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# Proposed Plan for Interim Remedial Actions at the 100-NR-1 Source Sites Operable Unit and the 100-NR-2 Groundwater Operable Unit

DEC 1997
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United States
Department of Energy
Richland, Washington

For External Review

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# Proposed Plan for Interim Remedial Actions at the 100-NR-1 Source Sites Operable Unit and the 100-NR-2 Groundwater Operable Unit

Date Published
November 1997

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

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# *PROPOSED PLAN SUMMARY*
## 100-N AREA CONTAMINATED SOIL AND GROUNDWATER

**This Proposed Plan summary includes brief descriptions of the key issues for the 100-N Area contaminated soil and groundwater. This summary is intended as a simplified introduction to readers who might not be familiar with the contaminated site cleanup process or Hanford issues. The detailed Proposed Plan is attached to this summary.**

The Tri-Parties (Washington State Department of Ecology [Ecology], the U.S. Environmental Protection Agency [EPA], and the U.S. Department of Energy, [DOE]) are requesting comments on the proposed cleanup plan for the contaminated soil and groundwater next to the Columbia River at the Hanford Site located near Richland, Washington (Figure S-1). The location of the contaminated soil and groundwater is commonly known as the 100-N Area. The Tri-Parties encourage you to comment on the cleanup alternatives described in this Proposed Plan. The public is also encouraged to review and comment on the *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units* (DOE/RL-95-111) and provide comments on the same schedule as the Proposed Plan. This is the public's opportunity to comment on the RCRA past-practice sites corrective actions and associated permit conditions that will be incorporated into the Hanford facility-wide permit. The selection of the cleanup alternative will be made taking public comment into consideration. Your comments will be accepted from *<date>* until *<date>*. You may also present your comments at a public meeting that will be held on *<date>* at *<place>*.

Some of the buildings and surrounding soils in the 100 Area of the Hanford Site were contaminated during operation of the nuclear reactors. The contamination poses a potential threat to public health and/or the environment. The potential threat to the public is exposure to people on or nearby the site to radiation and chemicals. The potential threat to the environment is contamination in the soil that has migrated to the groundwater and could eventually harm the Columbia River. Because of these potential threats, the Federal Government decided that the 100 Area was a high priority for cleanup and placed it on the National Priorities List (NPL). Hanford NPL sites are being cleaned up under the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA), which is commonly called Superfund. A number of other state and Federal laws and agreements govern how the 100 Area will be cleaned up. Figure S-2 is a general overview of the cleanup process that shows at what point the public can become involved. It also shows how this Proposed Plan fits into the process and the work that has been done to help the Tri-Parties develop the Proposed Plan.

The 100-N Area is located in the north-central part of the Hanford Site along a section of the Columbia River known as the "Hanford Reach." It encompasses four distinct components that require cleanup:

- Contaminated soils and underground pipelines
- Land areas used for treatment, storage, and disposal of wastes (called cribs and trenches) and associated pipelines
- Facilities (such as buildings, structures, and pipelines) to be decontaminated and/or taken out of service
- Groundwater beneath the areas listed above.

Two separate Proposed Plans have been developed for cleanup of the contaminated soils, pipelines, and groundwater. One Proposed Plan deals with the cribs and trenches and related soil sites. This Proposed Plan deals with all additional contaminated soil sites in the 100-N Area and the groundwater beneath them. Also, a study called an Engineering Evaluation and Cost Analysis has been conducted to determine what should be done with 100-N Area buildings and structures and how much it would cost. Comments from the public on that study have been requested separately. Finally, the 100-N Reactor Building is currently being addressed in a separate program called Interim Safe Storage. Figure S-3

provides a general diagram of the environmental cleanup strategy that is being pursued in the 100 Area as well as specific actions being proposed in the 100-N Area.

As summarized in the attached Proposed Plan, the Tri-Parties plan to use one of several alternatives to protect human health and the environment from potential hazards posed by 100-N Area contaminated soils and groundwater. The alternatives have been discussed in detail in the *Corrective Measures Study (CMS)*(published in the document DOE/RL-95-111). While the alternatives in this Proposed Plan are being evaluated, the Federal Government is taking actions to minimize the threats posed by the contaminated soil and groundwater, such as restricting access to use of the land and groundwater. In addition, contaminated water is being pumped from the groundwater and treated to reduce contamination to the Columbia River. However, these safeguards are costly and provide only temporary protection. The actions proposed in this Proposed Plan will provide a longer term remedy to the potential risks.

**The preferred cleanup alternatives that are proposed by the Tri-Parties for the 100-N Area contaminated soils include the following actions:**

- **Remove/Dispose of contaminated soil for radioactive, inorganic, burn pit, and surface solid waste sites,**
- **Remove/Ex Situ Bioremediate/Dispose (excavation of contaminated soils, periodic mixing of soil to expose soil to sun, and introduction of nutrients and bacteria to soil) for near-surface petroleum waste sites,**
- **In Situ Bioremediate (injection of bacteria and nutrients to soil beneath the surface) for deep petroleum waste sites, and**
- **Continued pump and treat with access restrictions for the shoreline waste site.**

**For the groundwater, the interim action recommended by the Tri-Parties is to maintain the existing pump and treat systems designed to remove strontium-90 contamination and reduce flow of contaminated water to the River while additional information is being gathered. In addition, petroleum will be recovered from existing wells.**

The primary purposes of this Proposed Plan are to:

- Describe the alternatives considered (which are presented in detail in DOE/RL-95-111);
- Compare the alternatives to determine the preferred alternative;
- Identify the preferred alternative for cleanup and explain the reasons for the preference;
- Solicit public review of and comments on all the alternatives described; and
- Provide information on how the public can be involved in the selection of the cleanup alternative for the 100-N Area soil and groundwater.

Once the Tri-Parties evaluate public comments regarding the proposed actions for the sites covered by this Proposed Plan, cleanup actions will be selected. Since this Proposed Plan involves sites that are also covered by the Hanford Facility RCRA Permit, the Permit will be modified by incorporation of the corrective actions for the associated past-practice sites. The selected cleanup actions and other decisions will be documented in an Interim Action Record of Decision. Located at the end of this Proposed Plan is a list of related publications that the public is encouraged to review to gain a greater understanding of the cleanup plans for the past practice sites.

**For a more detailed comparison of the cleanup alternatives and a discussion of the preferred alternative, refer to the Proposed Plan that follows this summary.**

**Figure S-1. 100-NR-1 Operable Unit.**

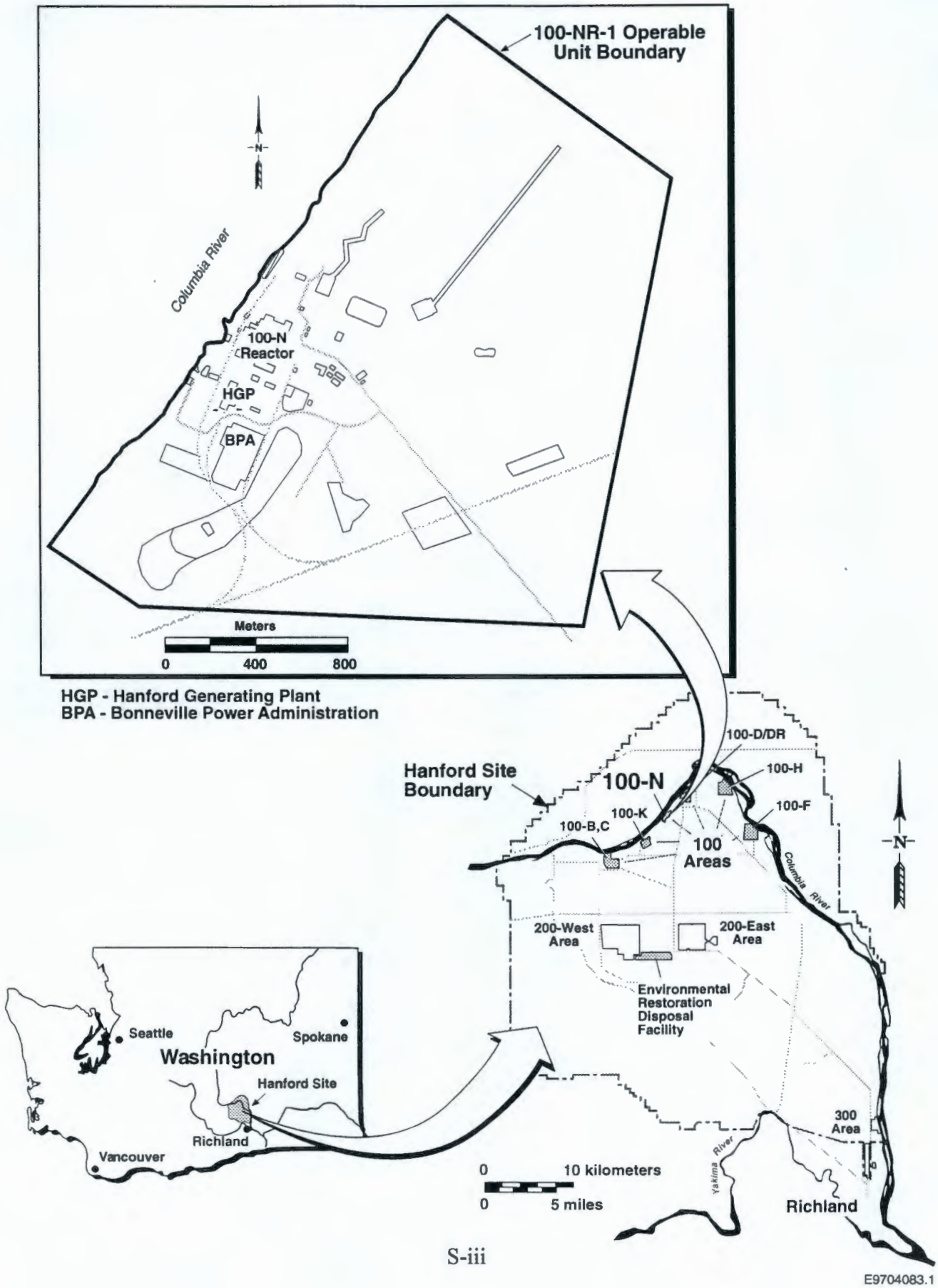
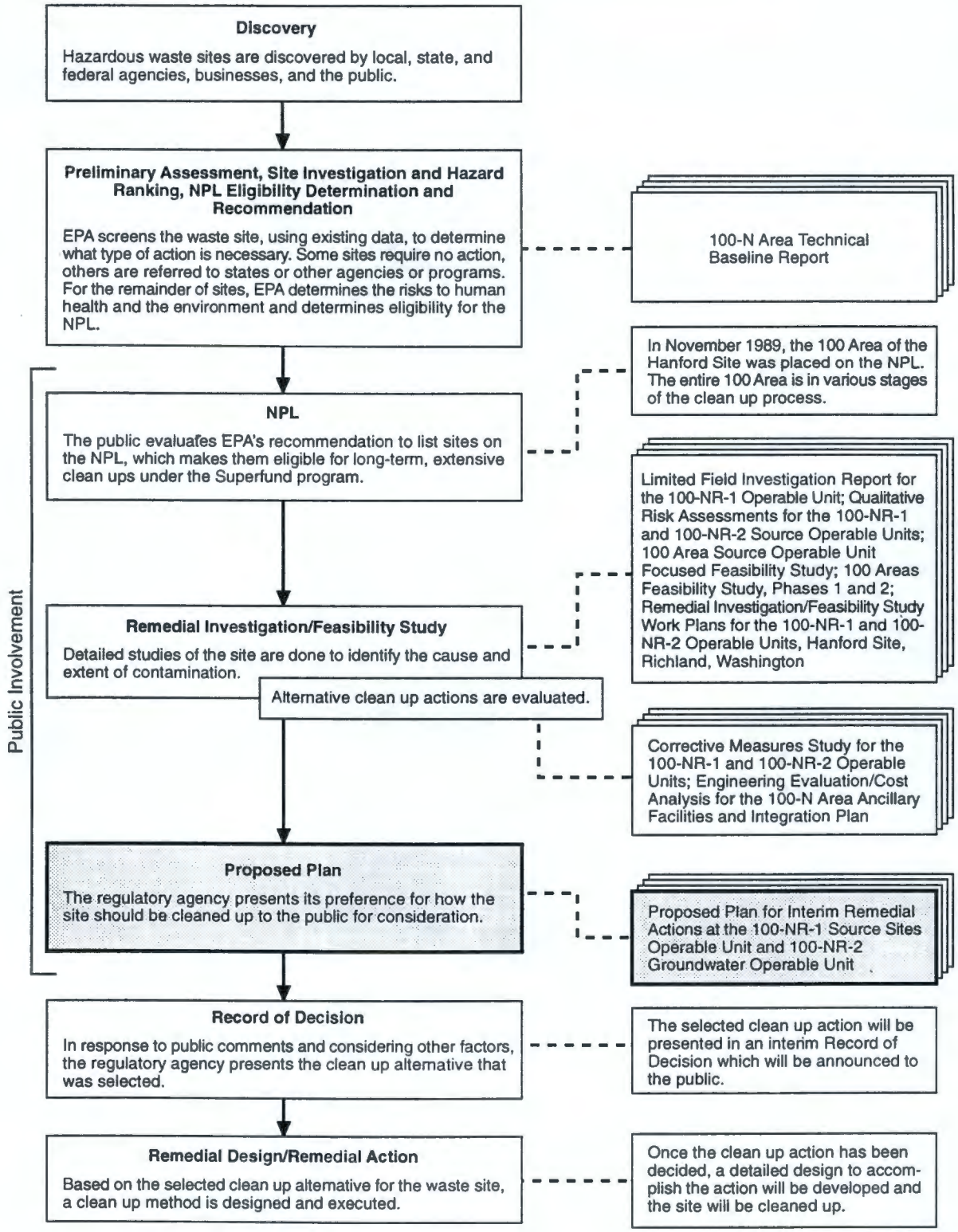


**Figure S-2. Overview of Waste Site Cleanup and Associated Documents.**




EPA - U.S. Environmental Protection Agency
NPL - National Priorities List

Note: The regulatory agency could be the U.S. EPA or the Washington State Department of Ecology.

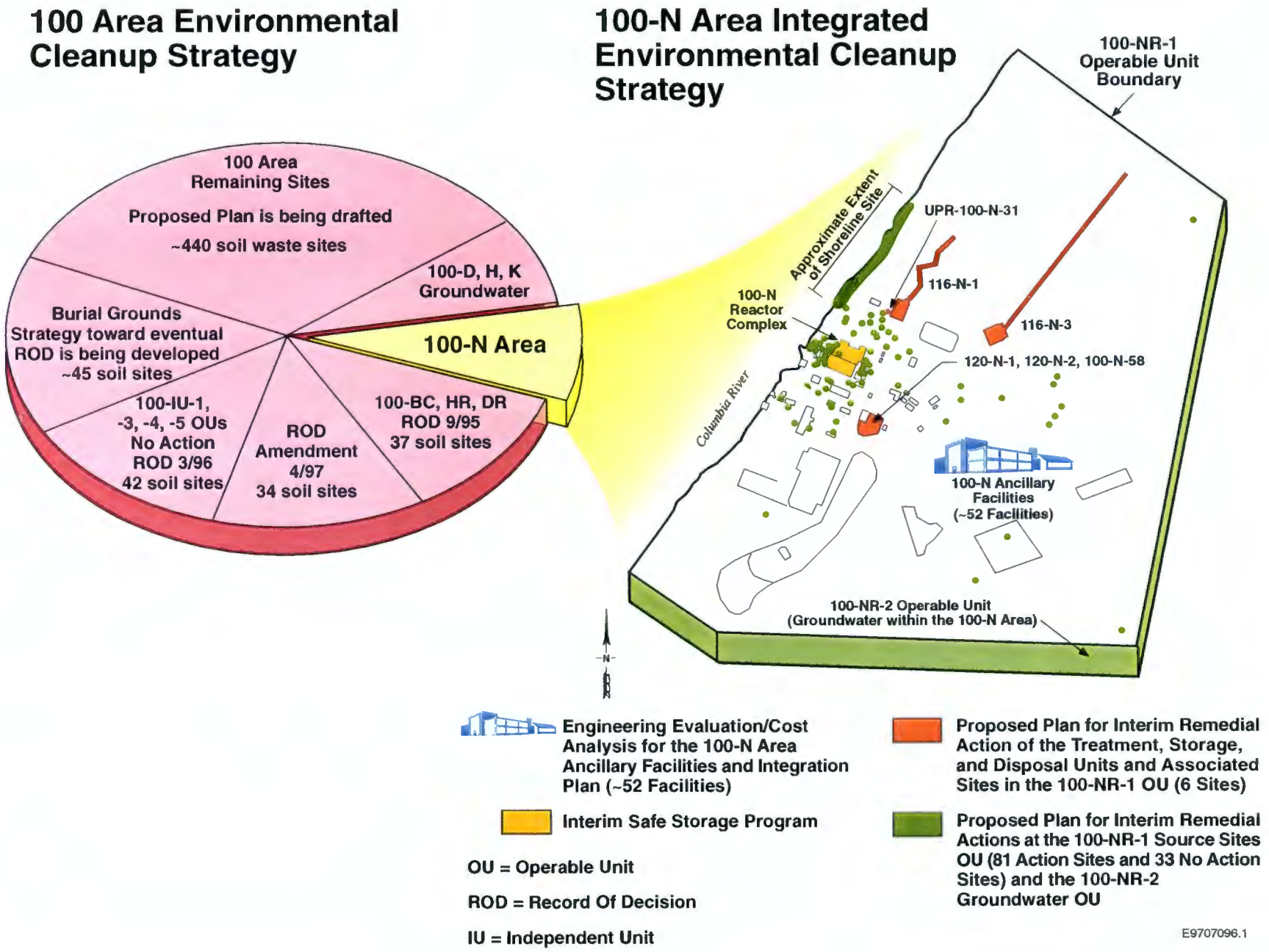



**Figure S-3. Environmental Cleanup Strategy.**

# PROPOSED PLAN FOR INTERIM REMEDIAL ACTIONS AT THE 100-NR-1 SOURCE SITES OPERABLE UNIT AND THE 100-NR-2 GROUNDWATER OPERABLE UNIT

## Hanford Site, Richland, Washington

### DOE, ECOLOGY, AND EPA ANNOUNCE PROPOSED PLAN

This Proposed Plan identifies the preferred alternatives for **interim remedial action** at the 100-NR-1 Source Sites **Operable Unit** and the 100-NR-2 Groundwater Operable Unit, located at the Hanford Site (Figure S-1). The 100-NR-1 Operable Unit contains contaminated soils and debris located at liquid waste disposal sites, **unplanned releases** (UPR), and solid waste surface disposal areas. The 100-NR-2 Operable Unit contains the contaminated groundwater in the aquifer underlying the 100-NR-1 Operable Unit. This Proposed Plan also summarizes the other alternatives analyzed for remedial action at these operable units. The intent of the proposed remedial actions is to address contaminated areas that pose potential threats to human health and the environment.

The remedial alternatives analyzed and the preferred alternative for the ***Resource Conservation and Recovery Act*** (RCRA) Treatment, Storage, and Disposal (TSD) units located in the 100-NR-1 Operable Unit are presented in a separate Proposed Plan (DOE/RL-97-30).

The remedial alternatives analyzed and the preferred alternative for the 100-N Area ancillary facilities are presented in a separate *Engineering Evaluation/Cost Analysis for the 100-N Area Ancillary Facilities and Integration Plan* (EE/CA) (DOE/RL-97-22). The EE/CA is intended to integrate all N-Area remedial activities in order to effectively and efficiently perform cleanup work.

This Proposed Plan is being issued by the Washington State Department of Ecology (Ecology), the lead regulatory agency for 100-NR-1 and 100-NR-2 Operable Unit activities; the U.S. Environmental Protection Agency (EPA), the support regulatory agency; and the U.S. Department of Energy (DOE), the responsible agency. Ecology, the EPA, and the DOE are issuing this Proposed Plan as part of their public participation responsibilities under Section 117(a) of the ***Comprehensive Environmental Response, Compensation, and Liability Act*** (CERCLA), commonly known as the "Superfund." The DOE is also issuing this Proposed Plan as part of its responsibilities under the ***National Environmental Policy Act*** (NEPA). NEPA values, including impacts to natural, cultural, and historical resources; socioeconomic aspects; and irreversible and irretrievable commitments of resources, are addressed in the *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units* (CMS) (DOE/RL-95-111).

**MARK YOUR CALENDAR**

Ecology, the EPA, and the DOE encourage you to comment during the public comment period on all of the remedial alternatives described in this Proposed Plan. Public comment is also requested on the Corrective Measures Study. Based on new information or public comments, Ecology, the EPA, and the DOE may modify the preferred alternatives or select other remedial alternatives presented in this Proposed Plan.

A 45-day public comment period for this 100-NR-1 and 100-NR-2 Proposed Plan will be from *<date>*, to *<date>*. A public meeting on this Proposed Plan is scheduled to be held on *<date>*.

Send written comments to:

Phil Staats
Washington State Department of Ecology
1315 West Fourth Avenue
Kennewick, Washington 99336-6018

As determined in the *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement, the 100-NR-1 and 100-NR-2 Operable Units are designated as operable units requiring corrective action under Section 3004(u) of RCRA (as implemented through Washington Administrative Code [WAC] 173-303-646). The 100-NR-1/100-NR-2 CMS fulfills both the RCRA corrective action and CERCLA remedial action processes (i.e., the CMS is functionally equivalent to a CERCLA feasibility study) for describing and analyzing remedial alternatives.

Ecology, the EPA, and the DOE recognize the similarities between RCRA corrective action and CERCLA remedial

**Technical terms and other text in bold are defined in the glossary at the end of this document.**

action processes, and their common objective of protecting human health and the environment from potential releases of hazardous substances, wastes, or constituents. The regulatory conditions, such as **applicable or relevant and appropriate requirements** (ARARs), controlling remediation should remain similar and consistent in implementation. Actions taken to remediate these operable units will comply with the provisions of both CERCLA and RCRA.

The CERCLA public involvement process, including public notice and opportunity to comment, has been modified as necessary to concurrently satisfy the public involvement requirements for the RCRA corrective action process. The lead regulatory agency (Ecology) will prepare a CERCLA **Record of Decision** (ROD) (following the CERCLA completion of the public involvement process for this Proposed Plan), which, after signature by DOE and EPA, will authorize the selected remedial action. Incorporation of the selected action under RCRA corrective action will occur through a modification to the **Hanford Sitewide Permit** at the next scheduled modification. Since this Proposed Plan process has been modified to address the public review requirements for a RCRA **Class 3 permit modification**, Ecology intends to use the **Class 1 permit modification** procedure for subsequent incorporation of requirements into the Hanford Sitewide Permit, unless other changes being made at the same time require that Class 2 or Class 3 permit modification procedures be used instead.

This Proposed Plan briefly describes the remedial alternatives analyzed in the 100-NR-1/100-NR-2 CMS, identifies the preferred alternatives, and summarizes the information relied upon to recommend the preferred alternatives, for public review.

**Source Waste Sites**

One hundred and fourteen sites in the 100-NR-1 Operable Unit were identified in the 100-NR-1/100-NR-2 CMS as potentially contaminated source waste sites. Thirty-three of these 114 sites were not considered further in the CMS or this Proposed Plan because they met one or both of the following criteria: (1) sites that were never contaminated or are not currently contaminated and (2) sites that will be remediated through a process other than this Proposed Plan (Section 3.2 of the *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable* Units [DOE/RL-95-111]). One waste site (100-N-20), for example, will be addressed as part of the 100 Area Remaining Sites remedial effort. Another (UPR-100-N-31) is addressed in conjunction with the 116-N-1 TSD.

Each of the 81 remaining potentially contaminated waste sites (and associated buried pipelines) was considered under this remedial action, and remedial alternatives were identified for each site. To facilitate the development of remedial alternatives and the subsequent detailed and comparative analyses of their suitability, all but one (the shoreline site) of the 81 waste sites were placed (based on suspected primary contaminants and unique characteristics) into one of five waste groups: radioactive, petroleum (near-surface contamination and deep contamination), inorganic, burn pit, and surface solid (Appendix A).

The shoreline site presents unique remedial challenges because of its location at the groundwater/Columbia River interface. Furthermore, the remediation of the shoreline site is closely tied to final remediation of the 100-NR-2 Groundwater Operable Unit because of the complex, dynamic relationships among the Columbia River, the contaminated groundwater in the 100-N Area, and the contaminated soils at the shoreline site. Therefore, the shoreline site was not assigned to a waste group, but addressed separately as a single, unique waste site in the 100-NR-1/100-NR-2 CMS.

The shoreline site contains two distinct areas: (1) the river-bank seeps in the 100-N Area (the N-Springs) and associated contaminated soils in their vicinity and (2) the contaminated soil associated with waste site 100-N-65 (an interceptor trench built to collect diesel/fuel oil leaked to the groundwater). Although addressed separately due to differences with respect to source of contamination, **contaminants of concern**, and potential remedial action, these two areas overlap and together constitute the shoreline site for the purpose of developing and comparing remedial alternatives. Throughout this Proposed Plan, the shoreline site, the remedial alternatives associated with it, and the analysis of the remedial alternatives applicable to the shoreline site are discussed separately from the rest of the 100-NR-1 waste sites.

Remedial alternatives for the 81 100-NR-1 waste sites for which remedial action is planned were analyzed under two conceptual exposure model scenarios: **rural-residential** and **modified Columbia River Comprehensive Impact Assessment (CRCIA) ranger/industrial**. The rural-residential exposure scenario assumes unrestricted land use to a depth of 4.6 m. The modified CRCIA ranger/industrial exposure scenario does not include the food ingestion pathway, but assumes occasional use of the ground surface with potential intrusion into soils by humans, animals, and plants to a depth of 3 m. These scenarios include restrictions on the use of groundwater. Drinking and irrigation water would need to be supplied from an offsite source (additional details of the scenarios are provided in Appendix F of the 100-NR-1/100-NR-2 CMS).

Under the rural-residential scenario, five remedial alternatives for the five 100-NR-1 Operable Unit waste groups were analyzed initially in the 100-NR-1/100-NR-2 CMS. The alternatives analyzed were No Action, Institutional Controls, Remove/Dispose, Remove/Ex Situ Bioremediation/Dispose, and In Situ Bioremediation. Under the modified CRCIA ranger/industrial scenario, Containment and In Situ Solidification were also analyzed in addition to the five alternatives analyzed under the rural-residential scenario.

For the shoreline site, the remedial alternatives analyzed under the rural-residential scenario were No Action and Remove/Dispose. Under the modified CRCIA ranger/ industrial scenario, Institutional Controls and Cover were also analyzed for the shoreline site.

The final land use for the 100 Area has not been determined. For the purpose of this Proposed Plan, the preferred remedial alternative has been proposed based on the rural-residential scenario so as to not preclude any future land use. **Remedial action objectives** and cleanup goals will be reevaluated if future land-use and groundwater-use determinations are inconsistent with the preferred remedial alternatives presented in this plan.

The preferred remedial alternatives for the 100-NR-1 Operable Unit source waste sites presented in this Proposed Plan are as follows: Remove/Dispose for the radioactive, inorganic, burn pit, and surface solid groups; Remove/Ex Situ Bioremediation/Dispose (for near-surface contamination) and In Situ Bioremediation (for deep contamination) for the petroleum waste group; and Institutional Controls for the shoreline site (Table 1). For those alternatives involving disposal, treatment of excavated soils would be conducted before disposal, as required, to meet **land disposal restrictions** and the **Environmental Restoration Disposal Facility** (ERDF) waste acceptance criteria. The ERDF is an onsite CERCLA landfill located on the 200 Area plateau in the central part of the Hanford Site. The disposal of waste from inactive RCRA, past practice sites was determined to be within the definition of Hanford Site remediation waste provided in the ERDF ROD, as clarified by the explanation of significant differences (*U.S. Department of Energy Environmental Restoration Disposal Facility - Hanford Site Benton County, Washington - Explanation of Significant Difference*).

Because the exact nature and extent of contamination is unknown for the 100-NR-1 source waste sites, it is possible that some sites for which remedial action is planned may not contain contaminant concentrations in excess of **remedial action goals**. It is also possible that contamination concentrations may be greater or more extensive (e.g., located deeper) than expected. In such cases, based on characterization information gathered during remedial design or during remedial action using the **observational approach**, these sites may require no action or more extensive remediation than planned.

The preferred remedial alternatives will reduce potential threats to human health and the environment at 100-NR-1 source waste sites. The remedial actions described are intended to (1) reduce potential risks to human health and the environment, (2) ensure that contaminants present at these waste sites will not adversely impact existing groundwater quality beneath the sites or beneficial uses of the Columbia River (designated a **Class A river**), and (3) to accommodate the goal of not precluding any future land use.

**Groundwater Site**

Seven groundwater remedial alternatives for the 100-NR-2 Operable Unit were analyzed in the 100-NR-1/ 100-NR-2 CMS. The alternatives analyzed were:

- No Action for Groundwater Remediation and River Protection for all contaminants of concern
- Institutional Controls for Groundwater Remediation and River Protection for all contaminants of concern
- Institutional Controls for Groundwater Remediation and Permeable Barrier for River Protection from Sr-90
- **Pump and Treat** for Groundwater Remediation of Sr-90 and Hydraulic Controls for River Protection from Sr-90
- Pump and Treat for Groundwater Remediation of Sr-90 and other contaminants of concern and Hydraulic Controls for River Protection from Sr-90
- Pump and Treat for Groundwater Remediation for Sr-90 and other contaminants of concern and Cryogenic Barrier for River Protection from Sr-90
- Soil Flush/Pump and Treat for Groundwater Remediation of Sr-90, Pump and Treat for Groundwater Remediation for other contaminants of concern, and Sheet Pile Barrier for River Protection.

Insufficient information exists to make a final remedy decision for Sr-90; therefore, Ecology, the EPA, and the DOE propose to control movement of Sr-90 to the Columbia River as an interim remedial action for river protection. This interim control would be accomplished through operation of the existing pump and treat system while further information is gathered for a final remedy. The pump and treat system (as recently modified and restarted in December 1996) has been in operation since September 1995 at the 100-NR-2 Operable Unit under the N-Springs **Expedited Response Action** and associated **Action Memorandum**. It removes Sr-90-contaminated groundwater, treats it by **ion exchange**, and returns

**Table 1. Waste Groups for the Source Waste Sites in the 100-NR-1 Operable Unit and Preferred Remedial Alternatives for Each Waste Group.**

| Waste Group | | Preferred Alternatives | | | | |
|---|---|---|---|---|---|---|
| | | Institutional Controls | Remove/ Dispose | Remove/Ex Situ Bioremediation/ Dispose | In Situ Bioremediation | Number of Source Waste Sites[1] |
| Radioactive | | | X | | | 37 |
| Petroleum | Near Surface | | | X | | 20 |
| | Deep | | | | X | 2 |
| Inorganic | | | X | | | 6 |
| Burn Pit | | | X | | | 6 |
| Surface Solid and Miscellaneous Source Waste Sites | | | X | | | 9 |
| Shoreline | | X | | | | 1 |

[1] Buried pipelines associated with waste sites will be remediated with those waste sites.

treated groundwater to the unconfined aquifer using upgradient injection wells. The preferred alternative for the interim will provide some control over movement of Sr-90 to the Columbia River and will not preclude possible final remedies at this operable unit or the source sites operable unit.

Selection of the preferred alternatives for the 100-NR-1 and 100-NR-2 Operable Units is consistent with recommendations presented in the ROD signed by Ecology, the EPA, and the DOE in September 1995 and thereafter for the 100-BC-1, 100-DR-1, and 100-HR-1 Source Sites Operable Units and the 100-HR-3 and 100-KR-4 Groundwater Operable Units. These RODs also discuss key uncertainties in the human health and ecological risk assessments that result from limited data that may not completely represent each site.

The preferred remedial alternatives presented in this Proposed Plan are the initial recommendations of Ecology, the EPA, and the DOE. Remedial alternatives will be selected only after the public has had the opportunity to comment on these recommendations and all comments have been reviewed and considered. The agencies are seeking comments on each alternative that has been considered and on all supporting documentation in the **Administrative Record**, not just on the preferred alternatives. Comments may be made in person at the public meeting or may be submitted in writing to the address in the box on the first page. Written comments must be submitted by *<date>*. Responses to comments will be presented in a responsiveness summary that will be part of the ROD, which is the legal decision document that presents the selected remedial actions. The public is also encouraged to review and comment on the *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units* (DOE/RL-95-111) and provide comments on the same schedule as the proposed plan. This constitutes the Hazardous and Solid Waste Amendment (HSWA) corrective action public participation opportunity for the RCRA past-practice sites addressed in the CMS. This and other related documents listed at the end of this Proposed Plan provide greater detail about these operable units and are available for review in the Administrative Record and public information repositories.

## HANFORD SITE HISTORY

The Hanford Site is located in southeastern Washington State (Figure S-1). It was established in 1943 to produce plutonium for nuclear weapons using reactors and chemical processing plants. The 100 Area of the Hanford Site is located along the Columbia River and includes nine inactive nuclear reactors used for plutonium production between 1943 and 1987. Operations at the Hanford Site are now focused on environmental restoration and waste management. In November 1989, the EPA designated the

100 Area of the Hanford Site a Superfund site and placed it on the **National Priorities List** (NPL) because of soil and groundwater contamination that resulted from past operation of the nuclear facilities. To organize cleanup efforts under Superfund, contaminated areas at the nine inactive reactors were subdivided into geographic areas called "operable units."

### 100-N AREA BACKGROUND

The 100-N Area is located in the north-central part of the Hanford Site along a section of the Columbia River known as the "Hanford Reach." It encompasses four distinct components requiring remedial action: the 100-NR-1 Source Sites Operable Unit, the 100-NR-2 Groundwater Operable Unit, the TSD units within the 100-NR-1 Operable Unit, and facilities within all the operable units. A separate Proposed Plan addresses the TSD units within the 100-NR-1 Operable Unit and the EE/CA addresses the facilities with the operable units.

## 100-NR-1 OPERABLE UNIT PROPOSED PLAN ELEMENTS

### 100-NR-1 OPERABLE UNIT BACKGROUND

The 100-NR-1 Operable Unit encompasses an area of approximately 405 hectares and contains the N Reactor, the Hanford Generating Plant (HGP), a Bonneville Power Administration (BPA) switching station, and adjacent support facilities (Figure 1). The N Reactor operated between 1963 and 1987. It was designed for two modes of operation: (1) plutonium production and (2) plutonium production with steam production as a byproduct. The byproduct steam was used to produce electricity in the adjacent HGP. Reactor operations and former waste-handling practices have caused contamination in the soil around the N Reactor, the HGP, and the adjacent support facilities, and in the groundwater beneath the operable unit.

The 100-NR-1 Operable Unit includes sites contaminated as a result of intentional discharges of contaminated liquid effluents to operational facilities such as cribs, neutralization basins, and french drains; UPRs or leaks from piping systems and storage tanks; and placing (sometimes burning) construction debris, used equipment, and office/industrial waste at surface disposal areas.

The 100-NR-1 waste sites, their former uses, waste type (contaminants of concern), and designated waste group are tabulated in Appendix A. The principal contaminants of concern for the 100-NR-1 Operable Unit are radionuclides, metals, and petroleum hydrocarbons. This information is based on historical operations knowledge, limited site data, and other information found in the *100-N Area Technical Baseline Report* (WHC-SD-EN-TI-251); the *Limited Field Investigation Report for the 100-NR-1 Operable Unit* (DOE/RL-93-80); the ***Qualitative Risk Assessment*** *for the 100-NR-1 Source Operable Unit*, Revision 1 (BHI-00054), and the 100-NR-1/100-NR-2 CMS. Figure 1 depicts the locations of the 100-NR-1 waste sites for which remedial action is planned. Groundwater underlying the 100-NR-1 Operable Unit is discussed later in this Proposed Plan as part of the 100-NR-2 Operable Unit.

### SCOPE AND ROLE OF ACTION AT 100-NR-1

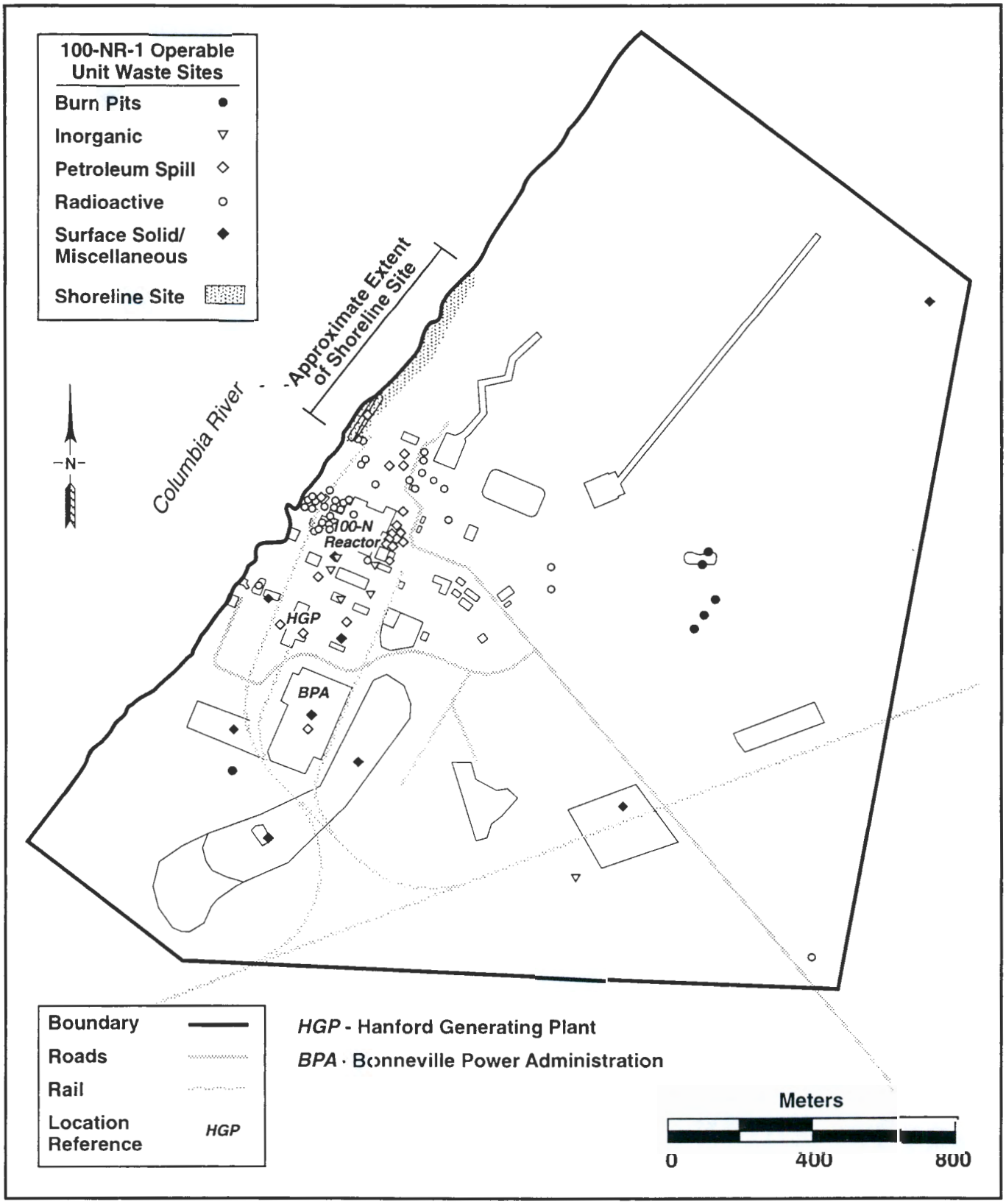
The interim remedial action objectives for the 100-NR-1 Operable Unit are:

- Protect exposure to contaminated soil
- Remediate the soil for future beneficial use
- Protect the unconfined aquifer from adverse impacts from soil contamination
- Protect the Columbia River from adverse impacts so that designated beneficial uses are maintained and potential human health and ecological receptors are protected.

This Proposed Plan addresses 81 potentially contaminated waste sites in the 100-NR-1 Operable Unit identified as candidates for remedial action. This Proposed Plan recommends preferred remedial alternatives for the 81 sites (and associated buried pipelines). The proposed remedial actions for the 100-NR-1 waste sites, except for the shoreline site and any deferred sites located next to the N Reactor, are considered interim actions.

Final remediation of the shoreline site is dependent upon final remediation of the 100-NR-2 Groundwater Operable Unit because of the complex, dynamic relationships among the Columbia River, the contaminated groundwater in the 100-N Area, and the contaminated soils at the shoreline site. Because of insufficient site-specific characterization information, unique remedial challenges (as a result of its location at the groundwater/river interface), and dependence on the final remedial action selected for the 100-NR-2 Operable Unit, the preferred interim remedial alternative for the shoreline site, Institutional Controls, will be reevaluated when a final remedial action for groundwater is selected. During this interim time frame, data will be collected on the contaminated soil associated with waste site 100-N-65 in conjunction with remediation of UPR-100-N-17, and a preferred remedial alternative for waste site 100-N-65 will be determined at that time. The N-Springs area of the shoreline site will remain under existing institutional

**Figure 1. Locations of the 100-NR-1 Waste Sites.**

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controls until a final remedial action is chosen for the 100-NR-2 Operable Unit. The dependence of the shoreline remediation on the final remedial action for groundwater will be discussed further in the 100-NR-2 Operable Unit section of this Proposed Plan.

The principal threats posed by the 100-NR-1 waste sites are the potential for direct human and ecological receptor contact with contaminated soils, and the potential for contaminants in the soils to migrate to the groundwater and, eventually, the Columbia River. The objective of the proposed interim remedial actions is to reduce potential future threats to human health and the environment from these waste sites. It is expected that no additional remedial actions will be required at these sites.

Remedial action for 15 (Table A-1) of the 81 100-NR-1 waste sites may be deferred because the sites are located within 15.2 m (50 ft) of the buffer zone of the N Reactor. The area near the N Reactor building is referred to as the buffer zone. Remediation of these sites could interfere with the stability of the reactor building. Additionally, cleanup of these sites may be premature given that future work may be conducted in this area which could recontaminate these sites. Recontamination could occur as the nearby facilities are removed. The proposed remedial alternatives for these sites have been included in this plan. This inclusion will allow early action at these sites should the opportunity occur, but in no case later than the **interim safe storage** (ISS) action planned for the reactor building. The ISS of the 100-N Reactor building is scheduled within the time frame of the 100-N Area remedial action.

The public has provided input to the DOE on the future use of the 100 Area through various forums, including the **Hanford Future Site Uses Working Group**. However, the final land use for the 100 Area of the Hanford Site has not been determined. For the purpose of this Proposed Plan, the remedial action goals and preferred remedial alternatives, to the extent practicable, would support an objective of not precluding any future land use in the 100 Area. This objective would be accomplished by remediating the sites to address the potential direct effects of exposure to contaminants, potential releases of contaminants to air and groundwater, and potential impacts to ecological and cultural resources. The development of mitigation plans, with input from the Natural Resources Trustee Council, to address site-specific ecological and cultural resources will occur during the remedial design phase that follows development and approval of the ROD. **Remedial action objectives** and goals may be reevaluated if final land-use and groundwater-use determinations are inconsistent with the remedial actions proposed in this plan.

To facilitate future remediation of the 100-N Area, the ancillary facilities located adjacent to or overlapping contaminated waste sites will need to be removed prior to remediation of those waste sites. A plan integrating decontamination and decommissioning of the ancillary facilities with the remedial action work for the waste sites has been developed and is a part of the EE/CA (DOE/RL-97-22). The Integration Plan establishes a sequence in which decontamination and decommissioning and remedial action work can be effectively completed.

## SUMMARY OF SITE RISK AT 100-NR-1

As discussed in the *Limited Field Investigation Report for the 100-NR-1 Operable Unit* (DOE/RL-93-80), Ecology, the EPA, and the DOE designated several waste sites within the 100-NR-1 Operable Unit as high or medium priority sites requiring remediation. Potential risks to human and ecological receptors posed by these designated high and medium priority waste sites, as well as other waste sites, were evaluated in the *Qualitative Risk Assessment for the 100-NR-1 Source Operable Unit* (BHI-00054). Based on limited site-specific soil data, 100-N Area historical operations information, and/or process knowledge at analogous sites in other operable units, this qualitative risk assessment (QRA) determined that several waste sites posed high or medium risk to human and/or ecological receptors, thereby supporting the decision to remediate the waste sites within the 100-NR-1 Operable Unit.

The risk determinations made during the QRA process were based on the frequent-use and the occasional-use scenarios identified in the QRA. The frequent-use scenario is generally similar to the rural residential scenario, and the occasional-use scenario is generally similar to the modified CRCIA ranger/industrial scenario used in the CMS (modified CRCIA ranger/industrial) exposure scenarios for humans, and a comparison of estimated doses to acceptable doses (ecological benchmarks) for animals. Because the exposure scenarios were slightly different and site-specific data were not available for all the waste sites in the 100-NR-1 Operable Unit, the definition of potential site risk and subsequent development of remedial alternatives in the CMS were based on establishing preliminary remediation goals that comply with risk-based ARARs or **To Be Considered** (TBC) requirements. Radionuclide preliminary remediation goals protective of human health were calculated based on a TBC national dose standard: the draft EPA standard of 15 millirem per year (mrem/yr) above natural background. This cleanup level is consistent with other cleanup activities in the 100 Areas. Radionuclide preliminary remediation goals protective of ecological receptors were calculated based on a TBC dose standard: a draft DOE standard of 0.1 rad/day for

terrestrial animals. For nonradionuclides, preliminary remediation goals for soils were defined by risk-based ARARs in the Washington State ***Model Toxics Control Act*** (MTCA). Both human and ecological receptors were considered protected by MTCA Method B values.

**Human Health Risk**

Because of limited characterization data, actual quantitative risk levels for carcinogenic and noncarcinogenic health impacts could not be calculated for the 100-NR-1 waste sites. Thus, potential human health risks were qualitatively evaluated by comparing 100-N Area operations information, limited site-specific data, and analogous site information to risk-reduction or risk-based remedial action goals. Conceptual exposure models that consider the potential contaminants, receptors, and exposure pathways through which the contact might occur aided the evaluation. Based on this qualitative evaluation, contamination in soil thought to exist at some of the 100-NR-1 waste sites poses a potential health risk to future users of the site. The level of potential health risk posed by these contaminants differs depending upon the future site use. Two future site uses (conceptual exposure models) were evaluated: rural-residential and modified CRCIA ranger/industrial. In either case, future site users could be exposed to contaminants in soil at concentrations above acceptable levels through ingestion of soil, inhalation of suspended dust, and external exposure to radiation. Potential exposure to contaminants at concentrations above ARARs indicates that remedial actions should be taken at the 100-NR-1 Operable Unit. Table 2 provides a comparison of the maximum contaminant levels with the preliminary remediation goal in soil (cleanup standard) for each contaminant of concern. The *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units* (DOE/RL-95-111) provides more detail on the contaminant levels.

The potential for direct human exposure to contaminants in soil at a depth greater than 4.6 m is unlikely. However, these deeper contaminants could migrate to groundwater. The potential for such migration was also considered in determining the need to remediate waste sites. Past disposal of liquid waste to the soil in the 100-N Area has impacted the underlying groundwater. Should groundwater under the site be used, future users could be exposed to contaminants. The existing groundwater contamination that resulted from past operations in the 100-N Area is part of the 100-NR-2 Operable Unit.

**Ecological Risk**

As with human health risks, actual quantitative risk levels for ecological impacts could not be calculated for the individual waste sites within the 100-NR-1 Operable Unit because of limited site-specific data. Thus, potential ecological risks were qualitatively evaluated by estimating preliminary remediation goals for terrestrial animals. There are a large number of possible animal receptors (such as rodents, hawks, and large mammals), but the Great Basin pocket mouse was used as a representative receptor. This mouse would potentially receive a greater exposure to site contaminants than many other ecological receptors, thereby providing a conservative estimate of risk. Risks to the mouse were estimated assuming the food pathway was the primary route of exposure to both radionuclides and inorganic contaminants. Based on this qualitative evaluation, contamination in soil thought to exist at some of the 100-NR-1 waste sites poses a potential risk to ecological receptors.

**Table 2. Comparison of Maximum Representative Concentration with Preliminary Remediation Goal in Soil.**

| Contaminant | Maximum Representative Concentration[1] | Preliminary Remediation[2] Goal in Soil (Cleanup Standard) |
|---|---|---|
| Cs-137 | 15.5 pCi/g | 6.1 pCi/g |
| Co-60 | 254 pCi/g | 1.4 pCi/g |
| Sr-90 | 431 pCi/g | 3.7 pCi/g |
| Th-232 | 3 pCi/g | 0.97 pCi/g |
| Lead | 577 mg/kg | 250 mg/kg |

[1] These are maximum concentration limits from soil samples collected during the 100-NR-1 Limited Field Investigation.
[2] Limit represents the contaminant concentration that would equal 15 mrem/yr above natural background. Preliminary remediation goals were based on the largest contaminated site.

## SUMMARY OF ALTERNATIVES FOR 100-NR-1

The *100 Area Source Operable Unit Focused Feasibility Study* (DOE/RL-94-61) identified six general response actions that could be applied to waste sites in the 100 Area. The remedial alternatives corresponding to these general response actions evaluated for the 100-NR-1 Operable Unit in the 100-NR-1/100-NR-2 CMS are as follows:

- No Action (all sites)
- Institutional Controls (shoreline site)
- Remove/Dispose (all sites)
- Remove/Ex Situ Bioremediation/Dispose (near-surface petroleum sites)
- In Situ Bioremediation (deep petroleum sites)

- Containment (Cover) (modified CRCIA ranger/industrial scenario only; 16 radioactive sites [containment] and shoreline site [cover])
- In Situ Solidification (modified CRCIA ranger/industrial scenario only; 20 radioactive sites).

Notes:

- The No Action Alternative is not protective of human health or the environment, but was considered as a baseline to compare with other alternatives.

- The Institutional Controls Alternative is inconsistent with the goal of not precluding any future land use (e.g., the rural-residential scenario). Thus, the Institutional Controls Alternative was only considered for the shoreline site under a modified CRCIA ranger/industrial scenario. This alternative may achieve protection of human health during the period when institutional controls could be maintained. Presently, impacts to ecological receptors are not quantifiable, and further study may be warranted.

- The Containment (Cover) and In Situ Solidification Alternatives are inconsistent with the goal of not precluding any future land use at the actual waste site. Thus, they were considered under the modified CRCIA ranger/industrial scenario but not the rural-residential scenario. Furthermore, the In Situ Solidification Alternative was not considered for the shoreline site because of problems associated with leaving a solidified mass of contamination at the river's edge.

Applicable cleanup standards to be achieved by the remedial alternatives include: MTCA Method B for nonradioactive inorganic and organic contaminants in soil, MTCA Method A for petroleum contaminants, and 15 mrem/yr above natural background for radionuclides. If remedial alternatives involve excavation of contaminants (e.g., removal action) to achieve these cleanup standards, the applicable depth for the rural-residential scenario is 4.6 m below surrounding grade and the applicable depth for the modified CRCIA ranger/industrial scenario is 3 m below surrounding grade. A summary of all remedial alternatives considered is provided below.

**No Action**

The No Action Alternative was evaluated to provide a baseline to compare to the other alternatives. It represents a hypothetical scenario where no restrictions, controls, or active remedial actions are applied to a site. The No Action Alternative would limit future use of the 100-N Area.

**Institutional Controls**

This alternative includes the following elements:

- Land use restrictions and/or access controls
- Groundwater monitoring.

Institutional controls would be consistent with the institutional controls discussed in the 100-NR-2 section of this Proposed Plan. Land use restrictions would be used to limit certain types of land use (e.g., restricting drilling or excavation). Access controls would be limited to signs. Groundwater monitoring would be used to evaluate the effectiveness of the proposed remedial action, and to support decisions to continue the action or implement other actions. Institutional controls would be required to prevent human exposure to and use of contaminated land and groundwater. The DOE would be responsible for establishing and maintaining land use and access restrictions until MCLs and risk-based criteria are met or the final remedy is selected. Institutional controls include placing written notification of the remedial action in the facility land use master plan. The DOE would prohibit any activities that would interfere with the remedial activity without EPA and Ecology concurrence. In addition, measures necessary to ensure the continuation of these restrictions would be taken in the event of any transfer or lease of the property before a final remedy is selected. A copy of the notification would be given to any prospective purchaser/transferee before any transfer or lease. The DOE would provide EPA and Ecology with written verification that these restrictions were put in place.

**Remove/Dispose**

This alternative includes the following elements:

- Remove contaminated media
- Dispose media at the ERDF
- Backfill excavated areas and revegetate[1]
- Deed restrictions and/or access control.

Under this alternative, contaminated media would be excavated, transported to, and disposed at the ERDF in accordance with ERDF's waste acceptance criteria, including land disposal restrictions. Any material that

[1] Various locations in this Proposed Plan refer to revegetation efforts. Revegetation efforts will provide overall environmental benefits to the site, and will be done as indicated. However, the revegetation activities are not part of or necessary for completion of the remedial actions proposed in this plan. Efforts will be made to avoid or minimize impacts to natural resources during remedial activities, and the Natural Resources Trustees will be consulted during mitigation and restoration activities.

exceeds the disposal facility acceptance criteria would be stored on site consistent with requirements until treated to meet acceptance criteria, utilizing an agreed upon path forward. If and when such waste material is discovered, the path forward will be agreed to by the DOE, EPA, and Ecology before the waste material is dispositioned. As the contaminated material is excavated, it would be characterized and segregated before transportation. Excavation would continue until all contaminated material exceeding the remedial action goals is removed. The site would then be backfilled and revegetated.

**Remove/Ex Situ Bioremediation/Dispose**

This alternative includes the following elements:

- Remove contaminated media
- **Ex situ bioremediation**
- Dispose residual, contaminated media at the ERDF
- Backfill excavated areas and revegetate
- Groundwater monitoring.

This alternative is the same as the previous alternative except that petroleum-contaminated soil would be placed on a nearby remediation pad, and treated using bioremediation. Bioremediation helps to achieve a reduction in waste volume requiring disposal. Following remediation, previously contaminated soil that meets the bioremediation treatment goal, and that does not contain other contaminants above remedial action goals, could be used as clean backfill. Soil not meeting the treatment goal would be transported to the ERDF for disposal. Groundwater, leachate, and runoff would be monitored for any impacts.

**In Situ Bioremediation**

This alternative includes the following elements:

- **In situ bioremediation**
- Revegetate
- Groundwater monitoring.

Under this alternative, a system of injection wells would supply oxygen, bacteria, and nutrients to the petroleum-contaminated soils at depth, where remediation would take place. Monitoring wells would be used to monitor the bioremediation and any impacts to groundwater. No excavation or removal is required.

**Containment (Cover)**

This alternative includes the following elements:

- Institutional controls
- Groundwater monitoring
- Surface water controls
- Installation of a surface barrier
- Revegetate.

As described under the Institutional Controls Alternative, deed restrictions and/or access restrictions, combined with groundwater monitoring, would be implemented along with surface water runon/runoff controls during and after installation of a surface barrier. The surface barrier would be designed to eliminate direct exposure pathways for human and ecological receptors. Details of proposed cover design are in the 100-NR-1/100-NR-2 CMS.

**In Situ Solidification**

This alternative includes the following elements:

- Remove underground obstructions
- Mix contaminated soils and solidifying agents
- Revegetate
- Groundwater monitoring
- Deed restrictions and/or access controls.

This alternative would consist of removing underground obstructions (such as piping) and mixing contaminated soils and solidifying agents using special drilling equipment with augers. Solidification would leave contamination in place in an immobile form. Wells would be installed for groundwater monitoring.

## PREFERRED ALTERNATIVES FOR 100-NR-1

The preferred remedial alternatives for the waste sites (waste groups) addressed in this Proposed Plan are as follows: Remove/Dispose for the radioactive, inorganic, burn pit, and surface solid waste groups; Remove/Ex Situ Bioremediation/Dispose for the near-surface petroleum sites; In Situ Bioremediation for the deep petroleum sites; and Institutional Controls for the shoreline site (Table 1). The preferred alternatives meet the remedial action objectives under the rural residential land use scenario.

The use of ARARs (e.g., MTCA B, maximum contaminant levels, ambient water quality criteria) as the remedial action goals was established during previous feasibility studies and is consistent with the interim remedial action RODs for the other 100 Areas. (Additional information can be found in the 100-NR-1 and 100-NR-2 CMS, Section 3.0.) For sites where soil contamination in excess of remedial action goals is present more than 4.6 m below surrounding grade, several factors will be considered to determine the extent of additional remediation. These factors include reduction of risk by decay of short-lived radionuclides, protection of human health and the environment, remediation costs, size

of ERDF, worker safety, presence of ecological and cultural resources, the use of institutional controls, and long-term monitoring costs. The extent of remediation must also ensure that contaminant levels in the soil are protective of groundwater and the Columbia River. The decision of whether to proceed with the Remove/Dispose Alternative below 4.6 m will be made by Ecology, the EPA, and the DOE in consideration of the factors listed above.

Ecological and cultural resource impacts from implementation of any of these alternatives will be addressed should they occur. Ecological and cultural resource reviews will consider such aspects as revegetation, habitat restoration, and timing of field activities to minimize disturbance to sensitive species prior to construction activities.

Post-remediation monitoring of the vadose zone and groundwater is also proposed to confirm the effectiveness of remediation efforts and accuracy of modeling predictions associated with the selected alternative.

The preferred alternatives meet the **remedial action objectives** under the rural-residential land use, provide long-term effectiveness and permanence, and overall protectiveness. They are implementable, use proven technologies and equipment to complete the action, and are cost effective.

## EVALUATION OF ALTERNATIVES FOR 100-NR-1

The preferred remedial alternatives are believed to provide the best balance of tradeoffs among the alternatives with respect to the nine CERCLA evaluation criteria used to evaluate remedies. These criteria are described on the previous page. The criteria are divided into three categories of weighted importance: threshold, balancing, and modifying criteria. The first two criteria (Overall Protection of Human Health and the Environment and Compliance with ARARs) are threshold criteria: only those remedial alternatives that provide adequate protection of human health and the environment and comply with ARARs (or justify a waiver) are eligible for consideration. The five balancing criteria help describe relative technical and cost differences among the remedial alternatives. The two modifying criteria (State and Community Acceptance) may prompt modification of the remedial alternatives based on state and community comments and concerns.

A comparative analysis of the remedial alternatives relative to the first seven evaluation criteria (the two modifying criteria will be considered after all public comments on this Proposed Plan have been received) is required by CERCLA, and is presented in the following paragraphs for the 100-NR-1 waste sites (excluding the shoreline site) remedial alternatives. A similar comparative analysis for the shoreline site remedial alternatives is presented separately.

### 100-NR-1 Waste Sites (Excluding the Shoreline Site)

Six remedial alternatives were considered for the 100-NR-1 waste sites (excluding the shoreline site) under the modified CRCIA ranger/industrial scenario:

- No Action
- Remove/Dispose
- Remove/Ex Situ Bioremediation/Dispose
- In Situ Bioremediation
- Containment
- In Situ Solidification.

Four remedial alternatives were considered for the 100-NR-1 waste sites (excluding the shoreline site) under the rural-residential scenario:

- No Action
- Remove/Dispose
- Remove/Ex Situ Bioremediation/Dispose
- In Situ Bioremediation.

The Containment and In Situ Solidification Alternatives would limit the future use of the waste site; therefore, they were not considered under the rural-residential scenario.

The following is a comparative analysis of these remedial alternatives against the CERCLA criteria.

**Overall Protection.** The No Action Alternative provides no control of exposure to the contaminants at the waste sites. The Remove/Dispose, Remove/Ex Situ Bioremediation/Dispose, and In Situ Bioremediation Alternatives would provide protection of human health and the environment by removing or treating contaminants to attain protective concentrations. The Containment and In Situ Solidification Alternatives would provide protection by eliminating or reducing exposure to the contaminants.

**Compliance with Applicable or Relevant and Appropriate Requirements.** The No Action Alternative would not meet the principal ARARs identified for all of the sites. The Remove/ Dispose, Remove/Ex Situ Bioremediation/Dispose, and In Situ Bioremediation Alternatives would meet the ARARs (e.g., cleanup standard required under MTCA such as direct soil exposure levels, *Clean Water Act*, primary and secondary drinking water standards, Ambient Water Quality Criteria, *Migratory Bird Treaty Act*, and *Endangered Species Act*). If wastes subject to land disposal

**EXPLANATION OF CERCLA EVALUATION CRITERIA**

1. *Overall Protection of Human Health and the Environment* is the primary objective of the remedial action and addresses whether or not a remedial action provides adequate overall protection of human health and the environment.

2. *Compliance with Applicable or Relevant and Appropriate Requirements* addresses whether or not a remedial action will meet all of the applicable or relevant and appropriate requirements and other federal and state environmental statutes, or provides grounds for invoking a waiver of the requirements.

3. *Long-Term Effectiveness and Permanence* refers to the magnitude of residual risk and the ability of a remedial action to maintain reliable protection of human health and the environment after remedial goals have been met.

4. *Reduction of Toxicity, Mobility, or Volume Through Treatment* refers to an evaluation of the anticipated performance of the treatment technologies that may be employed in a remedy.

5. *Short-Term Effectiveness* refers to evaluation of the speed with which the remedy achieves protection. It also refers to any potential adverse effects on human health and the environment during the construction and implementation phases of a remedial action.

6. *Implementability* refers to the technical and administrative feasibility of a remedial action, including the availability of materials and services needed to implement the selected solution.

7. *Cost* refers to an evaluation of the capital, operation and maintenance, and monitoring costs for each alternative.

8. *State Acceptance* indicates whether the state concurs with, opposes, or has no comment on the preferred interim alternative based on review of the corrective measures study and the proposed plan.

9. *Community Acceptance* assesses the general public response to the proposed plan, following a review of the public comments received during the public comment period and open community meetings.

restrictions under RCRA are encountered, they would be treated before disposal or a treatability variance could be requested. The Containment and In Situ Solidification Alternatives would comply with the ARARs.

**Long-Term Effectiveness and Permanence.** The No Action Alternative would not meet remedial action goals and, therefore, would not provide for long-term effectiveness. The Remove/Dispose, Remove/Ex Situ Bioremediation/Dispose, and In Situ Bioremediation Alternatives provide long-term effectiveness and permanence because no source of risk above cleanup levels would remain at the site. All removed soils would be treated, if needed and as appropriate, before being placed in ERDF. The Containment and In Situ Solidification Alternatives would provide a greater degree of long-term effectiveness by stabilizing and isolating the contaminants in place; however, the requirement for long-term maintenance would be significant. Therefore, these alternatives do not provide a great degree of permanence.

**Reduction of Toxicity, Mobility, or Volume Through Treatment.** The No Action and the Remove/Dispose Alternatives would not reduce the mobility, toxicity, or volume of the contaminants through treatment. The Remove/Ex Situ Bioremediation/Dispose and In Situ Bioremediation Alternatives provide the most significant level of treatment, and they would reduce volume and mobility. The Containment Alternative would not reduce the toxicity or volume of the contaminants through treatment. The In Situ Solidification Alternative includes treatment that would reduce the mobility of contaminants more effectively than containment, but it would not reduce the toxicity or volume.

**Short-Term Effectiveness.** The No Action Alternative would pose no additional risks to the community, the workers, or the environment, if implemented. All alternatives, except the No Action Alternative, would achieve remedial action objectives relatively quickly. The Remove/Dispose Alternative would pose a risk of release of contaminants and worker exposure during excavation, transport, and disposal of contaminated media that is not present with the other alternatives; remediation activities would need to be carefully planned to minimize the associated risk. The In Situ Bioremediation and Remove/Ex Situ Bioremediation/Dispose Alternatives would be used only for remediation of petroleum; therefore, they pose a relatively low risk of release or worker exposure. The Cover Alternative could be

implemented with minimal risks to community, workers, or the environment.

**Implementability.** The No Action Alternative would be easy to implement both technically and administratively. The Remove/Dispose and In Situ Bioremediation Alternatives would be easier to implement than the Remove/Ex Situ Bioremediation/Dispose Alternative. The Containment and In Situ Solidification Alternatives are implementable with existing technologies.

**Costs.** Appendix A provides an estimated cost to implement the preferred alternative for each waste site. The estimated cost to implement the preferred alternative is $48,745,386. For the petroleum sites, a comparison of estimated costs to implement the Remove/Dispose, Remove/Ex Situ Bioremediation, and In Situ Bioremediation Alternatives indicates that in situ bioremediation is 65 percent less expensive than remove/dispose, and that estimated costs for ex situ bioremediation are comparable to remove/dispose. Under the modified CRCIA ranger/industrial scenario, estimated costs to implement either the Containment or the In Situ Solidification Alternative are higher than the Remove/Dispose Alternative, 27 times and 2 times higher, respectively. A detailed comparison of estimated costs for implementing the 100-NR-1 remedial alternatives is presented in the 100-NR-1/100-NR-2 CMS (Section 7.2).

**The Shoreline Site**

Four remedial alternatives were considered for the shoreline site under the modified CRCIA ranger/industrial scenario:

- No Action
- Institutional Controls
- Remove/Dispose
- Cover (containment). (Note: The cover ( containment) design of the shoreline site is different than at the other sites.)

Two remedial alternatives were considered for the shoreline site under the rural-residential scenario:

- No Action
- Remove/Dispose.

The Institutional Controls and Cover Alternatives would limit the future use of the waste site; therefore, they were not considered under the rural-residential scenario.

The following is a comparative analysis of these remedial alternatives against the CERCLA criteria.

**Overall Protection.** The draft Columbia River Comprehensive Impact Assessment Screening Assessment indicates that contaminant levels in the 100-N Area may pose a potential risk to human and ecological receptors under some scenarios, and that further investigations may be warranted. The No Action Alternative provides no control of exposure to the contaminants at the shoreline site, and thus provides no protection from potential risks. The Institutional Controls Alternative would provide protection of human health by preventing exposure to contaminants for an interim period, during which time potential ecological impacts and human health risks could be further evaluated. However, it would not fully protect the entire shoreline site, as some portions of the site would not have the full cover thickness (i.e., the cover would be less than 4.6 or 3.0 m). The Remove/Dispose Alternative would be protective of human health and the environment upon completion of the action. However, the Remove/Dispose Alternative would only provide protection for an interim period as the clean fill would be subject to recontamination. Recontamination could occur as groundwater moves through the area and/or from fluctuating river levels. Although both the Cover and Remove/Dispose Alternatives would provide some protection to human health and the environment from risk due to contamination, they would cause severe environmental impacts at the shoreline site during implementation.

**Compliance with Applicable or Relevant and Appropriate Requirements.** The No Action Alternative does not meet the ARARs identified for the site. The Cover and the Remove/Dispose Alternatives would meet the ARARs (e.g., cleanup standards required under MTCA, such as direct soil exposure levels, *Clean Water Act*, primary and secondary drinking water standards, Ambient Water Quality Criteria, *Migratory Bird Treaty Act, and Endangered Species Act* ) identified for the site. The Institutional Controls Alternative, which Ecology, EPA, and DOE view as an interim action pending selection of a final remedy for the 100-NR-2 Operable Unit, would not attain cleanup standards during the interim action time frame. The Cover Alternative would comply with the ARARs. The Remove/Dispose Alternative would meet the ARARs. If wastes subject to land disposal restrictions under RCRA are encountered, they would be treated before disposal, or a treatability variance or waiver could be requested.

**Long-Term Effectiveness and Permanence.** At the shoreline site, the ability of a remedial action to provide long-term effectiveness and permanence is dependent upon final remedial action for the contaminated groundwater in the 100-NR-2 Operable Unit. The No Action Alternative would not meet remedial action goals and, therefore, would not provide for long-term

effectiveness. The Institutional Controls Alternative, if selected as a final remedy, would require long-term maintenance to remain protective of human health, and would not be effective in protecting ecological receptors from potential risks. The Cover Alternative would provide a greater degree of long-term effectiveness by stabilizing and isolating the contaminants in place; however, the requirement for long-term maintenance would be significant. The Remove/Dispose Alternative would provide the greatest long-term effectiveness and permanence. However, depending upon the final remedial action for groundwater and the timing of remedial action at the shoreline site, the remove/dispose action may have to be repeated on a periodic basis due to recontamination of the soil by contaminated groundwater.

**Reduction of Toxicity, Mobility, or Volume Through Treatment.** None of the alternatives evaluated would reduce the mobility, toxicity, or volume of the contaminants through treatment.

**Short-Term Effectiveness.** The No Action and Institutional Controls Alternatives would pose no additional risks to the community, the workers, or the environment, if implemented. The Cover Alternative could be implemented relatively quickly with minimal risks to the community or workers, but would affect the environment and ecological receptors at the shoreline site during implementation. The Remove/Dispose Alternative would achieve protection relatively quickly. During implementation of this alternative, contaminated soil would be uncovered, representing the potential for a release of contaminants and worker exposure. Remediation activities would be carefully planned to minimize the associated risk. The environment and ecological receptors at the shoreline site would be affected during implementation of the Remove/Dispose Alternative. Both the Cover and Remove/Dispose Alternatives would impact the shoreline environment during implementation.

**Implementability.** The No Action Alternative would be easy to implement both technically and administratively. Because institutional controls are already in place at the shoreline site, this alternative is easily implemented. The Cover Alternative is implementable with existing technologies, but not without significant impacts to the shoreline environment. The Remove/Dispose Alternative is implementable with existing technologies. However, the Cover and Remove/Dispose Alternatives would be difficult to implement because of technical and administrative problems posed by the proximity of the Columbia River.

**Costs.** The cost estimates for the Shoreline Alternatives are presented in Table 3.

**Table 3. Comparative Cost Summary of the Shoreline Site Remedial Alternatives.**

| Scenario | Alternative | Cost ($) |
|---|---|---|
| Rural Residential | No Action | $0 |
| | Remove/Dispose | $10,895,911 |
| Modified CRCIA Ranger/ Industrial | No Action | $0 |
| | Institutional Controls | $63,358 |
| | Remove/Dispose | $9,802,293 |
| | Cover | $6,456,230 |

Note: These are initial costs; however, costs comparable to the initial costs may be incurred for repeating the remove/dispose action on a periodic basis should recontamination occur from the rise and fall of the river elevation.

## NATIONAL ENVIRONMENTAL POLICY ACT EVALUATION

The NEPA regulations require an evaluation of the environmental consequences of remedial alternatives under consideration. Criteria used to compare alternatives include potential effects on ecological, cultural, and historical resources; socioeconomic aspects; and identification of irreversible and irretrievable commitment of resources. The following summary compares how the remedial alternatives for the 100-NR-1 Operable Unit impact NEPA values.

The No Action and Institutional Controls Alternatives would require irreversible and irretrievable commitment of natural resources by restricting availability of surface use of the sites. Cumulative impacts would also occur at the borrow pit associated with the Containment (Cover) Alternative.

The Remove/Dispose and Remove/Ex Situ Bioremediation/Dispose Alternatives would result in an irreversible and irretrievable commitment of natural resources at the disposal unit (i.e., the ERDF) and borrow sites used to obtain materials for fill of the excavated sites and cover at the ERDF. Contaminated soils would be removed from a site and transported to the ERDF; therefore, there would be a commitment to use portions of that disposal unit for long-term waste management. Excavated material would be replaced with clean fill and topsoil, and then revegetated. Excavation could disturb cultural resources located at a site, and careful adherence to cultural resource mitigation planning would be

required. Excavation may also impact ecological resources. Cumulative impacts may occur at borrow sites and transportation routes.

The In Situ Bioremediation Alternative would not irreversibly or irretrievably commit significant amounts of natural resources. The use of ERDF resources would not be required. Potential impacts to future land use would be comparable to the removal alternatives. The Containment (Cover) and In Situ Solidification Alternatives would require an irreversible and irretrievable commitment of natural resources. The use of the ERDF would not be required. Cultural resources may be impacted. Ecological resources may also be impacted in the short term. Cumulative impacts would occur at the site themselves, depending on future land use.

## 100-NR-2 OPERABLE UNIT PROPOSED PLAN ELEMENTS

### 100-NR-2 OPERABLE UNIT BACKGROUND

#### Site Description

The 100-NR-2 Operable Unit encompasses the contaminated groundwater underlying the 100-N Area. During the years of reactor operations until shortly after reactor shutdown, large volumes of reactor coolant wastewater containing activation and fission products, as well as small quantities of corrosive liquids and laboratory chemicals generated by various N Reactor operations, were discharged to the soil through cribs and trenches. These wastewaters, as well as other smaller contributions disposed or spilled from facilities within the 100-N Area, infiltrated through the **vadose zone** soil, and contaminated the groundwater. Because the large quantities of liquid effluents discharged to the soil during the operation of the N Reactor have been eliminated, the major driving force for migration of contaminants to the groundwater, and ultimately to the Columbia River, has been eliminated. Strontium-90 (Sr-90) is the contaminant of greatest concern in the groundwater because, without remediation, it renders the groundwater unusable for nearly 300 years and presents a potential human and environmental threat as it mixes with the Columbia River at the N-Springs area.

The groundwater and river protection standard for Sr-90 is 8 Ci/L based on the drinking water standard. Maximum Sr-90 concentrations in the groundwater over 5,000 pCi/L have been reported between 1993 and 1995 in wells near the river. Concentrations of Sr-90 in the groundwater at the point of discharge into the river have not been determined, however, given the known properties of Sr-90, it is expected that these concentrations would be similar to those found in the near-river wells. Intermittent high water in the Columbia River has caused and will continue to cause periods of higher Sr-90 concentrations in the groundwater and river interface. Concentrations of Sr-90 taken from Columbia River water transects have never been found to exceed drinking water standards.

Besides Sr-90 contamination, the groundwater currently contains tritium, nitrate, sulfate, iron, chromium, manganese, and total petroleum hydrocarbons (TPH) above groundwater and/or river protection standards (e.g., drinking water standards and ambient water quality standards). Groundwater is migrating toward and discharging into the Columbia River because of the natural water table gradient. Groundwater discharges through the riverbed and riverbank seeps known as N-Springs. Figure 2 illustrates a conceptual model for the Sr-90 contamination in the 100-NR-2 Operable Unit and the recommended interim action.

The Columbia River adjacent to the 100-NR-2 Operable Unit is currently being used for activities such as hunting, fishing, and boating. The Hanford Reach of the Columbia River is under consideration for designation as a recreational river under the *Wild and Scenic Rivers Act*. The wild and scenic river designation would define many aspects of future uses of the Hanford Reach and the land immediately adjacent to it. Other aspects of future use, such as Tribal uses, would be required to be consistent with this designation.

#### Strontium-90 Characteristics at 100-NR-2

Characteristics of Sr-90 in 100-N Area soils result in significant problems with the remediation of groundwater at the 100-NR-2 Operable Unit. With its 29-year **half-life**, current concentrations in groundwater, concentrations **adsorbed** onto the saturated soil, and rate of migration, it would take 300 years for the Sr-90 to meet drinking water standards (8 pCi/L) through **natural attenuation,** mostly as the result of **radioactive decay**. Strontium-90 is adsorbed to soil in the saturated zone and exists in equilibrium with the Sr-90 in the groundwater at a ratio of approximately 100 parts in soil to 1 part in groundwater. These adsorption and equilibrium properties are the reasons for the difficulties in Sr-90 remediation of the 100-NR-2 Operable Unit. These difficulties are summarized below.

**Groundwater Remediation.** As Sr-90-contaminated groundwater is removed by a groundwater remedial technology, such as pump and treat, the clean water that replaces it becomes recontaminated by contact with the contaminated soil and the 100 to 1 equilibrium ratio is reestablished. Because of the substantial quantity of Sr-90

cations adsorbed to soil, this results in virtually no short-term decrease in Sr-90 concentrations in the groundwater. No remedial alternatives were identified in the 100-NR-1/100-NR-2 CMS that are known to be safely implementable and able to substantially shorten the 300-year remediation time associated with natural attenuation by radioactive decay. The Expedited Response Action pump and treat system at N-Springs is currently removing approximately 0.1 Curie (Ci)/yr. There are approximately 85 Ci of Sr-90 in the saturated soils within the 100-N Area. The time frame necessary to meet drinking water standards (8 pCi/L) with this removal rate is not significantly different from that of natural attenuation by radioactive decay (270 years with pump and treat versus 300 years for natural attenuation by radioactive decay). Innovative applications of technologies, such as **soil flushing**, that may be able to disrupt the soil-groundwater equilibrium and remove significant quantities of Sr-90 are considered experimental. More information would be needed to define the implementability of this or other innovative technologies that could shorten the time necessary to achieve groundwater remedial goals.

**River Protection.** The movement of Sr-90-contaminated groundwater from the waste sites to the Columbia River has extended the contaminated soil zone to the river's edge (identified as the shoreline site in the 100-NR-1 Operable Unit). Remediation for the purpose of river protection is complicated by the shoreline site. Technologies to prevent the flow of Sr-90 to the Columbia River include various forms of barriers, including **hydraulic barriers** and physical barriers. These technologies must be physically located slightly inland of the Columbia River to operate properly. The shoreline site, located between the river and a barrier, contains approximately 2 to 5 Ci of Sr-90 that may remain unaffected by implementing these technologies. However, the effect of hydraulic or physical barriers on the shoreline site is not known at this time. Because of the loading of Sr-90 and because of the 100 to 1 equilibrium phenomenon of Sr-90 in 100-N Area soils, contaminated sediments would continue to release Sr-90 into the groundwater near the river at concentrations above drinking water standards. This is due to the flushing action as the river level rises and falls. The amount of time that it would take to remediate the shoreline site and thereby reduce the concentrations migrating to the river may or may not be shorter than would occur solely through natural decay and attenuation. Not enough information is known about the relationship between the barrier technologies and the flushing capability of the river with barrier placement to determine this time frame.

**Receptor Pathway Descriptions**

Existing restrictions in the 100-NR-2 Operable Unit prevent human receptors from using the groundwater for drinking water or irrigating crops. River water is not contaminated above drinking water standards because of the large volumes of water in the river. Contaminated groundwater emanating at N-Springs provides a potential exposure pathway to humans. However, access control by DOE currently prevents such exposure.

Groundwater entering the river could reach an aquatic and riparian ecological receptor through direct uptake of Sr-90 in contaminated food and water. Ecological receptors may contact contaminants in groundwater seeps that may be present when the Columbia River is at low stage and in sediment **pore water** at the groundwater/river bottom interface. While the Sr-90 concentration in pore water and its potential impact to ecological receptor is not entirely known, no significant adverse impacts have been identified at this time. More information must be obtained to determine whether Sr-90 concentrations are causing short- or long-term impacts to these receptors.

## SCOPE AND ROLE OF PROPOSED ACTION AT 100-NR-2

The capability of a technology to achieve groundwater and river protection, and the identification of aquatic or riparian resources that may be impacted by Sr-90 concentrations, cannot be determined at this time. Ecology, the EPA, and the DOE consider this information a prerequisite to determination of a final remedy. Therefore, at this time, Ecology, the EPA, and the DOE are recommending an interim action for the 100-NR-2 Operable Unit. The goals of this interim action are:

- Prevent exposure to contaminated groundwater
- Provide protection of the river by limiting the Sr-90 movement to the river
- Obtain information to allow selection of a final remedial action
- Be consistent with the likely final remedies.

The interim action will allow time to investigate the ability of various technologies to achieve groundwater remediation and river protection in a shorter time frame and to determine whether impacts to aquatic and riparian receptors may be occurring from exposure to Sr-90.

The interim remedial action for the 100-NR-2 Operable Unit will also allow time to determine final actions necessary to remediate the shoreline site within the 100-NR-1 Operable Unit, as its remediation is dependent upon the choice of a final remedial action for groundwater.

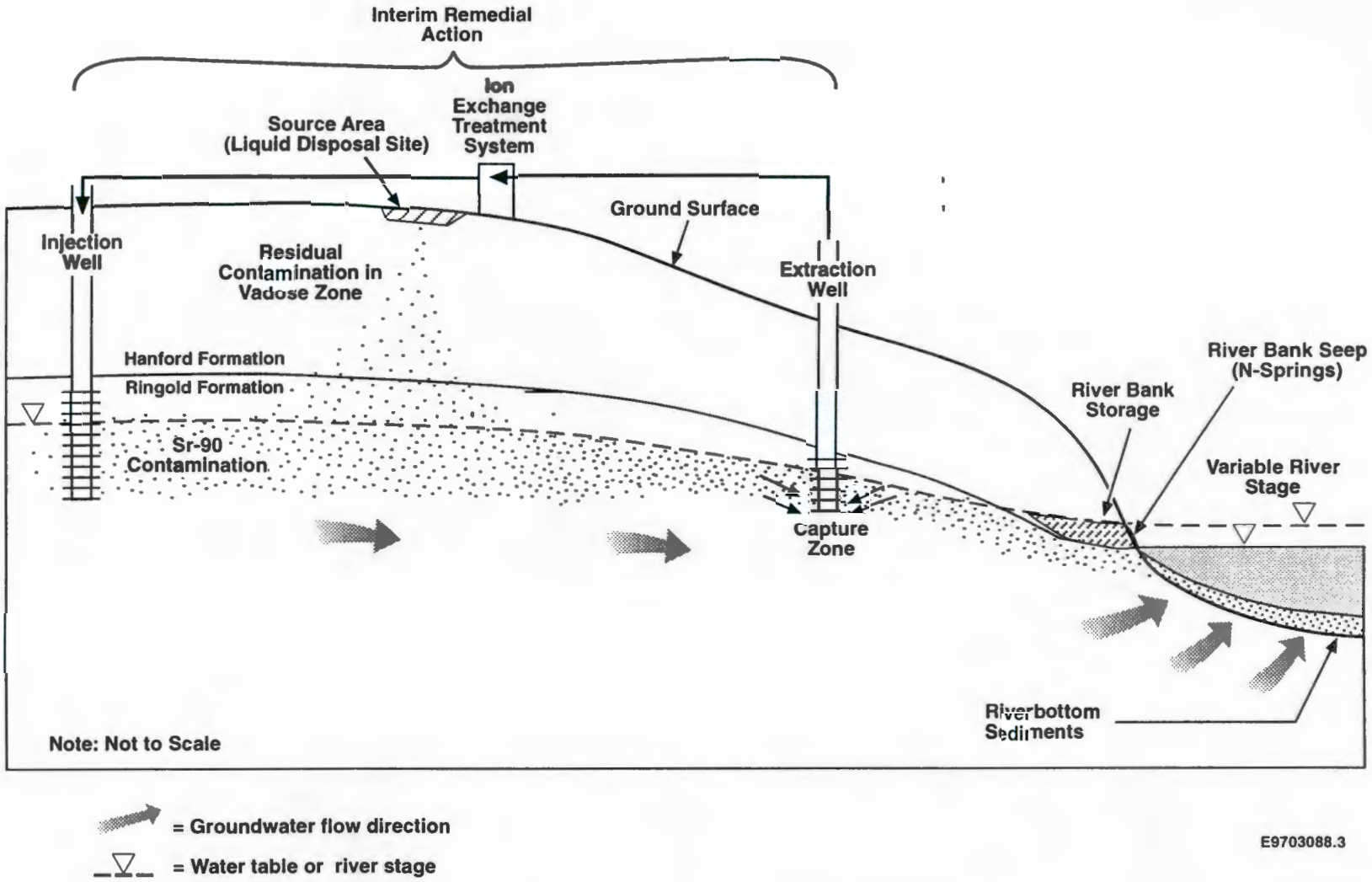


**Figure 2. Conceptual Model and Interim Remedial Action for the 100-N Area Strontium-90 Contamination in Groundwater.**

## SUMMARY OF SITE RISK AT 100-NR-2

Potential risks to human and ecological receptors were evaluated in the *Qualitative Risk Assessment for the 100-NR-2 Operable Unit* (BHI-00055). This document determined that some contaminant concentrations in groundwater exceed health-based risk levels established for drinking water. As a result, an evaluation of human health and ecological risks and selection of potential remedial alternatives was performed in the 100-NR-1/100-NR-2 CMS. The human health and ecological risks are summarized in the following sections.

### Human Health Risk

The 100-NR-1/100-NR-2 CMS concluded that contaminants in the groundwater that exceed drinking water standards are Sr-90, tritium, chromium (VI), manganese, nitrate, sulfate, and TPH. Existing restrictions prevent direct use of the groundwater as a drinking water supply. Therefore, no immediate threat to human health exists from groundwater use at the 100-NR-2 Operable Unit. Remedial actions necessary to obtain future unrestricted use of the groundwater as a drinking water supply will be evaluated as part of the final remedy for the 100-NR-2 Operable Unit.

Contaminants that exceed drinking water standards at the groundwater/river interface are Sr-90 and tritium. No immediate risk to human health from these contaminants entering the river was identified in the 100-NR-1/100-NR-2 CMS due to river water concentrations being below drinking water standards and the lack of a human receptor at the groundwater seeps. DOE exercises control over this area of discharge immediately adjacent to the river (i.e., N-Springs).

### Ecological Risk

The 100-NR-1/100-NR-2 CMS concluded that no groundwater contaminants of concern are above ecological remedial action goals based on EPA's Ambient Water Quality Criteria (AWQC) for protection of freshwater aquatic life. However, AWQC standards have not been established for Sr-90. Strontium-90 concentrations in groundwater and seeps are known to be elevated. Because of this, it is possible that concentrations of Sr-90 are also high in the pore water where aquatic receptors could be exposed. Further evaluation of potential impacts to aquatic and riparian resources is considered a vital part of the proposed interim action.

## SUMMARY OF ALTERNATIVES FOR 100-NR-2

The 100-NR-1/100-NR-2 CMS described and analyzed six alternatives for the purposes of final remediation for river protection and Sr-90 in the groundwater. These alternatives are as follows:

- No Action for Groundwater Remediation and River Protection
- Institutional Controls for Groundwater Remediation and River Protection
- Institutional Controls for Groundwater Remediation and Permeable Barrier for River Protection
- Pump and Treat for Groundwater Remediation and Hydraulic Controls for River Protection
- Pump and Treat for Groundwater Remediation and **Cryogenic Barrier** for River Protection, and
- Soil Flush/Pump and Treat for Groundwater Remediation and Sheet Pile Barrier for River Protection.

Not all of these final action alternatives are considered appropriate for a 100-NR-2 Operable Unit interim action. Criteria that preclude consideration of an alternative for an interim action are high implementation costs, questionable implementability, and consistency with possible final remedies.

The Permeable Barrier, Cryogenic Barrier, and Sheet Pile Barrier Alternatives all require very high initial capital costs for implementation. These costs are $8,182,000, $15,525,000, and $8,417,000, respectively. The Soil Flush Alternative relies on impermeable physical barrier, and therefore its initial capital cost is very high as well.

The 100-NR-1/100-NR-2 CMS pointed out a number of unresolved technical issues with regard to some of the alternatives. All barrier alternatives are considered implementable; however, their application at Hanford is new and therefore not entirely reliable. The implementability of a Soil Flush Alternative is very questionable. Completion of a series of laboratory, bench-scale, and field tests would be required to determine whether safe implementation is possible.

An interim action may be inconsistent with a final remedy if it precludes implementation of a final action or requires costly installation or removal in order to implement a final action. Physical barriers (e.g., permeable, cryogenic, and sheet pile barriers) could be inconsistent as an interim action because they could potentially preclude the implementation of final remedies that do not incorporate the chosen barrier in the final action, or could require significant removal costs to allow implementation of a differing final remedy.

For the reasons cited above, physical barriers and soil flush technologies were excluded as potential interim action alternatives.

Four alternatives were analyzed for purposes of an interim action. These alternatives are as follows:

- No Action
- Institutional Controls
- Hydraulic Controls
- Pump and Treat.

The Sr-90 pump and treat system is currently operational under the Expedited Response Action/Action Memorandum for Sr-90 at N-Springs. This system consists of four ion-exchange columns configured to provide sequential flow and removal of Sr-90 through the system. This system operates at a rate of 228 L/minute with an average removal of 90 percent for the volume of water treated over a given period of time. The current pump and treat system is removing 0.1 Ci/year of Sr-90. Additional information on this system is available in the following documents: *N-Springs Expedited Response Action Performance Evaluation Report* (DOE/RL-95-110) and *N-Springs Pump and Treat System Optimization Study* (DOE/RL-97-34).

**No Action for Groundwater Remediation and River Protection**

**Groundwater Remediation and River Protection.** Evaluation of this alternative is required by CERCLA to provide a baseline to compare with the other alternatives. Therefore, this alternative is retained for evaluation. Under a typical No Action Alternative, groundwater monitoring would not be required, use restrictions would not be implemented, and contamination in the groundwater would dissipate through natural attenuation.

**Institutional Controls for Groundwater Remediation and River Protection**

**Groundwater Remediation and River Protection.** This alternative involves continuation of existing groundwater monitoring and institutional control during the interim action. Institutional controls would include access controls, water-use and land-use restrictions, and signs. Groundwater monitoring would be used to continually evaluate the effectiveness of the action, and to support decisions to continue the action or implement other actions (including the No Action Alternative). Institutional controls are already in place at the 100-N Area. This alternative requires very little capital cost or operation and maintenance cost to implement. Short-term implementation of this alternative would be consistent with possible final actions and would require no change in existing access controls.

**Pump and Treat for Groundwater Remediation and Hydraulic Controls for River Protection**

**Groundwater Remediation.** In this alternative, contaminated groundwater would be extracted and the Sr-90 would be treated on the surface using a clinoptilolite-loaded ion exchange technology. The Sr-90-contaminated clinoptilolite would be disposed to ERDF, and treated effluent would be returned to the groundwater using injection wells located within an upgradient area of the existing Sr-90 plume. As stated previously, an existing Sr-90 pump and treat system is currently operational under the Expedited Response Action/Action Memorandum for Sr-90 at N-Springs. All of these alternatives would utilize the existing systems; therefore, the interim action alternatives would be consistent with possible final actions.

**River Protection.** These alternatives would use existing extraction wells to control movement of contaminated groundwater to the river. The hydraulic controls provided by the existing pump and treat system can stop at least 90 percent of the mass of Sr-90 at the point of hydraulic control from reaching the Columbia River. However, even if a 100 percent reduction was achieved, enough Sr-90 contamination exists in the sediments within the shoreline site to cause the release of Sr-90 to the river to be above drinking water standards at the groundwater-river interface for some indeterminate period of time. The effect of hydraulic controls on these concentrations of Sr-90 in the shoreline sediments is not well understood; therefore, it is unclear whether these alternatives could remediate the shoreline site any faster than natural attenuation by radioactive decay. Whether these alternatives are able to significantly reduce concentrations (and thus remediation time) in the shoreline site sediments is currently unknown and would require further investigation. Implementation of a hydraulic control system for an interim action would entail no capital cost because such control can be attained by use of the existing pump and treat system. Short-term implementation would also be consistent with possible final actions.

## PREFERRED INTERIM ACTIONS FOR 100-NR-2

The alternatives considered to date for final remediation of the 100-NR-2 Operable Unit appear very costly and have remediation time frames of approximately 300 years. However, information gaps exist that make the reliability of the current cost and time estimates uncertain. As a consequence, selection of a final remedial action is not appropriate at this time. Instead, Ecology, the DOE, and

the EPA propose an interim remedial action while information is gathered to support a more thorough evaluation of final remediation alternatives.

**Preferred Interim Alternative**

The preferred interim alternative for the 100-NR-2 Operable Unit is to control Sr-90 discharges to the Columbia River for a 5-year period during which time further evaluation of final alternative technologies and receptor impacts will occur. In order to meet the objective of controlling the Sr-90 discharges to the Columbia River for the interim actions, the DOE believes that the existing pump and treat system could be operated in a "hydraulic control" only mode (without treatment). Ecology believes that the existing pump and treat system is providing an environmental benefit by reducing the concentration in the treated discharge. The total mass removal being achieved by the system is small as compared to the total inventory of Sr-90 present in the groundwater; however, injecting water containing significantly less Sr-90 than the amount contained in the extracted water minimizes the spread of Sr-90 contamination in the existing plume at the injection point. Furthermore, the discharge point and the extraction wells have been placed in such a way that the system recaptures the injected water, thus creating a "closed loop" system. Therefore, Ecology, the EPA, and the DOE propose to provide control of Sr-90 through operation of the existing pump and treat system under optimized cost conditions during the 5-year evaluation period.

Additional actions may be proposed during the 5-year period if information gathered indicates that such measures may be necessary to protect human health or the environment or if the pump and treat system is shown to have no beneficial effect on discharges to the river. Continued operation of the pump and treat system after the 5-year period may be proposed if evaluations indicate that such action is a cost-effective and protective measure.

Because of the dependence upon final remedial action for groundwater, recommendation of a preferred alternative for the shoreline site will follow selection of a final action for the 100-NR-2 Operable Unit.

Petroleum hydrocarbons have been observed as floating product in two 100-N Area wells. These two wells, 199-N-17 and 199-N-18, and other 100-N Area wells where product may be observed during future monitoring activities are proposed to be remediated. Remediation would use a discriminating intake system. The system would be installed directly in the well and be designed to remove floating product. The recovered product would be purged into an onsite tank for separation of the product from water. Waste would then be recovered, contained, and handled accordingly.

**Alternative Technology Evaluation**

During this interim action, Ecology, the EPA, and the DOE will determine the scope of an evaluation of groundwater remediation and river protection technologies for Sr-90 contamination. The three parties will determine which technologies warrant further investigation. Investigations will include literature review studies and, if appropriate, bench-scale and field testing. Ecology, the EPA, and the DOE conclude that pump and treat, as a sole remedy, is not an effective alternative for groundwater remediation. Therefore, no additional study is anticipated for this alternative. Pump and treat may be considered as an integral part of other alternatives; however, groundwater remediation technologies to be evaluated will focus on innovative technologies to remove Sr-90 from contaminated sediments at the groundwater interface. River protection technologies to be evaluated may include hydraulic control or physical barrier systems to assess their impact on Sr-90 concentrations at the shoreline site.

**Evaluation of Sr-90 Impacts to Aquatic and Riparian Receptors**

The exact nature of the aquatic and riparian resource evaluation has yet to be determined. The three parties will work together with stakeholders and Tribal members to develop criteria for this evaluation, and coordinate with ongoing efforts such as the CRCIA project. However, it is anticipated that an evaluation would include a literature search and an evaluation of existing data. Laboratory testing and studies of ecological receptors (such as through bioassays or injury assessments) and their habitat (such as pore water sampling) may be performed, as appropriate.

**Interim Remedial Action Monitoring**

During the interim period of this action, the DOE will continue to monitor the network of wells within the 100-N Area groundwater system of interest (the uppermost, unconfined shallow system that has been contaminated by the source waste sites) for all contaminants of concern identified in the 100-NR-1/100-NR-2 CMS. The continued monitoring will (1) assess the performance of the chosen interim action; (2) assess the performance of technologies including, if appropriate, field testing; (3) further define the extent and nature of the Sr-90 groundwater plume; and (4) further define the extent and nature of contaminant plumes for the other contaminants of concern - tritium, chromium (VI), manganese, nitrate, sulfate, and TPH. This last monitoring objective will be

used to determine a final groundwater remedial action, or the need for other interim actions, for these contaminants of concern. Details of the monitoring program will be defined as part of the Operations and Maintenance Plan and will be submitted to Ecology for approval. The monitoring plan shall include monitoring methods, schedules, documentation and tracking, and methods of analysis.

## EVALUATION OF ALTERNATIVES FOR 100-NR-2

The preferred interim remedial action is believed to provide the best balance of tradeoffs between the alternatives with respect to the CERCLA evaluation criteria. Categories and descriptions of these criteria were presented earlier in the 100-NR-1 evaluation of alternatives.

### Overall Protection

All of the interim alternatives except for the No Action Alternative would provide protection of human health by preventing exposure to contaminants. The Hydraulic Controls and Pump and Treat Alternatives would control the flux of Sr-90 discharges to the river while potential adverse impacts are evaluated.

### Compliance with Applicable or Relevant and Appropriate Requirements

An interim action is an action designed to accomplish certain objectives in a short period of time. These interim actions, by their nature, are not intended to specifically meet ARARs that would be applicable to a final remedial action. Groundwater and river protection ARARs (e.g., drinking water or ambient water quality standards) will, therefore, not be ARARs for the interim action.

Waste management ARARs will be complied with for all alternatives generating waste. Air and radiation protection standards will also be complied with for all alternatives other than the No Action Alternative.

For the interim Hydraulic Controls and Pump and Treat Alternatives, reinjection of groundwater will occur within a portion of the groundwater plume that is already contaminated with Sr-90. The reinjected groundwater may not meet drinking water standards for Sr-90, tritium, and nitrate. This interim remedial action is only part of a total remedial action that will address all ARARs when completed.

### Long-Term Effectiveness and Permanence

This criterion is not applicable to an interim action.

### Reduction of Toxicity, Mobility, or Volume through Treatment

Only the Pump and Treat Alternative would reduce the toxicity of the extracted groundwater by removing Sr-90 through ion exchange. However, the concentration of Sr-90 remaining in the contaminated groundwater plume would not be measurably reduced by use of the treatment system. None of the other interim action alternatives use a treatment element.

### Short-Term Effectiveness

The No Action and Institutional Controls Alternatives would present no increased risk to workers, the community, or the environment. Neither of these alternatives would achieve the interim action objective of controlling the flux of Sr-90 discharges to the river.

Implementation of the Pump and Treat and Hydraulic Controls Alternatives would be accomplished by use of the existing pump and treat system, and therefore would immediately obtain the objective of controlling flux of Sr-90 discharges to the river. Due to use of the existing system, there would be no construction associated with these alternatives. Short-term impacts associated with worker risk from operation of either of these alternatives are small. Because the Pump and Treat Alternative contains a treatment element to maintain (the ion exchange system), it would have a slightly higher potential for short-term worker risk than Hydraulic Controls.

### Implementability

All of the interim alternatives are technically and administratively feasible, and implementability is not expected to be significantly different for any of the four alternatives. The No Action Alternative would be the easiest alternative to implement. Institutional Controls are already in place as part of the DOE operation of the Hanford Site, and continued maintenance of these controls would be anticipated during the 5-year interim action period in any event. The Hydraulic Controls and Pump and Treat Alternatives would require routine maintenance and operation, and therefore may be slightly more difficult to implement than the No Action and Institutional Controls Alternatives.

### Cost

No anticipated costs are associated with the No Action Alternative. No additional costs are associated with the Institutional Controls Alternative because existing controls will be maintained during the interim. The annual operating costs for Hydraulic Controls and Pump

and Treat are $261,900 and $329,100, respectively. No capital costs are associated with any of the four alternatives. A comparative cost analysis (Table 4) for a 5-year period shows that Hydraulic Controls, at a Present Worth cost of $1,153,109, is the third lowest cost alternative, after No Action and Institutional Controls. The Pump and Treat Alternative is the most expensive alternative, at a Present Worth cost of $1,448,981.

**State Acceptance**

Ecology supports the preferred interim alternative.

## NATIONAL ENVIRONMENTAL POLICY ACT EVALUATION

The NEPA regulations require an evaluation of the potential environmental consequences of remedial alternatives under consideration. Criteria used to compare alternatives include potential effects on cultural and historical resources, socioeconomic aspects, and identification of any irreversible and irretrievable commitments of resources, including ecological resources. The following summary compares how the remedial alternatives for the 100-NR-2 Operable Unit affect NEPA values.

No additional irreversible and irretrievable commitment of resources will occur with any of the interim action alternatives. Impacts to aquatic and riparian resources are not anticipated to be significantly different for any of the four interim actions during the 5-year period. Decreases in shoreline sediment concentrations are not expected to occur from implementation of any of the interim alternatives in this time frame. Other than the No Action Alternative, restrictions on the use of groundwater as a drinking water source will remain during the interim action for any alternative due to continued DOE control over the Hanford Site. Ecological and cultural resource impacts from implementation of any of these alternatives are not expected to occur. Ecological and cultural resource reviews will be conducted prior to initiating any construction activities to determine if any mitigation is required.

**Table 4. Comparative Cost Summary of the Interim Groundwater Remedial Alternatives.**

| Alternative | Capital Cost ($) | One-Year Operating Cost ($) | Total Present Worth Cost ($) |
|---|---|---|---|
| No Action | 0 | 0 | 0 |
| Institutional Controls[1] | 0 | 0 | 0 |
| Hydraulic Controls[2] | 0 | $261,900 | $1,153,109 |
| Pump and Treat[2] | 0 | $329,100 | $1,448,981 |

[1] No additional costs, over and above the costs of existing controls, are expected.
[2] Present worth costs are for 5 years. Calculation of Net Present Worth of a cash flow annually escalated at 3.2% and annually discounted at 10.2% (7% plus 3.2%) per year for 300 years. The 3.2% annual escalation is published by DOE (ERC rates 12/20/96) and is assumed constant for 300 years. The 7% Discount Rate was obtained from the EPA Hotline (800)424-9346. The first year is not escalated or discounted.

## SUPPORTING DOCUMENTS

The public is encouraged to read the following documents to gain a better understanding of the 100-NR-1 and 100-NR-2 Operable Units:

*Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units* (DOE/RL-95-111)

*Engineering Evaluation/Cost Analysis for the 100-N Area Ancillary Facilities and Integration Plan* (DOE/RL-97-22)

*Proposed Plan for Final Remedial Action of the Treatment, Storage, and Disposal Units and Associated Sites in the 100-NR-1 Operable Unit* (DOE/RL-97-30)

*Limited Field Investigation Report for the 100-NR-1 Operable Unit* (DOE/RL-93-80)

*Qualitative Risk Assessment for the 100-NR-1 Source Operable Unit* (BHI-00054)

*Qualitative Risk Assessment for the 100-NR-2 Operable Unit* (BHI-00055)

*100 Area Source Operable Unit Focused Feasibility Study* (DOE/RL-94-61)

*100 Areas Feasibility Study, Phases 1 and 2* (DOE/RL-92-11)

*Remedial Investigation/Feasibility Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE/RL-90-22)

*Remedial Investigation/Feasibility Study Work Plan for the 100-NR-2 Operable Unit, Hanford Site, Richland, Washington* (DOE/RL-91-46)

*100-N Area Technical Baseline Report* (WHC-SD-EN-TI-251)

*N-Springs Expedited Response Action Performance Evaluation Report* (DOE/RL-95-110)

*N-Springs Pump and Treat System Optimization Study* (DOE/RL-97-34).

## ADMINISTRATIVE RECORD

The Administrative Record can be reviewed at the following locations:

Lockheed Martin Services, Inc.
Administrative Record
2440 Stevens Center Place, Room 1101
Richland, Washington 99352
509/376-2530
ATTN: Debbi Isom

U.S. Environmental Protection Agency
1200 Sixth Avenue, HW-070
Seattle, Washington 98101
206/553-4494
206/553-4973

Washington State Department of Ecology
Nuclear Waste Program Library
300 Desmond Drive
Lacey, Washington 98503
206/407-7097
ATTN: Marilyn Smith

## POINTS OF CONTACT

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David Olson
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509/376-7142

U.S. Environmental Protection Agency Representative
EPA (Region 10)
Larry Gadbois
Project Manager
509/376-9884

Washington State Department of Ecology Representative
Phil Staats
Project Manager
509/736-3029

## INFORMATION REPOSITORIES

This proposed plan is available for viewing at the following repositories:

University of Washington, Suzzallo Library
Government Publications Room
Box 3529000
Seattle, Washington 98195
206/543-4664
ATTN: Eleanor Chase

Gonzaga University, Foley Center
Tri-Party Information Repository
E. 502 Boone
Spokane, Washington 99258
509/324-5932
ATTN: Tim Fuhrman

Portland State University, Branford Price Millar Library
Science and Engineering Floor
Tri-Party Information Repository
SW Harrison and Park
Portland, Oregon 97207-1151
503/725-3690
ATTN: Michael Bowman

U.S. DOE Richland Public Reading Room
Washington State University, Tri-Cities
Consolidated Information Center, Room 101L
P.O. Box 999, MSIN H2-53
Richland, Washington 99352
509/376-8583
ATTN: Terri Traub

## GLOSSARY

The first usage of technical terms and other specialized text in this Proposed Plan is shown in bold in the document and defined below.

**Action Memorandum** - The formal document in which the regulatory agencies set forth the selected expedited response action and the reason for its selection.

**Administrative Record** - The files containing all the documents used to select a response action at a CERCLA remedial action site.

**Adsorbed** -When a gas, vapor, or dissolved matter is incorporated onto the surface of a solid or liquid.

**Applicable or Relevant and Appropriate Requirements (ARARs)** -Those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, or that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

**Class 1 Permit Modification** - Changes to a dangerous waste permit that are generally minor in nature. Class 1 modifications either become effective through notification of the permit changes to the regulating agency or, for certain Class 1 modifications, through prior approval by the regulating agency. Categories of Class 1 modifications are contained in WAC 173-303-830 Appendix I.

**Class 3 Permit Modification** - Changes to dangerous waste permit that are generally significant in nature. Class 3 modifications become effective upon completion of a public review process and approval by the regulating agency. Categories of Class 3 modifications are contained in WAC 173-303-830 Appendix I.

**Class A River** - There are five general water use and criteria classes specified in water quality standards for surface waters of the state of Washington (WAC Chapter 173-201A). The water quality of a Class A River shall meet or exceed the requirements for all or substantially all uses.

**Columbia River Comprehensive Impact Assessment (CRCIA)** - An ongoing assessment of Columbia River impacts with the purpose of advising Ecology, EPA, and DOE on impacts to the quality of the Columbia River for human and ecological use.

**Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)** - A federal law that establishes a program to provide for the identification of hazardous waste sites, to ensure that they are cleaned up, and to allow government entities to evaluate damages to natural resources. CERCLA is also known as the "Superfund law."

**Contaminants of Concern** - Chemical and radioactive constituents that must be addressed by remedial action.

**Cryogenic Barrier** - An impermeable barrier constructed by freezing subsurface soils and groundwater over an extended area near the shoreline, thus diverting contaminated groundwater around the frozen barrier allowing time for radionuclide contaminants to decay before migrating to the river.

**Environmental Restoration Disposal Facility (ERDF)** - The Hanford Site's disposal facility for most waste and contaminated environmental media (contingent upon meeting the Environmental Restoration Disposal Facility waste acceptance criteria) generated under a CERCLA remedial action.

**Expedited Response Action** - Early removal actions taken under CERCLA authority as a result of findings during field investigation.

**Ex Situ Bioremediation** - A treatment for organic contamination in soil that relies upon biodegradation to reduce or eliminate the toxicity of the contamination. In ex situ remediation, the contaminated soil is excavated and treated at another location.

**Half-life** - Used to measure the rate of radioactive decay of disintegration; the time lapse during which a radioactive mass loses one-half of its radioactivity.

**Hanford Future Site Uses Working Group** - A working group composed of representatives of interested parties concerned with the cleanup and possible future uses of the Hanford Site. The group was active in 1992 and produced a report identifying possible future site uses and an examination of the cleanup necessary to make those uses possible.

**Hydraulic Barriers** - A technology that uses extraction wells placed strategically along a line or surrounding an area to control the horizontal movement of groundwater and associated contaminants.

**In Situ Bioremediation** - A treatment for organic contamination in soil that relies upon biodegradation to reduce or eliminate the toxicity of the contamination. In situ bioremediation is accomplished without having to excavate and remove the contaminated soil to another location.

**Interim Remedial Action** - A remedial action that is taken at a site for a limited period of time to address one or more of the contamination problems, but not necessarily all of the contamination problems.

**Interim Safe Storage (ISS) Plan** - The first stage of final disposition. It consists of (I) ensuring that facility hazardous substances are and will remain safe and secure, and (ii) reducing the footprint of the reactor building to the primary shield wall, and sealing all openings such that the facility is in an environmentally safe and secure condition prior to initiation of disposition phase II. During reactor ISS, all ancillary structures surrounding the shield wall will be removed. Resulting wastes will be disposed at the Hanford Environmental Restoration Disposal Facility, or other disposal facility as may be approved by the Tri-Parties. On completion of ISS, surveillance and maintenance systems will be upgraded as appropriate to provide for remote monitoring of the remaining structure prior to disposition phase II.

**Ion Exchange** - A treatment technology for groundwater where ions of contaminants present in extracted groundwater are exchanged for similar ions of noncontaminants. The exchange occurs within an above-ground treatment facility.

**Land Disposal Restrictions** - Regulations promulgated under RCRA that provide treatment standards and requirements on the generation, treatment, storage, and disposal of hazardous waste.

**Model Toxics Control Act Regulations (MTCA)** - An Act set forth by the State of Washington that provides risk-based cleanup levels for hazardous materials in the environment that are protective of human health and the environment.

**Modified Columbia River Comprehensive Impact Assessment (CRCIA) Ranger/Industrial Scenario** - An exposure scenario similar to an industrial scenario and based on the ranger scenario developed for the CRCIA. This exposure scenario assumes an individual will be exposed for 150 days per year for 30 years; exposure pathways include direct radiation, soil ingestion, and inhalation.

**National Environmental Policy Act (NEPA)** - A federal law that establishes a program to prevent and eliminate damage to the environment. Values for this act encompass a range of environmental concerns.

**National Priorities List** - A list of top-priority hazardous waste sites in the United States that are eligible for investigation and cleanup under the Superfund law.

**Natural Attenuation** - Natural processes, including dispersion, dilution, radioactive decay, and adsorption of contaminants on soil, that reduce concentrations of contaminants into the groundwater.

**Observational Approach** - A method of planning, designing, and implementing a remedial action that uses a limited amount of initial field characterization data to create a general understanding of the site conditions. Information that is gathered during the remedial action phase is used to make real-time decisions to guide the remedial action. For certain actions or problems at the Hanford Site, this method is considered more cost- and time-effective than traditional methods that require large amounts of initial data to make very detailed plans and designs for remedial actions.

**Operable Unit** - A subset of a larger Superfund CERCLA site; it is typically the subject of operable unit-specific investigations and remedial actions. As applied to the Hanford Site, a source site operable unit is a group of land disposal sites placed together for the purposes of investigation and subsequent cleanup actions. A groundwater operable unit generally includes all of the groundwater underneath one or more source site operable units.

**Pore Water** - Water that fills the spaces between riverbed sediment particles.

**Pump and Treat** - A treatment technology where water is pumped out of the ground through wells and treated at the ground surface to remove contaminants using one or more treatment technologies.

**Qualitative Risk Assessment (QRA)** - Evaluation of risk for a predefined set of human and environmental exposure scenarios that assists Tri-Party signatories in making decisions on the necessity of interim remedial measures.

**Radioactive Decay** - The disintegration, unaffected by external forces, of the nucleus of an atom by the emission of charged particles (e.g., alpha or beta) sometime accompanied by the emission of photons (a quantity of electromagnetic energy) resulting in another radioactive or stable isotope.

**Record of Decision** - The formal document in which the lead regulatory agency sets forth the selected remedial measure and the reasons for its selection.

**Resource Conservation and Recovery Act (RCRA)** - A federal law that establishes requirements for the storage, treatment, and disposal of hazardous waste.

**Remedial Action Goals** - Cleanup standards for contaminants, usually risk-based, to be met by remedial action.

**Remedial Action Objective** - Site-specific quantitative goals that define the extent of cleanup required to achieve initial cleanup objectives that are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure.

**Rural-Residential Scenario** - A hypothetical, future exposure scenario similar to the frequent-use scenario in HSRAM. It assumes continuous occupancy of the land surface for 365 days per year for a period of 30 years. It also assumes direct human exposure to radionuclide contaminants within the top 4.6 m (15 ft) of soil occurs through ingestion of contaminated soil, inhalation of dust, and external exposure to radiation. Indirect exposure pathways are by consumption of locally acquired vegetables, meat, fish, and milk. Exposure to nonradionuclide contaminants in soil is based solely on the soil ingestion pathway.

**Soil Flushing** - Extraction of contaminants from in situ by injection of a chemical solution which acts to mobilize the contaminant in soluble form so that it can be pumped to the surface and treated.

**To Be Considered** - Generally unpromulgated criteria, advisories, or guidance that are used with discretion to define cleanup parameters at a site. Not considered "applicable or relevant and appropriate" requirements.

**Unplanned Release (UPR)** - An unintentional release, including a spill of hazardous wastes or hazardous substance into the environment.

**Vadose Zone** - The zone of unsaturated soil.

# APPENDIX A

## SUMMARY INFORMATION AND ESTIMATED REMEDIAL COST FOR SOURCE WASTE SITES LOCATED WITHIN THE 100-NR-1 OPERABLE UNIT

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 1 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 1 | 100-N-1<br>SWMU 6<br>HGP Settling Pond<br>WIDS | Received discharges from condenser pit, HGP floor drains, demineralizer backwash, roof and parking lot runoff | TPH; radionuclides; chrome, lead, nickel, zinc, copper, calcium; morpholine, hydrazine, ammonia | Soil | | RAD | 320,925 |
| 2 | 100-N-3<br>SWMU 9<br>HGP Maintenance Garage Septic System (french drain)<br>WIDS | Received septic and garage waste (oils, etc.) | Petroleum products | Soil | | PET | 329,895 |
| 3 | 100-N-4<br>SWMU 5<br>HGP Tile Field<br>WIDS | HGP Sanitary Sewer and tile field; received lab waste and sanitary waste | Morpholine and hydrazine | Soil | | MISC | 386,783 |
| 4 | 100-N-5<br>SWMU 10<br>HGP Bone Yard<br>WIDS | Open storage of metals, electrical equipment, and scrap iron | Potential for PCB, TPH, metals; ion exchange resin beds and sandblast grit | Soil | | MISC | 349,327 |
| 5 | 100-N-6<br>Burn Pit<br>WIDS | East of 1120-N Building | Construction debris; VOC, TPH, PCB, and metals not detected. | Soil | | BURN | 94,113 |
| 6 | 100-N-7<br>182-N Unplanned Release<br>WIDS | 19-L (5-gal) release of lubricating oil to the river | Oil | Water | X | | NA |
| 7 | 100-N-8<br>108-N Unplanned Release<br>WIDS | Leak in transfer line | Sodium hydroxide | Soil | X | | NA |
| 8 | 100-N-9<br>120-N-5 Unplanned Release<br>WIDS | Leak in acid/caustic transfer trench | Caustic and sulfuric acid | Soil<br>Concrete | X | | NA |
| 9 | 100-N-10<br>120-N-5 Unplanned Release<br>WIDS | Leak in acid/caustic transfer trench | Caustic | Soil<br>Concrete | X | | NA |
| 10 | 100-N-11<br>120-N-5 Unplanned Release<br>WIDS | Leak in acid/caustic transfer trench | Sulfuric acid | Soil<br>Concrete | X | | NA |
| 11 | 100-N-12<br>184-N Pipeline<br>WIDS | Spill inside the 184-N Building leaked to the outside | TPH | Soil | | PET | 94,334 |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 2 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 12 | 100-N-13<br>Contaminated Soil (rad)<br>WIDS | NE of the 1120-N Building; posted underground rad site | Co-60 | Soil | | RAD | 98,242 |
| 13 | 100-N-14<br>Dumping Area<br>WIDS | East of the 1120-N Building; posted underground rad site | Cs-137 | Soil | | RAD | 98,242 |
| 14 | 100-N-16<br>Burn Pit<br>WIDS | East of 1120-N; used to burn municipal type waste | PCB. VOC, TPH, and metals not detected. | Soil | | BURN | 94,446 |
| 15 | 100-N-17<br>Burn Pit<br>WIDS | East of 1120-N Building; used to burn office waste | Paints, solvents. VOC, TPH, and PCB not detected. | Soil | | BURN | 94,224 |
| 16 | 100-N-18<br>HGP Burn Pit<br>WIDS | HGP burn pit | Residuals of construction, combustible wastes | Soil | | BURN | 93,965 |
| 17 | 100-N-19<br>SWMU 11<br>HGP Construction Dump<br>WIDS | HGP construction debris dump | Construction debris, concrete, and sandblast grit | Soil<br>Construction Debris | | MISC | 94,502 |
| 18 | 100-N-20<br>Concrete Foundation<br>WIDS | Small concrete foundation located in the 600 Area | Considered to be part of 100-D Operable Unit as 100-D-36. | N/A | X | | NA |
| 19 | 100-N-21<br>Blast Yard<br>WIDS | Sandblast yard southeast of the 1143-N Paint Shop | Analysis clears the site per WAC | Soil | X | | NA |
| 20 | 100-N-22<br>Septic System Tank and Cesspool<br>WIDS | Facility served the 105-N, 1705-N, and 1706-N Buildings | N/A | Soil | | RAD | 125,274 |
| 21 | 100-N-23<br>Resin Disposal Pit No. 1<br>WIDS | Resin Disposal Pit | Unknown | Soil | | INORG | 93,891 |
| 22 | 100-N-24<br>Hydrogen Dry Well<br>WIDS | Hydrogen peroxide sump | Hydrogen peroxide from storage tank drainage, water from tank area | Soil | | INORG | 114,943 |
| 23 | 100-N-25<br>French Drain Site No. 1<br>WIDS | Unknown | Mixed chemical wastes | Soil | | RAD | 108,555 |
| 24 | 100-N-26<br>French Drain Site No. 2<br>WIDS | Site received yard steam condensate | Low-level fission products | Soil | | RAD | 101,593 |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 3 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 25 | 100-N-27<br>108-N Neutralization Pit<br>WIDS | Structure used to neutralize floor drain effluents | Acid waste and neutralizer | Concrete | X | | NA |
| 26 | 100-N-28<br>Resin Disposal Pit No. 2<br>WIDS | Disposal pit for reactor decontamination solutions | Decon solutions | Soil | | RAD | ** |
| 27 | 100-N-29*<br>10" Blowdown Pipe No. 1<br>WIDS | From steam generators to 1300-N basin | Low-level fission products | Soil | | RAD | 130,884 |
| 28 | 100-N-30*<br>10" Blowdown Pipe No. 2<br>WIDS | From steam generators to 1300-N Basin | Low-level fission products | Soil | | RAD | 130,884 |
| 29 | 100-N-31*<br>30" Pipeline<br>WIDS | From steam generators to 1300-N Basin | Low-level fission products | Soil | | RAD | 130,884 |
| 30 | 100-N-32*<br>30" Pipeline No. 3<br>WIDS | From steam generators to 1300-N Basin | Low-level fission products | Soil | | RAD | 130,884 |
| 31 | 100-N-33<br>Military Site Ash Pit<br>WIDS | Dumping ground for coal ash | Heavy metals | Soil | | INORG | 106,777 |
| 32 | 100-N-34<br>Dumping Area, Burn Pit<br>WIDS | East of 1120-N Building | Construction debris, asphalt | Soil | | BURN | 93,817 |
| 33 | 100-N-35<br>Hanford Substation<br>WIDS | HGP/BPA switch yard | PCBs to 7 ppm | Soil<br>Concrete | | PET | 99,369 |
| 34 | 100-N-36<br>107-N Oil Stained Pad<br>WIDS | Air compressor lube oil leakage and spillage | TPH | Concrete | | PET | 98,254 |
| 35 | 100-N-37<br>Asbestos Release<br>WIDS | 109-N Asbestos Release | Asbestos | Soil | | MISC | 197,021 |
| 36 | 100-N-38*<br>Unplanned Release | From steam generators to 1300-N basin | Low-level fission products | Soil | | RAD | 130,884 |
| 37 | 100-N-39<br>Substation Dumping Area<br>WIDS | HGP construction dump | Construction debris and fluids | Soil<br>Construction Debris | | MISC | 97,483 |
| 38 | 100-N-40<br>108-N Unplanned Release<br>WIDS | Disconnected rail transfer line | Sodium hydroxide | Soil | X | | NA |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 4 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 39 | 100-N-41<br>SWMU 9<br>1701-NE Septic System<br>WIDS | Near 1701-NE Guardhouse | N/A | Soil | X | | NA |
| 40 | 100-N-45<br>SWMU 9<br>1703-N Septic System<br>WIDS | Near NE corner of 1703-N office building and warehouse | N/A | Soil | | MISC | 149,807 |
| 41 | 100-N-46<br>HGP Oil Storage Tank | 75,708-L (20,000-gal) underground tank. inactive. | Diesel fuel oil | Soil | | PET | 75,261 |
| 42 | 100-N-47<br>Military Site<br>WIDS | Former AAA Battalion Headquarters site | Unknown. solid waste | Soil | | MISC | 197,021 |
| 43 | 100-N-50<br>SWMU 4<br>Turbine Oil Filter Unit in HGP<br>RCRA-FA | Turbine oil cleaning system in HGP basement; large spills could go to SWMU 3 | Turbine oil; no information available on filter disposal | Concrete<br>Soil | | PET | ++ |
| 44 | 100-N-51a<br>SWMU 2<br>HGP Bldg. Oil Storage<br>RCRA-FA | Basement storage room in HGP building for oil, lubricants, and petroleum; no outlet | Oil. lubricants, and small quantities of petroleum products | Concrete | | PET | ++ |
| 45 | 100-N-51b**<br>SWMU 3<br>HGP Bldg. Floor Drains and Sumps<br>RCRA-FA | Floor drains and central sump in HGP basement; received spills, leaks, and flood water. Discharged to 100-N-1 or 1908NE. | Oil or maintenance spills and water | Water<br>Soil | | PET | ++ |
| 46 | 100-N-52<br>SWMU 8<br>Maintenance Garage east of HGP<br>RCRA-FA | Garage for servicing vehicles; floor drains and sink discharge to 100-N-3 | Used oil, solvents, paint, gasoline. pesticides | Concrete<br>Soil | X | | NA |
| 47 | 100-N-65<br>Diesel Burn Pit | Pit excavated adjacent to river to intercept and burn diesel oil spill (UPR-100-N-17) | Diesel oil | Soil | | PET | ++ |
| 48 | 116-N-4*<br>Emergency Dump Basin<br>TBR 4.4 | Emergency cooling water and steam blowdown | Low-level fission products | Soil<br>Groundwater | | RAD | ** |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 5 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 49 | 116-N-8<br>163-N Mixed/Hazardous Waste Container Storage Pad<br>TBR 4.5 | Active mixed solid-waste site located south of the 163-N Building | Pad tested and found to be free of chemical and rad contamination | Soil | X | | NA |
| 50 | 118-N-1*<br>Spacer Silos<br>TBR 4.6 | Temporary storage of irradiated spacers | Sr-90, Cs-137, H-3, Pu-239/240, Eu-152, Eu-155 | Soil<br>Groundwater | | RAD | ** |
| 51 | 120-N-3<br>163-N Neutralization Pit<br>WP 3.25 | Acid/caustic discharged to french drain | Sulfuric acid and sodium hydroxide | Soil | | INORG | 117,146 |
| 52 | 120-N-4<br>1310 Hazardous Waste Staging Area<br>TBR 4.10 | Active; concrete replaced gravel pad in 1985; no known spills | Oil, nonhazardous nonradioactive waste | Soil | X | | NA |
| 53 | 120-N-5<br>108-N Transfer Line<br>WP 3.24 | Received acid/caustics from transfer line | Sulfuric acid and sodium hydroxide | Soil | X | | NA |
| 54 | 120-N-6<br>Five 108-N French Drains<br>WP 3.24 | Drains received condensate from acid tanks and lines | Sulfuric acid | Soil | X | | NA |
| 55 | 120-N-7<br>Unloading French Drain<br>WP 3.23 | Drains received intermittent amounts of acid discharges | Sulfuric acid, sodium hydroxide | Soil | X | | NA |
| 56 | 120-N-8<br>Sulfuric Vent French Drain<br>WP 3.26 | Received discharges from 163-N Water Treatment | Sulfuric acid | Soil | X | | NA |
| 57 | 124-N-1<br>Septic System<br>WIDS | South of 163-N Building; active | N/A | Soil | X | | NA |
| 58 | 124-N-2<br>Septic System<br>WIDS | East of 182-N Building | N/A | Soil | | PET | 212,349 |
| 59 | 124-N-3<br>Septic System No. 3<br>TBR 4.17 | Serviced restroom facilities in 107-N Building | None | Soil | | RAD | 149,807 |
| 60 | 124-N-4<br>Septic System No. 4<br>TBR 4.18 | Two septic tanks and a leach field | Surface radioactive contamination | Soil | | RAD | 766,864 |
| 61 | 124-N-5<br>Septic System No. 5 | Septic tank and drain field; system abandoned in place | None | Soil | X | | NA |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 6 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 62 | 124-N-6<br>Septic System No. 6 | Septic tank and leach field; system abandoned in place | None | Soil | X | | NA |
| 63 | 124-N-7<br>Septic System No. 7 | Septic tank and leach field; operated from 1984 to 1987 | None | Soil | X | | NA |
| 64 | 124-N-8<br>Septic System No. 8 | Septic tank and leach field; operated from 1983 to 1987 | None | Soil | X | | NA |
| 65 | 124-N-9<br>Septic System No. 9 | Two septic tanks and a leach field active since 1985 | None | Soil | X | | NA |
| 66 | 124-N-10<br>Septic Lagoon System<br>WIDS | Central sewer system; active site | N/A | Soil | X | | NA |
| 67 | 128-N-1<br>Burn Pit<br>WIDS | Located 1500 NE of 1120-N Building | Municipal type waste, paints, solvents | Soil | | BURN | 140,531 |
| 68 | 130-N-1<br>Backwash Pond<br>WIDS | Marsh-like pond received filter backwash from the 183-N | Polyacrylamide and aluminum sulfate | Soil | X | | NA |
| 69 | 1908-N<br>102" Diameter Outfall<br>WIDS | Active; cooling water from the Reactor to the river | N/A | Water | X | | NA |
| 70 | 1908-NE<br>SWMU 7<br>HGP Outfall<br>WIDS | Cooling water and settling pond discharges from the HGP facility to the Columbia River | Low-level fission products, and chemical contamination from 100-N-1 | Water | X | | NA |
| 71 | 600-32<br>100-N Area Landfill<br>WIDS | Former gravel pit | Surface debris, paint cans, transite, and concrete | Soil | | MISC | 2,046,397 |
| 72 | 600-35<br>Dumping Area<br>WIDS | Borrow pit | Surface debris including drums, batteries | Soil | | MISC | 161,268 |
| 73 | UPR-100-N-1<br>Inlet Valve Box Leak<br>TBR 4.27 | 1304-N Emergency Dump Tank | Low-level fission products | Soil | | RAD | 176,709 |
| 74 | UPR-100-N-2<br>FLV-858 Valve Leak<br>TBR 4.28 | Valve to isolate the return line | Low-level fission products | Soil | | RAD | 163,508 |
| 75 | UPR-100-N-3*<br>Transport Line Leak<br>TBR 4.29 | Dummy fuel transport line; see UPR-100-N-12 | Co-60, Sr-90, Cs-137, Pu-239, Ce-144, H-3 | Soil | | RAD | 253,288 |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 7 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 76 | UPR-100-N-4<br>1322-A Sump Overflow<br>TBR 4.30 | 1322-A sump overflowed | Radioactive water | Soil | | RAD | 97,464 |
| 77 | UPR-100-N-5<br>1310-N Tank Leak<br>TBR 4.31 | Underground leak of 340,000 L (90,000 gal) radioactive decontamination solution. | Decontamination solutions and mixed chemicals; Co-60 | Soil | | RAD | 335,922 |
| 78 | UPR-100-N-6<br>Chemical Waste Line<br>TBR 4.32 | 1.5-in. line leaked | Radioactive water, Co-60, Mn-54, Cs-137, Ru-103 | Soil | | RAD | 104,056 |
| 79 | UPR-100-N-7*<br>Return Line Leak<br>TBR 4.33 | 10-in. drainline from 105-N to 1304-N Dump Tank | Mn-154, Co-60, Ce-144 | Soil | | RAD | 375,378 |
| 80 | UPR-100-N-8<br>1322-A Sump Overflow<br>TBR 4.34 | 1322-N sump overflowed | Radioactive water | Soil | | RAD | 95,409 |
| 81 | UPR-100-N-9*<br>Drain Line Leak<br>TBR 4.35 | Ruptured 2-in. drainline from the 119-N Building | Contaminated water | Soil | | RAD | 104,037 |
| 82 | UPR-100-N-10*<br>Lift Station Drain Leak<br>TBR 4.36 | Contaminated water from drains in the 105-N Building | Mixed waste; fission and activation products | Soil | | RAD | 95,409 |
| 83 | UPR-100-N-11<br>500-lb Valve Bonnet<br>TBR 4.37 | The valve bonnet fell from a truck causing the uncontrolled release of surface contamination | Cleaned up | Soil | | RAD | 95,853 |
| 84 | UPR-100-N-12*<br>Spacer Line Leak<br>TBR 4.38 | Dummy fuel transport line (see UPR-100-N-3) | Co-60, Cs-137, Pu-239/240 | Soil | | RAD | 459,863 |
| 85 | UPR-100-N-13<br>1314-N Drywell Overflow<br>TBR 4.39 | Tank car overflowed to catch basin, sump, and soil | Radioactive, spent decon solution | Soil | | RAD | 88,873 |
| 86 | UPR-100-N-14*<br>Drain System Leak<br>TBR 4.40 | 119-N leak during maintenance activity | Radioactive effluent water | Soil | | RAD | 95,409 |
| 87 | UPR-100-N-15<br>Neutralization Sump Spill<br>WP 3.24 | 108-N transfer line leaked to soil | Sulfuric acid | Soil | X | | NA |
| 88 | UPR-100-N-17<br>166-N Supply Line Leak<br>TBR 4.42 | 4-in. line in tank farm leaked to the ground; trench dug at the river shoreline (100-N-65) to intercept oil | TPH diesel oil | Soil<br>Groundwater | | PET | 903,509 |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 8 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 89 | UPR-100-N-18<br>166-N Supply Line Leak<br>TBR 4.43 | 4-in. diesel supply line between the 166-N and 184-N storage area | TPH diesel oil | Soil | | PET | 107,994 |
| 90 | UPR-100-N-19<br>184-N Fuel Oil Spill<br>TBR 4.44 | Fuel oil day tank | TPH No. 6 fuel oil | Soil | | PET | 112,486 |
| 91 | UPR-100-N-20<br>166-N Return Line Leak<br>TBR 4.45 | Leak from Tank Farm 2-in. return line | TPH No. 2 diesel oil | Soil | | PET | 105,660 |
| 92 | UPR-100-N-21<br>184-N Tank Overflow<br>TBR 4.46 | Diesel oil day tank | TPH No. 2 diesel oil | Soil | | PET | 100,162 |
| 93 | UPR-100-N-22<br>Diesel Supply Leak No. 1<br>TBR 4.47 | Piping corrosion caused leak outside 184-N Building | TPH No. 2 diesel oil | Soil<br>Groundwater | | PET | 108,696 |
| 94 | UPR-100-N-23<br>184-N Leak No. 2<br>TBR 4.48 | Supply line located near the diesel day tank | TPH No. 2 diesel oil | Soil<br>Groundwater | | PET | 104,720 |
| 95 | UPR-100-N-24<br>166-N Supply Line Leak<br>TBR 4.49 | Leak caused by corrosion on transfer line | TPH No. 6 fuel oil | Soil | | PET | 121,304 |
| 96 | UPR-100-N-25<br>Uncontrolled Venting<br>TBR 4.50 | 1310-N, contamination in bermed area | Phosphoric acid and diethylthiourea solution | Soil | | RAD | 97,779 |
| 97 | UPR-100-N-26<br>Backflow of Waste<br>TBR 4.51 | Release occurred within the 1313-N facility | Phosphoric acid and diethylthiourea | Soil | | RAD | 99,908 |
| 98 | UPR-100-N-29<br>Bypass Line Leak<br>TBR 4.52 | East side of 1304-N Dump Tank | Primary coolant water; Mn-56, Na-24 | Soil | | RAD | 101,704 |
| 99 | UPR-100-N-30<br>1304-N Dump Tank<br>TBR 4.53 | Spill to ground; stabilized with sand fines | Primary coolant water | Soil | | RAD | 117,313 |
| 100 | UPR-100-N-31<br>Spill Near 1301-N<br>TBR 4.54 | Radioactive water leaked through 1301-N berm penetration; to be addressed with the 1301-N RCRA TSD | Radioactive water | Soil | X | | NA |
| 101 | UPR-100-N-32<br>1304-N Bypass Line Leak<br>TBR 4.58 | Leaking check valve at the emergency dump tank | Low-level fission products | Soil | | RAD | 105,092 |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 9 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 102 | UPR-100-N-33<br>108-N Acid Transfer Spill<br>WP 3.24 | Spill during transfer from rail car outside 108-N | Sulfuric acid | Soil | X | | NA |
| 103 | UPR-100-N-34<br>Sulfuric Acid Line Break<br>WP 3.25 | Transfer line leak | Sulfuric acid | Soil<br>Concrete | X | | NA |
| 104 | UPR-100-N-35*<br>Fuel Storage Basin Leak<br>TBR 4.58 | Pipe grouted beneath the 105-N Storage Basin | Mn-5, Co-60, Cs-137, Ce-144, I-131 | Soil<br>Groundwater | | RAD | ** |
| 105 | UPR-100-N-36<br>184-N Annex<br>WIDS | Located near the diesel day tank, 184-N Powerhouse | TPH, diesel fuel, and motor oil | Soil | | PET | 97,408 |
| 106 | UPR-100-N-37<br>SWMU 1<br>HGP Transformer Yard<br>WIDS | Fenced area along northwest wall of the HGP; location of nine large transformers | Potential for asbestos, PCB | Soil<br>Concrete | | PET | 93,983 |
| 107 | UPR-100-N-38<br>116-N-2 Caustic Spill<br>WIDS | Sodium hydroxide spill during off-loading of a truck | Sodium hydroxide | Soil | X | | NA |
| 108 | UPR-100-N-39*<br>Liquid Unplanned Release<br>TBR 4.62 | Scrub water spill outside the corridor 22 doorway | Low-level fission products | Soil | | RAD | 99,297 |
| 109 | UPR-100-N-40<br>Regeneration Waste<br>TBR 4.68 | Leak in the transport line | Acid/caustics, heavy metals | Soil | | INORG | 143,993 |
| 110 | UPR-100-N-41<br>Regeneration Waste<br>WIDS | Spill from the 163-N Water Treatment Plant | Acid/caustic | Soil | | INORG | 94,761 |
| 111 | UPR-100-N-42<br>184-N Diesel Oil Spill<br>WIDS | Located near the diesel day tank, 184-N Powerhouse | TPH | Soil | | PET | 910,025 |
| 112 | UPR-100-N-43<br>Pipelines<br>WIDS | Oil supply pipeline from 116-N to 184-N | TPH and diesel oil | Soil<br>Groundwater | | PET | 116,719 |
| 113 | UPR-600-17<br>Patrol Boat Spill<br>WIDS | Gas spilled in a patrol boat was discharged to the river | TPH and gasoline | N/A | X | | NA |
| 114 | Shoreline Site | Soil contaminated by groundwater flows from 116-N-1 and 116-N-3 cribs and trenches | Radionuclides and possibly inorganics: petroleum | Soil | | | 0 to 15,584,275 depending on the alternative selected |

**Table A-1. Summary Information and Estimated Remedial Cost for Source Waste Sites Located Within the 100-NR-1 Operable Unit, Hanford Site. (Page 10 of 10)**

| No. | Site Name Information Source | Site History | Contaminants | Media | Sites Not Addressed in the CMS | Waste Group | Estimated Remedial Cost ($)+ |
|---|---|---|---|---|---|---|---|
| 115 | Piping | Piping sites will be remediated along with nearby waste sites | Radionuclides, petroleum, and inorganics | Soil Piping | | RAD PET INORG | 34,440,348 |
| | Total | | | | | | 48,745,386 |

BURN = Burn Pit Waste Group
HGP = Hanford Generating Plant
INORG = Inorganic Waste Group
MISC = Surface Solid Waste and Miscellaneous Waste Group
NA = not applicable
ND = none detected
NPDES = National Pollutant Discharge Elimination System Permit
OU = operable unit
PCB = polychlorinated biphenyls
PET = Petroleum Waste Group
RAD = Radioactive Waste Group
RCRA = *Resource Conservation and Recovery Act of 1976*
RCRA-FA = RCRA Facility Assessment
SWMU = solid waste management unit
TBR = technical baseline report
TPH = total petroleum hydrocarbons
TSD = treatment, storage and/or disposal
VOC = volatile organic compounds
WAC = Washington Administrative Code
WIDS = Waste Information Database System
WP = Work Plan

Ce-144 = cerium
Co-60 = cobalt
Cs-137 = cesium
Eu-152, Eu-155 = europium
I-131 = iodine
Mn-154 = manganese
Pu-239/240 = plutonium
H-3 = tritium
Ru-103 = ruthenium
Sr-90 = strontium

*Buffer zone site.
**Available information indicates that there may be no contaminants within the upper 4.6 m of the soil column. Further information will be acquired during design.
+ Costs do not include a 6 percent design/data collections cost.
++ Costs and/or additional costs for these sites will be established during design.