4. Overview of 200-UP-1 Remedial Alternatives

Remedy Components	No Action	Alternative 2—45 Years Active Remediation, MNA, Hydraulic Containment and ICs	Alternative 3—35 Years Active Remediation, MNA, Hydraulic Containment and ICs	Alternative 4—25 Years Active Remediation MNA, Hydraulic Containment and ICs
Institutional Controls	The NCP (40 CFR 300.430 (e)(6)) requires consideration of a No Action Alternative.	Maintain ICs for all COCs until PRGs are achieved. (up to 125 years for all remedial alternatives)		
Groundwater pump-and-treat		Pump-and-treat for carbon tetrachloride, uranium, concentrated nitrate plume areas, chromium (total and hexavalent) and Tc-99. Estimated pumping rate of 330 gpm.	Moderately aggressive pump-and-treat for carbon tetrachloride, uranium, concentrated nitrate plume areas, chromium (total and hexavalent) and Tc-99. Estimated pumping rate of 430 gpm.	Highly aggressive pump-and-treat for carbon tetrachloride, uranium, nitrate plume areas (high and low concentration), chromium (total and hexavalent) and Tc-99. Estimated pumping rate of 530 gpm.
MNA		Tritium, low-concentration parts of nitrate plume, and the remaining parts of the carbon tetrachloride plume.	Tritium, low-concentration parts of nitrate plume, and the remaining parts of the carbon tetrachloride plume.	Tritium and the remaining parts of the carbon tetrachloride plume.
Hydraulic Containment		I-129	I-129	I-129
Total Pump-and-Treat Duration	Not applicable	45 Years	35 Years	25 Years
Cost (NPV)*	Not applicable	$304 Million	$319 Million	$342 Million

Source: 40 CFR 300.430, "National Oil and Hazardous Substances Pollution Contingency Plan," "Remedial Investigation/Feasibility Study and Selection of Remedy."

* NPV: Net Present Value

Alternative 2 would use pump-and-treat to achieve PRGs for uranium, the concentrated nitrate plume near U Plant, and the chromium (total and hexavalent) and Tc-99 plumes within a 45-year period. The common components of MNA, ICs, hydraulic containment and remedy performance monitoring would be included.

Alternative 3 provides a more aggressive pump-and-treat alternative by requiring pump-and-treat to achieve PRGs for the same COCs within 35 years, which is estimated to require an increase in the uranium plume area pumping rate from 100 gpm to 150 gpm, and the chromium plumes pumping rate from 150 gpm to 200 gpm, resulting in a total estimated extraction rate of 430 gpm. The common components of MNA, ICs, hydraulic containment and remedy performance monitoring would be included.

Alternative 4 is the most aggressive pump-and-treat alternative and would result in the PRGs being reached for the same COCs and all of the nitrate plume within 25 years. The estimated pumping rate is similar to Alternative 3, but with one additional extraction well pumping at a rate of 100 gpm in the low-concentration area of the nitrate plume expected to be needed to bring the total estimated extraction well pumping rate to 530 gpm. The common components of MNA, ICs, hydraulic containment and remedy performance monitoring would be included.

No Action Alternative

Under 40 CFR 300.430(e)(6), a No Action Alternative is included to provide a baseline for comparison against the other alternatives. Under the No Action Alternative, no active remedial action would be taken to address potential threats to human health and the environment posed by the COCs present. While radioactive decay and other natural attenuation processes would reduce COC concentrations in groundwater over time, no monitoring would be conducted to track concentration changes or plume migration.

Alternative 2 - 45 Years Active Remediation, MNA, Hydraulic Containment, and ICs

- Estimated Capital Cost: $88 million
- Estimated O&M Cost: $341 million
- Estimated Present Value: $304 million
- Estimated Time to Achieve PRGs: 15 years for Tc-99, 40 years for uranium, and 45 years for chromium (total and hexavalent) through pump-and-treat; 35 years for nitrate and 125 years for carbon tetrachloride through pump-and-treat and MNA; 25 years for tritium through MNA.

Approach and Description

Alternative 2 combines groundwater pump-and-treat at an estimated total pumping rate of 330 gpm for the parts of the carbon tetrachloride plume, the Tc-99 plumes, the uranium plume, the high concentration nitrate plume, and the chromium (total and hexavalent) plumes, with hydraulic containment of the I-129 plume at an estimated injection rate of 150 gpm. Groundwater treatment is expected to be complete for Tc-99 within 15 years, for uranium within 40 years, and for chromium (total and hexavalent) within 45 years. Limited modifications to the 200 West groundwater treatment facility are required for this alternative. The facility would be maintained and updated to extend operations for up to 45 years. MNA for the low concentration nitrate plume area, and tritium plume achieves PRGs within 35 years, and 25 years, respectively. A total duration of approximately 125 years (including active restoration and MNA) is required for carbon tetrachloride to reach the PRG. ICs prevent exposure and groundwater use until PRGs are achieved.

Estimated number of wells and pumping rates are as follows:

- Tc-99 pump-and-treat operation in the WMA S-SX area—three extraction wells with a total pumping rate of 80 gpm for 15 years.
- Pump-and-treat for the uranium plume and high concentration nitrate plume area—two extraction wells and two injection wells with a total pumping rate of 100 gpm for 40 years.
- Pump-and-treat for the chromium (total and hexavalent) plume—two extraction wells and two injection wells with a total pumping rate of 150 gpm for 45 years.

Alternative 3 - 35 Years Active Remediation, MNA, Hydraulic Containment, and ICs

- Estimated Capital Cost: $131 million
- Estimated O&M Cost: $267 million
- Estimated Present Value: $319 million
- Estimated Time to Achieve PRGs: 15 years for Tc-99, 25 years for uranium, and 25 years for chromium (total and hexavalent) through pump-and-treat; 35 years for nitrate and 125 years for carbon tetrachloride through pump-and-treat and MNA;. 25 years for tritium through MNA.

Approach and Description

Alternative 3 combines groundwater pump-and-treat at an estimated extraction rate of 1,250 L/min (430 gpm) for parts of the carbon tetrachloride plume, the Tc-99 plumes, the uranium plume, the high concentration nitrate plume, and the chromium (total and hexavalent) plumes, with hydraulic containment of the I-129 plume at an estimated injection rate of 150 gpm to reach PRGs for uranium, chromium (total and hexavalent) and Tc-99 within a 25 year time frame. Groundwater treatment is expected to be complete for Tc-99 within 15 years, for uranium within 25 years, and for chromium (total and hexavalent) within 25 years. MNA for the low concentration nitrate plume area, and tritium plume achieves PRGs within 35 years and 25 years, respectively. A total duration of approximately 125 years (including active restoration and MNA) is required for carbon tetrachloride to reach the PRG. ICs prevent exposure and groundwater use until PRGs are achieved.

Alternative 3 includes the same remedy components described in Alternative 2, but adds additional groundwater extraction flow from the nitrate and chromium areas. The estimated number of additional wells and pumping rates are as follows:

- Pump-and-treat for the uranium plume and high concentration nitrate plume area – two extraction wells and two injection wells with a pumping rate of 150 gpm for 25 years.
- Pump-and-treat for the chromium (total and hexavalent) plumes – two extraction wells and two injection wells with a total pumping rate of 200 gpm for 25 years.

This alternative requires that the additional flow and COC concentrations from the extraction wells be accommodated at the 200 West groundwater treatment facility with the installation of additional biological treatment process equipment. This additional capacity and space for the needed equipment has already been designed into the plant’s foot print.

Alternative 4 - 25 Years Active Remediation, MNA, Hydraulic Containment, and ICs

- Estimated Capital Cost: $142 million
- Estimated O&M Cost: $282 million
- Estimated Present Value: $342 million
- Estimated Time to Achieve PRGs: 15 years for Tc-99, 25 years for uranium, 25 years for chromium (total and hexavalent), and 25 years for nitrate through pump-and-treat; 125 years for carbon tetrachloride through pump-and-treat and MNA; 25 years for tritium through MNA.

Approach and Description

Alternative 4 is identical to Alternative 3 but it would require at least one additional extraction well pumping at a rate of 100 gpm for 20 years to address the low-concentration portion of the nitrate plume. This increases the overall estimated pumping rate to 530 gpm. The duration of active remediation for Alternative 4 is 25 years. Groundwater treatment is expected to be complete for Tc-99 within 15 years, for uranium within 25 years, for chromium (total and hexavalent) within 25 years, and for nitrate within 25 years. MNA for the tritium plume achieves PRGs within 25 years and MNA for carbon tetrachloride remains at 125 years under this alternative.

Introduction > Site Background > Site Characteristics > Scope and Role > Summary of Site Risks > Remedial Action Objectives > Summary of Remedial Alternatives > Evaluation of Remedial Alternatives > Preferred Remedial Alternative > Community Participation

Evaluation of Remedial Alternatives

The remedial alternatives were subjected to a detailed and comparative evaluation as part of the FS to identify the advantages and disadvantages of each alternative relative to one another. The detailed evaluation was conducted using the nine CERCLA criteria (Figure 6) described in 40 CFR 300.430(e)(9).

The nine CERCLA criteria are categorized into three groups: threshold criteria, balancing criteria, and modifying criteria. A remedial alternative must satisfy the two threshold criteria of overall protection of human health and the environment and compliance with ARARs to be eligible as a Preferred Alternative. The five balancing criteria allow for a comparison of major trade-offs among the alternatives. The two modifying criteria, state acceptance and community acceptance, are not fully considered until public comments are received on this Proposed Plan. The DOE and EPA identified the Preferred Alternative presented in this Proposed Plan by determining which of the four remedial action alternatives satisfy the threshold criteria and performs best relative to the balancing criteria.

Comparative Evaluation of Remedial Alternatives

The comparative evaluation of remedial alternatives is summarized in this section. A more detailed presentation of the comparative evaluation is available in the RI/FS Report (DOE/RL-2009-122). The comparative evaluation provides a narrative assessment of each alternative's performance against the CERCLA threshold and balancing criteria and identifies the advantages and disadvantages of each alternative relative to the CERCLA balancing criteria and one another.

Threshold Criteria

Overall Protection of Human Health and the Environment

All of the alternatives, except the No Action Alternative, are protective of human health and the environment through ICs that prevent groundwater use and thereby prevent potential exposure until PRGs are achieved. Alternative 4 is expected to provide the highest level of protection of human health and the environment because carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), and Tc-99 contaminated groundwater are removed from the aquifer using highly aggressive pump-and-treat. Alternatives 2 and 3 also provide a high level of protection of human health and the environment as they reach the same PRGs, but using slightly different means, methods and time frames. However, under these two alternatives, only the concentrated portion of the nitrate plume is addressed using pump-and-treat and the diffuse portion of the plume is addressed though MNA. Alternatives 2, 3, and 4 provide comparable levels of protection relative to tritium and the remaining portion of the carbon tetrachloride plumes, which are addressed through MNA, and I-129 which is hydraulically contained while the treatment technology evaluation is performed.

The "No Action" alternative does not provide adequate protection of human health and the environment because no measures would be implemented to control potential exposures to contaminated groundwater or to reduce risks to human health from groundwater ingestion. Because it does not meet this threshold criteria, the "No Action" alternative is not discussed further in this evaluation.

Figure 6. NCP Remedial Action Alternative Evaluation Criteria

Compliance with ARARs

All of the alternatives, except the No Action Alternative, meet the threshold criterion for ARARs either by complying with ARARs or satisfying the criteria for an ARAR waiver. Since the alternatives are based on pump-and-treat technology and MNA, the ARARs are the same for each. The principal ARARs are drinking water standards for the COCs. However, Alternatives 2 through 4 include a waiver of the federal DWS of 1 pCi/L for I-129. Alternatives 2 through 4 are for an interim remedial action which will only be part of the total remedial action for 200-UP-1 OU that will attain or otherwise waive the ARAR for I-129 upon completion of remedial action as required by CERCLA Section 121(d)(4). A subsequent ROD will be needed to complete the total remedial action for 200 UP-1.

The alternatives achieve the DWS ARARs (with the exception of I-129) in periods that decrease from 45 years under Alternative 2, to 35 years under Alternative 3, to 25 years under Alternative 4 for all COCs except carbon tetrachloride which will require 125 years and tritium which will require 25 years (using MNA) under each alternative. Compliance with the nitrate DWS ARAR will require 35 years under Alternative 2 and 3 and 25 years under Alternative 4.

Alternatives 2 through 4 include a technology evaluation to identify potential I-129 treatment options, as there is no available treatment technology that can achieve the federal drinking water standard (DWS) of 1 pCi/L. The evaluation would include a feasibility analysis of potential treatment options for implementation. In the event a viable treatment technology is not available, the use of a technical impracticable waiver under 40 CFR 300.430(f)(l)(ii)(c) may need to be considered as part of the final remedy.

Balancing Criteria

Long-term Effectiveness and Permanence

Long-term effectiveness is evaluated through two criteria: (1) the magnitude of the residual risk remaining at the site after cleanup, and (2) the adequacy and reliability of controls, such as ICs. Alternatives 2, 3, and 4 provide good and similar levels of long-term effectiveness and permanence because the total volume of contaminated groundwater treated for the carbon tetrachloride, uranium, chromium (total and hexavalent), and Tc-99 plumes is similar. However, with respect to nitrate, Alternative 4 is superior because it treats a larger volume and mass of nitrate-contaminated groundwater. All three alternatives provide comparable levels of long-term effectiveness and permanence for I-129 and tritium because the common element components addressing these two COCs are the same. The adequacy and reliability of ICs that will be used to prevent exposure to contaminated groundwater until PRGs are achieved is similar for each of the alternatives as ICs will be required under each alternative for 125 years or until remediation goals are achieved.

Reduction of Toxicity, Mobility, and Volume through Treatment

This evaluation criterion addresses the statutory preference for actions that incorporate treatment technologies as their principal element, and that permanently and significantly reduce toxicity, mobility, or volume (TMV) of hazardous substances. Alternative 4 provides superior TMV reduction through treatment for the carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), and Tc-99 plumes because a majority of the COC mass is removed from the aquifer using highly aggressive pump-and-treat systems. The 200 West groundwater treatment facility residuals generated from groundwater treatment for Alternatives 2 through 4 will be immobilized and disposed at a secure long-term managed facility (Environmental Restoration and Disposal Facility [ERDF]), which is a lined, monitored landfill in the central area for CERCLA waste disposal. Alternatives 2 and 3 provide moderate and similar levels of TMV reduction through treatment for all COCs. Although the total volume of groundwater pumped and treated is similar amongst the three alternatives, Alternative 2 has less uranium and chromium (total and hexavalent) TMV reduction early in the implementation process because it employs lower pumping rates. All three alternatives have comparable levels of TMV reduction for Tc-99, I-129 and tritium because the approach for addressing these three COCs is the same.

Short-term Effectiveness

This criterion addresses human health and environmental effects during the construction and implementation phase of remedial actions. It evaluates the potential impacts to workers, the public, and the environment associated with implementing actions. It also addresses the time frame under which an alternative achieves protection. Alternatives 2, 3, and 4 provide similar levels of short-term effectiveness relative to protection of the community during implementation because the 200-UP-1 OU is located in a remote restricted access portion of the Hanford Site where community exposure would not occur.

With respect to protection of workers, all work associated with these alternatives can be performed safely with minimal risk to workers and the environment by conducting the work per existing Hanford Site work processes. However, as the scope of a remedial alternative grows (more wells, piping, site construction, treatment plant capacity, etc.), the potential for worker and environmental risk increases. Therefore, Alternative 2 would pose the least short-term risk to workers and the environment (least numbers of wells, piping and general construction) followed by Alternative 3 and Alternative 4, respectively.

At 25 years, Alternative 4 has the shortest active remediation period followed by Alternative 3 at 35 years, and Alternative 2 at 45 years. However, under all three alternatives, up to 125 years is required for MNA to achieve the PRG for carbon tetrachloride. Based on the shorter active remediation periods, Alternatives 3 and 4 were ranked higher than Alternative 2 relative to this factor.

Implementability

This criterion addresses the technical and administrative feasibility of implementing the remedial alternatives. While all three alternatives are readily implemented using existing technology and Hanford Site work processes and procedures, Alternative 3 was assessed as having good implementation characteristics while Alternative 2 and Alternative 4 were assessed as having moderate implementability characteristics. The current design life of the 200 West groundwater treatment facility is 25 years but it can be updated and maintained to operate for up to 45 years.

Alternative 4 is expected to pose the greatest overall implementation challenge because of the higher number of wells to be drilled, the longer pipe lengths to be laid, and the increased operation and maintenance associated with operation of the overall treatment plant. Alternative 2 only requires limited expansion of the 200 West groundwater treatment facility, whereas Alternatives 3 and 4 require more extensive modifications.

Cost – Total Present Value

Alternative 2 at a net present value (NPV) cost of $304 million has the lowest cost followed by Alternative 3 at a NPV cost of $319 million and Alternative 4 is the highest at a NPV cost of $342 million. The NPV cost represents the dollars that would need to be set aside today, at the interest rate identified in Table 5, to ensure that funds would be available in the future as they are needed to perform the work. Table 5 present a breakdown of the various cost categories applicable to each alternative.

The cost estimates for each remedial alternative include allowances for the following capital costs, O&M items, and periodic costs:

1. Capital costs consist primarily of expenditures incurred during construction of the remedial action (e.g., construction of a groundwater treatment system, wells, piping, pump stations, and other related site work). It also includes all labor, equipment, and material costs for mobilization, demobilization and site work.

2. O&M costs are those post-construction expenses necessary to support the remedial action until PRGs are achieved. These costs are estimated on an annual basis. Annual O&M costs include all labor, equipment, and material costs for monitoring; operating and maintaining of extraction, injection, and treatment systems; and waste disposal.

3. Periodic costs occur only once every few years (e.g., non-annual equipment replacement, well rehabilitation/replacement, etc.) or non-capital related expenditures that occur only once during the entire remedial period (decommissioning of facilities). Upgrades and maintenance to extend the operating life of the treatment plant are included.

These estimated costs, presented herein and in Appendix D of the RI/FS Report (DOE/RL-2009-122), are within the -30 to +50 percent range of accuracy as recommended by EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.*

Table 5. Comparison of Remedial Alternative Costs for the 200-UP-1 Groundwater OU

Item Description	No Action	Alternative 2	Alternative 3	Alternative 4
Nominal Extraction Flow Rate L/min (gpm)	0	1,250 (330)	1,630 (430)	2,000 (530)
Active Remediation Duration (years)	0	45	35	25
Capital Cost	$0	$88,048,000	$131,346,000	$141,629,000
Total Annual O&M Cost (non-discounted), summed over the remedy performance period	$0	$207,297,000	$179,164,000	$189,052,000
Total Periodic Cost (non-discounted), summed over the performance period	$0	$133,493,000	$87,690,000	$93,201,000
Total Non-Discounted Cost	$0	$428,837,000	$398,200,000	$423,881,000
Total NPV (Discounted)	**$0**	**$304,043,000**	**$319,083,000**	**$342,180,000**

Note: Net Present Value discount percent used is 2.7 percent.
Range of accuracy is expected to be +50-30 percent.

Modifying Criteria

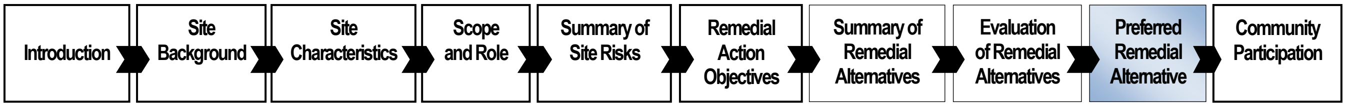
There are two modifying criteria: State Acceptance, and Public Acceptance. These criteria are generally considered after comments have been received through the public participation process, but they can be considered earlier in the feasibility study development process, if such information is available. Draft versions of the RI/FS Report and the Proposed Plan were released to the Hanford Site Stake holders and their comments have been considered. The modifying criteria are important in the final evaluation of each remedial alternative and selection of the final remedy.

Sustainable Evaluation Factors

With increased emphasis on development and implementation of remedial actions that include “green” or “sustainable elements”, a sustainable evaluation was also performed. A sustainable evaluation considers the complete life-cycle impacts of an alternative such as energy consumption, air emissions (greenhouse gas and hazardous substance emissions), water use, materials and waste generation, and land-ecosystem effects. Alternatives 3 and 4 have less favorable sustainable elements than Alternative 2 because with Alternatives 3 and 4 there would be an increase in the following:

- Energy use associated with the higher groundwater pumping rates
- Energy use associated with construction and operation of the third treatment train needed to handle the higher groundwater flow rates
- Greenhouse gas emissions associated with the higher energy demand/use
- Solid waste volumes (biological solids, spent ion exchange and spent carbon treatment media) sent to ERDF associated with O&M of the third treatment train

Consistent with the RAOs, opportunities may be sought during the implementation of the remedy to reduce its environmental footprint as defined in *Principles for Greener Cleanups* (EPA, 2009).



Preferred Remedial Alternative

Based on the comparative evaluation, DOE and EPA selected Alternative 3, 35 Years of Active Remediation using pump-and-treat, MNA, ICs and hydraulic containment as the Preferred Alternative. Figure 7 illustrates the proposed extraction and injection well locations for Alternative 3 and Figure 8 depicts the estimated reduction in COC concentrations to their respective PRGs over time for each COC (that is actively pumped) based on their 95th upper confidence limit concentration trend. Alternative 3 achieves the RAOs by reducing contaminant concentrations to their respective PRGs and is readily implementable, which is especially important given the 25-year time frame that the pump-and-treat system will operate. Alternative 3 would present fewer operations, maintenance and residuals handling challenges than Alternative 4 due to the lower amounts of nitrate contaminated groundwater that would require biological treatment. Higher amounts of nitrate contamination sent to the treatment facility adds additional complexity for operations and creates additional solid material handling, dewatering and onsite disposal. Alternative 3 meets the threshold criteria and provides the best balance of cost and performance tradeoffs compared with Alternatives 2 and 4 with respect to the balancing criteria. Alternative 3 will satisfy the following statutory requirements of CERCLA Section 121(b), "Cleanup Standards," "General Rules":

- Protect human health and the environment
- Complies with ARARs, or satisfies the criteria for an ARAR waiver (I-129)
- Be cost effective
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
- Satisfy the preference for treatment as a principal element

It is important to note that the overall time to return the aquifer to beneficial use is the same for Alternatives 2 through 4 based on the time required to achieve the DWS for carbon tetrachloride (125 years). Additionally, more aggressive pumping of contaminated groundwater does not reduce the overall time required to restore the aquifer.

State Acceptance

The State supports Alternative 3, which have been identified by EPA and DOE as the Preferred Alternative: use of pump-and-treat technology, use of MNA for tritium, selection of an interim remedial action, and monitoring for organic contaminants identified as final COPCs. The selection of an interim remedial action should allow time for further characterization of the vadose zone prior to issuing a final ROD, along with technology evaluation for the I-129 contamination. Additionally, the remedy does not take into account the potential for further contaminant contribution from source units along with the possibility of additional contaminants impacting groundwater. The State supports monitoring of final COPC organic contaminants present at risk values greater than 1×10^{-6} including chloroform, 1,4 dioxane, PCE, and TCE. Although EPA and DOE did not retain them as COCs, Ecology concludes that the treatment approach identified in Alternative 3 combined with comprehensive monitoring for the final COPCs establishes carbon tetrachloride as an indicator contaminant as defined in MTCA (WAC 173-340-703, "Selection of Indicator Hazardous Substances"). Therefore, Ecology concludes that the proposed approach for treatment and monitoring complies with the Applicable or Relevant and Appropriate Requirements (ARARs) of MTCA (WAC 173-340).

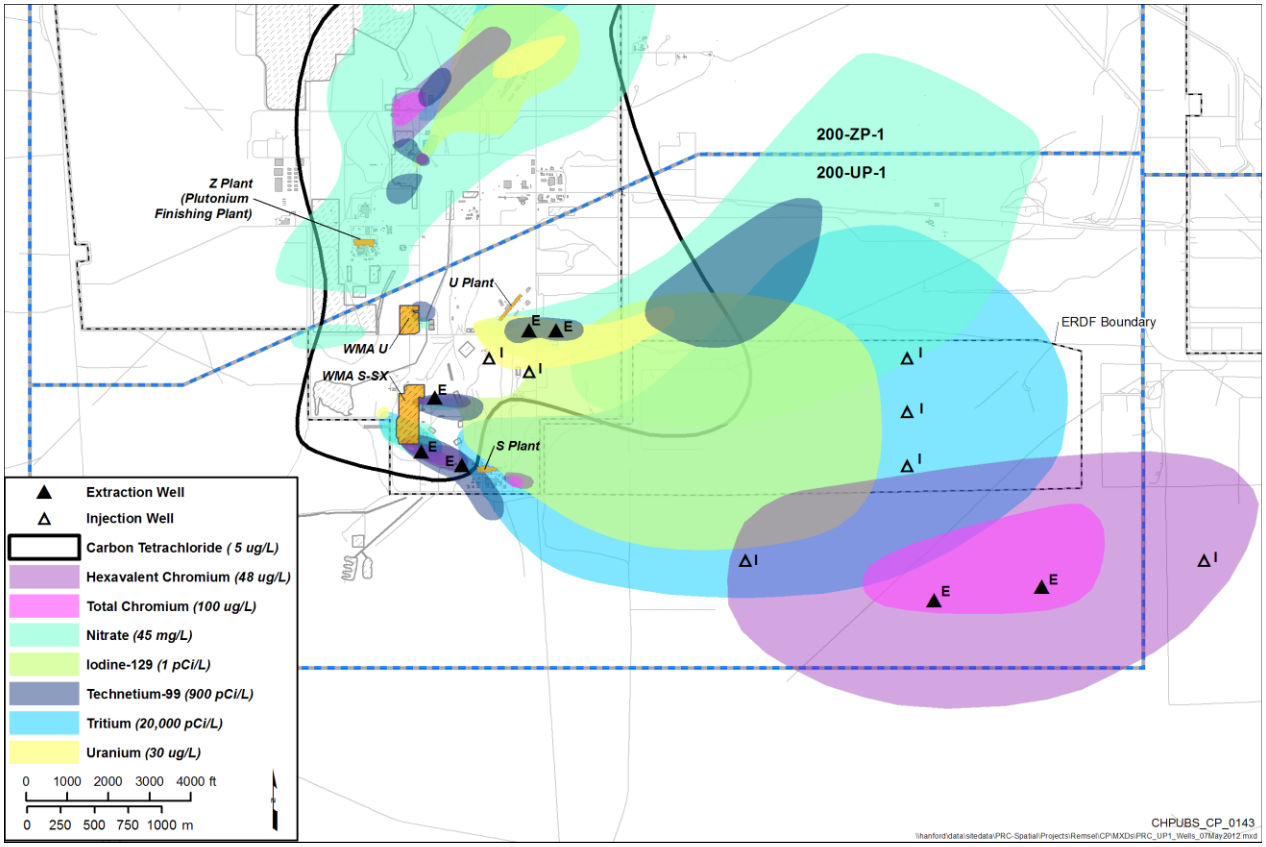


Figure 7. Alternative 3 – DOE Proposed Extraction and Injection **Well Locations**

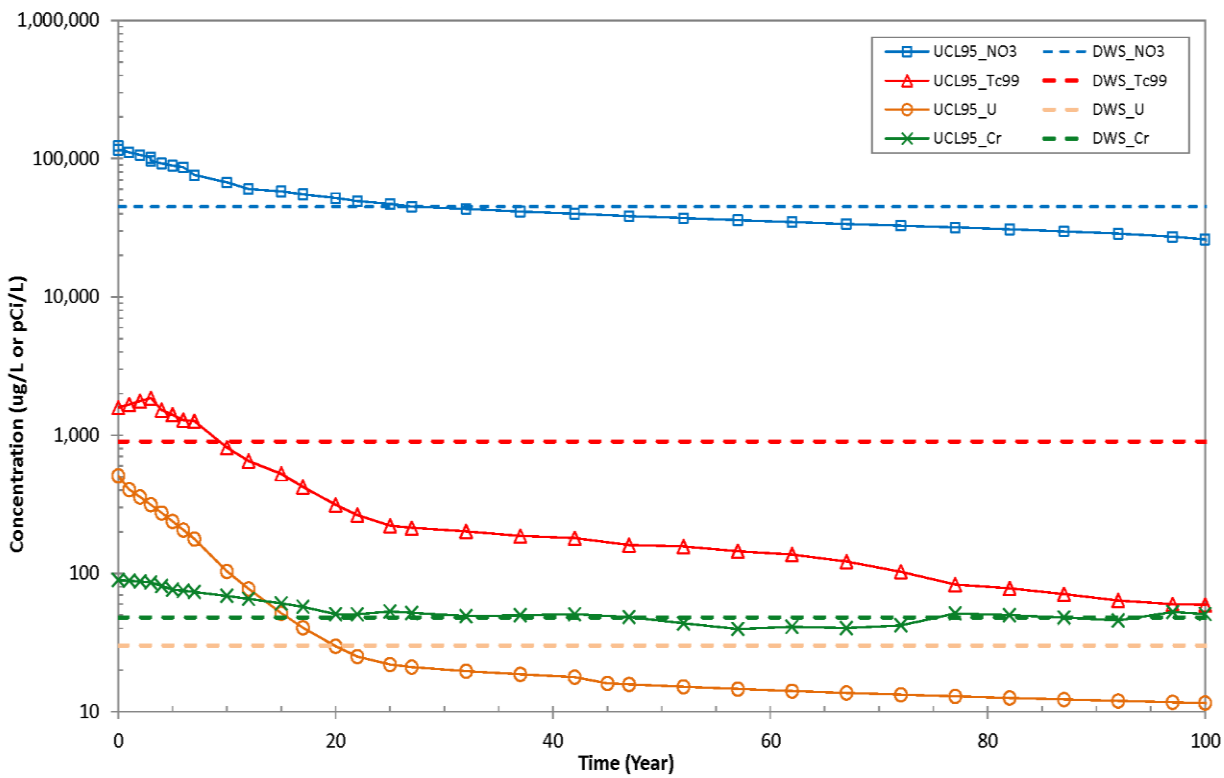


Figure 8. Alternative 3 Estimated Reduction in EPC (95th UCL) Contaminant Concentrations Over Time for Active Pumping Areas

NEPA Values

DOE policy calls for *National Environmental Policy Act of 1969* (NEPA) values to be incorporated into DOE's CERCLA documentation (DOE O 451.1B, Chg 2, *National Environmental Policy Act Compliance Program*). NEPA values include (but are not limited to) consideration of the cumulative, ecological, cultural, historical, and socioeconomic impacts of the proposed remedial action alternative.

NEPA values were incorporated into the assessment conducted as part of the FS. For the remedies evaluated for this Proposed Plan, environmental impacts include temporary short-term disturbance (e.g., increased traffic, noise levels, and fugitive dust) of approximately 26.2 km^2 (10.2 mi^2) for a disturbed industrial area that has marginal to good habitat quality. DOE expects minimal, if any, long-term impacts to air quality, natural resources, historic resources, transportation, socioeconomic values, or environmental justice.

Community Participation

Public input is a key element in the decision-making process. The Tribal Nations and the public are encouraged to read and provide comments on any of the alternatives presented in this Proposed Plan, including the Preferred Alternative.

The Administrative Record for this proposed 200-UP-1 remedial action decision is available for public review at 2440 Stevens Center Place, Room 1101, Richland, WA.

The public comment period for this Proposed Plan extends from 07/17/2012 through 08/16/2012. Comments on the Preferred Alternative, other alternatives, or any element of this Proposed Plan will be accepted through 08/16/2012. Comments need to be sent to **Tifany Nguyen,** U.S. Department of Energy, Richland Operations Office, at the following addresses:

Mail: P.O. Box 550, A7-75
Richland, WA 99352
Email: 200UP1PP@rl.gov
Phone: (509) 376-4919

At this time, a public meeting has not been scheduled. To request a meeting in your area, please contact Emerald Laija, Environmental Protection Agency, no later than 07/31/2012 at the following:

Mail: 309 Bradley Blvd. Suite 115
Richland, WA 99352
Email: laija.emerald@epa.gov
Phone: (509) 376-3361

After the comment period, DOE and EPA will consider the comments regarding the Proposed Plan and information gathered during the comment period and then select an alternative for implementation.

The Preferred Alternative could be modified or another alternative selected in response to public comment or new information. DOE and EPA will then prepare a CERCLA ROD. This ROD will identify the chosen alternative (i.e., remedy) and include a responsiveness summary containing agency responses to the comments received during the comment period.

Hanford Public Information Repository Locations

Administrative Record and Public Information Repository:
2440 Stevens Center Place,
Room 1101, Richland, WA
Phone: (509) 376-2530
Website address:
http://www2.hanford.gov/arpir/

Portland
Portland State University
Government Information
Brandford Price and Millar Library
1875 SW Park Avenue
Portland, OR 97207
Attn: Liz Paulus (503) 725-4542
Map: http://www.pdx.edu/map.html

Seattle
University of Washington
Suzallo Library
Government Publications Department
Box 352900
Seattle, WA 98195
Attn: Hilary Reinert (206) 543-5597
Map: http://tinyurl.com/m8ebj

Richland
U.S. Department of Energy
Public Reading Room
Washington State University,
Tri-Cities Consolidated Information Center,
Room 101-L
2770 University Drive, Richland, WA
Attn: Janice Parthree (509) 375-3308
Map: http://tinyurl.com/2axam2

Spokane
Gonzaga University
Foley Center Library
East 502 Boone Ave., Spokane, WA 99258
Attn: John Spencer (509) 313-6110
Map: http://tinyurl.com/2c6bpm

Glossary

Administrative Record: The collection of information, including reports, public comments, and correspondence, that contains the documents that form the basis for the selection of a response action. A list of locations where the Administrative Record is available appears in the Community Participation section of this Proposed Plan.

Applicable or Relevant and Appropriate Requirements (ARARs)*:* Applicable requirements are those clean-up standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, response action, location, or other circumstance at a CERCLA site. "Relevant and appropriate" requirements are those clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law which, while not "applicable" at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited.

Baseline Risk Assessment (BRA): Characterizes the current and potential risks to human health and the environment that may be posed by contaminants migrating to groundwater or surface water, releasing to air, leaching through soil, remaining in soil, and bio-accumulating in the food chain. The BRA identifies which contaminants are present in an area and assesses the risk they pose to human health and the environment if no remedial action is taken.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980**, as amended (CERCLA):** A federal law, also known as the Superfund Act.

Contaminant: Any chemical or radionuclide or other element, solution, substance, compound, or mixture that is expected to be present at a site based upon past and current land uses and associated releases, and which presents a threat to human health and/or the environment.

Contaminants of Potential Concern (COPCs): Contaminants identified as a potential threat to human health or the environment and are evaluated further in the baseline risk assessment.

Contaminants of Concern (COCs): A subset of the COPCs that are identified in the RI/FS as needing to be addressed by a response action.

Drinking Water Standards (DWS): The maximum allowable concentration of a chemical or radionuclide contaminant in drinking water that is protective of human health. The DWS, described in 40 CFR 141, are also known as maximum contaminant levels (MCLs).

Environmental Restoration Disposal Facility (ERDF): The Hanford Site's state and federally approved disposal facility for most hazardous (radioactive and nonradioactive) waste and contaminated environmental media generated under a CERCLA response action.

Excess Lifetime Cancer Risk (ELCR): Potential carcinogenic effects are typically characterized by estimating the probability of cancer incidence in a population of individuals exposed to the contaminated groundwater for a specific lifetime from projected intakes (and exposures) and chemical-specific dose-response data (i.e., slope factors). By multiplying the intake by the slope factor, the ELCR result is a probability, which represents additional risk of developing cancer due to exposure to the contaminated groundwater.

Feasibility Study (FS): A CERCLA study undertaken by the lead regulatory agency to develop and evaluate options for remedial action. The FS emphasizes data analysis and is generally performed concurrently and in an interactive fashion with the remedial investigation, using data gathered during the remedial investigation. The remedial investigation data are used to define the objectives of the response action, to develop remedial action alternatives, and to undertake an initial screening and detailed analysis of the alternatives. The term also refers to a report that describes the results of the study.

Groundwater: Water in a saturated zone or geologic stratum beneath the land surface or beneath a surface water body.

Groundwater Remediation: A process used to treat, remove or prevent migration of contaminants in groundwater.

Hazard Index (HI): The sum of hazard quotients (HQs) for substances that affect the same target organ or organ system. Because different pollutants can cause similar adverse health effects, it is often appropriate to combine HQs associated with different substances.

Hazard Quotient (HQ): The ratio of the potential exposure to the substance and the level at which no adverse effects are expected. If the HQ is calculated to be equal to or less than 1, then no adverse health effects are expected as a result of exposure. If the HQ is greater than 1, then adverse health effects are possible.

Hydraulic Containment: The ratio of the potential exposure to the substance and the level at which no adverse effects are expected. If the HQ is calculated to be equal to or less than 1, then no adverse health effects are expected as a result of exposure. If the HQ is greater than 1, then adverse health effects are possible.

Institutional controls (ICs): Administrative measures to protect human health and the environment from exposure to contamination. ICs are maintained until remedial goals are met.

Model Toxics Control Act (MTCA): Provides state cleanup regulations (WAC 173-340) for protection of human health and the environment. The standards and requirements established to implement the Act are published in Chapter 173-340 of the Washington Administrative Code.

Monitored Natural Attenuation (MNA): The reliance on natural attenuation processes to achieve site-specific remedial objectives. Natural attenuation processes include; physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These processes include biodegradation; dispersion; dilution; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of contaminants. Monitoring is always required as a component of MNA to ensure that field conditions remain favorable for the contaminant attenuation and to document the attenuation processes.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The NCP is required by section 105 of CERCLA, 42 USC 9605, as amended by the *Superfund Amendments and Reauthorization Act of 1986* (SARA). The purpose of the NCP is to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants.

National Priorities List (NPL): The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

90^{th} Percentile Concentration: The 90^{th} percentile is a way of saying that 90 percent of the observed concentration values are below this value. It is used in this document to estimate the exposure point concentration for contaminants in groundwater.

95th Upper Confidence Limit (95^{th} UCL): A term used to estimate the exposure point concentrations for contaminants. The calculation of this value provides 95% confidence that the mean concentration will be lower than the 95^{th} UCL.

Operable Unit (OU): A discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of OUs, depending on the complexity of the problems associated with the site. The OUs may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site (see the "National Oil and Hazardous Substances Pollution Contingency Plan" [NCP], 40 CFR 300.5).

Proposed Plan: A plan that briefly describes the remedial alternatives analyzed, proposes a Preferred Alternative and summarizes the information relied upon to select the Preferred Alternative and which provides the public with an opportunity to comment on the preferred alternative as well as the other alternatives under consideration.

Record of Decision (ROD): A legally binding public document that identifies the selected remedy for an operable unit and indicates why the remedy was chosen. The Responsiveness Summary in the ROD contains public comments received on the Proposed Plan and the Tri-Parties' responses.

Remedial Action: Those actions consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so they do not migrate to cause substantial danger to present or future public health or welfare or the environment (see the NCP [40 CFR 300.5, "Definitions"]).

Remedial Action Objectives (RAOs): Are descriptions of what the remedial action is expected to accomplish (i.e., medium specific or site-specific goals for protecting human health and the environment).

Remedial Investigation (RI): A process undertaken by the lead agency to determine the nature and extent of the problem presented by the release. The RI emphasizes data collection and site characterization, and is generally performed concurrently and in an interactive fashion with the feasibility study. The RI includes sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for remedial action and to support the evaluation of remedial alternatives (see the NCP [40 CFR 300.5, "Definitions"]).

Responsiveness Summary: A section in the Record of Decision, typically an appendix, which contains significant Tribal Nations and public comment on the Proposed Plan and the Tri-Party agencies' responses to those comments.

Tri-Party Agencies: Three agencies composed of the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology).

Tri-Party Agreement: The Hanford Federal Facility Agreement and Consent Order, or Tri-Party Agreement, signed by DOE, EPA, and Ecology on May 15, 1989. The Tri-Party Agreement, as updated and modified through formal change control, is an agreement for achieving compliance with the CERCLA Remedial Action provisions and with the *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal unit regulations and corrective action provisions. More specifically, the Tri-Party Agreement defines and prioritizes CERCLA and RCRA cleanup commitments, establishes responsibilities, provides a basis for budgeting, and reflects a concerted goal of achieving full regulatory compliance and remediation, with enforceable milestones.

Vadose Zone: The unsaturated soil between the land surface and the groundwater.

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