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SECTION 3 OF 3

100-NR-1

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 100-NR-1 **January 2007**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	01/2007	
1.0 Comparative Analysis of Remedial Alternatives	01/2007	
2.0 Recommended Corrective Measures for 100-NR-1 Operable Unit	01/2007	
3.0 Applicable or Relevant and Appropriate Requirements	01/2007	
4.0 Cost Estimates	01/2007	
5.0 Comparative Analysis of Alternatives	01/2007	
6.0 Recommended Alternatives	01/2007	
7.0 Integration Plan for D&D & Remedial Action	01/2007	
8.0 Hanford Generating Plant	01/2007	
Supporting Documents	**Last Modification Date**	**Modification Number**
11-24-2003 Letter	11/24/2003	
Chapter 7 Contract Surety Bonds		
D4 Project Facility Completion Form Attachments 1-4		
Facility Status Change Form	9/10/2009	

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100-NR-1
PART IV CORRECTIVE ACTION UNIT 1 UNIT SPECIFIC CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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PART IV CORRECTIVE ACTION UNIT 1 UNIT SPECIFIC CONDITIONS 100-NR-1

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PART IV CORRECTIVE ACTION UNIT 1 UNIT SPECIFIC CONDITIONS 100-NR-1

The 100-NR-1 includes solid waste management units and one-time spill sites, which are undergoing corrective action. As prescribed by Permit Conditions II.Y of this Permit, this Chapter sets forth the corrective action requirements for the 100-NR-1.

IV.1.A Compliance with Approved Corrective Measures Study

The Permittees shall comply with all requirements set forth in Corrective Action Unit 1. Enforceable portions are listed below; all subsections, figures, and tables included in these portions are also enforceable, unless stated otherwise.

Corrective Action Unit 1

Chapter 1.0	Comparative Analysis of Remedial Alternatives
Chapter 2.0	Recommended Corrective Measures
Chapter 3.0	Applicable or Relevant and Appropriate Requirements
Chapter 4.0	Cost Estimates
Chapter 5.0	Compliance with ARARS
Chapter 6.0	Recommended Alternative
Chapter 7.0	Integration Plan for Decontamination and Demolition and Remedial Action in the 100-N Area
Chapter 8.0	Hanford Generating Plant

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100-NR-1
CHAPTER 1.0
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 1.0
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

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CHAPTER 1.0
COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

TABLE OF CONTENTS

1.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES 5
1.1 Evaluation Criteria and Key Discriminators 5
1.1.1 Long-Term Effectiveness and Permanence 6
1.1.2 Reduction of Toxicity, Mobility, or Volume through Treatment 6
1.1.3 Short-Term Effectiveness 6
1.1.4 Implementability 6
1.1.5 Cost 7
1.1.6 NEPA Values 7
1.2 Comparison of Remedial Alternatives for Source Waste Sites 7
1.2.1 Rural-Residential Exposure Scenario 8
1.2.2 Modified CRCIA Ranger/Industrial Exposure Scenario 11
1.3 Comparison of Remedial Alternatives for Groundwater 15
1.3.1 Long-Term Effectiveness and Permanence 16
1.3.2 Reduction in Toxicity, Mobility, or Volume through Treatment 18
1.3.3 Short-Term Effectiveness 19
1.3.4 Implementability 19
1.3.5 Cost 20
1.3.6 NEPA Values 21
1.4 Interim Action for Remediation of Groundwater 21
1.4.1 Potential for Implementing an Interim Action 21
1.4.2 Remedial Action Objective for a Groundwater Interim Action 22
1.4.3 Remedial Technology Descriptions for an Interim Action 22
1.4.4 Detailed Analysis of Remedial Alternatives for Groundwater Interim Action 23
1.4.5 Comparative Analysis of Remedial Alternatives for Groundwater Interim Action 24

TABLES

Table 1.1. Applicable Remedial Alternatives for Source Waste Sites Assuming a Rural Residential Exposure Scenario. 26

Table 1.2. Applicable Remedial Alternatives for Source Waste Sites Assuming a Modified CRCIA Ranger/Industrial Exposure Scenario 26

Table 1.3. Cost Comparison of Remedial Action Alternatives for Deep Petroleum Source Sites[a] 26

Table 1.4. Cost Comparison of Remedial Action Alternatives for Near-Surface Petroleum Source Sites[a] 27

Table 1.5. Present Worth Cost Comparison of Remedial Alternatives for Source Waste Sites for the Rural-Residential Exposure Scenario 27

Table 1.6. Costs for Source Units 28

Table 1.7. Present Worth Cost Comparison of Remedial Alternatives for Source Waste Sites for the Modified CRCIA Ranger/Industrial Exposure Scenario [a] 29

Table 1.8. Remedial Alternatives for Groundwater Contamination at the 100-N Area 30

Table 1.9. Cost of Remedial Alternatives for Groundwater 30

Table 1.10. Comparative Cost Summary of the Interim Groundwater Remedial Alternatives 31

1.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the rationale and results of a comparison of remedial alternatives for the 100-NR-1 source operable unit (OU) and the 100-NR-2 groundwater OU. This comparison is based on five of the nine Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) evaluation criteria (EPA 1988) and National Environmental Policy Act (NEPA) values as discussed in DOE/RL-95-111, Rev. 0, Section 6.0. Source-site comparisons were done according to waste group types.

Key discriminators were selected within the evaluation criteria to compare the applicable remedial alternatives within each exposure scenario (i.e., rural-residential and modified Columbia River Comprehensive Impact Assessment [CRCIA] ranger/industrial) and are identified in Section 7.1. Based on key discriminators, this comparative analysis identifies the relative advantages and disadvantages of each alternative and provides a basis for selecting a remedial alternative for each exposure scenario.

1.1 Evaluation Criteria and Key Discriminators

To facilitate the evaluation of remedial alternatives, CERCLA prescribes nine specific evaluation criteria:

1. Overall protection of human health and the environment.
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARAR).
3. Long-term effectiveness and permanence.
4. Reduction of toxicity, mobility, and volume through treatment.
5. Short-term effectiveness.
6. Implementability.
7. Cost.
8. State acceptance.
9. Community acceptance.

The first two criteria, overall protection of human health and the environment and compliance with ARARs, are considered threshold criteria that, if not met, would eliminate an alternative from consideration. Though it fails to meet the threshold criteria, the No-Action Alternative is retained in this comparative analysis for the purposes of providing a baseline assessment. The Institutional Controls Alternative for the 100-NR-1 OU (source sites) also fails the first criterion for the waste site groups, and it is inconsistent with unrestricted land use. Both the Institutional Controls and No-Action Alternatives, by definition in DOE/RL-95-111, Rev. 0, Section 5.0, may become part of other alternatives should site-specific soils data dictate that these alternatives are appropriate for individual sites.

The Institutional Controls Alternative is retained as a viable option for the 100-NR-2 OU (groundwater) remedial actions.

The overall protection and ARAR compliance criteria are not included in the comparative analysis presented in this section because all alternatives retained meet these threshold criteria. In addition, certain key discriminators within the overall protection criterion (e.g., impacts to natural and cultural resources, and residual risk) are inherent to other evaluation criteria such as long-term effectiveness and permanence and short-term effectiveness.

The last two criteria, state and community acceptance, will not be evaluated until after the proposed plan has been issued; therefore, they are not part of the comparative analysis presented below. This leaves five CERCLA evaluation criteria that are addressed in this Comparative Analysis:

- Long-term effectiveness and permanence.
- Reduction of toxicity, mobility, and volume through treatment.
- Short-term effectiveness.
- Implementability.
- Cost.

An evaluation of NEPA values also has been added so as to comply with the policy requiring integration of NEPA values into the CERCLA process.

Sections 7.1.1 through 7.1.6 discuss the five evaluation criteria and NEPA values, as well as the associated key discriminators used to compare alternatives.

1.1.1 Long-Term Effectiveness and Permanence

This criterion is concerned with the long-term consequences of the Remedial Alternative. Key discriminators for this criterion include the following:

- Residual risk (e.g., removal of the source contaminants eliminates site risk while the capping of wastes in place results in residual risk that limits land use and requires monitoring).
- Adequacy and reliability of controls (e.g., the Containment Alternative needs to address the reliability of the containment barrier, and the Remove/Dispose Alternative needs to address the reliability of the engineered disposal site).
- Long-term natural resource and environmental consequences (e.g., ability to manage residual risks, potential for habitat restoration, and influence on biodiversity).

1.1.2 Reduction of Toxicity, Mobility, or Volume through Treatment

The key discriminator for this criterion is the ability of the remedial alternative to reduce the mobility, toxicity, or volume of contaminants. Most alternatives considered would decrease contaminant mobility using containment or treatment technologies, but the effectiveness of the alternatives differs. Some remedial alternatives may also reduce waste volume (e.g., soil washing by using physical separation processes to segregate clean material from contaminated material). In situ and ex situ bioremediation are expected to reduce toxicity.

1.1.3 Short-Term Effectiveness

The EPA (1988) includes several discriminators (risk to the community, the worker, and the environment) in the short-term effectiveness criterion. This criterion also considers the time required to achieve protectiveness. Several NEPA values also relate to short-term effectiveness, including potential impacts to cultural resources, natural resources, socioeconomics, and transportation. The health risk to the community is considered insignificant for this evaluation because of the remote location of the 100-N Area. Socioeconomics was not considered a key discriminator because impacts of the remedial alternatives being considered probably would not make much difference on a regional level. Risk to the environment varies at each waste site. The impacts to vegetation and natural habitats would be minor as most of the waste sites have been previously disturbed. However, the capability to revegetate and restore wildlife habitats has been considered. Also, impacts to protected or sensitive species may be critical. The key discriminators for this criterion follow:

- Risk to workers.
- Transportation impacts.
- Risks to natural and cultural resources.

1.1.4 Implementability

Technical feasibility, administrative feasibility, and availability of services and materials are discriminators for implementability. Technical feasibility is important because it takes into account the technical aspects of implementing a remedial action. Administrative feasibility considers how consistent

the remedial action is with the future land-use options. Administrative feasibility is also significant because it includes coordination with other agencies and parties (agencies, trustees, and tribes) that have regulatory responsibility or stakeholder interests. Availability of services and materials is significant when considering waste removal and disposal, in situ treatment, capping, subsurface barriers, hydraulic controls, and sources of fill material. The key discriminators follow:

- Technical feasibility
- Administrative feasibility
- Availability of services and materials.

1.1.5 Cost

The estimated cost of each alternative is considered in all evaluations. The estimated costs available at this time should only be used to compare relative differences between remedial alternatives. These costs are not intended to be accurate estimates of total costs to remediate the sites.

1.1.6 NEPA Values

Key discriminators under this criterion include irreversible and irretrievable commitment of natural and cultural resources, cumulative impacts from implementation of the alternative, and environmental justice issues as they relate to Native American use of the land.

1.2 Comparison of Remedial Alternatives for Source Waste Sites

Comparative analyses were performed for the following four alternatives for both the rural- residential and modified CRCIA ranger/industrial exposure scenarios:

- No action (all waste groups types).
- Remove/dispose (all waste groups types).
- Remove/ex situ bioremediation/dispose (petroleum waste group).
- In situ bioremediation (petroleum waste group).

Comparative analyses of the following two alternatives were performed only for the modified CRCIA ranger/industrial exposure scenario:

- Containment (radioactive waste group).
- Solidification (radioactive waste group).

As discussed in DOE/RL-95-111, Rev. 0, Section 5.3, due to the lack of data on the extent of contamination in soil, all alternatives may potentially result in implementing no action or institutional controls upon obtaining further characterization data at a specific site within the 100-NR-1 OU.

Table 7.1 presents the remedial alternatives discussed in DOE/RL-95-111, Rev. 0, Sections 5.3, and 6.2.2 that are applicable to the rural-residential exposure scenario. If the rural-residential exposure scenario is selected, the remedial alternatives to meet unrestricted use are as shown in Table 7.1.

Table 7.2 presents the remedial alternatives considered to be applicable to the modified CRCIA ranger/industrial exposure scenario. In this case, land-use restrictions are appropriate and allow more options for remedial action.

The No-Action Alternative has been retained in this comparative analysis for both exposure scenarios as a basis for comparison with the other alternatives. However, as described in the detailed analysis presented in DOE/RL-95-111, Rev. 0, Section 6.0, the No-Action Alternative does not satisfy evaluation criteria for overall protection; long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; or implementability. Therefore, the No-Action Alternative is not considered a viable alternative for the remediation of source sites at the 100-N Area.

Remedial alternatives compared under a rural-residential exposure scenario for all waste groups (Table 7.1) include the No-Action Alternative and the Remove/Dispose Alternative.

The Remove/Dispose Alternative encompasses treatment that may be required for the Resource Conservation and Recovery Act (RCRA) Land Disposal Restrictions (LDR) compliance or for meeting waste acceptance criteria for disposal; however, the need to treat for land-disposal-restriction compliance and waste acceptance is not anticipated. The Remove/Dispose Alternative assumes that no contamination above cleanup levels will be encountered at depths below 4.6m (15 feet). However, should contamination be found below 4.6m (15 ft), a site specific determination will be required to define the appropriate remedial action options may include leaving some contamination in place. An evaluation will be conducted during the remedial action activities that will balance the extent of deep excavation with the following: protection of human health and the environment; disturbance of ecological and cultural resources; worker health and safety; remediation costs; operation and maintenance (O&M) costs; radioactive decay of short-lived radionuclides; the use of institutional controls; and long-term monitoring costs.

Specific information on ex situ bioremediation that is pertinent to a comparison of alternatives has been outlined in the comparative analyses in Sections 7.2.1 and 7.2.2. It must be emphasized that ex situ bioremediation is dependent upon detailed, site-specific information to determine if it is a cost-effective remedy. Because this information is not available, the comparative analysis cannot definitively assess the appropriateness of this technology for individual sites relative to other technologies. In addition, the petroleum waste group includes the In Situ Bioremediation Alternative, which is considered appropriate for two TPH-contaminated sites where TPH contaminants were detected in the groundwater. DOE/RL-95-111, Rev. 0, Section 6.0 provides detailed information on ex situ bioremediation, in situ bioremediation, and a no-treatment option that supports the comparative analysis.

Remedial alternatives compared for the modified CRCIA ranger/industrial scenario (Table 7.2) include the No-Action Alternative and the Remove/Dispose Alternative for all waste groups. In addition, the radioactive waste group includes the Containment Alternative, applicable to 16 sites, and the Solidification Alternative, which is applicable to 21 sites. Similarly to the rural-residential exposure scenario, the petroleum waste group includes the In Situ Bioremediation Alternative and the Ex Situ Bioremediation Alternative.

The comparative analysis of alternatives for source sites is presented in two subsections, Section 7.2.1 for the rural-residential exposure scenario, and Section 7.2.2 for the modified CRCIA ranger/industrial exposure scenario. The reader should note the following organization in reading the comparative analysis for source sites:

- In the comparative analysis, no distinction is made among the five waste groups. During the detailed analysis process, it was determined that the responses to the CERCLA and NEPA evaluation criteria depended primarily on the type of remedial action to be taken rather than on the type of contaminant present at the site.
- No direct comparison is made in the modified CRCIA ranger/industrial scenario between in situ bioremediation and containment (or solidification) because these alternatives do not apply to the same sites. In situ bioremediation is presented as an alternative to remediate petroleum spills at two sites where petroleum was observed in the groundwater; containment and solidification are presented as alternatives to remediate certain sites within the radioactive waste group.

1.2.1 Rural-Residential Exposure Scenario

1.2.1.1 Long-Term Effectiveness and Permanence

The Remove/Dispose Alternative provides a high degree of long-term effectiveness and permanence. No sources of risk above approved cleanup levels would remain at the site. All removed soils would be treated, if needed and as appropriate, with treatment residuals being disposed at the Environmental Restoration and Disposal Facility (ERDF). No additional long-term restrictions for residential use at the waste site would be required following remediation with this alternative, unless it is determined that wastes that could pose a direct exposure hazard may be left below 4.6 m (15 ft). In this case, restrictions

on excavation below 4.6 m (15 ft) would be required. If appropriate, revegetation and restoration efforts could be implemented that have the potential to more rapidly restore ecological habitats to healthy, sustainable conditions than is currently possible through natural succession.

The Remove/Ex Situ Bioremediation/Dispose Alternative would compare similarly to the Remove/Dispose Alternative, but it would have the added advantage of returning all, or a significant part of the soil, to the site rather than sending it to the ERDF.

The In Situ Bioremediation Alternative would also provide a high degree of long-term effectiveness and permanence. No risks from TPH contamination would remain because the contaminants would be destroyed, assuming complete treatment. However, it may be impossible to determine whether the treatment reaches all of the contamination. Post-remediation monitoring would be required.

The No-Action Alternative does not offer long-term effectiveness and permanence. Contaminants would remain in near-surface and subsurface soils above levels protective of human health and the environment. Sources of contamination that could contribute to groundwater contamination would remain. No revegetation or restoration efforts would be performed with this alternative.

1.2.1.2 Reduction in Toxicity, Mobility, or Volume

The Remove/Dispose Alternative would potentially provide reduced toxicity, mobility, or volume through application of treatment technologies, as appropriate for LDR compliance and ERDF waste acceptance. This alternative would remove wastes from the site, thereby reducing waste volume there. The Remove/Ex Situ Bioremediation Dispose Alternative might be employed for TPH where soil characteristics are amenable to the success of such a treatment technology. Ex situ and in situ bioremediation would reduce or destroy the toxicity of petroleum constituents through destruction. The reliability of technology and controls for ensuring complete treatment is less certain for in situ bioremediation. The No-Action Alternative would not reduce toxicity, mobility, or volume of contaminants in soils.

1.2.1.3 Short-Term Effectiveness

For the Remove/Dispose Alternative, a large volume of contaminated soils would be generated relative to the other alternatives. As this would require handling through excavation, treatment, and transportation, it would have the potential for inherently greater short-term impacts. Petroleum sites, as well as others, may have contamination at depth. Excavation to greater depths may increase short-term impacts to natural resources. During implementation, risks to workers from exposure to contaminated soils and fugitive dust or from accidents may increase; however, these risks can be effectively minimized through appropriate engineering controls and through health and safety procedures. Certain types of treatment may generate residuals that will require further management to meet LDR or ERDF waste acceptance criteria and, thus, would increase short-term risks to workers. Short-term impacts to vegetation and wildlife may be greatest with this alternative because it would disturb the largest land area. These impacts could be reduced through proper scheduling and implementation of the alternative. This alternative has the highest probability of impacting cultural resources in the short-term, simply due to the large land area impacted. Cultural resource locations are not precisely known; however, identification and mitigation of potential impacts would be addressed through the cultural resources mitigation plan.

Excavation impacts from the Remove/Ex Situ Bioremediation/Dispose Alternative would be similar to those of the Remove/Dispose Alternative. This alternative would take longer to be fully effective if determined to be appropriate. Therefore, at sites where treatment may be required, there may be more short-term disruption to the environment during this period. Transportation of wastes to ex situ bioremediation facilities may increase short-term impacts relative to the in situ treatment. Ex situ bioremediation, however, is expected to provide clean fill material to offset use of borrow material.

The In Situ Bioremediation Alternative is anticipated to require 5 to 25 years to complete at the two petroleum sites where it is applicable. Risks to workers from exposure to vented gases and fugitive dust or from accidents may be present during this time. However, these risks can be effectively minimized

through appropriate engineering controls and through health and safety procedures. The potential for worker exposure to contaminated soils would be minimal during in situ treatment in contrast to the ex situ bioremediation option. Because little or no waste would be generated by in situ treatment, few transportation impacts are anticipated. Only equipment would be transported to and from the site. Risks to natural and cultural resources would be minimized. Short-term impacts to vegetation and wildlife may occur but could be avoided or reduced through appropriate design and implementation of the alternative. Cultural resources, if present, should not be impacted. If potential impacts are identified, they would be addressed through the cultural resources mitigation plan.

The No-Action Alternative would not involve any remedial actions; therefore, risks to workers, transportation impacts, and short-term risks to natural and cultural resources would not be increased nor decreased.

1.2.1.4 Implementability

The Remove/Dispose Alternative performs most favorably for technical and administrative feasibility and the availability of services and materials. Technical problems in implementing excavation and disposal activities within this alternative are not expected.

Ex situ bioremediation implementability is dependent upon site specific information, much of which could be obtained using the observational approach during excavation. Equipment required for implementation is readily available. However, should contamination be found at great depths, it may become less feasible to excavate. Due to the lack of soil characterization data, this potential would have to be evaluated during the design phase of this alternative. It might also be necessary to treat soil constituents to meet LDRs for which there is no immediately available treatment technology. Should it be found upon characterization that petroleum contamination exists at depth or that radionuclide or inorganic contaminants are present, this alternative would not be considered readily implementable.

There is less certainty regarding reliable implementation of in situ bioremediation because completeness of treatment cannot be accurately monitored. Characterization to better determine the extent of remediation may be required. Equipment required for implementation is readily available.

The No-Action Alternative would be easy to implement but would not be consistent with the Department of Energy's (DOE) long-range objective.

1.2.1.5 Cost

Cost estimates for the source sites in DOE/RL-95-111, Rev. 0 were developed using either the Micro Computer Aided Cost Estimating System (MCACES) or the Remedial Action Cost Engineering and Requirements (RACER) package. Total costs presented in this section do not include a 3 percent design cost and a 3 percent cost data collection cost that applies to all estimates. Details of the cost estimates are presented in Permit Attachment 47, Appendix G. It needs to be kept in mind that the quality of a cost estimate is directly related to the quality of the input data used in the models. As has been noted earlier in this report, data on site-specific contamination, site locations, and site dimensions were limited, and this introduces uncertainty in the cost estimates. Despite this uncertainty, it is believed that the cost estimates are of sufficient quality to fulfill the primary objective, which is to aid in selecting preferred remedial alternatives. How representative these estimates might be of actual remediation costs is more difficult to answer and will not be resolved until the uncertainties in the data are resolved.

The No-Action Alternative would require no additional cost and is not considered further in this comparative analysis.

Individual cost estimates for each waste site, exposure scenario, and remedial alternative are presented in Table 6.2. Three alternatives (Remove/Dispose, Remove/Ex situ Bioremediation/Dispose, and In Situ Bioremediation) are proposed for petroleum-contaminated sites under both exposure scenarios. Ex situ bioremediation is proposed for 14 sites that have near-surface contamination, and in situ bioremediation is proposed for two sites with deep contamination. Because all of the petroleum contamination will be removed, there is no cost difference between the two exposure scenarios for this

alternative. The cost comparison in Table 7.3 shows that in situ bioremediation is 65 percent less expensive than the Remove/Dispose Alternative. The cost comparison in Table 7.4 shows that ex situ bioremediation is 12 percent more expensive than the Remove/Dispose Alternative. Because of the uncertainty in the data used to develop these estimates, cost should not be used as a factor in deciding between these two alternatives. This 12 percent difference is not considered significant.

A summary of these results is presented in Table 7.5. The least cost alternative for the rural-residential scenarios is to select the Remove/Disposal Alternative for all sites except the two deep petroleum sites. This produces a cost saving of 7 percent over the using the Remove/Dispose Alternative for all sites.

1.2.1.6 NEPA Values

Irreversible and irretrievable commitment of a significant number of natural resources would not occur with the Remove/Dispose Alternative. 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, then revegetated to mirror more closely the native plant community. (This may be an interim benefit should future rural-residential use of the land dictate another vegetative regime.) Future use of the river and adjacent lands would allow Native American use in concert with a modified CRCIA ranger/industrial exposure scenario in a relatively short time frame. Excavation could disturb cultural resources contained at a site, and careful adherence to cultural resource mitigation planning would be required. 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. Using ERDF resources would not be required under this alternative in comparison to the Remove/Dispose Alternative. Potential impacts on future land use would be comparable to the Remove/Dispose Alternative. Disturbance of cultural resources could occur with this alternative, but not to the degree that would be required with the Remove/Dispose Alternative. Irreversible and irretrievable commitment of natural resources would occur with the No-Action Alternative because contaminants would remain on site, so human and ecological receptors would continue to be exposed. For radiological constituents, this exposure will remain until decay results in contaminant levels below concern. For nonradiological constituents, exposure may be very long term. There may be an impact on Native Americans because they are potentially more likely than other groups to use the area. No direct impacts would result from implementing this alternative.

1.2.2 Modified CRCIA Ranger/Industrial Exposure Scenario

1.2.2.1 Long-Term Effectiveness and Permanence

The Remove/Dispose Alternative provides a high degree of long-term effectiveness and permanence. No sources of risk above approved cleanup levels would remain at the site. All removed soils would be treated, if needed and if appropriate, with treatment residuals being disposed at the ERDF. No additional long-term restrictions for residential use at the waste site would be required following remediation with this alternative unless it is determined that wastes that could pose a direct exposure hazard may be left below 4.6 m (15 ft). In this case, restrictions on excavation below 4.6 m (15 ft) would be required. If appropriate, revegetation and restoration efforts could be implemented that have the potential to more rapidly restore ecological habitats to healthy, sustainable conditions than is currently possible through natural succession.

The Remove/Ex Situ Bioremediation/Dispose Alternative would compare similarly to the Remove/Dispose Alternative, but it would have the added advantage of returning all, or a significant part of the soil, to the site rather than sending it to the ERDF.

The In Situ Bioremediation Alternative would also provide a high degree of long-term effectiveness and permanence. No risks from TPH contamination would remain because the contaminants would be destroyed, assuming complete treatment. However, it may be impossible to determine whether the treatment reaches all of the contamination. Post-remediation monitoring would be required.

The Containment and In Situ Solidification Alternatives perform relatively equally on long-term effectiveness and permanence, but neither performs as well as the Remove/ Dispose Alternative. While contaminants are left in place under both alternatives, for the near term, human health and the environment are considered protected. Both alternatives have the potential for long-term failure (i.e., containment through failure of the barrier and in situ solidification through incomplete treatment or deterioration of the solidified matrix). Long-term post-closure monitoring, including maintenance of barriers, would be required with these alternatives. Revegetation is considered to have a good probability for success with these alternatives, but wastes would be left in place and would limit complete restoration.

The No-Action Alternative does not offer long-term effectiveness and permanence. Contaminants would remain in near-surface and subsurface soils above levels protective of human health and the environment. Sources of contamination that could contribute to groundwater contamination would remain. No revegetation or restoration efforts would be included with this alternative.

1.2.2.2 Reduction in Toxicity, Mobility, or Volume

The Remove/Dispose Alternative would potentially provide reduced toxicity, mobility, or volume through application of treatment technologies, as appropriate for LDR compliance and ERDF waste acceptance. This alternative would remove wastes from the site, thereby reducing waste volume at the site. The Remove/ Ex Situ Bioremediation/Dispose Alternative might be employed for TPH where soil characteristics are amenable to the success of such a treatment technology. Ex situ and in situ bioremediation would reduce or destroy the toxicity of petroleum constituents through destruction. The reliability of technology and controls for ensuring complete treatment is less certain for in situ bioremediation.

Containment does not include a treatment option; however, a properly constructed engineered barrier would reduce the mobility of contaminants by reducing infiltration. Neither a reduction in toxicity nor volume is provided by this alternative.

The in situ solidification would reduce mobility through stabilization in the near term but would not reduce toxicity or volume of contaminants. Remobilization of contaminants could occur if the stabilized media degraded through time. Incomplete mixing of contaminants with the stabilization media could interfere with reduction in contaminant mobility, and some contaminants might not be stabilized to the same degree as others.

The No-Action Alternative would not reduce toxicity, mobility, or volume of contaminants in soils.

1.2.2.3 Short-Term Effectiveness

For the Remove/Dispose Alternative, a larger volume of contaminated soils would be generated relative to the other alternatives. This would require handling through excavation, treatment, and transportation, which would have the potential for inherently greater short-term impacts. Petroleum sites, as well as others, may have contamination at depth. Excavation to greater depths may increase short-term impacts to natural resources. During implementation, risks to workers from exposure to contaminated soils and fugitive dust or from accidents may increase; however, these risks can be effectively minimized through appropriate engineering controls and through health and safety procedures. Short-term impacts to vegetation and wildlife may be greatest with this alternative because it would disturb the largest land area. These impacts could be reduced through proper scheduling and implementation of the alternative. This alternative has the highest probability of impacting cultural resources in the short term simply due to the large land area impacted. Cultural resource locations are not precisely known; however, identification and mitigation of potential impacts would be addressed through the cultural resources mitigation plan.

Excavation impacts from the Remove/Ex Situ Bioremediation/Dispose Alternative would be similar to that of the Remove/Dispose Alternative. This alternative would take longer to be fully effective if determined to be appropriate. Therefore, at sites where treatment may be required, there may be more short-term disruption to the environment during this period. Transportation of wastes to ex situ

bioremediation facilities may increase short-term impacts relative to the in situ treatment. Ex situ bioremediation, however, is expected to provide clean fill material to offset the use of borrow material.

The In Situ Bioremediation Alternative is anticipated to require 5 to 25 years to complete at the two petroleum sites where it is applicable. Risks to workers from exposure to vented gases and fugitive dust or from accidents may be present during this time. However, these risks can be effectively minimized through appropriate engineering controls and through health and safety procedures. The potential for worker exposure to contaminated soils would be minimal during in situ treatment in contrast to the ex situ bioremediation option. Because little or no waste would be generated by in situ treatment, few transportation impacts are anticipated. Only equipment would be transported to and from the site. Risks to natural and cultural resources would be minimized. Short-term impacts to vegetation and wildlife may occur but could be avoided or reduced through appropriate design and implementation of the alternative. Cultural resources, if present, should not be impacted. If potential impacts are identified, they would be addressed through the cultural resources mitigation plan.

The Containment and In Situ Solidification Alternatives perform similarly with regard to short-term effectiveness. Both alternatives pose little risk to workers because they would not be exposed to contaminants during implementation. No contaminated soils would be transported. Transportation of materials and equipment for containment or solidification, and transportation of clean fill after containment, would increase traffic on haul roads. Short-term impacts to vegetation and wildlife could occur during the estimated 2- to 5-year restoration time frame, but these could be avoided or reduced through proper implementation of the alternative. Cultural resources, if present, should not be impacted. Identification and mitigation of these impacts would be addressed through the cultural resources mitigation plan.

The No-Action Alternative would not involve any remedial actions; therefore, risks to workers, transportation impacts, and short-term risks to natural and cultural resources would not occur.

1.2.2.4 Implementability

The Remove/Dispose Alternative performs most favorably for technical and administrative feasibility and the availability of services and materials. Technical problems in implementing excavation and disposal activities within this alternative are not expected.

Ex situ bioremediation implementability is dependent upon site-specific information, much of which could be obtained using the observational approach during excavation. Equipment required for implementation is readily available. However, should contamination be found at great depths, it may become less feasible to excavate. Due to the lack of soil characterization data, this potential would have to be evaluated during the design phase of this alternative. It might also be necessary to treat soil constituents to meet LDRs for which there is no immediately available treatment technology. Should it be found upon characterization that petroleum contamination exists at depth or that radionuclide or inorganic contaminants are present, this alternative would not be considered readily implementable.

There is less certainty regarding reliable implementation of in situ bioremediation because completeness of treatment cannot be accurately monitored. Characterization to determine the extent of remediation may be required. Equipment required for implementation is readily available.

Containment will be easy to implement; however, characterization of the extent of contamination will be required in order to properly locate the barrier. Technical problems causing delays are not anticipated. Large quantities of soil and rock material will be required for construction of the barrier; however, this material is considered available from sources within or near Hanford. The In Situ Solidification Alternative is considered less implementable than the Containment Alternative because of the potential for incomplete mixing of the treatment zone. Contaminants may be encountered that are not effectively treated through this technology. Problems in ensuring complete treatment could result in remediation delays. As with containment, further characterization of the extent of contamination will be required to determine proper treatment. Materials needed for implementation are considered readily available.

The No-Action Alternative would be easy to implement, but would not be consistent with DOE's long-range objective.

1.2.2.5 Cost

Cost estimates for the source sites in DOE/RL-95-111, Rev. 0 were, in general, developed using either the MCACES or the RACER package. Total costs presented in this section include neither a 3 percent design cost nor a 3 percent data collection cost. Details of the cost estimates are presented in Permit Attachment 47, Appendix G.

As has been noted earlier in this report, data on site-specific contamination, site locations, and site dimensions were limited, and this introduces uncertainty in the cost estimates. The quality of a cost estimate is directly related to the quality of the input data used in the models. Despite this uncertainty it is believed that the cost estimates are of sufficient quality to fulfill the primary objective, which is to aid in selecting preferred remedial alternatives. How representative these estimates might be of actual remediation costs is more difficult to answer and will not be resolved until the uncertainties in the data are resolved.

The No-Action Alternative would require no additional cost and is not considered further in this comparative analysis.

Individual cost estimates for each waste site, exposure scenario, and remedial alternative are presented in Table 6.2. Five remedial alternatives (Remove/Dispose, Remove/Ex Situ Bioremediation/Dispose, In Situ Bioremediation, Capping, and In Situ Solidification) have been proposed for the modified CRCIA ranger/industrial exposure scenario. The evaluation of alternatives for the sites with petroleum contamination is the same as just presented for the rural-residential scenario and concludes that in situ bioremediation is the least expensive alternative for the two deep petroleum sites and remove/dispose for the near-surface petroleum sites.

Capping is considered for 5 clusters of waste sites to cover a total of 16 sites. As shown in Table 7.6, the cost of remediating 16 sites by capping is about $65,000,000 versus $2,400,000 for the Remove/Dispose Alternative for 20 sites. This is 27 times the cost of the Remove/Dispose Alternative. Additionally, the Remove/Dispose Alternative is less expensive than capping at all five cap sites. Although it may appear that some sites could be capped at less cost than the Remove/Dispose Alternative, this is deceptive. These costs reflect the cost of capping a cluster of sites and must be evaluated as a group because the costs are shared among the several sites within the cluster. When evaluating capping costs it is necessary to keep in mind that this cost estimate is based upon using a specific barrier, the Modified RCRA Subtitle C barrier. This is perhaps one of the most expensive barrier options. It was selected for use in DOE/RL-95-111, Rev. 0, because there was limited site-specific data with which to make a decision. As additional data is collected during the design process, other, less expensive cap designs may be appropriate.

In situ solidification is considered for the 16 capping sites and 4 additional ones. As shown in Table 7.6, the cost of remediating 20 sites by in situ solidification is about $6,600,000 as opposed to $3,100,000 for the Remove/Dispose Alternative. This is over two times the cost of the Remove/Dispose Alternative. Additionally, the In Situ Solidification Alternative was more expensive than the Remove/Dispose Alternative at all 20 sites. A summary of these results is presented in Table 7.7. The least cost alternative for the modified CRCIA ranger/industrial scenario is to select the Remove/Disposal Alternative for all sites except the two deep petroleum sites. This produces a cost saving of 7 percent over using the Remove/Dispose Alternative for all sites.

There are many uncertainties dealing with developing cost estimate for sites with limited site-specific information. As already noted, for example, limited data lead to the selection of an expensive cap design.

1.2.2.6 NEPA Values

By definition, the modified CRCIA ranger/industrial scenario requires more of a commitment of onsite resources than does the residential exposure scenario. At the same time, there would be less commitment

of ERDF resources because less soil may require excavation and disposal. There would also be less impact on cultural resources, and fewer cumulative impacts under a modified CRCIA ranger/industrial exposure scenario because of this. Restrictions on hunting and gathering are also inherent in the modified CRCIA ranger/industrial scenario defined in DOE/RL-95-111, Rev. 0.

An irreversible and irretrievable commitment of natural resources would occur with the Remove/Dispose Alternative. Contaminated soils would be removed and transported to the ERDF; therefore, there would be a commitment to use portions of that disposal unit for long-term waste management and the associated borrow pit commitment for ERDF cover. Excavated material would be replaced with clean fill topsoil (from the borrow pits), then revegetated to mirror more closely the native plant community existing prior to disturbance from 100-N Area activities. Future use of the river and adjacent lands would allow Native American use in concert with a modified CRCIA ranger/industrial exposure scenario in a relatively short time frame. Excavation could disturb cultural resources existing at a site, and careful adherence to cultural resource mitigation planning would be required. Cumulative impacts may occur at borrow sites and transportation routes.

The In Situ Bioremediation, Containment, and In Situ Solidification Alternatives perform similarly to the Remove/Dispose Alternative for key discriminators under this criterion with the exception that fewer ERDF resources would be utilized under these alternatives.

Irreversible and irretrievable commitment of natural resources would occur with the No-Action Alternative because contaminants would remain on site, and human and ecological receptors would continue to be exposed. For radiological constituents, this exposure would remain until decay results in contaminant levels below concern. For nonradiological constituents, exposure may be very long term. There may be an impact on Native Americans because they are potentially more likely to use the area than are other groups. No cumulative impacts would result from implementing this alternative.

1.3 Comparison of Remedial Alternatives for Groundwater

Table 7.8 presents the seven alternatives described in DOE/RL-95-111, Rev. 0, Section 5.0 for the remediation of groundwater underlying the 100-N Area and for protection of the Columbia River. It indicates which technologies are used within each remedial alternative to address the four issues considered to be critical for remediating the contaminated groundwater system at the 100-N Area. These four issues follow:

- Protection of the river from tritium.
- Protection of the river from Sr-90.
- Reduction of Sr-90 in the aquifer.
- Reduction of other contaminants in the aquifer.

In the comparative analysis of groundwater alternatives, no distinction is made between the rural-residential and modified CRCIA ranger/industrial exposure scenarios. No distinction is necessary because, under either exposure scenario, the existing beneficial uses of the Columbia River must be protected. The existing beneficial uses of the river include water supply, recreation, fish and wildlife habitat, hydroelectric power production, transportation, and agriculture.
The remedial alternatives must meet the appropriate ARARs for these beneficial uses, regardless of whether the exposure scenario is rural-residential or modified CRCIA ranger/industrial. Also, under both scenarios, it is assumed that the goal is to restore groundwater for beneficial uses. Therefore, no distinction is required with respect to aquifer remediation.

The No-Action Alternative is not considered a viable alternative because it does not meet overall protectiveness or compliance with ARARs. The No-Action Alternative is retained as the baseline case for comparison with the other alternatives that incorporate some active response action.

1.3.1 Long-Term Effectiveness and Permanence

1.3.1.1 Protection of the River from Tritium

Alternative 5 and Alternative 7 (Table 7.8) describe technologies to reduce tritium flux to the river (hydraulic controls or barrier with hydraulic controls) and therefore are equally effective in preventing the tritium from entering the river at concentrations above the MCL for tritium. The added impermeable barrier in Alternative 7 may provide some degree of protection above hydraulic controls alone for tritium, but the differences are considered neither quantifiable nor great because tritium is easily controlled hydraulically. Both are considered comparable in their reliability of controls, as well. The other alternatives do not include any action to prevent tritium from entering the river except through decay (although Alternative 4 might coincidentally prevent tritium discharge through hydraulic controls placed on the Sr-90 plume). For alternatives 1, 2, 3, and 6, the tritium reaching the river will exceed Maximum Containment Levels (MCL) for approximately 15 years.

1.3.1.2 Protection of the River from Sr-90

Alternatives 1 and 2 do not include any action to prevent Sr-90 from entering the river; therefore, they provide a basis for comparison to the other alternatives. Taking no physical action, the Sr-90 concentrations in the groundwater/river interface will decay to concentrations below MCLs over a 300-year period. The remaining five alternatives use three different technologies to reduce the Sr-90 flux to the river: a permeable barrier (Alternative 3), hydraulic controls (Alternatives 4 and 5), and impermeable barriers (Alternatives 6 and 7). These three technologies for reducing flux may be interchanged within the three alternatives to accomplish this objective.

Although these technologies reduce flux of Sr-90 discharging to the Columbia River (i.e., mass of Sr-90 per unit time moving through the aquifer into the river), none of the alternatives are expected to significantly reduce Sr-90 concentrations entering the river above MCLs because a section of aquifer next to the river would be essentially unaffected by the technologies, and the slow release of the Sr-90 adsorbed onto the aquifer soils in this section would continue. This is true with all alternatives because a section of land remains between the river and the barrier in all cases--either by a physical barrier (impermeable or permeable) or a hydraulic barrier. This phenomenon is due to the sorbing ability of Sr-90 on soils, which retard dissolution in the groundwater, as described in DOE/RL-95-111, Rev. 0, Sections 3.0, and 5.0. The impact of this Sr-90-contaminated area adjacent to the river on concentrations at the groundwater/river interface is not anticipated to decrease significantly faster than the decease that will occur solely because of natural decay. However, comparatively, hydraulic controls contained in Alternatives 4 and 5 may potentially reduce concentrations at the groundwater/river interface more effectively than the other alternatives, although not significantly, because of the net gradient effect. For example, the net groundwater flow in the aquifer immediately adjacent to the river is inland, with hydraulic controls in place, while the net groundwater flow with the barriers is toward the river. A permeable barrier (Alternative 3) is expected to be the next best alternative for reducing Sr-90 concentrations in the groundwater/river interface, with the impermeable barrier (Alternatives 6 and 7) being the least effective in reducing concentrations of Sr-90.

All alternatives (except 1 and 2) are expected to reduce flux of Sr-90 to the river by more than 90 percent. The Hydraulic Control Alternatives, because they reverse the groundwater flow near the river shoreline, are probably more effective than the other alternatives for reducing flux, and might be more effective in reducing concentrations of Sr-90. However, this increase in effectiveness has not been quantified. The Impermeable Barrier Alternatives would rank next in ability to reduce Sr-90 flux, with the Permeable Barrier Alternative ranking the least effective among Alternatives 3 through 7.

Relative to risk, reducing the flux of Sr-90 to the river may not be of great importance. Currently, the most stringent ARAR for Sr-90 is based on an MCL, which is established for the purposes of achieving human health protection from the use of surface or groundwater as a drinking water source. Decreasing the flux of Sr-90-contaminated waters to the river is inconsequential with respect to using the river as a drinking water supply, because of the near instantaneous reduction of Sr-90 concentrations that occurs

near the groundwater/river interface. DOE/RL-95-111, Rev. 0, Section 3.3.5 describes Columbia River water quality relative to Sr-90, and it concludes that concentrations in the river are consistently below MCLs for Sr-90. However, the seeps located at N-Springs on the river bank adjacent to the 116-N-1 Crib do exceed MCLs, and institutional controls would be required to restrict this area of the river from use as a drinking water source.

With the exception of N-Springs, Sr-90 does not threaten the Columbia River as a drinking water source. In contrast, however, concentrations of Sr-90 in the sediments at the groundwater/river interface may be harming aquatic organisms. Site-specific data related to ecological effects may not be complete, and in any case, no alternatives are capable of substantially decreasing these concentrations or significantly reducing the time frame for achieving a protective concentration.

1.3.1.3 Reduction of Sr-90 in the Aquifer

Alternatives 1, 2, and 3 do not include any action to reduce the Sr-90 contamination in the groundwater, but Alternatives 2 and 3 include institutional controls to prevent exposure to humans from use of the groundwater until Sr-90 decays to acceptable levels, thereby providing a measure of long-term protectiveness. Alternative 3 does, however, immobilize large quantities of Sr-90 through capture in the permeable barrier. This capture does not change concentrations of Sr-90 in the groundwater upgradient of the barrier due to the equilibrium that will occur between soil and groundwater, but it will immobilize a large mass of Sr-90 from the aquifer. This immobilization action may not contribute much to reducing Sr-90 concentrations at the groundwater/river interface as described above.

Alternatives 4, 5, and 6 are more effective in reducing Sr-90 in the aquifer than the first three alternatives because these alternatives include pump-and-treat systems. They do not, however, have a significant increase in effectiveness because the alternatives only achieve a 10 percent reduction in the time to attain the remediation goal – 270 years versus 300 years. Alternative 7 (soil flushing) has the potential to be more effective and result in a shorter restoration time frame than any of the other alternatives. However, at this stage, it is considered an innovative technology for Sr-90 in the aquifer and for the site-specific conditions of the 100-NR-2 OU. A series of laboratory, bench, and field-scale tests would be required before a decision on the feasibility of soil flushing could be made. Because of this requirement, no objective comparison of soil flushing can be made against the other alternatives in DOE/RL-95-111, Rev. 0.

1.3.1.4 Reduction of Other Contaminants in the Aquifer

Alternatives 1 through 4 include no action to reduce the contamination in the aquifer from other contaminants; therefore, they are not compared against each other for long-term effectiveness and permanence. The other contaminants include nitrate, sulfate, manganese, chromium IV, and TPH. Some migration of those contaminants will occur over time. Utilizing travel-time predictions contained in DOE/RL-95-111, Rev. 0, Appendix D, gross predictions of natural migration can be made. These predictions are based on modeling assumptions that may not account for the heterogeneity inherent in the groundwater/river system over time.

However, since groundwater at the 100-N Area flows into the river, the travel time for peak concentrations to reach the river roughly equates to the time required for natural migration of the contaminant from the aquifer (DOE/RL-95-111, Rev. 0, Appendix D).

Nitrate may migrate from groundwater to the river within 10 to 20 years. Sulfate may migrate from groundwater to the river in 5 to 15 years. Chromium VI may migrate to the river in 15 to 25 years. Manganese may take over 3,000 years to migrate from groundwater to the river. Migration times for TPH cannot be estimated because the product will continue to float on top of the aquifer for an indeterminate, but probably long, period of time.

It should be noted that chromium VI concentrations are based on data from a small number of wells and that there is no discernible plume. Also, since manganese and sulfate Primary Remediation Goals (PRG)

are based on secondary MCLs, the need for remediating these two contaminants may not be as critical as for the other contaminants.

Alternatives 5, 6, and 7 all rely upon the same pump-and-treat technology for remediation of the other contaminants. Pump-and-treat technologies can be effective in the long term because they permanently remove contaminants from the environment. It is anticipated that pump-and-treat technologies will decrease restoration time frames for groundwater protection as follows: nitrates, 5 years; sulfates, 5 years; chromium VI, 1 year; manganese, 88 years; and TPH, 5 years.

Given these estimates, long-term effectiveness can be achieved earlier with pump-and-treat technology than with natural migration:

- Nitrates may be remediated in the aquifer 5 to 15 years earlier.
- Sulfates may not be remediated in the groundwater at a significantly faster rate than could be achieved by natural migration.
- Chromium VI may be remediated 15 to 25 years earlier.

Manganese may be remediated over 3,000 years earlier.

- TPH may be remediated many years earlier, but time frames cannot be estimated.

Groundwater monitoring after cleanup would be required for a time to ensure that all of the plumes have been captured.

1.3.1.5 Summary

Seven alternatives have been compared that meet (except for no action) all or part of the needs for long-term effectiveness and permanence. For tritium river protection, Alternatives 5 and 7 are anticipated to provide, most effectively, long-term protection. Other than the No-Action Alternative, all of the alternatives that could be implemented are comparable for long-term effectiveness and permanence for addressing the Sr-90 releases to the river. An estimated 90 percent reduction in the mass of Sr-90 entering the river will result through utilization of Alternatives 3, 4, 5, 6, or 7 as opposed to an Institutional Controls Alternative. However, reduction in mass is anticipated to have little human health or environmental benefit. Reduction in the restoration time of Sr-90 concentrations is not anticipated to be significantly different for any of the alternatives with the possible exception of Alternatives 4 and 5 due to the net gradient effect of bringing clean river water inland.

For Sr-90 reduction in the aquifer, no alternative will resulting in remediation of Sr-90 to groundwater protection standards more rapidly than will natural attenuation, with the possible exception of soil flushing. Alternative 7 has the potential to improve the long-term effectiveness by shortening the time to meet remedial goals, but it is an innovative technology for Sr-90-contaminated soils at Hanford, and it must be the subject of further testing and evaluation before a decision on its use can be made. Alternative 7 has the potential for risks to natural resources by expansion of the Sr-90 plume, potentially to the river, if soil flushing is not carefully implemented. Given the uncertainties at this time relative to safe implementation of this option, these risks remain unknown.

Alternatives with pump and treat will reduce nitrate, chromium VI, and manganese (the latter two if proven to be a contaminant of concern (COC) upon further results of monitoring) at a faster rate than would be achieved through natural migration of contaminants in the aquifer. However, this improvement may not be significant when it is considered that a significant portion of the aquifer will remain unusable during the period of Sr-90 contamination.

1.3.2 Reduction in Toxicity, Mobility, or Volume through Treatment

For protection of the river from tritium, Alternatives 1 through 4 contain no treatment element and therefore would not reduce toxicity, mobility, or volume (i.e., mass) of tritium. Alternatives 5 and 7 reduce the mobility of the tritium to the river by establishing barriers to the flow to the river.

For protection of the river from Sr-90, Alternatives 1 and 2 contain no treatment element for Sr-90 and therefore would not reduce toxicity, mobility, or volume (i.e., mass) of Sr-90. Alternatives 3 through 7 would decrease the flux of Sr-90 entering the river by around 90 percent. Differences between these alternatives (permeable barrier, impermeable barrier, and hydraulic controls) are considered neither quantifiable nor great.

Alternatives 1 through 3 do not contain a treatment element for Sr-90 reduction in the aquifer. Alternatives 4 through 6, which have barriers to the river and pump-and-treat systems, compare favorably with respect to Sr-90 reduction in the groundwater; however, reductions in mobility, and/or volume are neither quantifiable nor great. Alternative 7 has the greatest potential for mass reduction, but will require that a test program be implemented before this alternative could be adequately compared with other alternatives.

For reducing other constituents in the aquifer, Alternatives 5 through 7, which have pump-and-treat systems, will reduce contaminant toxicity, mobility, and/or volume, dependent upon the specific constituent, to a higher degree than Alternatives 1 through 4.

1.3.3 Short-Term Effectiveness

None of the alternatives is expected to have significant short-term impacts on the community during implementation. No alternative will remediate the river or aquifer for Sr-90 within 270 years. Alternative 1, followed by Alternative 2, has the lowest short-term impacts associated with worker risk, as well as the lowest ecological, cultural, and transportation impacts from system installation. The greatest potential impacts to natural and cultural resources are from installation of barriers. Alternatives 4 and 5, which use wells rather than barrier, have less short-term impact than the barrier alternatives (Alternatives 3, 6, and 7) that use excavation techniques or cryogenics. Alternative 7 has the potential for risks to natural resources by expansion of the Sr-90 plume, potentially to the river, if soil flushing is not carefully implemented. Given the uncertainties at this time relative to safe implementation of soil flushing, these risks remain unknown.

1.3.4 Implementability

All alternatives, with the exception of the No-Action Alternative, will require institutional controls that will require some maintenance for close to 300 years. The technical and administrative feasibility of maintaining these controls is uncertain, but it is a comparable implementability issue for every alternative.

All three barriers are expected to be implementable, but each presents a concern because they represent a new application at Hanford. A treatability test plan is being considered for evaluation of the construction of the permeable wall in Alternative 3. This would help to refine this determination. Alternative 6 introduces some concerns because of the need to freeze the ground near the river and because of the need to maintain its integrity over 300 years. Alternative 7 presents implementability concerns regarding sheet pile installation because of past problems in installing a sheet pile barrier at Hanford. However, the alternative sheet pile installation method proposed in Alternative 7 is expected to resolve past concerns. There is little basis to distinguish between these alternatives with respect to barrier construction; however, all of the construction alternatives will require collection of additional information at the design stage.

Alternatives 4, 5, and 7 are less implementable than institutional controls because they involve installation of a complicated hydraulic control system. Hydraulic controls are subject to breakdown, and, as such, would not be effective 100 percent of the time. However, these alternatives are still technically and administratively feasible. Hydraulic control systems like the one contemplated in these alternatives would be similar to a system already in place at Hanford; therefore, these alternatives are considered more implementable than barrier construction alternatives.

The soil flush portion of Alternative 7 is not considered implementable without first successfully completing a series of laboratory, bench-scale, and field tests.

Alternatives that involve pump-and-treat systems for Sr-90 and/or other contaminants are considered less implementable than Alternatives 1 or 2.

In all of the alternatives, there is a strip of land along the river shoreline that is contaminated with Sr-90. The soil in this strip does not meet PRG levels for the rural-residential scenario and may not meet them for the modified CRCIA ranger/industrial exposure scenario. Remediation of the shoreline area would be difficult. The remove and dispose remedial alternative proposed for source waste sites could be implemented along the river shoreline, but would require excavation and backfilling to 4.6 m (15 ft) or 3 m (10 ft) for the rural-residential and modified CRCIA ranger/industrial scenarios, respectively. Such remedial actions would destroy the ecology of this riparian zone and possibly undercut the bluff along the shore, causing further destruction. Such actions may only provide temporary relief because there will likely be recontamination from upgradient groundwater. Additionally, the area appears to be within the Columbia River flood plain and residential construction may be limited or prohibited. Institutional Controls has been recommended in all of the alternatives (except No-Action) to ensure limited access to this area.

1.3.5 Cost

A summary of the cost estimates for each groundwater remedial alternative is presented in Table 7.9, and information that is more detailed is presented in Permit Attachment 47, Appendix G2. A simple quantitative comparison, as shown in Table 7.9 is not sufficient for evaluating the alternatives, since the alternatives represent different levels of remediation. An incremental analysis would be more appropriate. In this type of analysis, each alternative (or each group of alternatives with a similar level of remediation) is compared to the alternative with the next lowest level of remediation.

Alternative 1 includes no remediation because it proposes to do nothing and it costs nothing. Alternative 2 is similar to Alternative 1 in that it includes no remediation, but it proposes institutional controls such as warning signs and land-use restrictions. The total cost of institutional controls is $762,826.

Alternative 3 includes a remedial technology to prevent Sr-90 from entering the river. Constructing a clinoptilolite barrier will not prevent all Sr-90 from entering the river, but it will substantially reduce the amount. Strontium-90 will decay to an acceptable level in about 300 years. This degree of remediation will cost $8,499,399 more than Alternative 2, for a total cost of about $9,262,125. The objectives of Alternative 3 could also be met by using the hydraulic controls technology from Alternative 4 or the impermeable barrier technology from Alternatives 6 or 7.

In Alternative 4, the clinoptilolite barrier is replaced by hydraulic controls, which further reduces the amount of Sr-90 that will reach the river (although with less certainty). Additional remediation is provided by Alternative 4 in that a pump-and-treat system is used to remediate the Sr-90 that is present in the groundwater. The pump-and-treat system will extract Sr-90 from the aquifer and thereby reduce the mass of the contaminant. Operating the pump-and-treat system will reduce the time it takes to remediate the groundwater by about 10 percent, from 300 to 270 years. The cost of shortening this period by 30 years is about $4,983,489 more than Alternative 3, for a total of about $14,245,714.

Alternative 5 provides additional remediation by extending the hydraulic controls to protect the river from tritium, as well as Sr-90, and by to remediating the other contaminants (nitrate, iron, sulfate, manganese, TPH, and chromium VI) in the groundwater. Meeting this last objective is accomplished by operating a pump-and-treat system for the other contaminants. This pump and treat would shorten the time for the concentrations of these contaminants to reach acceptable levels in the groundwater, but it would not shorten the time until the groundwater would be available for use. The concentrations of these contaminants would be at acceptable levels (with no action) well before the Sr-90 concentration reached an acceptable level. The cost of the additional remediation is about $24,920,116 more than Alternative 4, for a total cost of about $39,165,605.

Alternative 6 actually results in less remediation than Alternative 5 because it replaces the hydraulic controls for protecting the river from Sr-90 with a cryogenic barrier that will not provide total protection from tritium. This alternative is not as effective as hydraulic controls used in preventing the Sr-90 from reaching the river. In this alternative, the protection of the river from tritium is not included as it was in

Alternative 5. These changes in remediation reduce the cost of Alternative 6 compared to Alternative 5 by about $17,492,921 to $56,658,526.

Alternative 7 has the potential to provide a greater degree of remediation than any of the other alternatives because it proposes to significantly shorten the time it will take for the Sr-90 concentration in the groundwater to reach acceptable levels. Because this alternative is still in the development and evaluation stage, a reliable estimate of what this reduction in time might be cannot be made. This alternative costs $79,872,099 more than Alternative 6, for a cost of $136,530,625. This alternative is in the development stage, and this cost estimate is not as reliable as the estimates for the other alternatives.

1.3.6 NEPA Values

An interim (270 to 300 years) irreversible and irretrievable commitment of the unconfined aquifer and river shoreline would result with all alternatives because none would effectively reduce Sr-90 concentrations in the aquifer or river bank seeps within a shorter time. Also, none are effective in reducing Sr-90 concentrations at the groundwater/river interface. Aquatic resources at the groundwater/river interface may be impacted; however, more information must be acquired before impacts can be quantified. Restrictions on the use of the shoreline by humans may be required for a long period of time, regardless of the alternative chosen. Use of the river as a downstream drinking water supply or for other uses such as fishing will not be impacted by implementation of any alternative. Restrictions on the use of the groundwater will be required for 300 years under Alternatives 1 through 3 and for 270 years under Alternatives 4 through 6. Alternative 7 may result in use of the groundwater in a shorter time frame if soil flushing can be successfully implemented, but reduction in years cannot be quantified at this time. Alternative 6 may require a large expenditure of energy in order to initially implement the cryogenic barrier. There may be an impact on Native Americans because they are potentially more likely than other groups to use the area.

1.4 Interim Action for Remediation of Groundwater

1.4.1 Potential for Implementing an Interim Action

An interim action for the 100-NR-2 groundwater OU may be warranted. Within the detailed and comparative analyses of alternatives for remediation of the groundwater, certain analyses have been complicated by a lack of information in two critical areas: confirmation that an alternative can or cannot significantly shorten restoration time frames from that of natural attenuation (300 years), and quantification of current and future risk to aquatic receptors living in the river and in river bottom substrate. A summary of these information needs and their significance in making a remedy decision is presented below.

1.4.1.1 Groundwater Remediation for Sr-90

No Sr-90 groundwater remedial alternative has been identified in DOE/RL-95-111, Rev. 0 that would provide a significantly shorter restoration period than the estimated natural attenuation period of 300 years. Soil flushing was identified as an innovative technology that could potentially shorten groundwater remediation. However, the lack of information regarding its implementability, safety, and cost raises doubts as to its technical feasibility.

State and public acceptance of a 300-year groundwater remedial action may be very difficult to obtain. Maintenance of a long-term remedy and its associated institutional controls would also be difficult over such an extended time frame. Because of the problems inherent with a long-term remedy and because of the lack of information supporting innovative technologies such as soil flushing, an interim action on groundwater remediation may be warranted.

River Protection from Sr-90. Data on Sr-90 impacts to aquatic resources are incomplete. Should it be concluded that there are no impacts to aquatic resources from Sr-90 contamination, no remediation for protection of the river would be necessary. Conversely, should it be concluded that substantial impacts exist, actions that are more aggressive may be warranted.

The existing alternatives may remove or prevent 90 percent or more of the Sr-90 mass within the aquifer from entering the river. However, the fate of approximately 5 Ci of Sr-90 in the soil (aquifer sediments) in the strip of land adjacent to the river is not well understood. The ability of any of the selected technologies to remove the Sr-90 from the aquifer sediments adjacent to the river is unknown. As detailed in Section 7.3.1.2, it is the persistent Sr-90 concentrations in this area that will cause long restoration time frames for protection of the river even if the movement of contaminated groundwater to the river is significantly reduced. Further evaluation of these technologies and their capabilities in this area may be warranted.

The lack of information on technologies and receptors may be deemed by the regulatory agencies, DOE, and the public to be of critical importance to the determination of a final remedy for the 100-NR-2 OU. Because of this, an interim action may be necessary in order to provide adequate time for investigations designed to support the selection of a final remedy. The length of the interim action will depend upon the type and scope of interim investigations needed. However, it is anticipated that an interim action would be planned and executed for approximately a 5-year period. At the conclusion of this period, the need to continue the interim action would be evaluated.

1.4.2 Remedial Action Objective for a Groundwater Interim Action

No alternative has been identified that can remediate the groundwater or protect the river in less than 270 years. The purpose for an interim action at this OU would be to:

- 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
- Take action consistent with the likely final remedies.

Remedial alternatives would be chosen that would act in concert with these objectives and be capable of providing further information for use in making a final alternative determination. Because of the uncertainties associated with ecological risk in the area along the river, and in the river bottom substrate, an alternative that controls the movement of Sr-90 to the groundwater-river interface would be an added objective of the interim action.

1.4.3 Remedial Technology Descriptions for an Interim Action

Viable remedial alternatives to achieve the interim remedial action objective should provide the most efficient use of budgetary resources and be consistent with any potential final remedy. It is evident using this basis that none of the final action alternatives presented in Section 7.3 that include long-term physical barriers would be appropriate for an interim action. Construction costs for these barriers are estimated at $8,200,000 for a permeable barrier (Alternative 3), $16,500,000 for a cryogenic barrier (Alternative 6), and $8,600,000 for a soil flush system that incorporates a sheet pile barrier (Alternative 7). The soil flush system associated with Alternative 7 is considered to be too speculative and costly at this time to be considered for an interim use. The physical barriers could potentially preclude the implementation of final remedies that do not incorporate the chosen barrier in the final action, or conversely would require removal costs to implement a different final remedy. Therefore, all alternatives associated with these physical barriers have been screened from consideration as viable interim actions.

The objectives of the interim action could be met by implementing hydraulic controls using a pump-and-treat system such as described in Alternative 4, or just by implementing the hydraulic control portion of such a system. Since this is for an interim action, the full system described as Alternative 4 would not be needed. The existing N-Springs Expedited Response Action (ERA) (as modified to optimize costs) could be used to fulfill the interim action objectives, operated as either a hydraulic control or a pump-and-treat operation.

The remedial alternatives that would remain as possible interim actions are: No-Action; Institutional Controls; Hydraulic Controls; and, Pump and Treat. These alternatives are compared below against

applicable interim action CERCLA criteria. This comparison has been performed for the purpose of supporting the selection of a remedial alternative should an interim action be recommended.

1.4.3.1 No-Action and Institutional Controls

Descriptions of the technologies included in these alternatives are contained in DOE/RL-95-111, Rev. 0, Sections 5.4.1 and 5.4.2, respectively. Components of the Institutional Controls Alternative specific to Sr-90 would apply during an interim action.

1.4.3.2 Pump-and-Treat Alternative

A full description of the pump-and-treat system and operating plan is described in (DOE-RL 1997). This system would consist of four extraction wells, an ion exchange treatment skid, two injection wells, and plant equipment such as piping, electrical equipment, and instrumentation. The extraction well network would include wells N-75, N-103A, N-105A, N-106A (although well N-105A is not being used), located downgradient of the 1301-N Crib. The pump-and-treat system would be operated continuously at a nominal rate of 228 L/min (60 gal/min) with an average removal of 90 percent for the volume of water treated over a given period. Water from the extraction wells would be pumped to a large influent tank located at the treatment facility. The influent tank acts as a surge tank and provides feed water to the treatment system.

The four ion exchange columns would each contain 1.4 m3 (50 ft3) of clinoptilolite (clino), a natural zeolite. Contaminated water would be pumped from the influent tank through the four clino-containing ion exchange columns, where the Sr-90 would be removed from the water. The clino would be changed out on a cycle duration that results in an average removal rate greater than or equal to 90 percent. The treated water would be discharged into a large effluent tank. The effluent tank acts as a surge tank and provides feed water to the injection well network.

The injection well network would include wells N-29 and N-104A, which are located upgradient of the 1301-N Crib. The processed water would be injected into both wells.

1.4.3.3 Hydraulic Controls Alternative

The Hydraulic Controls Alternative would consist of the same extraction and injection systems as in the Pump-and-Treat Alternative described above. The flow of contaminated liquid would bypass the treatment system and be injected without treatment.

1.4.4 Detailed Analysis of Remedial Alternatives for Groundwater Interim Action

Alternatives applicable to an interim action are compared against the CERCLA criteria described in DOE/RL-95-111, Rev. 0, Section 6.0, which for the most part would apply to an interim action. However, the long-term effectiveness criterion would not be applicable to an interim action, and the costs presented in DOE/RL-95-111, Rev. 0, Section 6.0 would not be applicable for the interim period. Interim costs are presented in Table 7.10.

1.4.4.1 No-Action Alternative

The No-Action Alternative (Alternative 1) discussed in DOE/RL-95-111, Rev. 0, Section 6.3.2.1 is retained for interim action as a baseline for comparison. This alternative is, however, not realistic since DOE is maintaining Institutional Controls in this area in connection with other activities. No costs are associated with the No-Action Alternative.

1.4.4.2 Institutional Controls Alternative

The Institutional Controls Alternative (Alternative 2) is discussed in DOE/RL-95-111, Rev. 0, Section 6.3.2.2. The detailed analysis of CERCLA criteria for this alternative as it relates to Sr-90 final remediation would be applicable to an interim action as well, with the following exceptions: (1) the NEPA values define irreversible and irretrievable commitments for the long-term action, which would not be applicable in the short term; (2) impacts on Native American access to cultural resources would not be applicable in the short term; and (3) no additional costs would be associated with the Institutional

Controls Interim Alternative because DOE would maintain its present system of site controls during the interim period. Other facilities and circumstances require institutional controls to continue; therefore, additional costs need not be considered for the interim action alternative.

1.4.4.3 Hydraulic Controls Alternative

A hydraulic controls system is discussed in DOE/RL-95-111, Rev. 0, Section 6.3.2.4 as a river protection technology within Alternative 4. The detailed analysis of CERCLA criteria relative to Sr-90 remediation that is presented in DOE/RL-95-111, Rev. 0, Section 6.3.2.4 would be applicable to an interim action, with the following exceptions: (1) the NEPA values define irreversible and irretrievable commitments for the long-term action, and this would not be applicable in the short term; (2) impacts on Native American access to cultural resources would not be applicable in the short term; and (3) a cost-effectiveness study (DOE-RL 1997) of operating the ERA pump-and-treat system at various treatment levels was recently completed. This study noted that no capital cost would be associated with operating this system since it is already in place. A cost analysis (Permit Attachment 47, Appendix G) based on that study shows that the hydraulic control system could operate at $261,900 per year. This cost includes an expanded well monitoring system but no treatment costs.

1.4.4.4 Pump-and-Treat Alternative

A pump-and-treat system is discussed in DOE/RL-95-111, Rev. 0, Section 6.3.2.4 as a groundwater remediation technology within Alternative 4. The detailed analysis of CERCLA criteria relative to Sr-90 remediation that is presented in that section would be applicable to an interim action, with the following exceptions: (1) the NEPA values define irreversible and irretrievable commitments for the long-term action, which would not be applicable in the short term; (2) impacts on Native American access to cultural resources would not be applicable in the short term; and (3) a cost-effectiveness study (DOE/RL-1997) of operating the ERA pump-and-treat system at various treatment levels was recently completed. This study noted that no capital cost would be associated with operating either system since the systems are already in place. A cost analysis (Permit Attachment 47, Appendix G) based on that study shows that the pump-and-treat system could operate at $329,100 per year. This cost includes a reduced well monitoring system and treatment costs.

1.4.5 Comparative Analysis of Remedial Alternatives for Groundwater Interim Action

The following information provides a comparison of the four interim action alternatives utilizing applicable CERCLA criteria. A discussion of how these alternatives compare for final remedy purposes is included in Sections 7.3.1 through 7.3.6. As stated in Section 7.1, the overall protection and ARAR compliance criteria have not been included in this comparative analysis because all alternatives retained (excluding the No-Action Alternative) meet these threshold criteria except for discharge limits for the discharge of groundwater MCLs, which would not be met. This, however, is an interim action. State and community acceptance will not be evaluated until after the proposed plan has been issued; therefore, they also are not part of this comparative analysis.

1.4.5.1 Long-Term Effectiveness and Permanence

This criterion would not apply to interim action.

1.4.5.2 Reduction of Toxicity, Mobility, or Volume through Treatment

Only the Pump-and-Treat Alternative would reduce Sr-90 mass in the groundwater through treatment. However, this reduction is not significant compared to what would occur by natural attenuation, or by implementing one of the other alternatives. The Hydraulic Controls and Pump-and-Treat Alternatives would significantly reduce the flux of Sr-90 towards the river, thus reducing the mobility of the major contaminant in the 100-N Area. None of the alternatives would provide for a shorter restoration time frame because none would remediate the groundwater or protect the river at the conclusion of the interim measure.

1.4.5.3 Short-term Effectiveness

The Pump-and-Treat and Hydraulic Control Alternatives are already in place as a result of the N-Springs ERA (DOE-RL 1996g, 1997). Therefore, short-term impacts from these alternatives would be small and associated primarily with worker risk from continued operation of these systems. Because pump-and-treat contains two operating systems, the hydraulic control system and the ion exchange treatment system, it would have a slightly higher potential for short-term worker risk during O&M than the Hydraulic Control Alternative. However, the short-term impacts would not be significantly different from the other interim action alternatives. Only minor, if any, short-term physical, biological, or cultural impacts would result from any of the alternatives.

1.4.5.4 Implementability

As a short-term action, all four of the alternatives would be considered technically and administratively feasible. Implementability would not be significantly different for any of the alternatives. No action would be the easiest alternative to implement; however, implementation of this alternative would not be viable because the DOE will continue to maintain restrictions and controls over the 100-N Area groundwater for purposes other than 100-NR-2 remediation. Institutional controls are already in place as part of the DOE operation of the Hanford Site. Hydraulic control implementation, required for both the Pump-and-Treat and Hydraulic Controls Alternatives, would be less implementable than the No-Action or Institutional Controls Alternatives due to the continued operation of a complicated hydraulic control system that could be subject to breakdown. Finally, because pump and treat contains another operating system, it would be slightly less implementable compared to hydraulic controls.

1.4.5.5 Cost

The detailed analysis in Section 7.4.4 showed that there were no additional costs associated with the No-Action and Institutional Controls Alternatives, because these interim action alternatives would not require actions beyond what is currently in place. A comparative cost analysis (Table 7-10) for a 5-year period shows that Hydraulic Controls, at a Present Worth cost of $1,153,109 is the second lowest cost alternative, after the No-Action and Institutional Controls Alternatives. The Pump-and-Treat Alternative is the most expensive alternative, at a Present Worth cost of $1,448,981.

1.4.5.6 NEPA Values

None of the alternatives would require construction of new systems. Impacts to wildlife from construction noise, and disturbance of the land area for construction of well systems, would therefore not occur from any alternative. Ecological, cultural, and natural resource reviews would not be required for any alternative. Impacts to aquatic resources are not anticipated to be significantly different for any of the four interim actions, because decreases in river-bottom and shoreline sediment concentrations during the interim period would not be appreciably different with any of the alternatives. Restrictions on the use of groundwater and river water in the vicinity of the 100-N Area would remain in the short-term regardless of which interim alternative is selected, due to continued DOE control over the Hanford Site in the time frame of the interim action.

Table 1.1. Applicable Remedial Alternatives for Source Waste Sites Assuming a Rural Residential Exposure Scenario.

Waste Group	No Action	Remove/ Dispose	In Situ Bioremediation
Radioactive	X	X	
Petroleum	X	X	X[a]
Inorganic	X	X	
Burn Pits	X	X	
Solid Waste	X	X	

[a] This alternative is only applicable to 2 out of 22 sites within the petroleum waste group.

Table 1.2. Applicable Remedial Alternatives for Source Waste Sites Assuming a Modified CRCIA Ranger/Industrial Exposure Scenario

Waste Group	No Action	Remove/Dispose	In Situ Bioremediation	Containment	Solidification
Radioactive	X	X		X[a]	X[b]
Petroleum	X	X	X[c]		
Inorganic	X	X			
Burn Pits	X	X			
Solid Waste	X	X			

[a] This alternative is only applicable to 16 out of 37 sites within the radioactive waste group.
[b] This alternative is only applicable to 20 out of 37 sites within the radioactive waste group.
[c] This alternative is only applicable to 2 out of 22 sites within the petroleum waste group.

Table 1.3. Cost Comparison of Remedial Action Alternatives for Deep Petroleum Source Sites[a]

(Applicable to both the Rural-Residential and Modified CRCIA Ranger/Industrial Exposure Scenarios)

Site	Remove/Dispose	In Situ Bioremediation	Percent Difference from Remove/ Dispose
UPR-100-N-17	$2,409,203	$ 903,509	
UPR-100-N-42	$2,842,571	$ 910,025	
Total Cost	$5,251,774	$1,813,534	-65%

[a] Costs do not include a 3 percent design cost and a 3 percent design data collection cost.
UPR = unplanned release

Table 1.4. Cost Comparison of Remedial Action Alternatives for Near-Surface Petroleum Source Sites[a]

(Applicable to both the Rural-Residential and Modified CRCIA/Ranger Industrial Exposure Scenarios)

Site	Remove/Dispose	Remove/Ex Situ Bioremediation/Dispose	Percent Difference from Remove/Dispose
UPR-100-N-18	$105,000	$107,994	
UPR-100-N-19	$105,944	$112,486	
UPR-100-N-20	$102,056	$105,660	
UPR-100-N-21	$97,168	$100,162	
UPR-100-N-22	$105,092	$108,696	
UPR-100-N-23	$103,593	$104,720	
UPR-100-N-24	$107,499	$121,304	
UPR-100-N-36	$96,816	$97,408	
UPR-100-N-43	$106,574	$116,719	
100-N-3	$254,529	$329,895	
100-N-12	$93,743	$94,334	
100-N-35	$98,242	$99,369	
100-N-36	$94,724	$98,254	
124-N-2	$149,807	$212,349	
Total Cost	$1,620,787	$1,809,350	+12

[a] Costs do not include a 3 percent design cost and a 3 percent design data collection cost.
UPR = unplanned release

Table 1.5. Present Worth Cost Comparison of Remedial Alternatives for Source Waste Sites for the Rural-Residential Exposure Scenario

Remedial Alternative	Number of Sites[a, b]	Remove/ Dispose	Remove/Ex Situ Bioremediation/ Dispose	In Situ Bioremediation	Percent Difference from Remove/ Dispose
Remove/Dispose	80	$52,030,513	N/A	N/A	NA
Remove/Dispose	63	$50,409,726	$50,409,726		
Remove/Ex Situ Bioremediation/ Dispose	17	$ 1,620,787	$1,809,350		+12
Cost	80	$52,030,513	$52,219,056		~ 0
Remove/Dispose	78	$46,777,739		$46,777,739	
In Situ Bioremediation[b]	2	$ 5,251,774	N/A	$ 1,813,350	-65
Cost	80	$52,030,513		$48,592,089	- 7

[a] There are four sites (100-N-28, 116-N-4, 118-N-1, UPR-100-N-35) where all of the waste is below 4.6 m (15 ft), and these sites may not be remediated under this scenario. See DOE/RL-95-111, Rev. 0, Appendix B for information regarding excavation depths.
[b] There are five sites (100-N-46, 100-N-50, 100-N-51a, 100-N-51b, and 100-N-65) for which costs or additional costs will be established during design.
[c] The cost shown in this table does not include a 3 percent design cost and a 3 percent cost for collecting design data in the field.
N/A = not applicable

Table 1.6. Costs for Source Units

Site Name	Remove/Dispose	Capping	In Situ Solidification
CAP 1-1			
UPR-100-N-10	$95,391	$653,884	$157,016
UPR-100-N-39	$99,297	$3,767,236	$415,600
Subtotal	$194,688	$4,421,120	$572,616
CAP 1-2			
UPR-100-N-29	$100,630	$41,563	$158,467
UPR-100-N-30	$112,776	$4,086,761	$349,849
UPR-100-N-32	$101,908	$389,430	$173,568
Subtotal	$315,314	$4,517,754	$681,884
CAP 4-1			
UPR-100-N-4	$97,464	$83,646	$192,295
UPR-100-N-5	$218,961		$651,238
UPR-100-N-6	$104,056	$190,527	$217,955
UPR-100-N-8	$95,391	$4,647	$157,016
UPR-100-N-25	$97,779	$106,881	$202,532
100-N-26	$101,593	$23,235	$163,047
124-N-4	$766,864	$38,909,260	$1,388,214
Subtotal	$1,482,108	$46,469,916	$2,972,297
CAP 4-2			
UPR-100-N-9	$104,307	$4,672,424	$345,617
UPR-100-N-14	$95,409	$82,740	$158,496
Subtotal	$199,716	$4,755,164	$504,113
CAP 4-3			
UPR-100-N-13	$88,873	$749,331	$181,321
UPR-100-N-26	$99,908	$3,674,112	$252,221
Subtotal	$188,781	$4,423,443	$433,542
Misc In Situ Solidification			
UPR-100-N-1	$150,214	N/A	$386,077
UPR-100-N-11	$95,835	N/A	$345,010
100-N-13	$98,242	N/A	$340,414
100-N-14	$98,242	N/A	$340,414
Subtotal	$442,533	N/A	$1,411,915
Total for Capping and Remove/ Dispose	$2,380,607	$64,587,397	
Total for In Situ Solidification and Remove/Dispose	$2,823,140	N/A	$6,576,367

[a] Costs based on the Modified CRCIA Ranger/Industrial Exposure Scenario.
NA = not applicable

Table 1.7. Present Worth Cost Comparison of Remedial Alternatives for Source Waste Sites for the Modified CRCIA Ranger/Industrial Exposure Scenario [a]

Remedial Alternative	Number of Sites[b,c]	Remove/ Dispose	Remove/ Ex Situ Bioreme-diation/ Dispose	In Situ Bioreme-diation	Contain-ment	In Situ Solidifi-cation	Percent Differen ce from Remove/ Dispose
Remove/Dispose	80	$49,896,037					
Remove/Dispose	63	$48,275,250	$48,275,250	N/A	N/A	N/A	
Remove/Ex Situ Bioremediation/ Dispose	17	$ 1,620,787	$ 1,809,350	N/A	N/A	N/A	+12
Cost	80	$49,896,037	$50,084,600				0
Remove/Dispose	78	$44,644,263	N/A	$44,644,263	N/A	N/A	
In Situ Bioremediation	2	$ 5,251,774	N/A	$ 1,813,350	N/A	N/A	-65
Cost	80	$49,896,037		$46,457,613			-7
Remove/Dispose	64	$47,515,430	N/A	N/A	$ 47,515,430	N/A	
Containment	16	$2,380,607	N/A	N/A	$64,587,397	N/A	+2703
Cost	80	$49,896,037			$112,102,827		+ 125
Remove/Dispose	60	$46,820,831	N/A	N/A	N/A	$46,820,831	
In Situ Solidification	20	$3,075,206	N/A	N/A	N/A	$6,576,367	+114
Cost	80	$49,896,037				$53,397,198	+7

[a] The cost shown in this table does not include a 3 percent design cost and a 3 percent cost for collecting design data in the field.
[b] There are five sites for which costs or additional costs will be established during design.
[c] There are eleven sites for which all of the waste is below 3 m (10 ft), and these sites may not be remediated under this scenario.

Table 1.8. Remedial Alternatives for Groundwater Contamination at the 100-N Area

Alternative		River Protection Technology		Aquifer Cleanup Technology	
No.	**Title**	**Protection of the River from Tritium**	**Protection of the River from Strontium**	**Reduce Strontium-90 Concentration /Activity in the Aquifer[a]**	**Reduce Concentrations of Other Contaminants in the Aquifer[b]**
1	No Action	No Action	No Action	No Action	No Action
2	Institutional Controls	Institutional Controls	Institutional Controls	Institutional Controls	Institutional Controls
3	Permeable Barrier for River Protection	Institutional Controls	Permeable Barrier Wall	Institutional Controls	Institutional Controls
4	Hydraulic Controls for River Protection and Pump and Treat for Strontium in the Aquifer	Institutional Controls	Hydraulic Control (270 years)	Pump and Treat	Institutional Controls
5	Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation	Hydraulic Control (15 years)	Hydraulic Control (270 years)	Pump and Treat	Pump and Treat
6	Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation	Institutional Controls	Impermeable Barrier Wall (cryogenic wall)	Pump and Treat	Pump and Treat
7	Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation	Impermeable Barrier Wall (with hydraulic control for tritium)	Impermeable Barrier Wall (sheet pile wall with pre-excavation)	Soil Flush System	Pump and Treat

[a] Strontium-90 remediated by removing strontium from the aquifer (concentration) and by providing time for natural radioactive decay (activity).
[b] Other contaminants include nitrate, sulfate, hexavalent chromium VI, TPH, and manganese.

Table 1.9. Cost of Remedial Alternatives for Groundwater

No.	Remedial Alternatives	Initial Capital Cost ($)	Present Worth of Future Costs ($)	Total Present Worth Cost ($)
1	No Action	0	0	0
2	Institutional Controls	63,558	699,468	762,826
3	Permeable Barrier for River Protection	8,240,697	1,021,528	9,262,225
4	Hydraulic Controls for River Protection and Pump and Treat for Strontium in the Aquifer	1,754,609	12,491,105	14,245,714
5	Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation	4,580,204	34,585,401	39,165,605
6	Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation	20,389,389	36,269,137	56,658,526
7[a]	Sheet Pile Barrier for River Protection and Soil Flushing/ Pump and Treat for Aquifer Remediation	22,416,808	114,113,817	136,530,625

[a] This alternative is in the development and evaluation stage; therefore, a reliable cost estimate cannot be made.

Table 1.10. Comparative Cost Summary of the Interim Groundwater Remedial Alternatives

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

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100-NR-1
CHAPTER 2.0
RECOMMENDED CORRECTIVE MEASURES FOR 100-NR-1 OPERABLE UNIT

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 2.0
RECOMMENDED CORRECTIVE MEASURES FOR 100-NR-1 OPERABLE UNIT

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CHAPTER 2.0
RECOMMENDED CORRECTIVE MEASURES FOR 100-NR-1 OPERABLE UNIT

TABLE OF CONTENTS

2.0 RECOMMENDED CORRECTIVE MEASURES FOR 100-NR-1 OPERABLE UNIT 5
2.1 Rcra Corrective Action Performance Standards 5
2.2 Corrective Measures for the 100-NR-1 Operable Unit Source Sites 7
2.2.1 Recommended Actions and Justifications 7
2.2.2 Cleanup Standards for the 100-NR-1 Operable Unit 8
2.2.3 Cost 8
2.2.4 Schedule 9
2.2.5 Training 9

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2.0 RECOMMENDED CORRECTIVE MEASURES FOR 100-NR-1 OPERABLE UNIT

According to U.S. Environmental Protection Agency (EPA) guidance, a Resource Conservation and Recovery Act (RCRA) corrective measures study should identify the recommended corrective measure. This section is included for consistency with EPA RCRA guidance, and the recommended corrective measures presented in this section correspond to the preferred remedial alternatives that will be identified in the integrated Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Proposed Plan and RCRA Permit Modification proposal for the 100-NR-1 and 100-NR-2 Operable Units (OUs). The preferred alternative that will be presented in the Proposed Plan is only a preliminary recommendation, and changes to the preferred alternative, or a change from the preferred alternative to another alternative, may be made based on public comment. The recommended corrective measures presented in this section will be revised, if necessary, to reflect the remedy eventually selected by the CERCLA Record of Decision (ROD).

In addition to identifying the recommended corrective measure, the RCRA process requires that the specific permit conditions associated with the recommendation be identified. This section includes detailed information to be referenced for purposes of establishing RCRA permit conditions. If, as a result of public comment, the preferred alternative is changed, then the permit conditions and information presented in this section will be modified accordingly.

The Tri-Party Agreement defines the 100-NR-1 and 100-NR-2 OUs as RCRA past-practice sites. RCRA corrective action authority applies to releases of dangerous[1] waste and dangerous constituents including releases from solid waste management units and to releases of mixed waste (mixtures of hazardous waste and radiological contaminants), but not to waste that only contains radiological contaminants. Since many of the waste sites in the operable units contain radiological contaminants, and because they are in the 100 Area, which is listed on the National Priorities List (NPL), the adequacy of any action taken under another regulatory authority will be evaluated against CERCLA program criteria. The recommended RCRA corrective measures[2] that are discussed in this section have been developed to satisfy requirements for both RCRA corrective action and CERCLA remedial action. By applying CERCLA authority concurrently with RCRA corrective action requirements through an integrated plan, all regulatory and environmental obligations at the 100-NR-1 and 100-NR-2 OUs can be met as effectively and efficiently as possible. Also, by applying CERCLA authority jointly with that of RCRA, additional options for disposal of corrective action and remedial action wastes at the Environmental Restoration and Disposal Facility (ERDF) are possible. By allowing flexibility in final disposal options, disposal costs can be minimized while still being protective of human health and the environment.

The following discussion explains RCRA corrective action performance standards, which must be met by the recommended corrective measures.

2.1 RCRA Corrective Action Performance Standards

The RCRA corrective action performance standards found at WAC 173-303-646(2) state that the corrective measure:

1. *Shall protect human health and the environment from all releases of dangerous wastes and dangerous constituents, including releases from all solid waste management units at the facility.* For purposes of corrective action at the 100-NR-1 and 100-NR-2 Operable Units, protection is generally determined as follows:

[1] RCRA authority with respect to hazardous waste management and corrective action has been delegated to the State of Washington. The State of Washington has published regulations for this authority at WAC 173-303, "Dangerous Waste Regulations." The State terms "dangerous waste" and "dangerous constituents" are generally equivalent to the RCRA terms "hazardous waste" and "hazardous constituents."

[2] RCRA corrective measures are essentially equivalent to CERCLA remedial actions.

a. Human health[3] will be protected by preventing exposure to contaminants above unacceptable levels (i.e., Model Toxic Control Act (MTCA) B with a residential land-use scenario for soil sites).

b. Protection of the Columbia River will be enhanced by removing contamination from the source sites and by utilizing the existing pump-and-treat system (via hydraulic controls) to reduce discharges of contaminated groundwater.

c. Ecological resources will be protected by minimizing impacts resulting from corrective measures, by cleaning up source sites (except the shoreline site) to levels that are protective of human health, and by continuing the existing pump-and-treat operations to reduce discharges of contaminated groundwater to the river.

d. Cultural resources will be protected by minimizing impacts resulting from corrective measures.

A discussion of how these performance standards will be achieved is provided in Permit Sections 9.2 and 9.3.

2. *Is required regardless of the time at which waste was managed at the facility or placed in such units, and regardless of whether such facilities or units were intended for the management of solid or dangerous waste;*

The 100 Area was evaluated to identify sites where waste was placed or handled. The results of this investigation are provided in a variety of documents listed in DOE/RL-95-111, Rev. 0, Section 2.2. Based on three principle resources (i.e., 100 Area Technical Baseline Report, RCRA Facility Investigation/Corrective Measure Study Work Plan, and WIDS), DOE/RL-95-111, Rev. 0 identifies 114 potentially contaminated source sites in the 100-NR-1 Operable Unit. Thirty three of these have been eliminated from further consideration in the evaluations of alternatives because either they were never contaminated, are not currently contaminated, or they fall under other regulatory jurisdictions and are not subject to RCRA regulations. The remaining 81 potentially contaminated waste sites would be subject to RCRA corrective measures because dangerous constituents were handled at and potentially released from the sites. Corrective measures recommended for the various categories of waste sites are described in Section 9.2.1 below.

3. *Must be implemented by the owner/operator beyond the facility property boundary, where necessary to protect human health and the environment.*

The recommended corrective measures are interim actions that address contaminated soils and groundwater within the 100-NR-1 and 100-NR-2 Operable Units. There have been releases of dangerous constituents to locations beyond the boundaries of the areas addressed by DOE/RL-95-111, Rev. 0 and the DOE is undertaking studies of the impacts of these releases and how they will need to be addressed in final actions for the Hanford Site. Although the recommended corrective measures will reduce the potential for future off site releases, this performance standard will be addressed during final remediation of the Hanford Site as discussed in Section 9.1 above.

In addition to the performance standards cited in the WAC, the following also applies:

4. Corrective action must be conducted in compliance with training requirements established in 29 *CFR* 1910.120(e) and Permit Condition II.C.2.

Training to be implemented to meet this requirement is described in Section 9.2.5 below.

[3] It is assumed that protection of human health will also result in the protection of various ecological receptors (i.e., plants and animals) that could come into contact with the potentially contaminated sites as discussed in Section 4.3. It is also a basic assumption in recommendations for corrective measures that they will not preclude any future land use.

2.2 Corrective Measures for The 100-NR-1 Operable Unit Source Sites

The 100-NR-1 OU addresses contaminated soils and underground pipelines. It also includes the shoreline site, which is composed of the riverbank seeps in the 100-N Area (N-Springs) and the contaminated soil associated with waste site 100-N-65. The 100-NR-1 Operable Unit does not include the contaminated groundwater underlying this area. The groundwater is addressed in the 100-NR-2 OU.

Based on the types of contaminants that occur at the waste sites, the 81 waste sites included in the 100-NR-1 OU have been categorized into the following types:

- Radioactive waste sites (37)[4].
- Inorganic waste sites (6).
- Burn pits (6).
- Surface solid and miscellaneous waste sites (9).
- Surface petroleum sites (20).
- Deep petroleum sites (2).
- Shoreline site (1).

2.2.1 Recommended Actions and Justifications

Different corrective measures have been recommended for the various categories of waste sites in the 100-NR-1 OU. The recommended corrective measures are as follows:

- Remove/Dispose for the radioactive and inorganic waste sites, the burn pits, and the surface solid and miscellaneous waste sites. The Remove/Dispose corrective measure would consist of removing contaminated media that exceed cleanup levels; disposing media at the ERDF; backfilling, grading, and revegetation excavated areas; and land-use restrictions and access controls as described in detail in DOE/RL-95-111, Rev. 0, Section 5.3.4.
- Remove/Ex Situ Bioremediation/Dispose for near-surface petroleum sites. The Remove/ Ex Situ Bioremediation/Dispose corrective measure would consist of removing contaminated media that exceed cleanup levels; treating excavated soil through biodegradation to reduce toxicity (ex situ bioremediation); disposing residual, contaminated media at the ERDF; backfilling and revegetation excavated areas; and groundwater monitoring as described in detail in DOE/RL-95-111, Rev. 0, Section 5.3.5.
- In Situ Bioremediation for deep petroleum sites. The In Situ Bioremediation corrective measure would consist of treating contaminated soil in place through biodegradation to reduce toxicity (in situ bioremediation); revegetating disturbed areas; and groundwater monitoring as described in detail in DOE/RL-95-111, Rev. 0, Section 5.3.6.
- Institutional Controls under a modified Columbia River Comprehensive Risk Assessment (CRCIA) ranger/industrial scenario for the shoreline site. The Institutional Controls corrective measure would consist of land-use and/or access controls and groundwater monitoring as described in detail in DOE/RL-95-111, Rev. 0, Section 8.7.2.

In developing the recommended corrective measures, the various alternatives were compared against both the CERCLA evaluation criteria and the RCRA performance standards. Alternatives that met the two CERCLA threshold criteria (i.e., overall protection of human health and the environment and compliance with Applicable or Relevant and Appropriate Requirements [ARAR]), would also meet the RCRA performance standards numbered 1 through 3 in Section 9.1. All the recommended corrective measures provide protection of human health (performance standard 1.a).

[4] These sites are called radioactive waste sites because radioactive constituents are the primary concern; however, these sites are also potentially contaminated with dangerous constituents.

The measures that include a removal or treatment component will be protective by removing and disposing of contaminated soil or treating contaminated soil to reach acceptable levels in accordance with ARARs. Similarly, the in situ component will treat contaminated soil to ARARs. The institutional controls recommendation will be protective of human health by preventing exposure through the use of access controls and land-use restrictions.

In addition, the recommended corrective measures, except for institutional controls, would be protective of the environment (performance standard 1.b). By removing or treating contaminated soils, no contaminants above acceptable cleanup levels would remain at the site. Therefore, the potential for contaminants to migrate to other environmental resources is minimized. Institutional controls would not be protective of the environment because they are not effective in preventing migration of contaminants to the groundwater or the river. However, the recommendation to implement institutional controls is viewed as only an interim measure pending availability of information that would support selection of a final remedy for the shoreline site. Attaining ARARs for final cleanup are beyond the scope of the recommended corrective measures, but they will be addressed as part of final cleanup of the site.

All of the recommended corrective measures would minimize impacts to ecological and cultural resources (performance standards 1.c and 1.d). For recommendations with removal components, impacts would be minimized through careful adherence to ecological and cultural resources mitigation planning. With the in situ treatment component, little disturbance of the site would be required, therefore impacts to ecological or cultural resources would be minimal. In addition, both the remove and treatment recommendations should have a beneficial impact on ecological and cultural resources by reducing the amount of contamination discharged to offsite sources. Institutional controls, which are already widely used at Hanford, would present no additional risk to ecological or cultural resources.

Performance standard 2 is being met with these recommended corrective measures because all of the sites that have been identified as being potentially contaminated in the 100-NR-1 are being addressed by one of the corrective measures.

By removing or treating contaminated soils to acceptable cleanup levels, and by controlling migration of contaminants to the groundwater, the potential for releases beyond the boundaries of the 100-NR-1 or 100-NR-2 Operable Units is greatly reduced. Therefore, the recommended corrective measures would satisfy performance standard 3, both in the near term and the future. In addition, this performance standard will be addressed during final remediation of the Hanford Site as discussed in Section 9.1 above.

Performance standard 4 pertaining to training is discussed in Section 9.2.5 below.

2.2.2 Cleanup Standards for the 100-NR-1 Operable Unit

The cleanup standards for the 100-NR-1 OU are MTCA Method B values identified for the contaminants of concern listed in DOE/RL-95-111, Rev. 0, Table 4-7. If there are sites where deep soil contamination (more than 4.6 m below surrounding grade) is in excess of the cleanup standards, several factors will be considered to determine the extent of additional corrective actions. These factors include protection of human health and the environment, remediation costs, size of the 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 recommendation below 4.6 m will be made by the regulators in consideration of the factors listed above.

2.2.3 Cost

The estimated cost for the various Remove/Dispose alternatives that are recommended for the 80 source sites (which excludes the shoreline site) is $48.7 million. The cost for the Institutional Controls under the Modified CRCIA Ranger/Industrial Alternative that would be applicable to the shoreline site is estimated to be $63,358. Detailed cost analyses for all the alternatives are contained in Permit Attachment 47, Chapter 7.0, §7.2.

2.2.4 Schedule

Corrective measures for the 100-NR-1 Operable Unit will begin upon completion of all the Treatment, Storage, and Disposal (TSD) units and will follow the duration schedule identified in the *Engineering Evaluation/Cost Analysis for the 100-N Area Ancillary Facilities and Integration Plan* (Permit Attachment 48).

2.2.5 Training

All personnel working at the Hanford Site, including at sites associated with the 100-NR-1 Operable Unit, will be provided with and will successfully complete general site training as specified in Permit Condition II.C.2 of the Hanford Facility Dangerous Waste Permit. The general requirements specified in Permit Condition II.C.2 are as follows:

All Hanford Facility personnel shall receive general training within 6 months of hire. This training shall provide personnel with orientation of dangerous waste management activities being conducted on the Hanford Facility. This training shall include:

- Description of emergency signals and appropriate personnel response.
- Identification of contacts for information regarding dangerous waste management activities.
- Introduction to waste minimization concepts.
- Identification of contact(s) for emergencies involving dangerous waste.
- Familiarization with the Hanford Facility Contingency Plan.

In addition to the training specified in the permit condition, personnel who work at or visit the 100-NR-1 OU sites and who have the potential for exposure to contaminants above permissible levels will be provided with training in accordance with 29 CFR 1910.120(e). All such personnel shall receive the required training before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards. The training shall consist of provision of the following information:

- Names of personnel and alternates responsible for site safety and health.
- Safety, health, and other hazards present on the site.
- Use of personal protective equipment.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazards.
- Familiarization with the site safety and health plan.

This information shall be provided both initially and in annual refresher courses, and certifications shall be made as summarized in subsection 9.2.5.3.

2.2.5.1 Initial Training

- For general site workers, initial training shall consist of a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.
- For workers who are on site only occasionally for a specific limited task, or those who will work only in areas where no health hazards or the possibility of an emergency exists (i.e., are not required to wear respirators), initial training shall consist of a minimum of 24 hours of instruction off the site, and a minimum of 1 day of supervised field experience.

- For on-site managers and supervisors directly responsible for employees engaged in hazardous waste operations, initial training shall consist of a minimum of 40 hours of instruction and 3 days of field experience. This may be reduced to 24 hours of instruction and 1 day of field experience if supervision is limited to those workers who are on site only occasionally or work in areas where no health hazards exist. Managers and supervisors must also have 8 hours of specialized training on such topics as employer's safety and health program and associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques.
- For trainers, they shall have academic credential and instruction experience in the subjects they are expected to teach, or must have satisfactorily completed a training program for teaching the subjects, and shall demonstrate competent instructional skills and knowledge of the subject matter.
- For those employees engaged in responding to hazardous emergency situations at hazardous waste cleanup sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

2.2.5.2 Refresher Training

Employees and supervisors required to have completed the initial training as described above shall receive 8 hours annually of refresher training in the required topics and/or a critique of incidents that occurred during the previous year that could serve as training examples.

2.2.5.3 Certification

Employees and supervisors that have received and successfully completed the training and field experience shall be certified by their instructor as evidenced by a written certificate. Uncertified employees shall be prohibited from engaging in hazardous waste operations.

100-NR-1
CHAPTER 3.0
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 3.0
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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CHAPTER 3.0
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

TABLE OF CONTENTS

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS 5
3.1 Introduction 5
3.1.1 Standards for Soil, Groundwater, and River Cleanup 5
3.1.2 Waste Management Standards 9
3.1.3 Wastewater Management Standards 12
3.1.4 Standards for Protection of the Columbia River from Direct Discharges 12
3.1.5 Air Standards 13
3.1.6 Standards for the Protection of Cultural and Ecological Resources 14
3.1.7 Radiation Protection Standards 17

TABLE

Table 3.1. Applicable or Relevant and Appropriate Requirements (ARAR) and To Be Considered (TBCs) 20

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3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.1 Introduction

Applicable or relevant and appropriate requirements (ARAR) are standards, requirements, criteria, or limitations promulgated under federal or state environmental laws that must be met or waived for remedial actions as required by Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Only the substantive provisions of ARARs must be met (or waived) for actions conducted entirely on site [CERCLA 121(d)(2)] because such onsite actions are exempted from obtaining federal, state, and local permits [CERCLA 121(e)(1)]. A component of an action's protectiveness is its ability to comply with ARARs. The to be considered (TBC) materials are other federal or state guidance, criteria, advisories, proposed regulations, or similar materials that, while not enforceable, provide additional standards that may be pertinent in selecting or designing a remedy.

Below is a listing of the major ARARs and TBCs pertinent to remediation of the 100-NR-1 and 100-NR-2 Operable Units. These ARARs and TBCs are further described and cited in Table 3.1 and are discussed relative to each remedial alternative in Sections 3.1.1 through 3.1.7.

- The Model Toxics Control Act (MTCA) Regulations
- The Safe Drinking Water Act (SDWA) Primary and Secondary Drinking Water Standards
- Draft EPA Radiation Site Cleanup Regulations
- The Resource Conservation and Recovery Act Hazardous Waste Regulations
- State of Washington Dangerous Waste Regulations
- The U.S. Environmental Protection Agency Transportation Regulations
- Nuclear Regulatory Commission Licensing Requirements for Land Disposal of Radioactive Wastes
- State of Washington Waste Discharge Permit Program
- State of Washington Underground Injection Control Program
- National Emissions Standards for Hazardous Air Pollutants
- State of Washington Radiation Protection Air Emissions
- State of Washington Control of New Sources of Toxic Air Pollutants
- The National Historic Preservation Act
- The Native American Graves Protection and Repatriation Act
- The Archeological and Historical Preservation Act
- The Endangered Species Act
- The Migratory Bird Treaty Act
- The Hanford Reach Preservation Act
- U.S. Department of Energy Occupational Radiation Protection Regulations
- Nuclear Regulatory Commission Standards for Protection Against Radiation
- U.S. Department of Energy Order - Radiation Dose Limit

3.1.1 Standards for Soil, Groundwater, and River Cleanup

The state MTCA is implemented by Chapter 173-340 of the Washington Administrative Code (WAC) and establishes cleanup standards (including cleanup levels and points of compliance) for nonradioactive contaminants in soil and groundwater. In setting standards, MTCA prescribes a methodology for calculating cleanup levels based on potential land use and exposure assumptions and draws on other standards, such as maximum contaminant levels (MCLs) established for drinking water under the SDWA. In addition, MTCA specifies that soil and groundwater cleanup must be accomplished so that other interconnected media, such as adjacent surface waters, are protected.

The MTCA standards are relevant and appropriate and are incorporated into the remediation goals for all remedial alternatives evaluated in this CMS.

Few standards exist for the cleanup of radioactive constituents at waste sites. Standards for MCLs for certain radionuclides, based on an annual dose limit, are provided in 40 CFR 141 and are relevant and appropriate and are incorporated into the remediation goals for alternatives that address groundwater. Standards for remediation of radioactive constituents in soil have not been promulgated. Two agencies (the U.S. Environmental Protection Agency [EPA] and the U.S. Nuclear Regulatory Commission [NRC]) have proposed regulations for acceptable levels of residual radioactivity for cleanup of soil. These are TBC materials rather than ARARs, but in the absence of ARARs, they are incorporated into the remediation goals for soil cleanup.

The following information provides an analysis of how each source-site and groundwater alternative category is anticipated to comply with these ARARs and TBCs.

3.1.1.1 100-NR-1 Source Site Alternative Compliance with ARARs/TBCs

No-Action Alternative. The No-Action Alternative would not result in compliance with soil and groundwater protection ARARs or TBCs.

Institutional Controls Alternative. Because there is a general lack of data on soils within the 100-NR-1 source operable unit, it is unknown whether institutional controls would be adequate to meet standards for soil and groundwater cleanup. Should contaminant of concern concentrations be present at a site that would contribute to an increase in groundwater contamination (i.e., cause new or expanded areas of contamination above and beyond existing contaminant plumes) or a decrease in river protection, the ARARs and TBCs for this alternative would not be met. The type of institutional controls that may be necessary to preclude direct exposure to contaminants is also dependent upon the need for more information on constituent concentrations in the soil. It is assumed, however, that controls such as access controls (e.g., signs) and restrictions on groundwater usage would be adequate to meet soil and groundwater standards based on direct exposure in the short term. However, because this alternative will require that controls be in place for over 200 years due to Sr-90 decay, it becomes less certain that institutional controls would be able to provide compliance with soil and groundwater direct exposure standards. Institutional controls would preclude rural-residential use at sites where direct soil exposure levels are above residential standards. At the shoreline site, contaminants would be left in place above groundwater and river protection standards with this alternative until contaminated groundwater is remediated. Compliance would be attained at the end of the groundwater/river protection remediation, which may require 270 to 300 years.

Remove/Dispose Alternative. Removal, treatment where appropriate and subsequent disposal of contaminated soils will provide compliance with all soil and groundwater cleanup standards. However, due to the lack of data on constituent concentrations in the soil, the degree of removal that would be required at a site in order to reach compliance with soil and groundwater cleanup standards cannot be ascertained. A potential exists that it would become technically impracticable or cost prohibitive to excavate deep vadose zone soils if large, deep areas of contamination are discovered. Removal, treatment where appropriate, and subsequent disposal of contaminated shoreline site soils will provide compliance with all soil and groundwater cleanup standards if contaminated groundwater is prevented from recontaminating the soil through implementation of a hydraulic or physical barrier system.

In Situ Bioremediation of Petroleum Waste Group. In situ bioremediation is a proven technology that has achieved good results at other remedial action sites. It is anticipated to achieve compliance with soil and groundwater cleanup standards for total petroleum hydrocarbons (TPH). However, given the lack of data identifying the extent of contamination, there is a possibility that remediation using this alternative would not be practical.

Containment for Radioactive Waste Group. Although this alternative likely will not comply with the direct soil exposure numerical cleanup standards and possibly the groundwater protection numerical cleanup standards of MTCA. MTCA considers this a compliant alternative if the compliance monitoring program is designed to ensure the long-term integrity of the containment system (WAC 173-340-740[4][6][d]). Without any removal of contaminants from soils, there is a potential that after failure of the cap, contaminants could still be in place in the soils that could exceed the soil cleanup standards and could cause exceedence of groundwater cleanup standards. Therefore, maintenance of the cover is critical to maintaining compliance with these ARARs and TBCs. For the shoreline site, a cover alternative would also be expected to comply with soil and groundwater cleanup standards during the design life of the cover. This alternative would be in conflict with unrestricted land use.

In Situ Solidification for Radioactive Waste Group and Shoreline Site. In situ solidification will provide compliance with soil and groundwater cleanup levels for constituents expected to be remaining in the soils for the radioactive waste group. It is possible that constituents might be present in the soil that cannot be immobilized through the chosen solidification technology, such as mobile inorganic constituents, but this possibility is considered unlikely.

3.1.1.2 100-NR-2 Groundwater Alternative Compliance with ARARs/TBCs

There is a general lack of data on the impacts of aquatic organisms from Sr-90 concentrations entering the river. Groundwater and river protection standards for Sr-90 are based on the MCL in this CMS. However, because ecological impacts are unknown and because concentrations of Sr-90 are anticipated to exceed MCL river-protection standards for 270 years for any of the alternatives, further study is warranted. (Note: Modeling efforts show that manganese will require over 3,000 years to meet cleanup standards based on its secondary MCL. Because of the uncertainties in modeling plume dispersion over this time frame and because the standard is based on a secondary MCL, Sr-90 remediation time frames are considered the primary focus.) One potential avenue for obtaining some information on impacts to aquatic organisms is the pending Columbia River Comprehensive Impact Assessment study (Tri-Party Agreement Milestone M-15-80, scheduled for submittal of a revised draft in March 1998). This study is planned to define further ecological impacts, including aquatic ecosystems potentially impacted by Sr-90 along the 100-NR-2 groundwater/river interface. When this information is obtained, it will become available to the public for consideration. In addition, reassessment of ecological impacts associated with remediation of 100-NR-2 will be made during the CERCLA five-year review (40 CFR 300.430(f)(4)(ii)).

No-Action Alternative. The No-Action Alternative would not result in compliance with soil and groundwater protection ARARs and TBCs.

Institutional Controls Alternative. Compliance with groundwater and river protection standards will be attained for all contaminants of concern (COC) at the end of remediation, which is estimated to require 300 years under this alternative. One exception will be manganese, which may exceed secondary MCLs for over 3,000 years.

Because of the length of time necessary to ensure that institutional controls are maintained, compliance with ARARs and TBCs becomes less certain. Access controls and groundwater use restrictions would restrict exposure to contaminants in groundwater until contaminant plumes decay and/or naturally attenuate to concentrations below groundwater protection standards. River protection standards would continue to be exceeded for Sr-90 for 270 years and would be exceeded for tritium for 10 to 15 years. Groundwater protection standards would be exceeded for Sr-90 and tritium for 300 years and 25 years, respectively. Except for manganese, inorganic contaminants will not meet MCLs in groundwater from a few to about 30 years, depending upon the specific contaminant. Nitrates will exceed MCLs at the groundwater/river interface in the future and manganese may exceed MCLs at a future date under this alternative.

Permeable Barrier for River Protection. Compliance with groundwater and river protection standards will be attained for all COCs at the end of remediation, which is estimated to require 300 years under this alternative. One exception will be manganese, which may exceed secondary MCLs for over 3,000 years.

The permeable wall would not allow compliance with groundwater protection standards at a significantly faster rate because this alternative does not actively treat the Sr-90. River protection standards are not met at a faster rate due to the continued flushing of Sr-90 into the groundwater/river interface from the contaminated soils that remain in the strip of land between the groundwater/river interface and the permeable wall. This alternative will reduce concentrations of Sr-90 entering the groundwater/river interface, thus allowing for greater overall protection of the river, but may have no effect on the time it will take to achieve compliance with groundwater and river protection standards due to the continued release of Sr-90 from this strip of land. River protection standards would continue to be exceeded for Sr-90 for 270 years and would be exceeded for tritium for 10 to 15 years. Tritium would continue to exceed groundwater protection standards until decay decreased concentrations below MCLs (25 years). "Other" inorganic contaminants will have restoration time frames for compliance with groundwater protection standards as identified in Section 5.0. Most significantly, manganese may exceed groundwater protection standards for over 3,000 years under this alternative.

Hydraulic Controls for River Protection and Pump and Treat for Sr-90 in the Aquifer. Compliance with groundwater and river protection standards will be attained for all COCs at the end of remediation, which is estimated to take 270 years under this alternative (except manganese, which may exceed secondary MCLs for over 3,000 years).

Hydraulic controls would not allow compliance with groundwater protection standards at a significantly faster rate because this alternative does not actively treat the Sr-90. The time necessary to achieve compliance with groundwater protection standards for Sr-90 would not be significantly shortened (from 300 years without treatment to 270 years with treatment). River protection standards would not be met in a significantly shorter time frame due to the continued flushing of Sr-90 into the groundwater/river interface from the Sr-90 that remains in the aquifer sediments adjacent to the river. This alternative will reduce concentrations of Sr-90 entering the groundwater/river interface, thus allowing for greater overall protection of the river, but may have no effect on the time it will take to achieve compliance with river protection standards due to the continued release of Sr-90 from the sediments. Tritium would not be actively remediated along the entire plume (although the hydraulic controls for Sr-90 would remediate much of the tritium plume), and, therefore, groundwater and river protection standards would not be met until decay and natural attenuation brought concentrations below the MCL (25 and 10 to 15 years, respectively). Other groundwater plumes would not be actively remediated with this alternative and, therefore, would not achieve compliance with groundwater or river protection standards until decay and/or natural attenuation resolved concentrations below the standards. "Other" inorganic contaminants will have restoration time frames for compliance with groundwater protection standards as identified in Section 5.0. Most significantly, manganese may exceed groundwater protection standards for over 3,000 years under this alternative.

Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation. Compliance with groundwater and river protection standards will be attained for all COCs at the end of remediation, which is estimated to take 270 years under this alternative.

Hydraulic controls and pump-and-treat systems would not allow compliance with river protection standards at a significantly faster rate because this alternative would reduce the time frame for Sr-90 remediation from 300 to 270 years. Groundwater protection standards would be met for all COCs, other than tritium and Sr-90, in a much shorter time frame than could be achieved through decay and/or natural attenuation. Strontium-90 groundwater protection standards would not be met in a significantly shorter time frame (300 years without treatment and 270 years with treatment). Tritium would continue to exceed groundwater protection standards until decay decreased concentrations below MCLs (25 years) but would meet MCLs in the groundwater/river interface shortly after hydraulic controls are fully operational. This alternative is anticipated to be able to reduce concentrations of Sr-90 entering the groundwater/river interface, thus allowing for greater overall protection of the river (although the amount may not be significant), but would have no effect on the time it will take to achieve compliance with river protection standards due to the continued release of Sr-90 from the aquifer sediments near the river.

Manganese will not meet MCLs in groundwater for close to 90 years using pump-and-treat technologies. Other inorganic contaminants will have shortened restoration time frames for compliance with groundwater protection standards as identified in Section 5.0.

Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation. Compliance with groundwater and river protection standards will be attained for all COCs at the end of remediation, which is estimated to take 270 years under this alternative.

The barrier and pump-and-treat systems would not allow compliance with river protection standards at a significantly faster rate because this alternative does not actively treat the Sr-90 in aquifer sediments immediately adjacent to the river. Strontium-90 would continue to cause exceedences of river protection standards due to continued flushing of sediments on the riverside of the barrier. Groundwater protection standards would be met with this alternative for all COCs, other than Sr-90 and tritium, in a much shorter time frame than could be attained through decay and/or natural attenuation. Strontium-90 groundwater protection standards would not be met in a significantly shorter time frame (300 years without treatment and 270 years with treatment), and tritium would continue to exceed groundwater protection standards until decay and natural attenuation decreased concentrations below MCLs (25 years). Manganese will not meet MCLs in groundwater for close to 90 years using pump-and-treat technologies. Other inorganic contaminants will have shortened restoration time frames for compliance with groundwater protection standards as identified in Section 5.0.

Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation. Compliance with groundwater and river protection standards will be attained for all COCs at the end of remediation, which is estimated to take 270 years under this alternative.

The barrier and pump-and-treat systems would not allow compliance with river protection standards at a significantly faster rate because this alternative does not actively treat the Sr-90 in aquifer sediments immediately adjacent to the river. Groundwater protection standards would be met with this alternative for all COCs, other than Sr-90 and tritium, in a much shorter time frame than could be attained through decay and/or natural attenuation. It is unknown how rapidly soil flushing could remediate groundwater for Sr-90. Tritium would continue to exceed groundwater protection standards until decay decreased concentrations below MCLs (25 years) but would meet MCLs in the groundwater/river interface shortly after hydraulic controls are fully operational. Manganese will not meet MCLs in groundwater for close to 90 years using pump-and-treat technologies. Other inorganic contaminants will have shortened restoration time frames for compliance with groundwater protection standards as identified in Section 5.0.

3.1.2 Waste Management Standards

The Resource Conservation and Recovery Act of 1976 (RCRA) regulates the generation, transportation, storage, treatment, and disposal of solid and hazardous waste. Authority to implement much of RCRA has been delegated to the state and is implemented by WAC 173-303 (for dangerous waste) and WAC 173-304 (for solid waste that is not dangerous waste). Authority for land disposal restrictions (LDR), including standards for the treatment of wastes prior to land disposal, are retained at the federal level and implemented via 40 CFR 268. The Atomic Energy Act (AEA) establishes standards for the management of radioactive wastes. Regulations pertaining to the management and land disposal of low-level radioactive waste are contained in 10 CFR 61.

Alternatives that involve the removal of waste or contaminated media or in situ or ex situ treatment may generate solid, dangerous, or radioactive waste. The RCRA requirements are applicable to those alternatives that may generate, transport, treat, store, or dispose of solid or dangerous waste. Offsite shipment of hazardous materials must comply with EPA's 49 CFR transportation and packaging requirements. U.S. Department of Energy (DOE) Order 1540.1A is considered a TBC for onsite waste transport. It requires substantive compliance with 49 CFR unless other methods allow an equivalent degree of safety. The substantive requirements of 10 CFR 61 is relevant and appropriate to those alternatives that generate, treat, or dispose of radioactive waste. All waste generated under any alternative would be evaluated and managed in compliance with the appropriate waste designation.

Waste disposal would be to the Environmental Restoration Disposal Facility (ERDF), which is designed to meet the requirements of both RCRA and the radioactive waste standards. For alternatives that involve leaving solid or dangerous waste in place, RCRA performance standards for landfill covers are applicable or relevant and appropriate (depending on the date when the waste was first placed at the site) and are incorporated into the design. Cover performance and boundary requirements, locators, and post-operational monitoring contained in 10 CFR 61.52 are relevant and appropriate to the in-place disposal of radioactive waste.

The following information provides an analysis of how each source-site alternative category is anticipated to comply with these ARARs and TBCs.

3.1.2.1 100-NR-1 Source Site Alternative Compliance with ARARs/TBCs

No-Action Alternative. Because the No-Action Alternative does not result in waste generation, information specific to compliance with ARARs and TBCs has not been provided.

Institutional Controls Alternatives. Institutional controls are not anticipated to generate waste.

Remove/Dispose Alternative. Potentially large quantities of soil and debris (piping, structures, and cleanup materials) may be generated under the alternatives requiring disposal. These wastes may or may not require treatment in order to be disposed to the ERDF. Shoreline site wastes may require dewatering. However, due to the lack of data on soils, the type and extent of waste treatment cannot be defined. It is anticipated, however, that compliance with waste management standards will be achievable. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. Because of the potential for much greater quantities of waste generated from this alternative, ARAR and TBC compliance will be more difficult than the other alternatives.

In Situ Bioremediation of Petroleum Waste Groups. Small quantities of waste may be generated from in situ bioremediation such as contaminated soils and cleanup debris during preparation of the soil surface for treatment. These wastes may or may not require treatment in order to be disposed to the ERDF. However, due to the lack of data on soils, the type and extent of waste treatment cannot be defined. It is anticipated, however, that compliance with waste-management standards will be achievable. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303.

Containment for Radioactive Waste Group and Shoreline Site. Small quantities of waste may be generated from placement of a cap such as contaminated soils and cleanup debris during site preparation and construction. Operational wastes may include run-on and run-off waters. Wastes may also be generated during maintenance of the cap. These wastes may or may not require treatment in order to be disposed to the ERDF; however, due to the lack of data on soils, the type and extent of waste treatment cannot be defined. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. It is anticipated, however, that treatment and subsequent compliance with waste-management standards will be achievable.

In Situ Solidification for Radioactive Waste Group and Shoreline Site. Small quantities of waste may be generated from in situ solidification such as contaminated soils and cleanup debris during preparation of the soil surface for treatment. These wastes may or may not require treatment in order to be disposed to the ERDF. However, due to the lack of data on soils, the type and extent of waste treatment cannot be defined. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. It is anticipated, however, that compliance with waste-management standards will be achievable.

3.1.2.2 100-NR-2 Groundwater Alternative Compliance with ARARs/TBCs

No-Action Alternative. Because the No-Action Alternative does not result in waste generation, information specific to compliance with ARARs and TBCs has not been provided.

Institutional Controls Alternative. Institutional controls are not anticipated to generate waste.

Permeable Barrier for River Protection. Construction of a permeable wall is anticipated to generate waste in the form of contaminated soils and construction debris. These waste streams may or may not require treatment in order to meet waste acceptance criteria for the ERDF and/or LDR requirements. Compliance with waste management ARARs and TBCs are anticipated to be easily attained.

Hydraulic Controls for River Protection and Pump and Treat for Sr-90 in the Aquifer. Construction and operation of wells and a pump-and-treat system will generate small quantities of waste in the form of contaminated soils, groundwater, cleanup debris, treatment residuals, and resins. These waste streams may or may not require treatment in order to meet waste acceptance criteria for the ERDF and/or LDR requirements. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. Compliance with waste management ARARs and TBCs are anticipated to be easily attained.

Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation. Construction and operation of wells and a pump-and-treat system will generate small quantities of waste in the form of contaminated soils, groundwater, cleanup debris, and resins. These waste streams may or may not require treatment in order to meet waste acceptance criteria for the ERDF and/or LDR requirements. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. Compliance with waste management ARARs and TBCs are anticipated to be easily attained.

Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation. Construction of a cryogenic barrier is anticipated to generate waste in the form of contaminated soils and construction debris. Construction and operation of wells and a pump-and-treat system will generate small quantities of waste in the form of contaminated soils, cleanup debris, treatment residuals, and adsorbents. These waste streams may or may not require treatment in order to meet waste acceptance criteria for the ERDF and/or LDR requirements. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303. Compliance with waste management ARARs and TBCs are anticipated to be easily attained.

Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation. Construction of a sheet pile barrier is anticipated to generate waste in the form of contaminated soils and construction debris. Construction and operation of wells and a pump-and-treat system will generate small quantities of waste in the form of contaminated soils, cleanup debris, treatment residuals, and adsorbents from treatment systems. These waste streams may or may not require treatment in order to meet waste acceptance criteria for the ERDF and/or LDR requirements. Compliance with waste management ARARs and TBCs are anticipated to be easily attained with the exception of the soil-flushing adsorbents. This waste stream is anticipated to contain extremely high concentrations of Sr-90, and treatment of this waste stream will be required in order to comply with the ERDF waste acceptance criteria. Management of this waste stream will require careful planning in order to comply with handling treatment, packaging, and transportation requirements. Treatment system design may be dictated by the type of wastes generated, e.g., dangerous waste treatment systems would require substantive compliance with unit-specific design requirements contained in WAC 173-303.

3.1.3 Wastewater Management Standards

WAC 173-216 establishes requirements for discharges to waters of the state, other than discharges subject to an National Pollutant Discharge Elimination System (NPDES) permit under the Clean Water Act, including effluent discharges to the soil column. WAC 173-218 establishes requirements for injection to the underground aquifer.

The following information provides an analysis of how each source-site alternative category is anticipated to comply with these ARARs and TBCs.

3.1.3.1 100-NR-1 Source-Site Alternative Compliance with ARARs/TBCs

All source-site alternatives, other than the No-Action and Institutional Controls Alternatives, could result in the generation of some quantity of decontamination or dewatering wastewaters. Depending upon volumes of soils, debris, and types and concentrations of contaminants, a number of treatment/disposal options may be used that may result in wastewater discharges to the ground or to groundwater. Treatment and disposal options that may invoke these standards include discharge of wastewaters to the ground after verification that contaminant concentrations are below the substantive requirements contained in WAC 173-216, transport of wastewaters to a pump-and-treat system in substantive compliance with WAC 173-218 and designed to treat COCs in wastewaters, and transport of wastewaters to a site water-treatment system in compliance, or substantive compliance depending upon operating authority, with WAC 173-216 or 40 CFR 122. Regardless of which alternative is used, compliance with these ARARs and TBCs can be accomplished.

Remove/Dispose Alternative. Some soil treatments will produce a wastewater stream that could require treatment at the end of the treatment phase. Treatment and disposal options would include trucking the wash waters to a water-treatment facility within the Hanford Site or testing the waters and, if they comply with ARARs associated with WAC 173-216, discharging them to the ground. The ARARs associated with wastewater management would be able to be complied with regardless of which treatment and disposal option is chosen.

3.1.3.2 100-NR-2 Groundwater Alternative Compliance with ARARs/TBCs

All alternatives other than the No-Action and Institutional Controls Alternatives will require construction and development of wells. This activity has the potential to require disposal of purge water from well installation and development activities. Purge-water management will be accomplished in accordance with the Hanford Site Purge Water Agreement. Injection of treated groundwater is considered in the groundwater removal and treatment alternatives. Reinjection would be subject to the provisions of WAC 173-218. If this cannot be accomplished, a waiver would be required.

3.1.4 Standards for Protection of the Columbia River from Direct Discharges

40 CFR 122 addresses technology-based limitations and standards, control of toxic pollutants, and monitoring for direct discharges to waters of the United States, including storm water.

No direct wastewater discharges to the Columbia River are planned under any of the alternatives. Use of National Pollutant Discharge Elimination System-permitted water-treatment units for treatment of wastewaters from source-unit cleanup may be utilized as identified above. Erosion and storm water controls would be used as necessary while working near the river. A storm water management plan would be prepared to prevent discharges of contaminated storm water to the Columbia River.

Two alternatives with remediation of the shoreline site, the Remove/Dispose and the Containment Alternatives, could trigger ARARs associated with river construction activities. These ARARs include the U.S. Army Corp of Engineers permitting requirements contained in 33 CFR 320-330, which contain provisions for dredging and filling material to the Columbia River. Because the Columbia River may be included in the Wild and Scenic River System, the substantive requirements associated with a Section 10 permit under 33 CFR 322 may be an ARAR for these alternatives. State ARARs associated with river

construction include the Shoreline Development Permits contained in WAC 173-27, and Hydraulic Projects Permits contained in WAC 220-110.

3.1.5 Air Standards

The Clean Air Act (CAA) establishes standards for the control of air emissions. Authority has partially been delegated to the state. Under 40 CFR 61, Subpart H, and WAC 246-247 , radionuclide airborne emissions from all combined operations at the Hanford Site may not exceed 10-mrem/yr effective dose equivalent to the hypothetical offsite maximally exposed individual (MEI). For an emission unit with a potential to emit less than 0.1 mrem/yr total effective dose equivalent to the MEI, WAC 246-247 allows for an estimate of those emissions in lieu of monitoring and requires verification of compliance through periodic confirmatory measurements. An emission unit is defined as a point source, nonpoint source, or source of fugitive emissions. WAC 246-247 requires verification of compliance through monitoring. WAC 173-400 establishes requirements for the control and/or prevention of the emission of air contaminants, including particulates. WAC 173-460 establishes acceptable source impact levels for more than 500 carcinogenic acutely toxic air pollutants. In addition, WAC 173-480-050 requires that emissions be kept as low as reasonably achievable (ALARA).

The radionuclide emission limits would apply to all fugitive, diffuse, and point source air emissions of radionuclides generated by any of the removal or treatment (in situ or ex situ) alternatives. If there were the potential for any non-zero radioactive emissions, best available radionuclide control technology (BARCT) would be required. If the alternative would generate an increase of toxic air pollutants to the atmosphere above the small-quantity emission rates, implementation of BARCT for toxics would be required.

The following information provides an analysis of how each source-site alternative category is anticipated to comply with these ARARs and TBCs.

3.1.5.1 Source-Site Alternative Compliance with ARARs/TBCs

No-Action Alternative. Because the No-Action Alternative would have contaminants in place, compliance with ARARs and TBCs would not be achieved.

Institutional Controls Alternative. Institutional controls are not anticipated to generate airborne emissions of radionuclides.

Remove/Dispose Alternative. Remove, treatment, and disposed activities have the potential to increase emissions of radionuclides. If radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247. No toxic emissions are expected.

Remove/Ex Situ Bioremediation/Dispose for Petroleum Waste Group. Remove, aboveground bioremediation, and dispose activities have the potential to increase emissions of radionuclides if radionuclides are present in the soil. However, ex situ bioremediation would not be used if radionuclides were present along with petroleum hydrocarbons. Bioremediation is not expected to increase any emissions of TPH; therefore, no additional controls are required.

In Situ Bioremediation of Petroleum Waste Group. Preparation for in situ bioremediation may require limited surface disturbance of a surface radiation area. If radionuclides are present in the surface soil at the site and there is the potential for any non-zero emissions, BARCT would be required, as specified in WAC 246-247. Once preparation is completed, no additional emissions are expected from the activity. If radionuclides were present in deep soil, then in situ bioremediation would not be selected as an alternative. In addition, bioremediation is not expected to increase any emissions of TPH; therefore, no additional controls are required.

Containment for Radioactive Waste Group and Shoreline Site. Containment is a standard practice on the Hanford Site for surface contaminants. The Radiation Area Remedial Action program uses clean fill to cover and stabilize surface contamination. The placement of a cover to contain radiation units is not

anticipated to generate airborne emissions of radionuclides. The BARCT will be required, as specified in WAC 246-247, to prevent the release of particulates during placement of the cover.

In Situ Solidification for Radioactive Waste Group and Shoreline Site. Preparation for in situ solidification may require limited surface disturbance of the surface radiation area. If radionuclides are present in the surface soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247. Once preparation is competed, no additional emissions are expected from the activity.

3.1.5.2 100-NR-2 Groundwater Alternative Compliance with ARARs

No-Action Alternative. Because the No-Action Alternative would not actively cause airborne emissions, compliance with ARARs and TBCs will be achieved.

Institutional Controls Alternative. Institutional controls are not anticipated to generate airborne emissions of radionuclides.

Permeable Barrier for River Protection. Installation of the permeable wall has the potential to encounter radionuclide contaminated soil. If radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247.

Hydraulic Controls for River Protection and Pump and Treat for Sr-90 in the

Aquifer. Installation of the pump-and-treat system should not generate radionuclide emissions. However, if radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247.

Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation. Installation of the pump-and-treat system should not generate radionuclide emissions. However, if radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247.

Cryogenic Barrier for River Protection and Pump and Treat Aquifer Remediation. Installation of the cryogenic barrier has the potential to generate emissions of radionuclides while the installation of the pump-and-treat system should not generate radionuclide emissions. However, if radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247.

Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation. Installation of the sheet pile barrier has the potential to generate emissions of radionuclides while the installation of the pump-and-treat system should not generate radionuclide emissions. However, if radionuclides are present in the soil at the site and there is the potential for any non-zero emissions, BARCT would be required as specified in WAC 246-247.

3.1.6 Standards for the Protection of Cultural and Ecological Resources

The National Historic Preservation Act of 1966 (16 USC 470 et seq, implemented in regulation by 36 CFR 800 requires federal agencies to take into account the effect of an activity on any significant cultural resource, including properties listed, or eligible for inclusion, on the National Register of Historic Places. The Native American Graves Protection and Repatriation Act establishes statutory provisions for the treatment of inadvertent discoveries of Native American remains and cultural objects. The Archeological and Historical Preservation Act of 1974 (16 USC 469a) requires action to recover and preserve archaeologic or historic data in areas where activity may cause irreparable harm, loss, or destruction of significant data.

The Endangered Species Act of 1973 (16 USC 1531) is implemented by 50 CFR 402 and WAC 232-12-297 and prohibits activities that threaten the continued existence of listed species or destroys critical habitat. The Migratory Bird Treaty Act makes it illegal to take, capture, or kill, as applicable, any migratory bird or any part, nest, or egg of any such birds.

All National Register evaluations have been performed to determine whether the buildings in the 100-N Area are eligible for inclusion on the National Register of Historic Places, and this determination may affect alternatives for nearby waste sites. The cultural resource protection requirements are applicable for those properties in the 100-N Area that have been determined to be historically significant. In addition, the 100 Area in general is rich in cultural resources related to Native Americans, and several of the alternatives involve ground-disturbing activities. If any discoveries related to Native American remains or cultural objects are made during such activities, activity in the area will cease, and appropriate notifications and negotiations regarding further actions will be made.

Threatened and endangered species are known to be present in the 100 Area, and the area is within an established migration route; however, no adverse impacts on protected species or sensitive habitat from any of the alternatives are anticipated. Area-specific ecological reviews will be conducted prior to implementing any alternative to identify potential adverse impacts. Mitigation plans will be prepared, as necessary, and implemented.

The Hanford Reach Preservation Act (PL 100-605) provides for a comprehensive river conservation study and prohibits the construction of any dam, channel, or navigation project by a federal agency for 8 years from enactment. Projects are required to be performed under the consultation and coordination of the National Park Service on any proposed remediation alternative.

The following information provides an analysis of how each source-site alternative category is anticipated to comply with these ARARs and TBCs.

3.1.6.1 100-NR-1 Source-Site Alternative Compliance with ARARs/TBCs

No-Action Alternative. Because the No-Action Alternative leaves waste in place, ARARs and TBCs relative to these standards may not be complied with, due to threat of contamination to the resources, or relative to the use of resources.

Institutional Controls Alternative. Minimal or no surface disturbances are anticipated to occur utilizing this alternative; therefore, ARARs/TBCs associated with preservation of cultural and ecological resources would be easily followed in the short term. This alternative will also afford continued protection of cultural and historical resources from public use. However, this alternative irreversibly or irretrievably commits natural resources during the remediation time frame, which can be for a very long time particularly, for the shoreline site. This alternative also has the potential for contaminating resources adjacent to the sites from contaminants remaining in place. Therefore, long-term compliance with these ARARs and TBCs cannot be ensured.

Remove/Dispose Alternative. This alternative will comply with all cultural and ecological resource ARARs and TBCs. However, this alternative has a high potential to impact cultural, historical, or traditional-use areas due to the need for extensive excavation of areas at and adjacent to the waste sites (e.g., shoring side walls for worker safety) particularly at the shoreline site. Much more care will be required with this alternative for completion of preconstruction surveys and development of mitigative measures should cultural or natural resources be encountered. Recontouring and revegetation of the disturbed areas will be required to ensure restoration of the natural resources. A benefit of this option is that no future threat of recontamination of the site or contamination of adjacent areas will occur once the contaminants are removed and appropriately disposed.

Remove/Ex Situ Bioremediation/Dispose for Petroleum Waste Group. This alternative will comply with all cultural and ecological resource ARARs and TBCs. However, this alternative has a high potential to impact cultural, historical, or traditional-use areas due to the need for extensive excavation of areas at and adjacent to the waste sites (e.g., shoring side walls for worker safety).

Much more care will be required with this alternative for completion of preconstruction surveys and development of mitigative measures should cultural or natural resources be encountered. Recontouring and revegetation of the disturbed areas will be required to ensure restoration of the natural resources. A benefit of this option is that no future threat of recontamination of the site or contamination of adjacent areas will occur once the contaminants are removed and appropriately disposed. The treatment action, aboveground bioremediation, should not require additional actions in order to comply with these standards.

In Situ Bioremediation for Petroleum Waste Group. This alternative will comply with all cultural and ecological resource ARARs and TBCs. This alternative is anticipated to cause minimal or no impacts to cultural resources since the area of concern has already been previously disturbed because of operations. Compliance with these standards can readily be achieved through proper preconstruction surveys and mitigative measures should resources be encountered.

Containment for Radioactive Waste Group and Shoreline Site. This alternative will comply with all cultural and ecological resource ARARs and TBCs. Placement of a cap is anticipated to cause minimal or no impacts to cultural resources since the area of concern has already been previously disturbed because of operations. This alternative will protect adjacent cultural resources from becoming contaminated by retaining contaminants in place. Compliance with these standards can readily be achieved during construction of the cap through proper preconstruction surveys and mitigative measures should resources be encountered. Implementation of this alternative will most likely enhance ecological resources by eliminating the exposure of contaminants and by providing an opportunity to revegetate the surface of the cap with plant species that provide for a viable and sustainable ecological environment.

In Situ Solidification for Radioactive Waste Group and Shoreline Site. This alternative will comply with all cultural and ecological resource ARARs and TBCs. This alternative is anticipated to cause minimal or no impacts to cultural resources since the area of concern has already been previously disturbed because of operations. Because this alternative will immobilize contaminants, protection of adjacent cultural resources will be ensured by contaminants remaining in place. Recontouring and revegetation efforts that could impact cultural resources would require mitigative measures. Compliance with these standards can readily be achieved through proper preconstruction surveys and mitigative measures should resources be encountered.

3.1.6.2 100-NR-2 Groundwater Alternative Compliance with ARARs/TBCs

All 100-NR-2 groundwater alternatives require very long restoration time frames for river protection (270 to 300 years for Sr-90 cleanup). Note: Based on modeling of current well data, manganese would require over 3,000 years to meet secondary MCL standards. Because of the uncertainties with modeling to this length of time and because the manganese MCL is based on a secondary drinking water standard, the Sr-90 remediation time frame is considered the primary focus). Due to the length of remediation, waivers from ecological resource ARARs may be required. Impacts to aquatic organisms from Sr-90 and tritium contamination have not been fully defined. In order to determine whether these constituents are damaging aquatic resources to the extent that they are irretrievable and irreversible, more data will need to be gathered and assessed. One potential avenue for obtaining this information is the pending Columbia River Comprehensive Impact Assessment study (Tri-Party Agreement Milestone M-15-80, scheduled for submittal of a revised draft in March of 1998). This study is planned to define further ecological impacts, including aquatic ecosystems potentially impacted by Sr-90 along the 100-NR-2 river interface. When this information is obtained, it will become available to the public for consideration. In addition, all 100-NR-2 groundwater alternatives other than the No-Action Alternative, may temporarily (for up to 300 years) restrict use of the shoreline, particularly at N-Springs.

No-Action Alternative. ARARs and TBCs would be complied with because no surface disturbances would occur with this alternative.

Institutional Controls Alternative. Minimal or no surface disturbances are anticipated to occur using this alternative; therefore, ARARs and TBCs associated with preservation of cultural and ecological resources would be easily complied with.

Permeable Barrier for River Protection. This alternative will cause major surface disturbances in an area near the river shoreline and unrestricted land use would conflict with this option, but it is anticipated that ARARs and TBCs will be complied with during implementation and after completion of this alternative. Because this area is particularly sensitive from both an ecological and cultural perspective, particular attention to ecological reviews will be necessary, as well as development of mitigative measures during construction activities, to ensure compliance with these ARARs and TBCs.

Hydraulic Controls for River Protection and Pump and Treat for Sr-90 in the Aquifer. This alternative will cause minimal surface disturbance through construction and operation of well systems and the pump-and-treat facility. These activities are anticipated to cause minimal disturbance to cultural and ecological resources, and compliance with ARARs and TBCs is anticipated to be easily met through standard Hanford practices for cultural and ecological surveys and mitigative measures.

Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation. This alternative will cause minimal surface disturbance through construction and operation of well systems and the pump-and-treat facilities. These activities are anticipated to cause minimal disturbance to cultural and ecological resources, and compliance with ARARs and TBCs is anticipated to be easily met through standard Hanford practices for cultural and ecological surveys and mitigative measures.

Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation. This alternative will cause major surface disturbances in an area near the river shoreline due to construction of a cryogenic barrier, but it is anticipated that ARARs and TBCs will be able to be complied with during implementation and after completion of this alternative. Because this area is particularly sensitive from both an ecological and cultural perspective, particular attention to ecological reviews will be necessary, as well as development of mitigative measures during construction activities to ensure compliance with these ARARs and TBCs. Minimal surface disturbance through construction and operation of well systems and the pump-and-treat facilities can be expected. These activities are anticipated to cause minimal disturbance to cultural and ecological resources, and compliance with ARARs and TBCs is anticipated to be easily met through standard Hanford practices for cultural and ecological surveys and mitigative measures.

Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation. This alternative will cause minimal surface disturbance through construction and operation of well systems and the pump-and-treat facilities. These activities are anticipated to cause minimal disturbance to cultural and ecological resources, and compliance with ARARs and TBCs is anticipated to be easily met through standard Hanford practices for cultural and ecological surveys and mitigative measures.

3.1.7 Radiation Protection Standards

The Atomic Energy Act establishes radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities. Title 10 CFR 835 establishes limits for doses to occupational workers and visitors and requires that measures be taken to maintain radiation exposure as low as reasonably achievable. Regulations regarding radiation protection of the public and the environment have been promulgated by the NRC in 10 CFR 20 and 10 CFR 61.

A combination of personal protective equipment, personnel training, physical design features (e.g., confinement and remote handling), and nonengineered controls (e.g., limiting time in radiation zones), for example, would be used to ensure that the requirements of 10 CFR 835 and DOE Order 5400.5 are met for all alternatives.

The following information provides an analysis of how each source-site alternative category is anticipated to comply with these ARARs and TBCs.

3.1.7.1 100-NR-1 Source-Site Alternative Compliance with ARARs/TBCs

No-Action Alternative. ARARs and TBCs associated with radiation protection standards may not be complied with because the No-Action Alternative would leave contamination in place.

Institutional Controls Alternative. Compliance with radiation worker exposure standards would be easily met with this alternative because it is anticipated that very little field-maintenance activities would be required with this alternative. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through access prevention to areas that would result in doses that exceed radiation protection standards for the public. However, because this alternative will require that controls be in place for over 200 years due to Sr-90 decay, it becomes less certain that institutional controls would be able to provide compliance with radiation protection standards. A decision for rural residential use at sites within 100-NR-1 is most probably precluded with the sole use of institutional controls where radiation protection standards are exceeded.

Remove/Dispose Alternative. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during site preparation and excavation of soils in radiologically contaminated areas. Radiation protection standards for the public will be complied with during excavation of radiologically contaminated soils through adequate planning and design of the excavation and disposal activities. Upon removal of soils, these requirements will cease to be applicable at the site.

Remove/Ex Situ Bioremediation/Dispose for Petroleum Waste Group. Radiation protection standards are not anticipated to be applicable to this alternative; however, due to the lack of data on soil sites, there is a potential for these standards to apply should radionuclides be discovered within petroleum-contaminated soils.

In Situ Bioremediation of Petroleum Waste Groups. Radiation protection standards for the public are not anticipated to be applicable to this alternative; however, because of the lack of data on soil sites, there is a potential for these standards to apply should radionuclides be discovered within petroleum-contaminated soils.

Containment for Radioactive Waste Group and Shoreline Site. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during site preparation and construction of a cap in radiologically contaminated areas. Compliance with radiation protection standards for the public can be achieved throughout construction and during operation and maintenance of the cap. Compliance would be achieved through access prevention to areas that would result in doses that exceed radiation protection standards for the public.

In Situ Solidification for Radioactive Waste Group and Shoreline Site. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during site preparation, construction activities, and implementation of the treatment activities in radiologically contaminated areas. In situ solidification by itself may not be able to ensure compliance with radiation protection standards for the public. Institutional controls would be required to prevent intrusion into the solidified mass and to prevent access should radiation protection standards be exceeded after solidification. In this manner, compliance with these standards can be achieved.

3.1.7.2 100-NR-2 Groundwater Alternative Compliance with ARARs/TBCs

No-Action Alternative. Because groundwater would remain accessible and contaminated, compliance with ARARs and TBCs may not be achieved.

Institutional Controls Alternative. Compliance with radiation worker exposure standards would be easily met with this alternative because it is anticipated that very little field maintenance activities would be required with this alternative. Compliance with radiation protection standards for the public can be

achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Permeable Barrier for River Protection. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during site preparation and construction of the permeable barrier in radiologically contaminated areas. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Hydraulic Controls for River Protection and Pump and Treat for Sr-90 in the Aquifer. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during construction and operation of wells and the pump-and-treat facility. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Hydraulic Controls for River Protection and Pump and Treat for Aquifer Remediation. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during construction and operation of wells and the pump-and-treat facilities. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Cryogenic Barrier for River Protection and Pump and Treat for Aquifer Remediation. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during construction and operation of wells and the pump-and-treat facilities. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Sheet Pile Barrier for River Protection and Soil Flushing/Pump and Treat for Aquifer Remediation. Compliance with radiation worker exposure standards can be attained with this alternative through compliance with the substantive requirements of 10 CFR 835 during construction and operation of wells and the pump-and-treat facilities. Compliance with radiation protection standards for the public can be achieved with this alternative through continued control of the site under the DOE or an equivalent agency. Compliance would be achieved through restrictions on groundwater use. At the end of remediation, radionuclide activity in the groundwater would have decayed to levels that would allow for unrestricted use.

Table 3.1. Applicable or Relevant and Appropriate Requirements (ARAR) and To Be Considered (TBCs)

Description	Citation	Requirements	Remarks	Operable Unit Affected
Atomic Energy Act of 1954, as amended	42 U.S.C. 2011 et seq.	Authorizes DOE to set standards and restrictions governing facilities used for research, development, and use of atomic energy.		100-NR-2
Department of Energy Occupational Radiation Protection (Final Rule)	10 CFR 835	Establishes occupational and visitor radiological exposure limits.	DOE Radiological Control Manual DOE/EH-02561, which is encompassed within the Hanford Site Radiological Control Manual adheres to these requirements.	100-NR-1 100-NR-2
Nuclear Regulatory Commission Standards for Protection Against Radiation	10 CFR 20, Subpart C and D	Sets occupational dose limits for adult workers. Total effect dose equivalent equal to 5 rem/year. Sets dose limits to members of the public.	Occupational dose limits will be followed during remediation in radiological areas.	100-NR-1 100-NR-2
Nuclear Regulatory Commission Licensing Requirements for Land Disposal of Radioactive Wastes	10 CFR 61	Provides regulations for the management and land disposal of radioactive wastes.	Cover performance standards are contained in this regulation.	100-NR-1
Uranium Mill Tailings Radiation Control Act of 1978	Public Law 95-604, as amended			
Standards for Uranium and Thorium Mill Tailings	40 CFR 192	Establishes standards for control, cleanup, and management of radioactive materials from inactive uranium processing sites.	May be relevant and appropriate if any radium-226 is encountered.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Land Cleanup Standards	40 CFR 192.10-192.12	Requires remedial actions to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site, the concentration of radium-226 in land averaged over any area of 100 m2 shall not exceed the background level by more than 5 pCi/g, averaged over the first 15 cm of soil below the surface and 15 pCi/g, averaged over 150-cm-thick layers of soil more than 15 cm below the surface. In any habitable building, a reasonable effort shall be made during remediation to achieve an annual average (or equivalent) radon decay product concentration (including background not to exceed 0.02 Working Level (WL). In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL and the level of gamma radiation shall not exceed the background level by more than 20 microroentegens per hour.	May be relevant and appropriate if any above-background radium-226 or radon-222 is encountered during remediation. Radium-226 did not result from uranium processing; therefore, regulation is not applicable.	100-NR-1 100-NR-2
Implementation	40 CFR 192.20-192.23	Requires that when radionuclides other than radium-226 and its decay products are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials, remedial action shall reduce other residual radioactivity to levels as low as reasonably achievable (ALARA).	May be relevant and appropriate if any radium-226 is encountered during remediation.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Archaeological and Historical Preservation Act of 1974	26 U.S.C. 469	Requires action to recover and preserve artifacts in areas where activity may cause irreparable harm, loss, or destruction of significant artifacts.	Applicable when remedial action threatens significant scientific, prehistorical, historical, or archeological data.	100-NR-1 100-NR-2
Archaeological Resources Protection Act of 1979	16 U.S.C. 4l70aa mm (1990)	Protects archaeological and traditional cultural properties associated with archaeological sites. Requires notification of Indian Tribes of possible harm to or destruction of sites having religious or cultural significance.	Applicable when remedial action threatens archaeological and traditional cultural properties.	100-NR-1 100-NR-2
Protection of Archaeological Resources	43 CFR 7	Establishes procedures to be followed by federal land managers to protect archaeological resources on federal lands. Sets civil and criminal penalties for violations; protects confidentiality of archaeological resource information.	Applicable when remedial action threatens archaeological resources.	100-NR-1 100-NR-2
American Indian Religious Freedom Act of 1978	42 U.S.C. 1996	Provides for access by Native Americans to religious sites and development of migration measures if actions will deny such access. Requires agency to consult with traditional religious leaders regarding activities that might affect religious sites.	Applicable when remedial action threatens Native American religious sites.	100-NR-1 100-NR-2
The Religious Freedom Restoration Act of 1993	42 U.S.C. 2000bb; P.L. 103-141	Requires agency to demonstrate compelling need for a project that will deny the free exercise of religion by Native Americans. If activities threaten access to religious site, consultation with tribes will be necessary.	Applicable when remedial action threatens Native American religious sites.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Antiquities Act of 1906	16 U.S.C. 431-433	Protects all historic and prehistoric ruins and objects of antiquity located on federal lands. Provides for criminal sanctions against excavation, injury, or destruction of such resources.	Applicable when remedial action threatens historic or prehistoric ruins.	100-NR-1 100-NR-2
Migratory Bird Treaty Act	16 U.S.C. 703 et seq. 50 CFR 10-24	Makes it illegal to pursue, hunt, take, capture, kill, possess, trade, or transport any migratory bird, part, nest, or egg included in the terms of the conventions between the U.S. and Great Britain, the U.S. and Mexico, and the U.S. and Japan. Although this Act does not require ecological assessments, be done for federal agency projects, if a disturbance is expected in an area where migratory birds may be affected, such an assessment should be done to ensure the law's intent.	If remedial actions potentially impact migrating birds, this Act is applicable.	100-NR-1 100-NR-2
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	Prohibits federal agencies from jeopardizing threatened or endangered species or adversely modifying habitats essential to their survival. If waste site remediation is within sensitive habitat or buffer zone surrounding threatened and endangered species, migration measures must be taken to protect this resource.	This law is applicable, as threatened or endangered species have been identified within the 100 Area.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Fish and Wildlife Services List of Endangered and Threatened Wildlife and Plants	50 CFR 17, 22, 225, 226, 227, 402 and 424	Requires identification of activities that may affect listed species. Actions must not threaten the continued existence of a listed species or destroy critical habitat. Requires consultation with the Fish and Wildlife Service to determine if threatened or endangered species could be impacted by activity.	This law is applicable, as threatened or endangered species have been identified within the 100 Area.	100-NR-1 100-NR-2
Historic Sites, Buildings, and Antiques Act	16 U.S.C. 461	Establishes requirements for preservation of historic sites, buildings, or objects of minimal significance. Undesirable impacts to such resources must be mitigated.	Applicable to properties listed in the National Register of Historic Places, or eligible for such listing.	100-NR-1 100-NR-2
National Historic Preservation Act of 1966, as amended	16 U.S.C. 470 et seq.	Prohibits impacts on cultural resources. Where impacts are unavailable, requires impact migration through design and data recovery.	Applicable to properties listed in the National Register of Historic Places, or eligible for such listing.	100-NR-1 100-NR-2
Protection of Historic Properties	36 CFR 800	Sets criteria to assess effects, to develop migration measures to address unavoidable adverse impacts, and to address properties discovered during implementation of an undertaking.	Applicable when remedial action threatens a historic property discovered during remedial activity.	100-NR-1 100-NR-2
Historic Sites Act of 1935	16 U.S.C. 461-467 36 CFR 65	Requires action to undertake the recovery, protection, and preservation of sites, buildings, objects, and antiquities of National significance.	Applicable when remedial action threatens sites, buildings, objects, and antiquities of National significance.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. 3001-3013 Public Las 101-601 (1993)	Requires action by federal agency when Native American human remains and associated funerary objects are inadvertently discovered during excavation. Requires work stoppage, protection of items, and notification to appropriate Indian Tribes.	Applicable if, during remedial action, Native American human remains or burial objects are discovered. Construction activities may resume 30 days after certification that agency head and Indian tribes have been notified.	100-NR-1 100-NR-2
Hanford Reach Study Act	P.L. 100-605	Provides for a comprehensive river conservation study. Prohibits the construction of any dam, channel, or navigation project by a federal agency for 8 years after enactment. New federal and nonfederal projects and activities are required, to the extent practicable, to minimize direct and adverse effects on the values for which the river is under study and to use existing structures.	This law as enacted November 4, 1988. Consultation and coordination with the National Park Service will be done to minimize and provide mitigation for any direct and adverse effects on the river.	100-NR-1 100-NR-2
Flood Plains/Wetlands Environmental Review	10 CFR 1022	Requires federal agencies to avoid, to the extent possible, adverse effects associated with the development of a floodplain or the destruction or loss of Wetlands.	Applicable if remedial activities take place in a floodplain or Wetlands.	100-NR-1 100-NR-2
Clean Air Act, as amended	42 U.S.C. 7401 et seq.	A comprehensive environmental law designed to regulate any activities that affect air quality, providing the national framework for controlling air pollution.		
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR 61	Establishes numerical standards for hazardous air pollutants.		

Description	Citation	Requirements	Remarks	Operable Unit Affected
Radionuclide Emissions from DOE Facilities (except Airborne radon-222, and radon-230	40 CFR 61.92	Prohibits emissions of radionuclides to the ambient air exceeding an effective dose equivalent of 10 mrem/year.	Applicable to point and diffuse sources.	
Emission Standards for Asbestos for Waste Disposal Operations for Demolition and Renovation	40 CFR 61.150	States there must be no visible emissions to the outside air during either the collection, processing (including incineration), packaging, or transporting of any asbestos-containing waste material generated by the source, or specified waste treatment methods must be used.	Applicable to recovery and handling of asbestos wastes.	100-NR-1
Asbestos Standard for Active Waste Disposal Sites	40 CFR 61.154	States there must either be no visible emissions to the outside air during the collection, processing (including incineration), packaging, or transporting of any asbestos-containing waste material generated by the source, or specified waste treatment methods must be used.	Applicable to landfill disposal of asbestos.	100-NR-1
Protection of Stratospheric Ozone	40 CFR 82	Management of refrigerant systems	Applicable to all buildings/ facilities containing refrigerant systems	100-NR-1
Federal Water Pollution Control Act (FWPCA), as amended by the Clean Water Act of 1988 (CWA)	33 U.S.C. 1251 et seq.	Creates the basic national framework for water pollution control and water quality management in the United States	Applicable to discharges of pollutants to navigable waters	
Water Quality Standards	40 CFR 131	Provides federal ambient water quality criteria for use in surface water cleanup	Also provides requirements for approving State water quality standards.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
NPDES Criteria and Standards	40 CFR 125.104	Best management practices program shall be developed in accordance with good engineering practices.	Applicable if remediation includes wastewater discharge; also applies to storm water runoff associated with industrial activities. Effluent limitations established by EPA are included in NPDES permit.	
Discharge of Oil	40 CFR 110	Prohibits discharge of oil that violates applicable water quality standards or causes a sheen of oil on water surface. Runoff from site will need control for oily water discharge to waters of the United States.		
Safe Drinking Water Act (SDWA)	42 U.S.C. 300 et seq.	Creates the basic framework for protection of drinking water supplies from pollutants	Applicable to remedial action objectives for soil and groundwater	100-NR-1 100-NR-2
National Primary Drinking Water Regulations	40 CFR 141	Identifies primary contaminants and concentration levels protective of drinking water supplies	Provides MCLs for medial action objective consideration	100-NR-1 100-NR-2
National Secondary Drinking Water Regulations	40 CFR 143	Identifies contaminants and concentration levels for aesthetic quality of drinking water supplies	Provides secondary MCLs for remedial action objective consideration	100-NR-1 100-NR-2
U.S. Army Corp of Engineers Permit Regulations	33 CFR 320-330	Establishes procedural and permit requirements of construction activities within the Columbia River. Permit programs include Section 10 Permits.	Substantive requirements are applicable if river construction activities will take place and would qualify under these permit programs.	NR-1 NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA)	40 U.S.C. 6901 et seq.	Establishes the basic framework for federal regulation of solid waste. Subpart C of RCRA controls the generation, transportation, treatment, storage, and disposal of hazardous waste through a comprehensive "cradle to grave" system of hazardous waste management techniques and requirements. Subtitle D of RCRA controls the disposal of solid waste.	The State has been authorized to implement most of Subtitle C, although certain HSWA provisions (e.g., LDR requirements) have not yet been delegated. Additionally, EPA has approved the State Subtitle D Program.	
Identification and Listing of Hazardous Waste	40 CFR 261 [WAC 173-303-016]	Identifies by listing and characterization, those solid wastes subject to regulation as hazardous wastes under Parts 261-265, 268, 270, 271, and 124.	Applicable if remediation techniques result in generation of hazardous wastes, Environmental media (e.g., soil and groundwater) contaminated with RCRA listed waste must be managed as RCRA listed waste unless the regulatory agencies determine that the media no longer contains the listed waste.	100-NR-1 100-NR-2
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262 [WAC 173-303]	Describes the regulatory requirements imposed on generators of hazardous wastes who treat, store, or dispose of the waste onsite.	Applicable if remediation techniques result in generation of hazardous waste.	100-NR-1 100-NR-2
Designation & Determination of LDR Status	40 CFR 262.11 (WAC 173-303-070)	Requires generator to determine waste designation and LDR Status.	Applicable if remediation techniques result in generation of solid waste.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Accumulation Time	40 CFR 262.34 [WAC 173-303-200]	Allows a generator to accumulate hazardous waste on site for 90 days or less without a permit, if all waste is containerized and labeled.	Hazardous waste removed from the operable units, and waste treatment residues, are subject to the 90 day generator accumulation requirements if the waste is stored on site for 90 days or less. If hazardous waste is stored on site for more than 90 days, the substantive provisions of permitting standards for TSD facilities are applicable.	100-NR-1 100-NR-2
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264 WAC 173-303]	Establishes requirements for operating hazardous waste treatment, storage, and disposal facilities. Applies to facilities put in operation since November 19, 1980. Facilities in operation before that date and existing facilities handling newly regulated wastes must meet similar requirements in 40 CFR 265.	Applicable if remediation technique results in onsite treatment, storage, or disposal of hazardous waste.	100-NR-1 100-NR-2
Closure	40 CFR 264.111-264.116 [WAC 173-303-610] Subpart G	Performance standard that controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post closure escape of chemicals, disposal, or decontamination of equipment, structures, and soils. All contaminated equipment, structures, and soils must be properly disposed.	Substantive requirements may be relevant and appropriate during remediation activities.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Post closure	40 CFR 264-117-264-120 [WAC 173-303-610] Subpart G	Post closure care must begin after completion of closure and continue for 30 years. During this period, the owner or operator must comply with all post closure requirements, including maintenance of cover, leachate monitoring, and groundwater monitoring.	Applicable to waste remaining in place after closure. Requires post closure care and monitoring to ensure elimination of escape of hazardous constituents, leachate, and contaminated runoff.	100-NR-1 100-NR-2
Container Storage	40 CFR 264.170-264-178 [WAC 173-303-160-173-303-161] Subpart I	Condition of containers, comparability of waste with containers, container management, containment, special requirements for ignitable or reactive wastes.	May be applicable if container storage is to occur. Inspection requirements may be in potential conflict with ALARA requirements.	100-NR-1 100-NR-2
Miscellaneous Unit	40 CFR 264-600-603 (WAC 173-303-680) Subpart X	Requires general environmental performance standards for operations including monitoring and inspections.	May be applicable if miscellaneous units occur, i.e., thermal treatment is used.	100-NR-1 100-NR-2
Waste Piles	40 CFR 264.250-259 (WAC 173-303-660) Subpart L	Design in operating requirements: monitoring, leachate system and lines.	May be applicable if waste piles occur outside area of contamination.	100-NR-1 100-NR-2
Tanks	40 CFR 264.190-199 (WAC 173-303-640)	Design operating standards for tanks including secondary containment and leak detection systems; tank management; containment; special requirements for ignitable or reactive wastes.	May be applicable if tank storage is to occur. Inspection requirements may be potential conflict with ALARA requirements. May be applicable for soil washing process.	100-NR-1 100-NR-2
Temporary Units	40 CFR 264-553 (WAC 173-303-645(7)	Establishes alternative performance standards for temporary tanks and containers used for treatment or storage of hazardous remediation wastes for up to one year.	Applicable if temporary unit is used.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Land Disposal Restrictions (LDR)	40 CFR 268 [WAC 173-303-140 WAC 173-303-141]	Generally prohibits placement of restricted RCRA hazardous wastes in land-based units such as landfills, surface impoundments, and waste piles.	Applicable unless waste has been treated, treatment has been waived, a treatment variance has been set for the waste, and equivalent treatment method has been established, or waste qualifies for delisting.	100-NR-1 100-NR-2
Dilution Prohibition	40 CFR 268.3 Subpart A	Requires remediation waste to be appropriately treated, which does not include dilution. Generators are required to identify applicable treatment standards at the point of generation and prior to mixing with other remediation wastes.	Applicable if RCRA hazardous waste.	100-NR-1 100-NR-2
Debris Rule	40 CFR 268.45	Establishes the alternative treatment standards of hazardous waste debris by using technologies specified in 40 CFR 268.45, Table 1.	Applicable if RCRA hazardous waste.	100-NR-1 100-NR-2
Prohibition and Treatment Standards	40 CFR 268-30-268.48 [WAC 173-303-140]	Establishes treatment standards that must be met prior to land disposal	Applicable if RCRA hazardous waste	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Prohibition on Storage	40 CFR 268.50 [WAC 173-303-141]	The storage of nonradioactive hazardous waste restricted from land disposal under RCRA Section 3004 and 40 CFR 268, Subpart C, is prohibited unless wastes are stored in tanks and containers by a generator or the onsite operator of a TSD facility solely for the purpose of accumulation of such quantities as to facilitate proper treatment or disposal. TSD facility operators may store wastes for up to one year under these circumstances. Radioactive mixed waste is not prohibited from storage pursuant to the Tri-Party Agreement.	Applicable only to nonradioactive hazardous waste	100-NR-1 100-NR-2
Transportation	49 CFR 100-199	Establishes standards applicable to the offsite transportation and packaging of hazardous materials	Applicable requirement for offsite shipments	100-NR-1 100-NR-2
Toxic Substances Control Act (TSCA), as amended	15 U.S.C. 2601 et seq.	Provides EPA with authority to regulate the production, use, distribution, and disposal of toxic substances		
Regulation of Polychlorinated Biphenyls (PCBs)	40 CFR 761	For spills, occurring after May 4, 1987, spillage or disposal must be reported to EPA. Unless otherwise approved, PCBs as concentrations of 50 ppm or greater must be treated in an incinerator. Spills that occurred before May 4, 1987, are to be decontaminated o requirements established at the discretion of the EPA.		100-NR-1 100-NR-2
Model Toxics Control Act (MTCA)	RCW 70.105	Requires remedial actions to attain a degree of cleanup protective of human health and the environment		

Description	Citation	Requirements	Remarks	Operable Unit Affected
Cleanup Regulations	WAC 173-340	Establishes cleanup levels and prescribes methods to calculate cleanup levels for soils, groundwater, surface water, and air.	Relevant and appropriate to remediation actions where hazardous substances have been released.	100-NR-1 100-NR-2
Soil Cleanup Standards	WAC 173-340-700-760	Establishes cleanup standards for contaminated media. These levels must be protective of the groundwater if groundwater is considered a pathway of exposure.	Applicable to remediation actions where hazardous substances have been released. Levels will be calculated based on final land use decision.	100-NR-1 100-NR-2
Selection of Cleanup Actions	WAC 173-340-360	Establishes h criteria for selection of cleanup actions	Must be considered within feasibility of corrective measures studies	100-NR-1 100-NR-2
Cleanup Actions	WAC 173-340-400	Ensures that the cleanup action is designed, constructed, and operated in accordance with the cleanup plan and other specified requirements.	Cleanup must follow remedial design document and remedial action work plans.	100-NR-1 100-NR-2
Institutional Controls	WAC 173-340-440	Requires physical measures, such as fences and signs, to limit interference with cleanup.	Physical measures may be applicable if institutional controls are used.	100-NR-1 100-NR-2
Cleanup Standards	WAC 173-340-700-750	Establishes cleanup standards for remedial and corrective actions	Soil, groundwater, and surface water standards are contained in these requirements.	100-NR-1 100-NR-2
Radiation Protection--Air Emissions	WAC 246-247	Establishes procedures to monitor and control airborne radionuclide emissions.	Applicable if airborne radionuclide emissions are anticipated during remedial action.	100-NR-1 100-NR-2
New and Modified Sources	WAC 246-247-120 (Appendix B)	Requires the use of best available radionuclide control technology (BARCT)	Substantive requirements applicable if airborne radionuclide emissions are anticipated during remedial action.	100-NR-1 100-NR-2
Habitat Buffer Zone for Bald Eagle Rules	RCW 77.12.655			

Description	Citation	Requirements	Remarks	Operable Unit Affected
Bald Eagle Protection Rules	WAC 232-12-292	Prescribes action to protect bald eagle habitat, such as nesting or roost sites, through the development of a site management plan.	Applicable if the areas of remedial activities include bald eagle habitat. No habitat buffer zones at the 100-N Area.	100-NR-1 100-NR-2
The Indian Graves and Records Act of the State of Washington	RCW 27.44	Prohibits the willful removal, mutilation, defacement, or destruction of any cairn, grave, or glyphic or painted record of any Native Indian or prehistoric people. Requires agency to consult with traditional religious leaders regarding activities that might affect religious sites.	There are Native American burial grounds and cultural areas within the 100 Area Operable Units; therefore, this is applicable.	100-NR-1 100-NR-2
Department of Game State Environmental Policy Act	WAC 232-012	Requires management plans if endangered, threatened, or sensitive wildlife or habitat is affected. Washington State Department of Fish and Wildlife will be consulted to minimize ecological impacts.	Upon the determination of impacts to threatened, endangered, or sensitive species or habitat by the remedial actions, this may be applicable.	100-NR-1 100-NR-2
U.S. Department of Ecology	RCW 43.12A	Vests the Washington Department of Ecology with the authority to undertake the state air regulation and management program.		
Air Pollution Regulations	WAC 173-400	Establishes requirements to control and/or prevent the emission of air contaminants.	Applicable if emission sources are created during remedial action.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Standards for Maximum Emissions	WAC 173-400-040	Requires best available control technology to use to control fugitive emissions of dust from materials handling, construction, demolition, or any other activities that are sources of fugitive emissions. Restricts emitted particulates from being deposited beyond the Hanford Site. Requires control of odors emitted from the source. Prohibits masking or concealing prohibited emissions. Requires measures to prevent fugitive dust from becoming airborne.	Applicable to dust emissions from cutting of concrete and metal and vehicular traffic during remediation	100-NR-1
Emission Limits for Radionuclides	WAC 173-480	Controls air emissions of radionuclides from specific sources.	Applicable to remedial activities that result in air emissions	100-NR-1 100-NR-2
New and Modified Emission Units	WAC 173-480-060	Requires the best available radionuclide control technology be used in planning constructing, installing, or establishing a new emissions unit.	Applicable to remedial actions that result in air emissions	100-NR-1 100-NR-2
Washington Clean Air Act	RCW 70.94	Establishes a statewide framework for the planning, regulation control, and management of air pollution sources.		
Controls for New Sources of Toxic Air Pollutants	WAC 173-460	Establishes systematic control of new sources emitting toxic air pollutants	Applicable if new sources emitting toxic air pollutants are established	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Decontaminating Ambient Impact Compliance	WAC 173-460-080	Requires the owner or operator of a new source to complete an acceptable source impact level analysis using dispersion modeling to estimate maximum incremental ambient impact of each Class A or B toxic air pollutant. Establishes numerical limits for small quantity emission rates.	Applicable to remedial alternatives with the potential to release toxic air pollutants	100-NR-1 100-NR-2
Hazardous Waste Management Act of 1976, as amended in 1980 and 1983	RCW 70.105	Establishes a statewide framework for the planning, regulation, control, and management of hazardous waste.		
Dangerous Waste Regulations	WAC 173-303	Establishes the design, operation, and monitoring requirements for management of dangerous waste. Includes requirements for generators of dangerous waste. Dangerous waste includes the full universe of wastes regulated by WAC 173-303, including extremely hazardous waste.	Applicable if dangerous or extremely hazardous waste is generated and/or managed during remedial action.	100-NR-1 100-NR-2
Waste Designation	WAC 173-303-070, 071, 080, 082, 090, 100, 110	Exceeds federal RCRA program by requiring designation of waste including additional parameters (i.e., toxicity and persistence), additional listed wastes, and PCBs.	Applicable if remediation wastes, based on process knowledge/analysis exceed the parameters.	100-NR-1 100-NR-2
Land Disposal Restrictions	WAC 173-303-140	State LDR requirements exceed the federal requirements for nonradiological extremely hazardous, organic/carbonaceous, and solid acid wastes.	Applicable if remediation wastes meet additional categories.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Corrective Action Management Unit (CAMU)	WAC 173-303-646(4)	Authorizes designation of a corrective action management unit, which does not constitute land disposal of dangerous waste	May be used if dangerous waste not meeting LDR standards is placed on the land	100-NR-1
Solid Waste Management Act	RCW 70.95	Establishes a statewide program for solid waste handling, recovery, and/or recycling		
Minimum Functional Standards for Solid Waste Handling	WAC 173-304	Establishes requirements to be met statewide to handle all solid waste	Applicable if management of solid waste occurs during remediation. Solid waste controlled by this Act includes garbage, industrial waste, construction waste, ashes, and swill.	100-NR-1
Onsite Containerized Storage, Collection, and Transportation Standards	WAC 173-304-200	Sets requirements for containers and vehicles to be used on site	Applicable if containers are used during remediation.	100-NR-1
Water Pollution Control Act	RCW 90.48	Prohibits discharge of polluting matter in waters		
Water Quality Standards for Groundwater	WAC 173-200	Establishes groundwater standards for groundwaters of the State of Washington	Provides groundwater standards based on MCLs.	NR-1 NR-2
Water Quality Standards for Surface Waters	WAC 173-201A	Establishes water quality standards for surface waters of the State of Washington	Defines the Columbia River as a Class A river	NR-1 NR-2
State Waste Discharge Permit Program	WAC 173-216	Requires the use of all known available and reasonable methods of prevention, control, and treatment. Discharges must meet limits, which ensure that groundwater, and surface water standards are not exceeded.	Applicable for any discharges of liquids to the ground	100-NR-1

Description	Citation	Requirements	Remarks	Operable Unit Affected
Underground Injection Control Program	WAC 173-218	Sets requirements for injection of effluents through wells that may endanger the groundwaters of the state	Applicable to any discharges of liquids through a well.	100-NR-2
Water Well Construction Act	RCW 18.104			
Standards for Construction and Maintenance of Wells	WAC 173-160	Establishes minimum standards for design, construction, capping, and sealing of all wells; sets additional requirements, including disinfection of equipment, abandonment of wells, and quality of drilling water.	Applicable if water supply wells, monitoring wells, or other wells are used during remediation.	100-NR-2
Shoreline Management Act	RCW 90.48			
Shoreline Development Permits	WAC 173-27	Requirements associated with administration and enforcement of shoreline management permits.	Substantive compliance with this ARAR and the Shoreline Management Act is required for river construction activities.	NR-1 NR-2
Hydraulic Projects Permits	WAC 220-110	Establishes regulations for construction activities that will use, divert, obstruct, or change the natural flow of the bed of the Columbia River.	Established for the protection of fish life	NR-1 NR-2
Benton Clean Air Authority	Regulation 1, Article 5	Establishes a regional program for open burning	These county regulations are authorized by the state Clean Air Act.	100-NR-1
Benton Clean Air Authority	Regulation 1, Article 8	Establishes regulations relative to asbestos	Must be considered if asbestos is found during remediation	100-NR-1 100-NR-2
A Guide on Remedial Actions at Superfund Sites with PCB Contamination	EPA Directive 9355-.4-01FS	Provides a general framework to determine cleanup levels, identify treatment options, and assess necessary management controls for residuals of PCBs.	Must be considered if PCBs are found during remediation	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
U.S. Department of Energy Orders		Select DOE Orders are contractual requirements of the ERC.		
Materials Transportation and Traffic Management	DOE Order 1540.1A	Establishes DOE requirements for transporting materials	For onsite shipments, these requirements specify compliance with 49 CFR but allow for other means of transportation and packaging if they offer an equivalent degree of safety.	100-NR-1 100-NR-2
Radiation Dose Limit (All Pathways)	DOE-5400.5, Chapter II, Section 1a	The exposure of the public to radiation sources because of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem from all exposure pathways, except under specified circumstances.	If remedial activities are considered "routine DOE activities", this order would be relevant and appropriate.	100-NR-1 100-NR-2
NRC Draft Radiological Criteria for Decommissioning	10 CFR 20 (proposed revision)	This rule provides a clear and consistent regulatory basis to determine the extent to which lands and structures must be remediated before a site can be considered decommissioned.	This will be applicable upon promulgation.	100-NR-1
Radioactive Waste Management	DOE Order 5820.2A	Defines waste designation for TRU, high- and low-level waste and establishes criteria for the management and disposal of LLW.		100-NR-1

Description	Citation	Requirements	Remarks	Operable Unit Affected
Radioactive Waste Management	DOE 5820.2A Chapters III and IV	Establishes policies and guidelines by which DOE manages radioactive waste, waste byproducts, and radioactive contaminated surplus facilities. Disposal shall be on the site, which it was generated, if practical, or at another DOE facility. DOE waste containing byproduct material shall be stored, stabilized in place, and/or disposed of consistent with the requirements of the residual radioactive material guidelines contained in 40 CFR 192.	Must be met when managing radioactive waste created by remediation activities.	100-NR-1
Safety Requirements for the Packaging of Fissile and Other Radioactive Materials	DOE 5480.3, Sections 7 and 8	Establishes requirements for packaging and transportation of radioactive materials for DOE facilities	Requirements must be met if radioactive material is packaged and transported to disposal facility.	100-NR-1
Draft EPA Radiation Site Cleanup Regulations	40 CFR 196 (draft notice of proposed rulemaking)	This draft notice of proposed rulemaking will set standards for the remediation of soils, groundwater, surface water, and structures at federal facilities.	These standards are intended to set limits for radiation doses to the public.	100-NR-1 100-NR-2
Draft Department of Energy Radiation Protection of the Public and the Environment	10 CFR 834	Additional requirements above 5400.5 that are more prescriptive	Substantive requirements largely the same as 5400.5	100-NR-1

Description	Citation	Requirements	Remarks	Operable Unit Affected
Wild and Scenic Rivers Act	16 U.S.C. 1271	Prohibits federal agencies from recommending authorization of any water resource project that would have a direct and adverse effect on the values for which a river was designated as a wild and scenic river or included as a study area.	The Hanford Reach of the Columbia River is under study for inclusion as a wild and scenic river.	100-NR-1 100-NR-2
Residual Radioactive Material as Surface Contamination	U.S. NRC Regulatory Guide 1.86	Sets contamination guidelines release equipment and building components for unrestricted use, and if buildings are demolished, shall not be exceeded for contamination in the ground.	Dependent upon land use decisions, this guide may be considered.	D&D Facilities
Fish and Wildlife Coordination Act	16 U.S.C. 661 et seq.	This Act ensures that wildlife conservation is given equal consideration with other values during the planning of activities that affect water resources. The Act authorizes the Secretary of the Interior to provide assistance to federal, state, and public or private agencies in the "development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat..." The Act also requires a consultation with the U.S. Fish and Wildlife Service (USFWS) when a federal agency plans to impound, deepen, or otherwise modify a body of water.	While the recommendations by the USFWS are not legally binding, DOE is required to give them full consideration.	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Executive Orders Protection of Wetlands	EO 11990	This Executive Order requires that each federal agency "....take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, including but not limited to, water and related land resources planning, regulating, and licensing activities."	Must be considered if action is taken that may impact wetland area.	100-NR-1 100-NR-2
Floodplain Management	EO 11988	This Order requires federal agencies to take floodplain management into account when formulating or evaluating water or land use plans. The Order specifies that "...each agency shall...restore and reserve the natural and beneficial values served by Flood Plains in carrying out its responsibilities for (1) acquiring, managing, and disposing of federal land and facilities; (2) providing federally undertaken, financial, or assisted construction and improvements; and (3) conducting federal activities and programs affecting land use, and licensing conducting activities.	Must be considered if actions are taken within a floodplain	100-NR-1 100-NR-2

Description	Citation	Requirements	Remarks	Operable Unit Affected
Protection and Enhancement of the Cultural Environment	EO 11593	Provides direction to federal agencies to preserve, restore, and maintain cultural resources.	Pertains to sites, structures, and objects of historical, archeological, or architectural significance	100-NR-1 100-NR-2
Exotic Organisms	EO 11987	This Order requires federal agencies to restrict, to the extent possible, the introduction of exotic species into the lands or waters that they own, lease, or hold for purposes of administration. It also restricts the use of federal funds and programs for importation and introduction of exotic species.	Must be considered during revegetation	100-NR-1
Department of Ecology Liquid Effluent Consent Order	DE 91NM-177	Requires discharges of liquid effluent to the soil to column to be eliminated, treated, or otherwise minimized.	Must be considered if discharges of liquid effluent to the soil column are part of the remedial alternative	100-NR-1
Tri-Party Agreement		Establishes requirements, guidelines, and schedules for the environmental restoration program at the Hanford Site	Must be adhered to and complied with by all parties with regard to remedial actions at all operable units.	100-NR-1 100-NR-2

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100-NR-1
CHAPTER 4.0
COST ESTIMATES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 4.0
COST ESTIMATES

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CHAPTER 4.0
COST ESTIMATES

TABLE OF CONTENTS

4.0 COST ESTIMATES 7
4.1 Cost Estimates for the 100-NR-1 Source Waste Sites 7
4.1.1 Attachment 1, MCACES Summary Report for the UPR-100-N-1 Site 39
4.1.2 Attachment 3, Model Assumptions for RACER-Ex Situ Bioremediation 44
4.1.3 Attachment 4, Model Assumptions for RACER-In Situ Bioremediation 52
4.1.4 Attachment 5, Model Assumptions for RACER-In Situ Solidification 60
4.2 Cost Estimates for Groundwater Alternatives 64
4.2.1 Costs – Alternative 2 64
4.2.2 Costs – Alternative 3 65
4.2.3 Costs – Alternative 4 66
4.2.4 Costs – Alternative 5 67
4.2.5 Costs – Alternative 6 68
4.2.6 Costs – Alternative 7 69
4.3 Groundwater Alternatives Descriptions 100-NR-1/100-NR-2 CMS 70
4.3.1 Alternative 1: No Action 70
4.3.2 Alternative 2: Institutional Controls 71
4.3.3 Alternative 3: Permeable Wall and Institutional Controls 72
4.3.4 Alternative 4: Hydraulic Controls and Pump and Treat for Strontium, Institutional Controls for Tritium to River and Other COCs in Aquifer 73
4.3.5 Alternative 5: Hydraulic Controls for Tritium and Strontium to River Pump and Treat Strontium and Other COCs in Aquifer 74
4.3.6 Alternative 6: Impermeable Barrier for Strontium, Institutional Controls for Tritium, Pump and Treat All Groundwater COCs 76
4.3.7 Alternative 7: Impermeable Barrier for Strontium to River, Impermeable Barrier and Hydraulic Controls for Tritium to River, Soil Flushing for Strontium in the Aquifer, Pump and Treat for Other COCs in Aquifer 77

TABLES

Table 4.1. 100-NR-1/2 CMS Residential Scenario Recalculate MCACES with 15 Percent PM/CM 9

Table 4.2. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Recalculate MCACES with 15 Percent PM/CM 10

Table 4.3. 100-NR-1 CMS MCACES Input Parameters 12

Table 4.4. Ex Situ Bioremediation Costs from RACER Model 13

Table 4.5. 100-NR-1 CMS Summary of Ex Situ Bioremediation Costs 14

Table 4.6. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Summary of Capping Costs 15

Table 4.7. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Summary of Capping Costs 16

Table 4.8. 100-NR-1 CMS In Situ Bioremediation 17

Table 4.9. 100-NR-1/2 CMS In Situ Solidification 18

Table 4.10. 100-N-46 Underground Fuel Storage Tank at HGP 21

Table 4.11. Rivershore Site Residential Scenario Remove/Dispose Summary 22

Table 4.12. Rivershore Site Modified CRCIA Ranger/Industrial Scenario Remove/Dispose Net Present Value 23

Table 4.13. Rivershore Site Modified CRCIA Ranger/Industrial Scenario Remove/Dispose Summary 30

Table 4.14. Rivershore Site Residential Scenario Remove/Dispose Net Present Value 31

Table 4.15. Rivershore Site Modified CRCIA Ranger/Industrial Cover Scenario Summary 38

ABBREVIATIONS AND ACRONYMS

bcy	Bank cubic yards
CMS	Corrective Measures Study
Distribs	Distributables
G&A	General and Administrative
ID	Identification
MCACES	A model used to provide cost estimates for some of the remedial alternatives
MCRIS	Modified CRCIA ranger/industrial scenario
O&M	Operations and maintenance
PM/CM	Project management/construction management
RACER	A model used to provide cost estimates for some of the remedial alternatives
Sub01	Mobilization & prep work costs
Sub02	Monitoring, sampling, & analysis costs
Sub08	Solid collection & containment costs
Sub20	Site restoration costs
Sub21	Demobilization costs
Sub70	Project/construction management & support cost

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4.0 COST ESTIMATES

4.1 Cost Estimates for the 100-NR-1 Source Waste Sites

The cost estimates for the 100-NR-1 source wastes sites were developed using the Micro Computer Aided Cost Estimating System (MCACES) software package or the Remedial Action Cost Engineering and Requirements (RACER) software package. The MCACES package was selected for estimating costs for the Remove/Dispose Remedial Alternative (using the crib and French drain, trench, and piping models) and the Containment Remedial Alternative (using the Resource Conservation and Recovery Act [RCRA] cap model). The cost models associated with these alternatives are presented in the *100 Areas Source Operable Unit Focused Feasibility Study Cost Models* (DOE-RL1995b). The MCACES and RACER packages were used for the move/ex situ bioremediation/dispose cost estimates. The RACER package was used for estimating costs for the remaining source remedial alternatives: in situ bioremediation, in situ solidification, and capping. Cost estimates provided by these two packages are suitable for comparative analysis of remedial alternatives but are not intended for establishing definitive cost estimates. The total costs as shown do not include design costs (3 percent) or costs for collecting design data in the field (3 percent).

Attachment 1 is the MCACES summary report for the UPR-100-N-1 site, and it typifies the reports generated for the remainder of the sites. In this model, costs are summarized into seven categories as follows:

Code	Cost category	Total Cost
01	Mobilization & Prep Work	14,320
02	Monitoring, Sampling, & Analysis	1,200
08	Solids Collection& Containment	34,390
18	Disposal (Other than Commercial)	11,970
20	Site Restoration	8,560
21	Demobilization	5,000
70	Project/Construction Mgmt & Supt	29,180

These costs are presented in Tables 4.1 and 4.2 for the Remove/Dispose Alternatives for both the Rural-Residential and Modified CRCIA Ranger/Industrial Exposure Scenarios.

These models rely upon a set of user-supplied input parameters. Six of these parameters (depth of excavation, top excavation length, bottom excavation length, contaminated soil volume, non-contaminated soil volume, and bottom area) are presented in Table 4.3 for the sites. The other five input parameters (hauling distance for borrow, hauling distance for contaminated soil, hauling distance for demo waste, transition zone soil percentages, and groundwater protection samples) are fixed for all the 100-NR-1 sites and areas presented on the third page of the example.

The cost estimating process for the Remove/Ex Situ Bioremediation/Dispose Remedial Alternative consisted of two steps. The initial step was to estimate the cost of removing the contaminated soil from the waste site and transporting it to the location selected for ex situ bioremediation. These costs were estimated using the MCACES program and are similar to the costs developed for similar tasks under the Remove/Dispose Alternative. The RACER program was then used to estimate the cost of the actual bioremediation. The minimum size remediation cell used in the estimate was 100 loose cubic yards (LCY) of material. Since the majority of sites were less than this volume, soils from these small sites were combined into one cell and the cost prorated on a LCY basis. These costs are presented in Tables 4.1 and 4.5.

The cost estimates for the Containment Remedial Alternative (capping) were determined in the same fashion as the Remove/Dispose Remedial Alternative and used the MCACES program.

The cost estimates are presented in Tables 4.6 and 4.7. The cost estimates for in situ bioremediation and in situ solidification were determined using the RACER program and are presented in Tables 4.8 and 4.9, respectively.

The cost estimate for site100-N-45, a septic system in the HGP area, was assumed the same as site 124-N-2. Site 100-N-46, an underground storage tank (UST) at HGP, was estimated following the existing practice for USTs at Hanford. A summary sheet for this estimate is on page G1-22. No estimates were made for three sites in the HGP area (100-N-50, 100-N-51a, and 100-N-51b) because of the limited data available. Cost estimates will be established during design.

The cost estimates for the river shoreline site followed Hanford cost estimating practices. These estimates are summarized, beginning on page G1-23. Institutional control costs need to be added to these numbers to reach the total costs presented in Section 8.0. No estimate was provided for site 100-N-65 (a petroleum intercepter trench) because remediation of this site depends, in part, upon the information developed during the remediation design of UPR-100-N-17, the source of this leak.

Table 4.1. 100-NR-1/2 CMS Residential Scenario Recalculate MCACES with 15 Percent PM/CM

Site ID	Sub01 $	Sub02 $	Sub08 $	Sub18 $	Sub20 $	Sub21 $	Subtotal w/o PM/CM	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Cntgcy 34%	Total Cost $
UPR-100-N-1	14,320	21,200	34,390	11,970	8,560	5,000	95,440	14,316	15,432	6,685	44,837	176,709
UPR-100-N-2	13,920	19,980	35,970	7,180	6,260	5,000	88,310	13,247	14,279	6,186	41,487	163,508
UPR-100-N-3	15,060	29,600	53,670	17,960	15,510	5,000	136,800	20,520	22,119	9,582	64,267	253,288
UPR-100-N-4	12,740	16,420	17,620	320	540	5,000	52,640	7,896	8,511	3,687	24,730	97,464
UPR-100-N-5	16,170	32,220	64,890	43,050	20,100	5,000	181,430	27,215	29,335	12,708	85,234	335,922
UPR-100-N-6	13,040	16,700	19,550	740	1,170	5,000	56,200	8,430	9,087	3,936	26,402	104,056
UPR-100-N-7	15,870	36,380	93,320	30,140	22,030	5,000	202,740	30,411	32,781	14,201	95,245	375,378
UPR-100-N-8	12,620	16,150	17,450	40	270	5,000	51,530	7,730	8,332	3,609	24,208	95,409
UPR-100-N-9	12,980	16,700	19,040	1,610	860	5,000	56,190	8,429	9,085	3,936	26,397	104,037
UPR-100-N-10	12,620	16,150	17,450	40	270	5,000	51,530	7,730	8,332	3,609	24,208	95,409
UPR-100-N-11	12,650	16,150	17,100	600	270	5,000	51,770	7,766	8,371	3,626	24,321	95,853
UPR-100-N-12	16,540	42,480	115,470	41,130	27,750	5,000	248,370	37,256	40,159	17,397	116,682	459,863
UPR-100-N-13	10,410	16,150	16,180	110	150	5,000	48,000	7,200	7,761	3,362	22,550	88,873
UPR-100-N-14	12,620	16,150	17,450	40	270	5,000	51,530	7,730	8,332	3,609	24,208	95,409
UPR-100-N-15												
UPR-100-N-17	18,100	284,460	767,570	31,920	194,150	5,000	1,301,200	195,180	210,391	91,142	611,290	2,409,203
UPR-100-N-18	13,070	16,970	20,060	180	1,430	5,000	56,710	8,507	9,169	3,972	26,642	105,000
UPR-100-N-19	13,140	16,970	20,180	420	1,510	5,000	57,220	8,583	9,252	4,008	26,881	105,944
UPR-100-N-20	13,000	16,700	19,120	210	1,090	5,000	55,120	8,268	8,912	3,861	25,895	102,056
UPR-100-N-21	12,730	16,420	17,620	180	530	5,000	52,480	7,872	8,485	3,676	24,655	97,168
UPR-100-N-22	13,080	16,970	20,070	210	1,430	5,000	56,760	8,514	9,178	3,976	26,665	105,092
UPR-100-N-23	13,020	16,970	19,680	110	1,170	5,000	55,950	8,393	9,047	3,919	26,285	103,593
UPR-100-N-24	13,150	16,970	20,540	810	1,590	5,000	58,060	8,709	9,388	4,067	27,276	107,499
UPR-100-N-25	12,770	16,420	17,660	420	540	5,000	52,810	7,922	8,539	3,699	24,810	97,779
UPR-100-N-26	12,850	16,420	18,140	810	740	5,000	53,960	8,094	8,725	3,780	25,350	99,908
UPR-100-N-29	12,980	16,700	19,120	40	1,090	5,000	54,930	8,240	8,882	3,848	25,806	101,704
UPR-100-N-30	13,350	17,520	23,020	2,000	2,470	5,000	63,360	9,504	10,245	4,438	29,766	117,313
UPR-100-N-32	13,080	16,970	20,070	210	1,430	5,000	56,760	8,514	9,178	3,976	26,665	105,092
UPR-100-N-36	12,680	16,420	17,620	40	530	5,000	52,290	7,844	8,455	3,663	24,565	96,816
UPR-100-N-37	12,420	16,150	17,030	40	120	5,000	50,760	7,614	8,207	3,555	23,847	93,983
UPR-100-N-38	12,620	16,150	17,410	110	270	5,000	51,560	7,734	8,337	3,611	24,222	95,465
UPR-100-N-39	12,880	16,420	18,480	110	740	5,000	53,630	8,045	8,671	3,756	25,195	99,297
UPR-100-N-40	13,710	18,890	31,310	4,690	4,170	5,000	77,770	11,666	12,575	5,447	36,536	143,993
UPR-100-N-41	12,570	16,150	17,060	210	190	5,000	51,180	7,677	8,275	3,585	24,044	94,761
UPR-100-N-42	19,720	326,530	891,310	67,170	225,530	5,000	1,535,260	230,289	248,236	107,536	721,249	2,842,571
UPR-100-N-43	13,150	16,970	20,220	630	1,590	5,000	57,560	8,634	9,307	4,032	27,041	106,574
100-N-1	15,960	44,750	55,390	35,810	16,420	5,000	173,330	26,000	28,026	12,141	81,429	320,925
100-N-3	14,740	23,520	42,640	19,710	11,100	5,000	116,710	17,507	18,871	8,175	54,829	216,091
100-N-4	17,540	30,760	63,520	72,450	19,630	5,000	208,900	31,335	33,777	14,632	98,139	386,783
100-N-5	20,360	44,590	49,070	54,670	14,980	5,000	188,670	28,301	30,506	13,215	88,635	349,327
100-N-6	12,420	16,150	17,030	110	120	5,000	50,830	7,625	8,219	3,560	23,879	94,113
100-N-12	12,300	16,150	17,030	40	110	5,000	50,630	7,595	8,186	3,546	23,785	93,743
100-N-13	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-14	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-16	12,510	16,150	17,030	140	180	5,000	51,010	7,652	8,248	3,573	23,964	94,446
100-N-17	12,490	16,150	17,030	40	180	5,000	50,890	7,634	8,228	3,565	23,908	94,224
100-N-18	12,410	16,150	17,030	40	120	5,000	50,750	7,613	8,206	3,555	23,842	93,965
100-N-19	12,500	16,150	17,030	180	180	5,000	51,040	7,656	8,253	3,575	23,978	94,502
100-N-22	13,510	17,790	23,700	4,870	2,790	5,000	67,660	10,149	10,940	4,739	31,786	125,274
100-N-23	12,310	16,150	17,030	110	110	5,000	50,710	7,607	8,199	3,552	23,823	93,891
100-N-24	13,280	17,790	23,180	140	2,690	5,000	62,080	9,312	10,038	4,348	29,165	114,943
100-N-25	13,170	16,970	21,010	810	1,670	5,000	58,630	8,795	9,480	4,107	27,544	108,555

Site ID	Sub01 $	Sub02 $	Sub08 $	Sub18 $	Sub20 $	Sub21 $	Subtotal w/o PM/CM	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Cntgcy 34%	Total Cost $
100-N-26	12,940	16,700	19,040	110	1,080	5,000	54,870	8,231	8,872	3,843	25,777	101,593
100-N-27												
100-N-29	13,470	18,340	29,570	670	3,640	5,000	70,690	10,604	11,430	4,951	33,209	130,884
100-N-30	13,470	18,340	29,570	670	3,640	5,000	70,690	10,604	11,430	4,951	33,209	130,884
100-N-31	13,470	18,340	29,570	670	3,640	5,000	70,690	10,604	11,430	4,951	33,209	130,884
100-N-32	13,470	18,340	29,570	670	3,640	5,000	70,690	10,604	11,430	4,951	33,209	130,884
100-N-33	13,250	16,970	19,710	1,510	1,230	5,000	57,670	8,651	9,325	4,039	27,093	106,777
100-N-34	12,340	16,150	17,030	40	110	5,000	50,670	7,601	8,193	3,549	23,804	93,817
100-N-35	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-36	12,550	16,150	17,030	250	180	5,000	51,160	7,674	8,272	3,583	24,034	94,724
100-N-37	15,130	36,250	29,610	14,910	5,510	5,000	106,410	15,962	17,205	7,453	49,990	197,021
100-N-38	13,470	18,340	29,570	670	3,640	5,000	70,690	10,604	11,430	4,951	33,209	130,884
100-N-39	12,830	16,150	17,500	810	360	5,000	52,650	7,898	8,513	3,688	24,734	97,483
100-N-47	15,130	36,250	29,610	14,910	5,510	5,000	106,410	15,962	17,205	7,453	49,990	197,021
120-N-3	13,350	17,790	23,620	740	2,770	5,000	63,270	9,491	10,230	4,432	29,724	117,146
124-N-2	13,510	33,990	20,750	4,870	2,790	5,000	80,910	12,137	13,082	5,667	38,011	149,807
124-N-3	13,510	33,990	20,750	4,870	2,790	5,000	80,910	12,137	13,082	5,667	38,011	149,807
124-N-4	21,330	75,940	125,480	143,360	43,070	5,000	414,180	62,127	66,969	29,011	194,577	766,864
128-N-1	14,740	18,580	21,500	11,550	4,530	5,000	75,900	11,385	12,272	5,316	35,657	140,531
130-N-1												
600-32	37,130	242,580	289,620	417,410	113,510	5,000	1,105,250	165,788	178,708	77,416	519,235	2,046,397
600-35	17,750	28,350	17,740	13,410	4,850	5,000	87,100	13,065	14,083	6,101	40,919	161,268
Pipelines	$855,845	$2,162,119	$3,138,771		$2,375,727	$5,000	$18,601,082	$2,790,162	$3,007,609	$1,302,899	$8,738,596	$34,440,348
Totals:							$28,010,722					$51,862,521

Table 4.2. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Recalculate MCACES with 15 Percent PM/CM

Site ID	Sub01	Sub02	Sub08	Sub18	Sub20	Sub21	Subtotal w/o PM/CM	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Cntgcy 34%	Total Cost
UPR-100-N-1	14,020	19,710	28,920	7,980	5,500	5,000	81,130	12,170	13,118	5,683	38,114	150,214
UPR-100-N-2							-	-	-	-	-	-
UPR-100-N-3							-	-	-	-	-	-
UPR-100-N-4	12,740	16,420	17,620	320	540	5,000	52,640	7,896	8,511	3,687	24,730	97,464
UPR-100-N-5	14,960	23,120	42,680	21,530	10,970	5,000	118,260	17,739	19,121	8,283	55,557	218,961
UPR-100-N-6	13,040	16,700	19,550	740	1,170	5,000	56,200	8,430	9,087	3,936	26,402	104,056
UPR-100-N-7							-	-	-	-	-	-
UPR-100-N-8	12,610	16,150	17,450	40	270	5,000	51,520	7,728	8,330	3,609	24,204	95,391
UPR-100-N-9	12,980	16,700	19,040	1,610	860	5,000	56,190	8,429	9,085	3,936	26,397	104,037
UPR-100-N-10	12,610	16,150	17,450	40	270	5,000	51,520	7,728	8,330	3,609	24,204	95,391
UPR-100-N-11	12,640	16,150	17,100	600	270	5,000	51,760	7,764	8,369	3,625	24,316	95,835
UPR-100-N-12							-	-	-	-	-	-
UPR-100-N-13	10,410	16,150	16,180	110	150	5,000	48,000	7,200	7,761	3,362	22,550	88,873
UPR-100-N-14	12,620	16,150	17,450	40	270	5,000	51,530	7,730	8,332	3,609	24,208	95,409
UPR-100-N-15							-	-	-	-	-	-
UPR-100-N-17	18,100	284,460	767,570	31,920	194,150	5,000	1,301,200	195,180	210,391	91,142	611,290	2,409,203
UPR-100-N-18	12,980	16,700	19,080	140	1,090	5,000	54,990	8,249	8,891	3,852	25,834	101,815
UPR-100-N-19	13,030	16,700	19,470	350	1,170	5,000	55,720	8,358	9,009	3,903	26,177	103,167
UPR-100-N-20	12,990	16,700	19,080	210	1,090	5,000	55,070	8,261	8,904	3,857	25,871	101,963
UPR-100-N-21	12,720	16,420	17,620	180	530	5,000	52,470	7,871	8,484	3,675	24,650	97,149
UPR-100-N-22	12,990	16,700	19,080	180	1,090	5,000	55,040	8,256	8,899	3,855	25,857	101,908
UPR-100-N-23	12,930	16,700	19,040	70	1,080	5,000	54,820	8,223	8,864	3,840	25,754	101,501
UPR-100-N-24	13,110	16,970	20,190	770	1,510	5,000	57,550	8,633	9,305	4,031	27,036	106,555

Site ID	Sub01	Sub02	Sub08	Sub18	Sub20	Sub21	Subtotal w/o PM/CM	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Cntgcy 34%	Total Cost
UPR-100-N-25	12,770	16,420	17,660	420	540	5,000	52,810	7,922	8,539	3,699	24,810	97,779
UPR-100-N-26	12,850	16,420	18,140	810	740	5,000	53,960	8,094	8,725	3,780	25,350	99,908
UPR-100-N-29	12,920	16,700	18,690	40	1,000	5,000	54,350	8,153	8,788	3,807	25,533	100,630
UPR-100-N-30	13,270	17,250	21,590	1,680	2,120	5,000	60,910	9,137	9,849	4,266	28,615	112,776
UPR-100-N-32	12,990	16,700	19,080	180	1,090	5,000	55,040	8,256	8,899	3,855	25,857	101,908
UPR-100-N-36	12,680	16,420	17,620	40	530	5,000	52,290	7,844	8,455	3,663	24,565	96,816
UPR-100-N-37	12,420	16,150	17,030	40	120	5,000	50,760	7,614	8,207	3,555	23,847	93,983
UPR-100-N-38	12,620	16,150	17,410	110	270	5,000	51,560	7,734	8,337	3,611	24,222	95,465
UPR-100-N-39	12,880	16,420	18,480	110	740	5,000	53,630	8,045	8,671	3,756	25,195	99,297
UPR-100-N-40	13,510	18,070	23,940	3,120	3,140	5,000	66,780	10,017	10,798	4,678	31,373	123,645
UPR-100-N-41	12,570	16,150	17,060	210	190	5,000	51,180	7,677	8,275	3,585	24,044	94,761
UPR-100-N-42	19,720	326,530	891,310	67,170	225,530	5,000	1,535,260	230,289	248,236	107,536	721,249	2,842,571
UPR-100-N-43	13,080	16,970	19,710	530	1,430	5,000	56,720	8,508	9,171	3,973	26,646	105,018
100-N-1	15,660	42,710	51,540	29,820	14,430	5,000	159,160	23,874	25,735	11,148	74,772	294,689
100-N-3	14,100	19,440	28,450	11,830	5,170	5,000	83,990	12,599	13,580	5,883	39,458	155,509
100-N-4	17,450	30,760	63,520	72,450	19,630	5,000	208,810	31,322	33,762	14,626	98,097	386,617
100-N-5	20,360	44,590	49,070	54,670	14,980	5,000	188,670	28,301	30,506	13,215	88,635	349,327
100-N-6	12,420	16,150	17,030	110	120	5,000	50,830	7,625	8,219	3,560	23,879	94,113
100-N-12	12,300	16,150	17,030	40	110	5,000	50,630	7,595	8,186	3,546	23,785	93,743
100-N-13	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-14	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-16	12,510	16,150	17,030	140	180	5,000	51,010	7,652	8,248	3,573	23,964	94,446
100-N-17	12,490	16,150	17,030	40	180	5,000	50,890	7,634	8,228	3,565	23,908	94,224
100-N-18	12,410	16,150	17,030	40	120	5,000	50,750	7,613	8,206	3,555	23,842	93,965
100-N-19	12,500	16,150	17,030	180	180	5,000	51,040	7,656	8,253	3,575	23,978	94,502
100-N-22	13,510	17,790	23,700	4,870	2,790	5,000	67,660	10,149	10,940	4,739	31,786	125,274
100-N-23	12,310	16,150	17,030	110	110	5,000	50,710	7,607	8,199	3,552	23,823	93,891
100-N-24	12,940	16,700	19,040	70	1,080	5,000	54,830	8,225	8,865	3,841	25,759	101,519
100-N-25	13,100	16,970	20,190	670	1,510	5,000	57,440	8,616	9,287	4,023	26,985	106,352
100-N-26	12,940	16,700	19,040	110	1,080	5,000	54,870	8,231	8,872	3,843	25,777	101,593
100-N-27	12,950	16,700	18,690	180	1,010	5,000	54,530	8,180	8,817	3,820	25,618	100,964
100-N-29												
100-N-30												
100-N-31												
100-N-32												
100-N-33	13,250	16,970	19,710	1,510	1,230	5,000	57,670	8,651	9,325	4,039	27,093	106,777
100-N-34	12,340	16,150	17,030	40	110	5,000	50,670	7,601	8,193	3,549	23,804	93,817
100-N-35	12,820	16,420	18,050	110	660	5,000	53,060	7,959	8,579	3,717	24,927	98,242
100-N-36	12,550	16,150	17,030	250	180	5,000	51,160	7,674	8,272	3,583	24,034	94,724
100-N-37	15,130	36,250	29,610	14,910	5,510	5,000	106,410	15,962	17,205	7,453	49,990	197,021
100-N-39	12,830	16,150	17,500	810	360	5,000	52,650	7,898	8,513	3,688	24,734	97,483
100-N-47	15,130	36,250	29,610	14,910	5,510	5,000	106,410	15,962	17,205	7,453	49,990	197,021
120-N-3	13,070	16,700	19,540	420	1,170	5,000	55,900	8,385	9,038	3,915	26,261	103,500
124-N-2	13,510	33,990	20,750	4,870	2,790	5,000	80,910	12,137	13,082	5,667	38,011	149,807
124-N-3	13,510	33,990	20,750	4,870	2,790	5,000	80,910	12,137	13,082	5,667	38,011	149,807
124-N-4	21,330	75,940	125,480	143,360	43,070	5,000	414,180	62,127	66,969	29,011	194,577	766,864
128-N-1	14,740	18,580	21,500	11,550	4,530	5,000	75,900	11,385	12,272	5,316	35,657	140,531
130-N-1							-	-	-	-	-	-
600-32	37,130	242,580	289,620	417,410	113,510	5,000	1,105,250	165,788	178,708	77,416	519,235	2,046,397
600-35	17,750	28,350	17,740	13,410	4,850	5,000	87,100	13,065	14,083	6,101	40,919	161,268
Pipelines	855,845	2,162,199	3,138,771		2,375,727	5,000	18,601,162	2,790,174	3,007,622	1,302,904	8,738,633	34,440,496
Totals:							$26,872,142					$49,754,413

1

Table 4.3. 100-NR-1 CMS MCACES Input Parameters

Site Name	Depth of Excavation Res (ft)	Depth of Excavation Rec (ft)	Top Excavation Length (ft)	Top Excavation Width (ft)	Contaminated Soil Res (bcf)	Non-Contaminated Soil Res (bcf)	Contaminated Soil Rec (bcf)	Non-Contaminated Soil Rec (bcf)	Bottom Area Rec (sq. ft.)	Bottom Area Res (sq. ft.)
UPR-100-N-1	12 00	10 00	72 60	72 60	8,021	30,761	5,348	23,017	1,340	1,340
UPR-100-N-2	15 00		62 90	62 90	4,813	28,787				320
UPR-100-N-3	15 00		94 10	94 10	12,032	70,751				2,411
UPR-100-N-4	6 00	6 00	23 80	23 80	201	1,490	201	1,490	34	34
UPR-100-N-5	15 00	10 00	98 80	98 80	28,877	64,287	14,439	34,612	2,894	2,894
UPR-100-N-6	9 25	9 25	36 55	36 55	481	5,657	481	5,657	77	77
UPR-100-N-7	15 00		108 60	108 60	20,214	96,880				4,045
UPR-100-N-8	6 00	6 00	19 50	19 50	13	1,026	13	1,026	2	2
UPR-100-N-9	6 25	6 25	31 75	31 75	1,059	2,500	1,059	2,500	169	169
UPR-100-N-10	6 00	6 00	19 50	19 50	13	1,026	13	1,026	2	2
UPR-100-N-11	2 00	2 00	20 00	20 00	392	200	392	200	196	196
UPR-100-N-12	15 00		120 00	120 00	27,852	120,375				5,625
UPR-100-N-13	3 00	3 00	13 20	13 20	53	221	53	221	18	18
UPR-100-N-14	6 00	6 00	19 80	19 80	19	1,058	19	1,058	3	3
UPR-100-N-17	64 00	64 00	210 90	210 90	21,390	1,282,248	21,390	1,282,248	357	357
UPR-100-N-18	11 25	11 25	37 85	37 85	107	7,336	107	7,336	17	17
UPR-100-N-19	11 25	11 25	40 25	40 25	267	8,375	267	8,375	42	42
UPR-100-N-20	10 25	10 25	35 35	35 35	134	5,842	134	5,842	21	21
UPR-100-N-21	6 25	6 25	22 85	22 85	107	1,457	107	1,457	17	17
UPR-100-N-22	11 25	11 25	38 35	38 35	134	7,548	134	7,548	21	21
UPR-100-N-23	11 25	11 25	36 65	36 65	53	6,838	53	6,838	8	8
UPR-100-N-24	10 25	10 25	40 05	40 05	535	7,585	535	7,585	86	86
UPR-100-N-25	6 25	6 25	25 25	25 25	267	1,738	267	1,738	42	42
UPR-100-N-26	6 25	6 25	28 05	28 05	535	2,066	535	2,066	86	86
UPR-100-N-29	11 00	10 00	34 50	34 50	13	5,880	11	4,461	2	2
UPR-100-N-30	11 00	10 00	47 90	47 90	1,337	11,843	1,114	9,580	222	222
UPR-100-N-32	11 25	10 00	38 35	38 35	134	7,548	107	5,486	21	21
UPR-100-N-36	7 00	7 00	22 40	22 40	13	1,588	13	1,588	2	2
UPR-100-N-37	3 00	3 00	10 30	10 30	5	143	5	143	2	2
UPR-100-N-39	9 00	9 00	30 60	30 60	53	3,856	53	3,856	13	13
UPR-100-N-40	12 00	10 00	58 80	58 80	3,128	19,881	2,086	13,959	520	520
UPR-100-N-41	4 00	4 00	17 10	17 10	134	553	134	553	26	26
UPR-100-N-42	65 00	65 00	222 40	222 40	45,046	1,449,549	45,046	1,449,549	751	751
UPR-100-N-43	11 00	11 00	41 20	41 20	401	8,637	401	8,637	67	67
100-N-1	15 00	10 00	145 00	85 00	24,000	80,750	20,000	45,000	4,000	4,000
100-N-3	17 50	17 50	85 00	85 00	15,840	53,938	15,840	53,938	1,056	1,056
100-N-4	6 00	6 00	118 00	99 00	48,600	10,638	48,600	10,638	8,100	8,100
100-N-5	2 00	2 00	141 00	141 00	36,664	1,652	36,664	1,652	18,225	18,225
100-N-6	1 00	1 00	10 30	10 30	53	26	53	26	53	53
100-N-12	1 00	1 00	5 60	5 60	7	12	7	12	7	7
100-N-13	8 00	8 00	28 20	28 20	54	2,943	54	2,943	18	18
100-N-14	8 00	8 00	28 20	28 20	54	2,943	54	2,943	18	18
100-N-16	3 00	3 00	14 50	14 50	90	317	90	317	30	30
100-N-17	3 00	3 00	13 20	13 20	18	257	18	257	18	18
100-N-18	2 00	2 00	10 20	10 20	18	100	18	100	18	18
100-N-19	1 00	1 00	13 40	13 40	108	35	108	35	108	108
100-N-22	10 00	10 00	49 00	49 00	3,249	10,061	3,249	10,061	361	361
100-N-23	1 00	1 00	5 70	5 70	53	12	53	12	7	7
100-N-24	15 00	10 00	48 00	48 00	90	15,570	45	4,945	9	9
100-N-25	11 00	10 00	42 40	42 40	535	9,178	446	7,262	88	88
100-N-26	10 00	10 00	33 00	33 00	53	4,945	53	4,945	9	9

Site Name	Depth of Excavation Res (ft)	Depth of Excavation Rec (ft)	Top Excavation Length (ft)	Top Excavation Width (ft)	Contaminated Soil Res (bcf)	Non-Contaminated Soil Res (bcf)	Contaminated Soil Rec (bcf)	Non-Contaminated Soil Rec (bcf)	Bottom Area Rec (sq. ft.)	Bottom Area Res (sq. ft.)
100-N-29	15 00		54 40	54 40	446	20,729				88
100-N-30	15 00		54 40	54 40	446	20,729				88
100-N-31	15 00		54 40	54 40	446	20,729				88
100-N-32	15 00		54 40	54 40	446	20,729				88
100-N-33	4 00	4 00	43 60	43 60	999	4,768	999	4,768	999	999
100-N-34	1 00	1 00	6 40	6 30	11	14	11	14	11	11
100-N-35	8 00	8 00	28 20	28 20	53	2,943	53	2,943	18	18
100-N-36	1 00	1 00	15 00	15 00	144	40	144	40	144	144
100-N-37	1 00	1 00	103 00	103 00	10,000	304	10,000	304	10,000	10,000
100-N-38	15 00		54 40	54 40	446	20,729				88
100-N-39	1 00	1 00	26 10	26 10	535	73	535	73	534	534
100-N-47	1 00	1 00	103 00	103 00	10,000	304	10,000	304	10,000	10,000
120-N-3	14 00	10 00	49 30	49 30	481	15,535	267	6,456	53	53
124-N-2	10 00	10 00	49 00	49 00	3,249	10,061	3,249	10,061	361	361
124-N-3	10 00	10 00	49 00	49 00	3,249	10,061	3,249	10,061	361	361
124-N-4	8 33	8 33	120 99	188 99	96,164	76,606	96,164	76,606	15,744	15,744
128-N-1	1 00	1 00	91 00	91 00	7,744	268	7,744	268	7,744	7,744
600-32	2 00	2 00	380 00	380 00	280,000	4,520	280,000	4,520	139,876	139,876
600-35	1 00	1 00	98 00	98 00	9,000	289	9,000	289	9,025	9,025

Table 4.4. Ex Situ Bioremediation Costs from RACER Model

Waste Site	Volume (LCY)	Unit Cost (/LCY)	Cost ()
UPR-100-N-18	5	359.39	1,797
UPR-100-N-19	11	359.39	3,953
UPR-100-N-20	6	359.39	2,156
UPR-100-N-21	5	359.39	1,797
UPR-100-N-22	6	359.39	2,156
UPR-100-N-23	2	359.39	719
UPR-100-N-24	23	359.39	8,266
UPR-100-N-36	1	359.39	359
UPR-100-N-43	17	359.39	6,110
100-N-3	562	N/A	64,335
100-N-12	1	359.39	359
100-N-35	2	359.39	719
100-N-36	6	359.39	2,156
124-N-2	138	N/A	38,649

Table 4.5. 100-NR-1 CMS Summary of Ex Situ Bioremediation Costs

Site ID	Sub01	Sub02	Sub08	Sub18	Sub20	Sub21	Subtotal w/o PM/CM	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Cntgcy 34%	Total Cost
UPR-100-N-18	13,070	16,970	20,060		1,430	5,000	56,530	8,480	9,140	3,960	26,557	104,667
XSITU-BIO							1,797	270	291	126	844	3,328
Total	13,070	16,970	20,060	-	1,430	5,000	58,327	8,749	9,431	4,086	27,402	107,995
UPR-100-N-19	13,140	16,970	20,180		1,510	5,000	56,800	8,520	9,184	3,979	26,684	105,167
XSITU-BIO							3,953	593	639	277	1,857	7,319
Total	13,140	16,970	20,180	-	1,510	5,000	60,753	9,113	9,823	4,256	28,541	112,486
UPR-100-N-20	13,000	16,700	19,120		1,090	5,000	54,910	8,237	8,878	3,846	25,796	101,667
XSITU-BIO							2,156	323	349	151	1,013	3,992
Total	13,000	16,700	19,120	-	1,090	5,000	57,066	8,560	9,227	3,997	26,809	105,660
UPR-100-N-21	12,730	16,420	17,620		530	5,000	52,300	7,845	8,456	3,663	24,570	96,835
XSITU-BIO							1,797	270	291	126	844	3,328
Total	12,730	16,420	17,620	-	530	5,000	54,097	8,115	8,747	3,789	25,414	100,163
UPR-100-N-22	13,080	16,970	20,070		1,430	5,000	56,550	8,483	9,144	3,961	26,567	104,704
XSITU-BIO							2,156	323	349	151	1,013	3,992
Total	13,080	16,970	20,070	-	1,430	5,000	58,706	8,806	9,493	4,112	27,580	108,696
UPR-100-N-23	13,020	16,970	19,680		1,170	5,000	55,840	8,376	9,029	3,911	26,233	103,389
XSITU-BIO							719	108	116	50	338	1,330
Total	13,020	16,970	19,680	-	1,170	5,000	56,559	8,484	9,145	3,961	26,571	104,720
UPR-100-N-24	13,150	16,970	20,540		1,590	5,000	57,250	8,588	9,257	4,010	26,895	106,000
XSITU-BIO							8,266	1,240	1,337	579	3,883	15,305
Total	13,150	16,970	20,540	-	1,590	5,000	65,516	9,827	10,594	4,589	30,779	121,305
UPR-100-N-36	12,680	16,420	17,620		530	5,000	52,250	7,838	8,448	3,660	24,547	96,742
XSITU-BIO							359	54	58	25	169	664
Total	12,680	16,420	17,620	-	530	5,000	52,609	7,891	8,506	3,685	24,715	97,407
UPR-100-N-43	13,150	16,970	20,220		1,590	5,000	56,930	8,540	9,205	3,988	26,745	105,407
XSITU-BIO							6,110	916	988	428	2,870	11,312
Total	13,150	16,970	20,220	-	1,590	5,000	63,040	9,456	10,193	4,416	29,615	116,720
100-N-3	15,030	27,260	52,230		14,320	5,000	113,840	17,076	18,407	7,974	53,481	210,777
XSITU-BIO							64,335	9,650	10,402	4,506	30,224	119,117
Total	15,030	27,260	52,230	-	14,320	5,000	178,175	26,726	28,809	12,480	83,705	329,894
100-N-12	12,300	16,150	17,030		110	5,000	50,590	7,589	8,180	3,544	23,767	93,669
XSITU-BIO							359	54	58	25	169	665
Total	12,300	16,150	17,030	-	110	5,000	50,949	7,643	8,238	3,569	23,935	94,333
100-N-35	12,820	16,420	18,050		660	5,000	52,950	7,943	8,561	3,709	24,875	98,038
XSITU-BIO							719	108	116	50	338	1,330
Total	12,820	16,420	18,050	-	660	5,000	53,669	8,050	8,677	3,759	25,213	99,369
100-N-36	12,550	16,150	17,030		180	5,000	50,910	7,637	8,232	3,566	23,917	94,261
XSITU-BIO							2,156	323	349	151	1,013	3,992
Total	12,550	16,150	17,030	-	180	5,000	53,066	7,960	8,581	3,717	24,930	98,253
124-N-2	13,510	33,990	20,750		2,790	5,000	76,040	11,406	12,295	5,326	35,723	140,790
XSITU-BIO							38,649	5,797	6,249	2,707	18,157	71,559
Total	13,510	33,990	20,750	-	2,790	5,000	114,689	17,203	18,544	8,033	53,880	212,349

Table 4.6. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Summary of Capping Costs

	Area %of	Sub01	Sub02	Sub08	Sub20	Sub21	Subtotal w/o	PM/CM	Direct Distribs	G&A	Cntgcy	Total Cost
Site ID	Total						PM/CM	15.00%	14.06%	5.34%	34%	
Unit#1Cap#1		242,000	6,918	211,765	193,308	18,236	672,227					
UPR-100-N-10	14.79%	35,792	1,023	31,320	28,590	2,697	99,422	14,913	16,076	6,964	46,708	184,083
UPR-100-N-39	85.21%	206,208	5,895	180,445	164,718	15,539	572,805	85,921	92,617	40,122	269,098	1,060,561
		242,000	6,918	211,765	193,308	18,236	672,227	100,834	108,692	47,086	315,805	1,244,644
Unit#1Cap#2		242,108	6,918	217,465	193,500	18,250	678,241					
UPR-100-N-29	0.92%	2,227	64	2,001	1,780	168	6,240	936	1,009	437	2,931	11,553
UPR-100-N-30	90.46%	219,011	6,258	196,719	175,040	16,509	613,537	92,031	99,203	42,975	288,233	1,135,978
UPR-100-N-32	8.62%	20,870	596	18,745	16,680	1,573	58,464	8,770	9,453	4,095	27,466	108,248
		242,108	6,918	217,465	193,500	18,250	678,241	101,736	109,665	47,507	318,631	1,255,779
Unit#4Cap#1		280,638	130,066	2,688,254	198,830	21,697	3,319,485					
UPR-100-N-4	0.18%	505	234	4,839	358	39	5,975	896	966	419	2,807	11,063
UPR-100-N-5	15.39%	43,190	20,017	413,722	30,600	3,339	510,869	76,630	82,602	35,783	240,001	945,886
UPR-100-N-6	0.41%	1,151	533	11,022	815	89	13,610	2,041	2,201	953	6,394	25,199
UPR-100-N-8	0.01%	28	13	269	20	2	332	50	54	23	156	615
UPR-100-N-25	0.23%	645	299	6,183	457	50	7,635	1,145	1,234	535	3,587	14,136
100-N-26	0.05%	140	65	1,344	99	11	1,660	249	268	116	780	3,073
124-N-4	83.73%	234,978	108,904	2,250,875	166,480	18,167	2,779,405	416,911	449,402	194,681	1,305,736	5,146,134
		280,638	130,066	2,688,254	198,830	21,697	3,319,485	497,923	536,728	232,511	1,559,460	6,146,106
Unit#4Cap#2		242,502	8,302	231,375	193,288	18,307	693,774					
UPR-100-N-9	98.26%	238,282	8,158	227,349	189,925	17,988	681,702	102,255	110,224	47,749	320,257	1,262,188
UPR-100-N-14	1.74%	4,220	144	4,026	3,363	319	12,072	1,811	1,952	846	5,671	22,351
		242,502	8,302	231,375	193,288	18,307	693,774	104,066	112,176	48,595	325,928	1,284,539
Unit#4Cap#3		242,195	6,918	211,877	193,306	18,279	672,575					
UPR-100-N-13	16.94%	41,028	1,172	35,892	32,746	3,096	113,934	17,090	18,422	7,980	53,525	210,952
UPR-100-N-26	83.06%	201,167	5,746	175,985	160,560	15,183	558,641	83,796	90,327	39,130	262,444	1,034,337
		242,195	6,918	211,877	193,306	18,279	672,575	100,886	108,749	47,110	315,969	1,245,289

Table 4.7. 100-NR-1 CMS Modified CRCIA Ranger/Industrial Scenario Summary of Capping Costs

Site Name	Remove/Dispose	Capping	In Situ Solidification
CAP1-1			
UPR-100-N-10	95,391	653,884	157,016
UPR-100-N-39	99,297	3,767,236	415,600
Subtotal	194,688	4,421,120	572,616
CAP1-2			
UPR-100-N-29	100,630	41,563	158,467
UPR-100-N-30	112,776	4,086,761	349,849
UPR-100-N-32	101,908	389,430	173,568
Subtotal	315,314	4,517,754	681,884
CAP4-1			
UPR-100-N-4	97,464	83,646	192,295
UPR-100-N-5	218,961	7,151,720	651,238
UPR-100-N-6	104,056	190,527	217,955
UPR-100-N-8	95,391	4,647	157,016
UPR-100-N-25	97,779	106,881	202,532
100-N-26	101,593	23,235	163,047
124-N-4	766,864	38,909,260	1,388,214
Subtotal	1,482,108	46,469,916	2,972,297
CAP4-2			
UPR-100-N-9	104,307	4,672,424	345,617
UPR-100-N-14	95,409	82,740	158,496
Subtotal	199,716	4,755,164	504,113
CAP4-3			
UPR-100-N-13	88,873	749,331	181,321
UPR-100-N-26	99,908	3,674,112	252,221
Subtotal	188,781	4,423,443	433,542
Miscellaneous In Situ Solidification			
UPR-100-N-1	150,214		386,077
UPR-100-N-11	95,835		345,010
100-N-13	98,242		340,414
100-N-14	98,242		340,414
Subtotal	442,533		1,411,915
Total for Capping and Remove/Dispose	2,380,607	64,587,397	
Total for In Situ Solidification and Remove/Dispose	2,823,140		6,576,367

[a] Costs based on the modified CRCIA ranger/industrial exposure scenario
NA-Not Applicable

Table 4.8. 100-NR-1 CMS In Situ Bioremediation

Site ID	Total Site Volume (bcy)	Time Frame Years	Task Subtotals	PM/CM 15.00%	Direct Distribs 14.06%	G&A 5.34%	Contingency 34%		Total Cost
UPR-100-N-17									
Site Restoration	1,170		1,170	176	189	82	550		3,336
Construction	77,100		77,100	11,565	12,466	5,400	36,221	Capital	219,852
RACERO & M Cost	23,644	15.00	354,660	53,199	57,345	24,842	166,616	O&M	680,321
Total			$432,930	$64,940	$70,000	$30,324	$203,386		$903,510
UPR-100-N-42									
Site Restoration	2,190		2,190	329	354	153	1,029		6,245
Construction	78,365		78,365	11,755	12,671	5,489	36,815	Capital	223,460
RACERO & M Cost	23,644	15.00	354,660	53,199	57,345	24,842	166,616	O&M	680,321
Total			$435,215	$65,282	$70,370	$30,484	$204,460		$910,026

Table 4.9. 100-NR-1/2 CMS In Situ Solidification

Site ID	Total Site Volume (bcy)	Fixed Unit Cost /bcy	Variable Unit Cost /bcy	PM/CM 1500%	Direct Distribs 1406%	G&A 534%	Contingency 34%		Total Cost $
UPR-100-N-1(rec)	4963	16835	24320	RACER Model Run					
RACER Fixed Cost	83,550			12,533	13,509	5,852	39,251	Capital	154,695
RACER Variable Cost	120,699			18,105	19,516	8,454	56,703	O&M	223,477
Soil Cover Cost	4,269			640	690	299	2,006	Cover	7,905
	204,249		-	31,278	33,715	14,606	97,960		386,077
UPR-100-N-5(rec)	8926	16835	24320	UPR-100-N-1(rec) Unit cost					
RACER Fixed Cost	83,550			12,533	13,509	5,852	39,251	Capital	154,695
RACER Variable Cost	217,078			32,562	35,099	15,205	101,981	O&M	401,926
Soil Cover Cost	9,385			1,408	1,518	657	4,409	Cover	17,377
	310,014		-	46,502	50,126	21,715	145,641		573,998
UPR-100-N-30(rec)	822	1,01285	1,26746	RACER Model Run					
Fixed Cost	83,256			12,488	13,462	5,832	39,113	Capital	154,150
Variable Cost	104,185			15,628	16,846	7,298	48,945	O&M	192,901
Soil Cover Cost	1,511			227	244	106	710	Cover	2,798
	187,441		-	28,343	30,552	13,235	88,768		349,849
UPR-100-N-6(rec)	264	1,01285	1,26746	UPR-100-N-30(rec) Unit cost					
Fixed Cost	83,256			12,488	13,462	5,832	39,113	Capital	154,150
Variable Cost	33,461			5,019	5,410	2,344	15,720	O&M	61,954
Soil Cover Cost	1,000			150	162	70	470	Cover	1,851
	116,717		-	17,657	19,034	8,245	55,302		217,955
UPR-100-N-32(rec)	78	1,01285	1,26746	UPR-100-N-30(rec) Unit cost					
Fixed Cost	83,256			12,488	13,462	5,832	39,113	Capital	154,150
Variable Cost	9,886			1,483	1,598	692	4,644	O&M	18,304
Soil Cover Cost	601			90	97	42	282	Cover	1,113
	93,142		-	14,061	15,157	6,566	44,040		173,568
100-N-26(rec)	33	1,01285	1,26746	UPR-100-N-30(rec) Unit cost					
Fixed Cost	83,256			12,488	13,462	5,832	39,113	Capital	154,150
Variable Cost	4,183			627	676	293	1,965	O&M	7,744
Soil Cover Cost	622			93	101	44	292	Cover	1,152
	87,439		-	13,209	14,239	6,168	41,370		163,047
UPR-100-N-9(rec)	391	2,12834	2,61148	RACER Model Run					
RACER Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
RACER Variable Cost	102,109			15,316	16,510	7,152	47,970	O&M	189,057
Soil Cover Cost	1,339			201	217	94	629	Cover	2,480
	185,327		-	28,000	30,182	13,075	87,694		345,617
UPR-100-N-4(rec)	76	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					

Site ID	Total Site Volume (bcy)	Fixed Unit Cost /bcy	Variable Unit Cost /bcy	PM/CM 1500%	Direct Distribs 1406%	G&A 534%	Contingency 34%		Total Cost $
Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Variable Cost	19,847			2,977	3,209	1,390	9,324	O&M	36,748
Soil Cover Cost	792			119	128	55	372	Cover	1,467
	103,065		-	15,579	16,793	7,275	48,791		192,295
UPR-100-N-8(rec)	04	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					
Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Variable Cost	1,045			157	169	73	491	O&M	1,934
Soil Cover Cost	541			81	87	38	254	Cover	1,002
	84,263		-	12,721	13,712	5,940	39,840		157,016
UPR-100-N-10(rec)	04	2,12834	2,61148	UPR-100-N-9(rec)Unit cost					
Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Variable Cost	1,045			157	169	73	491	O&M	1,934
Soil Cover Cost	541			81	87	38	254	Cover	1,002
	84,263		-	12,721	13,712	5,940	39,840		157,016
UPR-100-N-14(rec)	07	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					
Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Variable Cost	1,828			274	296	128	859	O&M	3,385
Soil Cover Cost	557			84	90	39	262	Cover	1,031
	85,046		-	12,840	13,841	5,996	40,215		158,496
UPR-100-N-25(rec)	97	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					
Capital Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Fixed Cost	25,331			3,800	4,096	1,774	11,900	O&M	46,902
Variable Cost	837			126	135	59	393	Cover	1,550
Soil Cover Cost	108,549		-	16,408	17,687	7,662	51,389		202,532
UPR-100-N-26(rec)	199	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					
Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
Variable Cost	51,969			7,795	8,403	3,640	24,414	O&M	96,221
Soil Cover Cost	1,037			156	168	73	487	Cover	1,920
	135,187		-	20,434	22,026	9,542	63,996		252,221
UPR-100-N-29(rec)	07	2,12834	2,61148	UPR-100-N-9(rec) Unit cost					
RACER Fixed Cost	83,218			12,483	13,456	5,829	39,095	Capital	154,080
RACER Variable Cost	1,828			274	296	128	859	O&M	3,385
Soil Cover Cost	541			81	87	38	254	Cover	1,002
	85,587		-	12,838	13,839	5,995	40,208		158,467
UPR-100-N-11(rec)	145	5,73869	7,01372	RACER Model Run					
RACER Fixed Cost	83,211			12,482	13,454	5,828	39,092	Capital	154,067
RACER Variable Cost	101,699			15,255	16,444	7,123	47,777	O&M	188,298
Soil Cover Cost	1,428			214	231	100	671	Cover	2,645
	186,338		-	27,951	30,129	13,052	87,540		345,010

Site ID	Total Site Volume (bcy)	Fixed Unit Cost /bcy	Variable Unit Cost /bcy	PM/CM 1500%	Direct Distribs 1406%	G&A 534%	Contingency 34%		Total Cost $
UPR-100-N-13(rec)	2	5,73869	7,01372	UPR-100-N-11(rec) Unit cost					
Fixed Cost	83,211			12,482	13,454	5,828	39,092	Capital	154,067
Variable Cost	14,027			2,104	2,268	983	6,590	O&M	25,972
Soil Cover Cost	692			104	112	48	325	Cover	1,282
	97,931		-	14,690	15,834	6,859	46,007		181,321
UPR-100-N-39(rec)	198	5,73869	7,01372	UPR-100-N-11(rec) Unit cost					
Fixed Cost	83,211			12,482	13,454	5,828	39,092	Capital	154,067
Variable Cost	138,872			20,831	22,454	9,727	65,241	O&M	257,124
Soil Cover Cost	2,381			357	385	167	1,119	Cover	4,409
	224,464		-	33,670	36,294	15,722	105,451		415,600
124-N-4(rec)	48573	4380	10416	RACER Model Run					
RACER Fixed Cost	212,729			31,909	34,396	14,900	99,938	Capital	393,873
RACER Variable Cost	505,941			75,891	81,806	35,438	237,686	O&M	936,762
Soil Cover Cost	31,098			4,665	5,028	2,178	14,610	Cover	57,579
	749,768		-	112,465	121,230	52,517	352,233		1,388,214
100-N-14(rec)	53	15,29528	19,26396	RACER Model Run					
RACER Fixed Cost	81,065			12,160	13,107	5,678	38,083	Capital	150,094
RACER Variable Cost	102,099			15,315	16,508	7,151	47,965	O&M	189,039
Soil Cover Cost	692			104	112	48	325	Cover	1,282
	183,164		-	27,578	29,728	12,878	86,374		340,414
100-N-13(rec)	53	15,29528	19,26396	100-N-14(rec) Unit cost					
Fixed Cost	81,065			12,160	13,107	5,678	38,083	Capital	150,094
Variable Cost	102,099			15,315	16,508	7,151	47,965	O&M	189,039
Soil Cover Cost	692			104	112	48	325	Cover	1,282
	183,164		-	27,578	29,728	12,878	86,374		340,414

Table 4.10. 100-N-46 Underground Fuel Storage Tank at HGP

Item Description	Equipment	Materials	Labor	S/C	Subtotal Direct	Field Distribs 26.0%	Home Off. 3.0%	S/C Fee 4.0%	B&O Tax 0.47%	Total Bid
Pre-Construction Activities	-	124	14,233	-	14,358	ERC Activities Include DD&G&A)				14,358
Prepare Site/ Mobilize	848	216	3,029	-	4,092	1,064	155	212	26	5,549
Removal Action	2,004	486	2,292	12,247	17,030	4,428	644	884	108	23,093
Restore Site	749	-	347	84	1,181	307	45	61	7	1,602
Tank Disposal	437	-	1,201	-	1,638	426	62	85	10	2,221
Removal Activity Closeout	-	-	1,920	-	1,920	ERC Activities (Include DD&G&A)				1,920
Subtotals:	$4,038	$826	$23,023	$12,332	$40,218	6,225	905	1,243	152	$48,743

	ERC Direct Distribs @18.09%			5,873
	(excludes ERC labor)			
Pre-Construction and Close out are performed with ERC Labor	ERC G&A @4.04		1,549	
Removal and site restoration work performed with Subcontractor (Building Trades) Labor.	(excludes ERC labor)			
Sample Analysis costs: Average ERC Cost for FY97 (Quanterra) (Inter office Memo Jan 15, 1997)	TOTAL:		56,165	
	Contingency @ 34%		19,096	
		TOTAL:	75,261	

Table 4.11. Rivershore Site Residential Scenario Remove/Dispose Summary

Item Description	Equipment	Materials	Labor	S/C	Subtotal Direct	Field Distribs 26.00%	Home Office 3.00%	S/C Fee 4.00%	B&O Tax 0.47%	Total Bid
Grout Wells	-	49	450	-	499	130	19	26	3	676
Excavate Site	107,489	92,794	285,981	577,095	1,063,359	276,473	40,195	55,201	6,746	1,441,974
Restore Site	197,503	266,706	113,099	42,830	620,137	161,236	23,441	32,193	3,934	840,941
Support Facilities	-	-	-	133,920	133,920	34,819	5,062	6,952	850	181,603
Mobilization/Demobilization	29,914	4,502	136,783	-	171,199	44,512	6,471	8,887	1,086	232,155
Subtotals:	334,905	364,052	536,312	753,844	1,989,114	517,170	75,189	103,259	12,618	2,697,349

Bond		25,962
Total Subcontractor Cost	SUBTOTAL:	2,723,311
PM/CM @15%		408,497
	SUBTOTAL:	3,131,808
Haul to ERDF and Disposal		3,447,990
	SUBTOTAL:	6,579,798
Assumptions:		
All excavation will take place above the water table.	Directdistribs@18.09%	1,190,285
Backfill material consists of clean natural fill material from the 100 BC Area.		
Riprap material above the water line is placed with a backhoe.	G&A@4.04%	313,911
Rip-rapmaterialwasassumedtoinclude4feetof+2ftmaterialrestingon2feetof12"minusmaterial.		
Existing wells will be grouted closed.	TOTAL:	8,083,995
Two new monitoring wells will be established through the clean cover material.		
Contractor markups are taken from the 300 FFFPE.	Contingency@34%	2,748,558
PM/CM was included as 15% of the project direct costs to be comparable to the other estimates in the CMS.		
	TOTAL:	**10,832,553**

Table 4.12. Rivershore Site Modified CRCIA Ranger/Industrial Scenario Remove/Dispose Net Present Value

Calculation of Net Present Value annually escalated at 3.2% per year and discounted at 10% (7% plus 3.2%) per year for 300 years. The 3.2% is published by the U.S. Department of Energy (DOE) and is an average for 300 years, and the 7% Discount Rate was obtained from the U.S. Environmental Protection Agency (EPA) Hotline (800) 424-9346. The first year is not escalated or discounted.

The cash flow is made up of the following:

100 NR-1 & 100-NR-2 CMS rivershore site recreational scenario: remove/dispose alternative work must be repeated every 20 years.

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
1	$9,738,935	$9,738,935	$9,738,935	1000	$9,738,935	100	$9,738,93500
2				1032		110	
3				1065		121	
4				1099		134	
5				1134		147	
6				1171		163	
7				1208		179	
8				1247		197	
9				1287		217	
10				1328		240	
11				1370		264	
12				1414		291	
13				1459		321	
14				1506		353	
15				1554		390	
16				1604		429	
17				1655		473	
18				1708		521	
19				1763		574	
20				1819		633	
21	$9,738,935	$9,738,935	$9,738,935	1878	$18,285,440	698	$2,621,03924
22				1938		769	
23				2000		847	
24				2064		934	
25				2130		1029	
26				2198		1134	
27				2268		1249	
28				2341		1377	
29				2416		1517	
30				2493		1672	
31				2573		1843	
32				2655		2031	
33				2740		2238	
34				2828		2466	
35				2918		2718	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
36				3012		2995	
37				3108		3300	
38				3207		3637	
39				3310		4008	
40				3416		4417	
41	$9,738,935	$9,738,935	$9,738,935	3525	$34,332,020	4867	$705,40020
42				3638		5363	
43				3754		5911	
44				3875		6513	
45				3999		7178	
46				4127		7910	
47				4259		8717	
48				4395		9606	
49				4536		10586	
50				4681		11665	
51				4830		12855	
52				4985		14166	
53				5145		15611	
54				5309		17204	
55				5479		18959	
56				5654		20892	
57				5835		23023	
58				6022		25372	
59				6215		27960	
60				6414		30812	
61	$9,738,935	$9,738,935	$9,738,935	6619	$64,460,446	33954	$189,84433
62				6831		37418	
63				7049		41234	
64				7275		45440	
65				7508		50075	
66				7748		55183	
67				7996		60811	
68				8252		67014	
69				8516		73850	
70				8788		81382	
71				9069		89683	
72				9360		98831	
73				9659		1,08912	
74				9968		1,20021	
75				10287		1,32263	
76				10616		1,45754	
77				10956		1,60621	
78				11307		1,77004	
79				11669		1,95058	
80				12042		2,14954	
81	$9,738,935	$9,738,935	$9,738,935	12427	$121,028,388	2,36880	$51,09280
82				12825		2,61041	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
83				13235		2,87667	
84				13659		3,17010	
85				14096		3,49345	
86				14547		3,84978	
87				15013		4,24245	
88				15493		4,67518	
89				15989		5,15205	
90				16500		5,67756	
91				17028		6,25667	
92				17573		6,89485	
93				18136		7,59813	
94				18716		8,37314	
95				19315		9,22720	
96				19933		10,16837	
97				20571		11,20555	
98				21229		12,34851	
99				21908		13,60806	
100				22609		14,99608	
101	$9,738,935	$9,738,935	$9,738,935	23333	$227,238,125	16,52568	$13,75060
102				24080		18,21130	
103				24850		20,06886	
104				25645		22,11588	
105				26466		24,37170	
106				27313		26,85761	
107				28187		29,59709	
108				29089		32,61599	
109				30020		35,94282	
110				30980		39,60899	
111				31972		43,64911	
112				32995		48,10132	
113				34051		53,00765	
114				35140		58,41443	
115				36265		64,37271	
116				37425		70,93872	
117				38623		78,17447	
118				39859		86,14827	
119				41134		94,93539	
120				42451		104,61880	
121	$9,738,935	$9,738,935	$9,738,935	43809	$426,653,333	115,28992	$3,70070
122				45211		127,04949	
123				46658		140,00854	
124				48151		154,28941	
125				49692		170,02693	
126				51282		187,36968	
127				52923		206,48139	
128				54616		227,54249	
129				56364		250,75182	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
130				58168		276,32851	
131				60029		304,51402	
132				61950		335,57445	
133				63932		369,80304	
134				65978		407,52295	
135				68089		449,09029	
136				70268		494,89750	
137				72517		545,37704	
138				74837		601,00550	
139				77232		662,30806	
140				79704		729,86349	
141	$9,738,935	$9,738,935	$9,738,935	82254	$801,067,455	804,30956	$99597
142				84886		886,34914	
143				87603		976,75675	
144				90406		1,076,38594	
145				93299		1,186,17730	
146				96284		1,307,16739	
147				99366		1,440,49846	
148				102545		1,587,42931	
149				105827		1,749,34710	
150				109213		1,927,78050	
151				112708		2,124,41411	
152				116315		2,341,10435	
153				120037		2,579,89699	
154				123878		2,843,04649	
155				127842		3,133,03723	
156				131933		3,452,60703	
157				136155		3,804,77294	
158				140512		4,192,85978	
159				145008		4,620,53148	
160				149648		5,091,82569	
161	$9,738,935	$9,738,935	$9,738,935	154437	$1,504,052,632	5,611,19191	$26805
162				159379		6,183,53349	
163				164479		6,814,25390	
164				169743		7,509,30780	
165				175174		8,275,25720	
166				180780		9,119,33343	
167				186565		10,049,50544	
168				192535		11,074,55499	
169				198696		12,204,15960	
170				205054		13,448,98388	
171				211616		14,820,78024	
172				218388		16,332,49982	
173				225376		17,998,41481	
174				232588		19,834,25312	
175				240031		21,857,34693	
176				247712		24,086,79632	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
177				255639		26,543,64955	
178				263819		29,251,10180	
179				272261		32,234,71418	
180				280974		35,522,65503	
181	$9,738,935	$9,738,935	$9,738,935	289965	$2,823,949,849	39,145,96584	$7214
182				299244		43,138,85436	
183				308820		47,539,01751	
184				318702		52,387,99729	
185				328900		57,731,57301	
186				339425		63,620,19346	
187				350287		70,109,45320	
188				361496		77,260,61742	
189				373064		85,141,20040	
190				385002		93,825,60284	
191				397322		103,395,81433	
192				410036		113,942,18739	
193				423157		125,564,29050	
194				436698		138,371,84814	
195				450673		152,485,77664	
196				465094		168,039,32586	
197				479977		185,179,33710	
198				495337		204,067,62949	
199				511187		224,882,52769	
200				527545		247,820,54552	
201	$9,738,935	$9,738,935	$9,738,935	544427	$5,302,136,760	273,098,24116	$1941
202				561848		300,954,26176	
203				579828		331,651,59646	
204				598382		365,480,05930	
205				617530		402,759,02534	
206				637291		443,840,44593	
207				657685		489,112,17141	
208				678730		539,001,61290	
209				700450		593,979,77741	
210				722864		654,565,71471	
211				745996		721,331,41761	
212				769868		794,907,22221	
213				794504		875,987,75887	
214				819928		965,338,51028	
215				846165		1,063,803,03833	
216				873243		1,172,310,94824	
217				901186		1,291,886,66496	
218				930024		1,423,659,10478	
219				959785		1,568,872,33347	
220				990498		1,728,897,31148	
221	$9,738,935	$9,738,935	$9,738,935	1022194	$9,955,082,680	1,905,244,83725	$523
222				1054904		2,099,579,81065	
223				1088661		2,313,736,95134	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
224				1123498		2,549,738,12038	
225				1159450		2,809,811,40865	
226				1196553		3,096,412,17234	
227				1234843		3,412,246,21392	
228				1274358		3,760,295,32773	
229				1315137		4,143,845,45116	
230				1357221		4,566,517,68718	
231				1400652		5,032,302,49128	
232				1445473		5,545,597,34539	
233				1491728		6,111,248,27461	
234				1539464		6,734,595,59863	
235				1588727		7,421,524,34968	
236				1639566		8,178,519,83335	
237				1692032		9,012,728,85635	
238				1746177		9,932,027,19970	
239				1802055		10,945,093,97407	
240				1859720		12,061,493,55943	
241	$9,738,935	$9,738,935	$9,738,935	1919231	$18,691,270,263	$13,291,765,90249	$141
242				1980647		14,647,526,02454	
243				2044028		16,141,573,67905	
244				2109436		17,788,014,19431	
245				2176938		19,602,391,64213	
246				2246600		21,601,835,58963	
247				2318492		23,805,222,81977	
248				2392683		26,233,355,54739	
249				2469249		28,909,157,81322	
250				2548265		31,857,891,91017	
251				2629810		35,107,396,88500	
252				2713964		38,688,351,36727	
253				2800810		42,634,563,20674	
254				2890436		46,983,288,65382	
255				2982930		51,775,584,09651	
256				3078384		57,056,693,67436	
257				3176892		62,876,476,42914	
258				3278553		69,289,877,02491	
259				3383467		76,357,444,48146	
260				3491738		84,145,903,81856	
261	$9,738,935	$9,738,935	$9,738,935	3603473	$35,093,991,210	92,728,786,00806	$038
262				3718784		102,187,122,18088	
263				3837785		112,610,208,64333	
264				3960595		124,096,449,92495	
265				4087334		136,754,287,81729	
266				4218128		150,703,225,17466	
267				4353108		166,074,954,14247	
268				4492408		183,014,599,46501	
269				4636165		201,682,088,61044	
270				4784522		222,253,661,64870	

				Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs				7%		1102	Present Worth
Inflation Rate % (DOE) for 300 Yrs				32%		1032	13,325,126
Yr of O & M		Total	Cash Flow in 1997 $	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs							
271				4937627		244,923,535,13687	
272				5095631		269,905,735,72083	
273				5258691		297,436,120,76435	
274				5426969		327,774,605,08232	
275				5600632		361,207,614,80071	
276				5779852		398,050,791,51039	
277				5964808		438,651,972,24445	
278				6155682		483,394,473,41338	
279				6352663		532,700,709,70154	
280				6555949		587,036,182,09110	
281	$9,738,935	$9,738,935	$9,738,935	6765739	$65,891,092,563	646,913,872,66439	$010
282				6982243		712,899,087,67616	
283				7205674		785,614,794,61913	
284				7436256		865,747,503,67028	
285				7674216		954,053,749,04465	
286				7919791		1,051,367,231,44720	
287				8173224		1,158,606,689,05482	
288				8434768		1,276,784,571,33841	
289				8704680		1,407,016,597,61493	
290				8983230		1,550,532,290,57165	
291				9270693		1,708,686,584,20996	
292				9567356		1,882,972,615,79938	
293				9873511		2,075,035,822,61091	
294				10189463		2,286,689,476,51723	
295				10515526		2,519,931,803,12198	
296				10852023		2,776,964,847,04043	
297				11199288		3,060,215,261,43855	
298				11557665		3,372,357,218,10528	
299				11927510		3,716,337,654,35202	
300				12309190		4,095,404,095,09593	
Total	$146,084,025	$146,084,025	$146,084,025		$140,964,380,098		$13,325,126

Table 4.13. Rivershore Site Modified CRCIA Ranger/Industrial Scenario Remove/Dispose Summary

Item Description	Equipment	Materials	Labor	S/C	Subtotal	Field Distribs	Home Office	S/C Fee	B&O Tax	Total Bid
	$	$	$	$	Direct	26.00%	3.00%	4.00%	0.47%	**$**
Grout Wells	$-	$66	$450	$-	$516	$134	$19	$27	$3	$699
Excavate Site	$93,772	$80,955	$249,486	$533,273	$957,486	$248,946	$36,193	$49,705	$6,074	$1,298,404
Restore Site	$175,411	$266,706	$98,275	$42,830	$583,222	$151,638	$22,046	$30,276	$3,700	$790,881
Support Facilities	$-	$-	$-	$133,920	$133,920	$34,819	$5,062	$6,952	$850	$181,603
Mobilization/ Demobilization	$29,914	$4,502	$136,783	$-	$171,199	$44,512	$6,471	$8,887	$1,086	$232,155
Subtotals:	$299,097	$352,230	$484,993	$710,022	$1,846,342	$480,049	$69,792	$95,847	$11,713	$2,503,743
Bond										$24,626
Total Subcontractor Cost								Subtotal:		$2,528,369
PM/CM @ 15%										$379,255
								Subtotal:		$2,907,624
Haul to ERDF& Disposal										$3,007,900
								Subtotal:		$5,915,524

Assumptions:	Direct distribs @ 18.09%	$1,070,118
All excavation will take place above the water table.		
Backfill material consists of clean natural fill material from the 100 BC Area.	G&A @ 4.04%	$282,220
Riprap material above the waterline is placed with a backhoe.		
Rip-rap material was assumed to include 4 feet of +2ft material resting on 2 feet of 12 " minus material.	TOTAL:	$7,267,862
Existing wells will be grouted closed.		
Two new monitoring wells will be established through the clean cover material.	Contingency @ 34%	$2,471,073
Contractor markups are taken from the 300 FF FPE.		
PM/CM was included as 15% of the project direct costs to be comparable to the other estimates in the CMS.	**TOTAL:**	**$9,738,935**

Table 4.14. Rivershore Site Residential Scenario Remove/Dispose Net Present Value

Calculation of Net Present Value annually escalated at 3.2 % per year and discounted at 10 % (7 % plus 3.2 %) per year for 300 years. The 3.2 % is published by DOE and is an average for 300 years, and the 7 % Discount Rate was obtained from the EPA Hotline (800) 424-9346. The first year is not escalated or discounted.

The cash flow is made up of the following:

100-NR-1 & 100-NR-2 CMS river shore site, residential scenario: remove/dispose alternative work must be repeated every 20 years

		Rate		Compounding Value	Total Net
Discount Rate % (EPA) for 300 Yrs.		7%		1.102	Present Worth
Inflation Rate % (DOE) for 300 Yrs.		3.2%		1.032	14,821,449

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
1	10,832,553	10,832,553	10,832,553	1.000	10,832,553	1.00	10,832,553.00
2			-	1.032	-	1.10	
3			-	1.065	-	1.21	
4			-	1.099	-	1.34	
5			-	1.134	-	1.47	
6			-	1.171	-	1.63	
7			-	1.208	-	1.79	
8			-	1.247	-	1.97	
9			-	1.287	-	2.17	
10			-	1.328	-	2.40	
11			-	1.370	-	2.64	
12			-	1.414	-	2.91	
13			-	1.459	-	3.21	
14			-	1.506	-	3.53	
15			-	1.554	-	3.90	
16			-	1.604	-	4.29	
17			-	1.655	-	4.73	
18			-	1.708	-	5.21	
19			-	1.763	-	5.74	
20			-	1.819	-	6.33	
21	10,832,553	10,832,553	10,832,553	1.878	20,338,774	6.98	2,915,364.61
22			-	1.938	-	7.69	
23			-	2.000	-	8.47	
24			-	2.064	-	9.34	
25			-	2.130	-	10.29	
26			-	2.198	-	11.34	
27			-	2.268	-	12.49	
28			-	2.341	-	13.77	
29			-	2.416	-	15.17	
30			-	2.493	-	16.72	
31			-	2.573	-	18.43	
32			-	2.655	-	20.31	
33			-	2.740	-	22.38	

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
34			-	2.828	-	24.66	
35			-	2.918	-	27.18	
36			-	3.012	-	29.95	
37			-	3.108	-	33.00	
38			-	3.207	-	36.37	
39			-	3.310	-	40.08	
40			-	3.416	-	44.17	
41	10,832,553	10,832,553	10,832,553	3.525	38,187,279	48.67	784,611.98
42			-	3.638	-	53.63	
43			-	3.754	-	59.11	
44			-	3.875	-	65.13	
45			-	3.999	-	71.78	
46			-	4.127	-	79.10	
47			-	4.259	-	87.17	
48			-	4.395	-	96.06	
49			-	4.536	-	105.86	
50			-	4.681	-	116.65	
51			-	4.830	-	128.55	
52			-	4.985	-	141.66	
53			-	5.145	-	156.11	
54			-	5.309	-	172.04	
55			-	5.479	-	189.59	
56			-	5.654	-	208.92	
57			-	5.835	-	230.23	
58			-	6.022	-	253.72	
59			-	6.215	-	279.60	
60			-	6.414	-	308.12	
61	10,832,553	10,832,553	10,832,553	6.619	71,698,928	339.54	211,162.59
62			-	6.831	-	374.18	
63			-	7.049	-	412.34	
64			-	7.275	-	454.40	
65			-	7.508	-	500.75	
66			-	7.748	-	551.83	
67			-	7.996	-	608.11	
68			-	8.252	-	670.14	
69			-	8.516	-	738.50	
70			-	8.788	-	813.82	
71			-	9.069	-	896.83	
72			-	9.360	-	988.31	
73			-	9.659	-	1,089.12	
74			-	9.968	-	1,200.21	
75			-	10.287	-	1,322.63	
76			-	10.616	-	1,457.54	
77			-	10.956	-	1,606.21	
78			-	11.307	-	1,770.04	
79			-	11.669	-	1,950.58	
80			-	12.042	-	2,149.54	
81	10,832,553	10,832,553	10,832,553	12.427	134,619,076	2,368.80	56,830.18

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
82			-	12.825	-	2,610.41	
83			-	13.235	-	2,876.67	
84			-	13.659	-	3,170.10	
85			-	14.096	-	3,493.45	
86			-	14.547	-	3,849.78	
87			-	15.013	-	4,242.45	
88			-	15.493	-	4,675.18	
89			-	15.989	-	5,152.05	
90			-	16.500	-	5,677.56	
91			-	17.028	-	6,256.67	
92			-	17.573	-	6,894.85	
93			-	18.136	-	7,598.13	
94			-	18.716	-	8,373.14	
95			-	19.315	-	9,227.20	
96			-	19.933	-	10,168.37	
97			-	20.571	-	11,205.55	
98			-	21.229	-	12,348.51	
99			-	21.908	-	13,608.06	
100			-	22.609	-	14,996.08	
101	10,832,553	10,832,553	10,832,553	23.333	252,755,463	16,525.68	15,294.70
102			-	24.080	-	18,211.30	
103			-	24.850	-	20,068.86	
104			-	25.645	-	22,115.88	
105			-	26.466	-	24,371.70	
106			-	27.313	-	26,857.61	
107			-	28.187	-	29,597.09	
108			-	29.089	-	32,615.99	
109			-	30.020	-	35,942.82	
110			-	30.980	-	39,608.99	
111			-	31.972	-	43,649.11	
112			-	32.995	-	48,101.32	
113			-	34.051	-	53,007.65	
114			-	35.140	-	58,414.43	
115			-	36.265	-	64,372.71	
116			-	37.425	-	70,938.72	
117			-	38.623	-	78,174.47	
118			-	39.859	-	86,148.27	
119			-	41.134	-	94,935.39	
120			-	42.451	-	104,618.80	
121	10,832,553	10,832,553	10,832,553	43.809	474,563,680	115,289.92	4,116.26
122			-	45.211	-	127,049.49	-
123			-	46.658	-	140,008.54	
124			-	48.151	-	154,289.41	
125			-	49.692	-	170,026.93	
126			-	51.282	-	187,369.68	
127			-	52.923	-	206,481.39	
128			-	54.616	-	227,542.49	
129			-	56.364	-	250,751.82	

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
130			-	58.168	-	276,328.51	
131			-	60.029	-	304,514.02	
132			-	61.950	-	335,574.45	
133			-	63.932	-	369,803.04	
134			-	65.978	-	407,522.95	
135			-	68.089	-	449,090.29	
136			-	70.268	-	494,897.50	
137			-	72.517	-	545,377.04	
138			-	74.837	-	601,005.50	
139			-	77.232	-	662,308.06	
140			-	79.704	-	729,863.49	
141	10,832,553	10,832,553	10,832,553	82.254	891,022,033	804,309.56	1,107.81
142			-	84.886	-	886,349.14	
143			-	87.603	-	976,756.75	
144			-	90.406	-	1,076,385.94	
145			-	93.299	-	1,186,177.30	
146			-	96.284	-	1,307,167.39	
147			-	99.366	-	1,440,498.46	
148			-	102.545	-	1,587,429.31	
149			-	105.827	-	1,749,347.10	
150			-	109.213	-	1,927,780.50	
151			-	112.708	-	2,124,414.11	
152			-	116.315	-	2,341,104.35	
153			-	120.037	-	2,579,896.99	
154			-	123.878	-	2,843,046.49	
155			-	127.842	-	3,133,037.23	
156			-	131.933	-	3,452,607.03	
157			-	136.155	-	3,804,772.94	
158			-	140.512	-	4,192,859.78	
159			-	145.008	-	4,620,531.48	
160			-	149.648	-	5,091,825.69	
161	10,832,553	10,832,553	10,832,553	154.437	1,672,947,796	5,611,191.91	298.14
162			-	159.379	-	6,183,533.49	
163			-	164.479	-	6,814,253.90	
164			-	169.743	-	7,509,307.80	
165			-	175.174	-	8,275,257.20	
166			-	180.780	-	9,119,333.43	
167			-	186.565	-	10,049,505.44	
168			-	192.535	-	11,074,554.99	
169			-	198.696	-	12,204,159.60	
170			-	205.054	-	13,448,983.88	
171			-	211.616	-	14,820,780.24	
172			-	218.388	-	16,332,499.82	
173			-	225.376	-	17,998,414.81	
174			-	232.588	-	19,834,253.12	
175			-	240.031	-	21,857,346.93	
176			-	247.712	-	24,086,796.32	
177			-	255.639	-	26,543,649.55	

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
178			-	263.819	-	29,251,101.80	
179			-	272.261	-	32,234,714.18	
180			-	280.974	-	35,522,655.03	
181	10,832,553	10,832,553	10,832,553	289.965	3,141,060,743	39,145,965.84	80.24
182			-	299.244	-	43,138,854.36	
183			-	308.820	-	47,539,017.51	
184			-	318.702	-	52,387,997.29	
185			-	328.900	-	57,731,573.01	
186			-	339.425	-	63,620,193.46	
187			-	350.287	-	70,109,453.20	
188			-	361.496	-	77,260,617.42	
189			-	373.064	-	85,141,200.40	
190			-	385.002	-	93,825,602.84	
191			-	397.322	-	103,395,814.33	
192			-	410.036	-	113,942,187.39	
193			-	423.157	-	125,564,290.50	
194			-	436.698	-	138,371,848.14	
195			-	450.673	-	152,485,776.64	
196			-	465.094	-	168,039,325.86	
197			-	479.977	-	185,179,337.10	
198			-	495.337	-	204,067,629.49	
199			-	511.187	-	224,882,527.69	
200			-	527.545	-	247,820,545.52	
201	10,832,553	10,832,553	10,832,553	544.427	5,897,531,657	273,098,241.16	21.59
202			-	561.848	-	300,954,261.76	
203			-	579.828	-	331,651,596.46	
204			-	598.382	-	365,480,059.30	
205			-	617.530	-	402,759,025.34	
206			-	637.291	-	443,840,445.93	
207			-	657.685	-	489,112,171.41	
208			-	678.730	-	539,001,612.90	
209			-	700.450	-	593,979,777.41	
210			-	722.864	-	654,565,714.71	
211			-	745.996	-	721,331,417.61	
212			-	769.868	-	794,907,222.21	
213			-	794.504	-	875,987,758.87	
214			-	819.928	-	965,338,510.28	
215			-	846.165	-	1,063,803,038.33	
216			-	873.243	-	1,172,310,948.24	
217			-	901.186	-	1,291,886,664.96	
218			-	930.024	-	1,423,659,104.78	
219			-	959.785	-	1,568,872,333.47	
220			-	990.498	-	1,728,897,311.48	
221	10,832,553	10,832,553	10,832,553	1022.194	11,072,972,635	1,905,244,837.25	5.81
222			-	1054.904	-	2,099,579,810.65	
223			-	1088.661	-	2,313,736,951.34	
224			-	1123.498	-	2,549,738,120.38	
225			-	1159.450	-	2,809,811,408.65	

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
226			-	1196.553	-	3,096,412,172.34	
227			-	1234.843	-	3,412,246,213.92	
228			-	1274.358	-	3,760,295,327.73	
229			-	1315.137	-	4,143,845,451.16	
230			-	1357.221	-	4,566,517,687.18	
231			-	1400.652	-	5,032,302,491.28	
232			-	1445.473	-	5,545,597,345.39	
233			-	1491.728	-	6,111,248,274.61	
234			-	1539.464	-	6,734,595,598.63	
235			-	1588.727	-	7,421,524,349.68	
236			-	1639.566	-	8,178,519,833.35	
237			-	1692.032	-	9,012,728,856.35	
238			-	1746.177	-	9,932,027,199.70	
239			-	1802.055	-	10,945,093,974.07	
240			-	1859.720	-	12,061,493,559.43	
241	10,832,553	10,832,553	10,832,553	1919.231	20,790,176,315	13,291,765,902.49	1.56
242			-	1980.647	-	14,647,526,024.54	
243			-	2044.028	-	16,141,573,679.05	
244			-	2109.436	-	17,788,014,194.31	
245			-	2176.938	-	19,602,391,642.13	
246			-	2246.600	-	21,601,835,589.63	
247			-	2318.492	-	23,805,222,819.77	
248			-	2392.683	-	26,233,355,547.39	
249			-	2469.249	-	28,909,157,813.22	
250			-	2548.265	-	31,857,891,910.17	
251			-	2629.810	-	35,107,396,885.00	
252			-	2713.964	-	38,688,351,367.27	
253			-	2800.810	-	42,634,563,206.74	
254			-	2890.436	-	46,983,288,653.82	
255			-	2982.930	-	51,775,584,096.51	
256			-	3078.384	-	57,056,693,674.36	
257			-	3176.892	-	62,876,476,429.14	
258			-	3278.553	-	69,289,877,024.91	
259			-	3383.467	-	76,357,444,481.46	
260			-	3491.738	-	84,145,903,818.56	
261	10,832,553	10,832,553	10,832,553	3603.473	39,034,814,357	92,728,786,008.06	0.42
262			-	3718.784	-	102,187,122,180.88	
263			-	3837.785	-	112,610,208,643.33	
264			-	3960.595	-	124,096,449,924.95	
265			-	4087.334	-	136,754,287,817.29	
266			-	4218.128	-	150,703,225,174.66	
267			-	4353.108	-	166,074,954,142.47	
268			-	4492.408	-	183,014,599,465.01	
269			-	4636.165	-	201,682,088,610.44	
270			-	4784.522	-	222,253,661,648.70	
271			-	4937.627	-	244,923,535,136.87	
272			-	5095.631	-	269,905,735,720.83	
273			-	5258.691	-	297,436,120,764.35	

Yr of O&M		Total	Cash Flow In 1997	Compounded Escalation Factor	Compounded Escalated Costs	Compounded @ Discount Rate Factor	Net Present Discounted Worth
Startup Capital Costs			-				
274			-	5426.969	-	327,774,605,082.32	
275			-	5600.632	-	361,207,614,800.71	
276			-	5779.852	-	398,050,791,510.39	
277			-	5964.808	-	438,651,972,244.45	
278			-	6155.682	-	483,394,473,413.38	
279			-	6352.663	-	532,700,709,701.54	
280			-	6555.949	-	587,036,182,091.10	
281	10,832,553	10,832,553	10,832,553	6765.739	73,290,226,540	646,913,872,664.39	0.11
282			-	6982.243	-	712,899,087,676.16	
283			-	7205.674	-	785,614,794,619.13	
284			-	7436.256	-	865,747,503,670.28	
285			-	7674.216	-	954,053,749,044.65	
286			-	7919.791	-	1,051,367,231,447.20	
287			-	8173.224	-	1,158,606,689,054.82	
288			-	8434.768	-	1,276,784,571,338.41	
289			-	8704.680	-	1,407,016,597,614.93	
290			-	8983.230	-	1,550,532,290,571.65	
291			-	9270.693	-	1,708,686,584,209.96	
292			-	9567.356	-	1,882,972,615,799.38	
293			-	9873.511	-	2,075,035,822,610.91	
294			-	10189.463	-	2,286,689,476,517.23	
295			-	10515.526	-	2,519,931,803,121.98	
296			-	10852.023	-	2,776,964,847,040.43	
297			-	11199.288	-	3,060,215,261,438.55	
298			-	11557.665	-	3,372,357,218,105.28	
299			-	11927.510	-	3,716,337,654,352.02	
300			-	12309.190	-	4,095,404,095,095.93	
Total	$162,488,295	$162,488,295	$162,488,295		$156,793,747,830		$14,821,449

Table 4.15. Rivershore Site Modified CRCIA Ranger/Industrial Cover Scenario Summary

Item	Equipment	Materials	Labor	S/C	Subtotal	Field Distribs	Home Office	S/C Fee	B&O Tax	Total Bid
Description					**Direct**	**2600%**	**300%**	**400%**	**047%**	
Grout Wells		590	899		1,489	387	56	77	9	2,019
Cover Construction	302,281	1,406,262	198,824	351,442	2,258,808	587,290	85,383	117,259	14,329	3,063,070
Support Facilities				45,036	45,036	11,709	1,702	2,338	286	61,071
Mobilization/ Demobilization	24,198	4,323	133,742		162,263	42,188	6,134	8,423	1,029	220,038
Subtotals:	326,479	1,411,174	333,466	396,478	2,467,596	641,575	93,275	128,098	15,654	3,346,198
Bond										30,439
									SUBTOTAL:	3,376,637
PM/CM @ 15%										506,496
									SUBTOTAL:	3,883,132

Assumptions:	Direct distribs @ 18.09%	$702,459
Cover material consists of clean natural fill material from the 100 BC Area.		
Riprap materials below the water line are placed from a barge in the river.	G&A @ 4.04%	$ 185,258
Riprap material above the waterline is placed with a backhoe.		
Rip-rap material was assumed to include 4 feet of +2ft material resting on 2 feet of 12 " minus material.	TOTAL:	$4,770,849
Existing wells will be grouted closed.		
Two new monitoring wells will be established through the clean cover material.	Contingency @ 34%	$1,622,089
Contractor markups are taken from the 300 FF FPE.		
PM/CM was included as 15% of the project direct costs to be comparable to the other estimates in the CMS.	**TOTAL:**	**$6,392,937**

4.1.1 Attachment 1, MCACES Summary Report for the UPR-100-N-1 Site

100-N Area CMS MCACES Estimating Models Notes, Qualifications, & Assumptions, May 8, 1997

The Corrective Measures Study (CMS) used three of the generic MCACESERC baseline estimating models, including the Trench model, the Crib/French Drain model, and the Modified RCRA 'C' Barrier model.

The CMS includes 76 sites in the 100-N area. Sixteen of the 76 sites were covered by Five Modified RCRA 'C' Barriers (Caps). Differences between the CMS model estimates and the generic model estimates are as follows:

- Contingency of 34% was included in the CMS estimates.
- The HAMTC rates in the CMS estimates were updated to reflect the IOM entitled, *FY96 ERC All-in wage rates for BHI, THI, HAMTC, Building Trades by resource Code, and Field Support Heavy Equipment Pool Rates*, dated October 18, 1996 (CCN#038622).
- RA Production rates in the CMS estimates for soil excavation are about 93% of the rates in the RA baseline models, which were updated after the CMS runs were completed.
- The ERC adders in the CMS estimate are 14.06% (DD) and 5.34% (G&A) as opposed to the 1997 adders, which are 18.09% (DD) and 4.04% (G&A). The DD and G&A rates were updated after the CMS runs.
- PM/CM cost in the CMS estimates was calculated by applying 15% to the project direct cost.
- Transportation and disposal costs are included in the CMS estimates based on ERDF experience.

4.1.1.1 Extract from the RD/RA Baseline Cost Estimates Notes, Qualifications, & Assumptions 1997

EXHIBIT 6 - MODEL ASSUMPTIONS

1.0 GENERAL

1.1 Background

In June 1993, RL tasked the U.S. Army Corps of Engineers, Walla Walla District with the preparation of pre-conceptual baseline estimates for RD/RA for a number of solid waste management units (SWMUs) at the Hanford Site. The purpose of the effort waste assist the Richland ER Project in baseline planning for FY94 through FY2000. The FY95-97 baseline efforts by BHI represents a continued refinement of the Remedial Action Estimating system initiated at the beginning of FY94. The estimates are considered preconceptual. Significant Remedial Action work began in 1996 and lessons learned will reflect in the models in mid 1997.

1.2 Methodology

Ten (10) RA estimating models were created by the USACE using MCACES Gold for the FY94 Baseline. The models were based on the type of site and there mediation approach. They reflect how work is performed at the Hanford Site interns of division of workscope performed by onsite and offsite contractors, labor rates, and contractor markups. Six (6) models were revised and used for the BL95 and eight (8) for BL97. The additional two models used in the BL97 were the site closure model and the Modified RCRA C Barrier model. (See 2.11 for model list).

The MCACES models are used to create baseline cost estimates for each waste site or group of waste sites requiring remediation. Subproject estimates are then created using EXCEL Spreadsheets to rollup the MCACES site remedial action model estimates by operable unit and Subproject.

1.3 Operable Unit and Waste Site Summary

A total of 1233 waste sites were estimated in the BL 97 using MCACES generic RA and Barrier models as per the *Richland Environmental Restoration Project Baseline, Volume 2: Fiscal Year 1997 Baseline Cost Summary*.

2.0 Cost Estimate Development

2.1 Cost Estimate Breakdown Structure

MCACES Gold allows up to six levels of titling hierarchy to organize cost estimate details. The cost estimate breakdown structure was developed from the U.S. Army Corps of Engineers HTRWWBS and modified for remediation work at Hanford. The following is an example of the breakdown structure used:

Level 0:	1.4.10.1.1.5.1.2.4	100-BC-1 Trench 116-B-1
Level 1:	08	Solids Collection & Containment
Level 2:	08.01	Excavation
Level 3:	08.01.03	Contaminated Soil
Level 4:	08.01.03.01	Excavate/Load Contaminated Soil
Level 5:		Cost Details
Level 6:		not used and available

2.2 Contractor Markups

Contractor markups were included for work performed by subcontractors to BHI. The models calculate Program Management and Construction Management by multiplying FTE's per functional group times the project duration. The ERC adders are then applied to total direct costs in the model.

2.3 Sales Tax

An 8.0% Washington State sales tax is applied to all materials.

2.4 Contingency

The models include a contingency calculation. A more refined calculation maybe used in the baseline.

The FY 97 baseline contingency analysis was performed by project area. The analysis resulted in contingency rates of 15.7% for the 100 area, 30% for the 200 area, and 15.6% for the 300 area. These rates were applied to the BL 97 estimates outside of the MCACES models.

2.5 Price Level

The pricing level used in the MCACES models is:

Labor-ERC Labor Rate *BHFY96-HanfordAll-inWageRate1995*.

Equipment-*BHI-93EE, Eq. Rates EP-1110-1-8, Aug.1993*

2.7 Escalation

Escalation is applied outside of the MCACES models.

2.8 Labor Rates

A Labor Rate database was created for all classifications to be used on the Hanford ERC Project. The rates reflect the ERC average wage rates issued on December 20, 1996 (CCN#040990). The database includes the labor resource categories and organizational codes, and reflects payroll additives and an average of 4% overtime. BHI's direct distributable and general indirect costs are applied at the bottom line in the models. The baseline database recomputes these costs using current approved rates.

2.9 Equipment

Equipment pricing data is based on an extract from the latest USACE equipment price book (EP1110-8, Aug 93) which is the basis for the MCACES Version 5.30 equipment rate database. The rates are equivalent to an owner ship rate, and include depreciation, maintenance, fuel, and repairs. These rates were judged adequate for present day costs.

2.10 Crews

The MCACES crew database, although available, was not used in these MCACES models.

2.11 List of Models

The following estimating models were developed based on type of waste site, size, and remediation approach:

1. Burial Ground (Small, Medium to Large)
2. Crib/French drain(Small, Medium, & Large)
3. Trench (Small, Medium, & Large)
4. Septic Tank
5. Below grade structure (Small & Medium)
6. Reactor Area Piping (Large)
7. Retention Basin (Large)
8. Site Closure (Created in 1996)
9. Modified RCRA 'C' Barrier (Created in 1996 from 1995 crew up estimates)

A model size categories area follows.

Small-<or=4,356SF Medium-4,357SFto87, 120SF Large->87,120SF

Separate models for each size were developed in 1996 to accommodate different productivity rates, crew sizes, and equipment types.

2.12 Summary of Model Input Parameters

Major cost drivers or "parameters" form the basis for each model. The major quantity inputs necessary to support the parameter calculations areas follows:

A. EXCAVATION MODELS:
   1. Length, width, and depth of waste site in linear feet (lf)
   2. Non-contaminated, contaminated, and demolition waste volume in bank cubic feet (bcf)
   3. Percent of Transition Soil

B. Modified RCRA 'C' Barrier Model:
   1. Barrier surface area in square feet.

3.0 Notes and Assumptions

3.1 Excavation Models

1. Remediation technology is excavation and disposal.
2. The model calculations include excavation, sampling, monitoring of the excavation, backfill, and site restoration.
3. All contaminated material was assumed to below level waste (LLW).
4. LLW samples were taken every 200L CY excavated for field monitoring and every 1,078 SF of bottom area for closure samples.
5. All LLW samples will be analyzed on site; an additional 5% for QA/QC samples will be analyzed offsite.
6. Material will be loaded into 20 cubic yard (cy) containers. Containers will be filled to approximately 15 LCY due to load restrictions on the total combined weight of the tractor, trailer, and filled container on the highways (40tons).
7. The transport and disposal rate per cubic yard was calculated by the ERDF Subproject based on actual ERDF costs. These costs are not applied in the MCACES models.
8. Appropriate contractor markups were added in the MCACES models.
9. Estimates include QA/Safety and Health Physics (HP) oversight by the ERC team.
10. Key estimate planning quantities and notes are included under each title level with in each estimate.

3.2 RCRA 'C' Barrier Models

1. Remediation technology is to cover the contaminated area with a soil barrier approved under RCRA guidelines.
2. Appropriate contractor markups were added in the MCACES models.
3. Estimates include QA/Safety and Health Physics (HP) oversight by the ERC team.
4. Key estimate planning quantities and notes are included under a title level with in each estimate.

4.0 MCACES Model Details

The MCACES models for excavation take 11 input quantities and calculate 25 additional quantities, which are used to price all resources required to setup, sample, excavate, and restore each waste site. These estimates are grouped on the baseline spreadsheets into operable units for each Subproject where contingency is applied. The MCACES models estimate to the base cost, plus subcontractor adders and BHI markups and computed in the ACCESS Baseline Database.

The basic input parameters include the following:

1. Non-contaminated Soil Volume in bcf
2. Contaminated Soil in bcf
3. Demolition Waste in bcf
4. Top Excavation Length in lf
5. Top Excavation Width in lf
6. Bottom Area in sf
7. Number of Groundwater Protection Samples (Small sites <10,000 sf-3 ea.; Medium sites 10,000 to 100,000 sf-21 ea.; and Large sites>100,000-60ea.)
8. Transition Zone Soil percentage
9. Hauling distance for Borrow in miles
10. Hauling distance for demolition waste in miles (not used)
11. Hauling distance for contaminated soil in miles (not used)

The models also include the following fixed values, which are used to calculate and/or convert additional quantities, and resource requirements (labor and equipment types and hours).

RA Models

1. Soils well factor-15%
2. Demolition wastes well factor - 60%
3. Non-contaminated soil excavation rate

   Small-56LCY/Hr (with exception of Burial Ground, which is 77 LCY/Hr)

   Medium-112LCY/Hr (with exception of Burial Ground, which is 154 LCY/Hr for Medium To Large)

   Large-224 LCY/Hr
4. Transition soil excavation rate

   Small-28 LCY/Hr (with exception of Burial Ground, which is 30 LCY/Hr)

   Medium-56 LCY/Hr (with exception of Burial Ground, which is 60 LCY/Hr for Medium To Large)

   Large-112 LCY/Hr
5. Contaminated soil excavation rate

   Small-37 LCY/Hr (with exception of Burial Ground, which is 20 LCY/Hr)

   Medium-70 LCY/Hr (with exception of Burial Ground, which is 40 LCY/Hr for Medium To Large)

   Large-140 LCY/Hr
6. Demolition waste excavation rate-12 LCY/Hr(with exception of 16 LCY/Hr for the Retention Basin model)
7. Sample analysis cost for on-site mobile lab-400.00/Sample
8. Sample analysis cost for off-site laboratory-2,000/Sample

RCRA 'C' Barrier Model

1. Load/Haul Soils & Other Materials-120LCY/Hr
2. Place Asphalt

   (Base course)-65 SY/Hr

   (Permeable Layer)-57.5 LCY/Hr

3. Spread/Compact Soils-120 LCY/Hr
4. Spread/Compact Sand/Gravel-105 LCY/Hr
5. Place Perimeter Berm Backfill-60 LCY/Hr

With these inputs, MCACES determines how much of each resource is needed for each operation estimated in the model. These resource quantities are then priced according to the rate tables provided with MCACES. The subcontractor markups on the labor and material, and the Owner markups were applied within MCACES models. The MCACES models estimate all costs with the exception of escalation and contingency.

4.1.2 Attachment 3, Model Assumptions for RACER-Ex Situ Bioremediation

Land Farming (Ex Situ)

Ex situ bioremediation – 1 and farming, is a process for treating contaminated soil that requires excavation and movement to a treatment cell. The contaminated soil is spread in a thin layer over an area to enhance volatilization, aeration, -biodegradation, and photolysis. This model estimates costs to construct and operate a lined treatment cell and enhance the biodegradation process. The model provides options to stimulate growth of indigenous bacteria (biostimulation) or to cultivate and add bacteria to the site (bioaugmentation).

State and local regulations often impact the location, design, and operation of a land farming treatment cell. The model assumes that the cell is located on the same property as the contaminated soil and is enclosed by a berm and covered. The model also assumes that the soil will be tilled at least once a week.

The following topics are available for the Land Farming (Ex Situ) model:

<u>Technical Help</u>

- General Information
- Required Parameters
- Secondary Parameters
- Other Related Costs
- References

<u>System Help</u>

- Button Bar
- Model Processing

Required Parameters

Required parameters are the minimum amount of information required to generate a cost estimate. There are no defaults as the values are site-specific. A reasonable cost estimate can be generated from the required parameters. The required parameters include:

- Total Volume of Soil Treated
- Volume of Soil Per Batch
- Number of Temporary Holding Areas
- Temporary Holding Area Size
- Treatment Duration per Batch
- Safety Level

Total Volume of Soil Treated

This is the total ex situ volume (in loose cubic yards) of the contaminated soil to be treated. Bank or in situ soil swells approximate) 110% to 130% when excavated. Assuming a swell factor of 1.3 (130%), a one-acre area would be needed to land farm 2500 loose cubic yards (1900.bank cubic yards) of soil 18 inches deep.

For this reason, it may be more desirable to treat larger volumes of soil in a series of successive batches rather than construct a treatment bed large-enough to treat all of the soil at one time. The valid range is 100 to 99,999 loose cubic yards.

Volume of Soil per Batch

This is the ex situ volume (in loose cubic yards) of the contaminated soil that will be treated at one time. The volume of soil per batch determines the size of the treatment cell, setup parameters, amount of tilling, quantity of nutrients, and cell parameters applicable to the site. Therefore, the largest volume of soil to be treated at one time should be entered at this parameter. In most cases, the optimum volume of soil per batch is between 1,000 and 2,000 loose cubic yards. Larger volumes would require excessively large treatment beds. The model determines the number of batches by dividing the total volume of soil treated by the volume of soil per batch, and the model will not allow any combination of input, which causes the number of batches to exceed 90. The valid range is 100 to 10,000 loose cubic yards. The volume of soil per batch cannot be less than the total volume of contaminated soil.

The primary cost driver in an ex situ land farming application is the construction of the treatment bed. Therefore, treating soil in a series of successive batches rather than treating all of the soil at one time will reduce the overall cost of treatment. In determining the total volume the optimum volume of soil per batch, the user may wish to run several different scenarios and observe the costs for each scenario.

Number of Temporary Holding Areas

The scheduling and coordination of ex situ soil remediation projects often require the contaminated soil to be temporarily stockpiled adjacent to the treatment bed. Contaminated stockpiles should be placed in lined holding areas and covered with plastic. The number of temporary holding areas should correspond to the maximum number of stockpiles, which will be present at any one time. The temporary holding area in this model is lined with a 40-mil PVC liner and is surrounded by a 1.5-foot high berm to prevent surface water intrusion. For each holding area, the model includes one pump and one holding tank for collection and containment of accumulated rainwater or leachate. The valid range is 0 to 99 areas.

Temporary Holding Area Size - If the number of temporary holding areas is one (1) or more, this parameter is used to specify the size of each holding area. The model assumes that all holding areas are the same size. Assuming a stockpile height of eight (8) feet and a soil angle of repose of 34 degrees will yield a conservative estimate for the holding area size required for a given volume of contaminated soil. The valid range is 100 to 999,999 square feet.

Treatment Duration per Batch

The treatment duration is the total time that each batch will be in the bioremediation cell. Treatment time can be estimated from information obtained in the bench and pilot studies. The duration is dependent upon the application rates of nutrients, moisture, pH, and microorganisms, as well as the specific contamination and concentration of the contaminant. Climate and soil type also significantly impact the treatment duration. Biodegradation occurs at much slower rates in colder climates. Also, soils having high clay contents require considerably longer treatment duration than sandy soils. The user should consider the climate and the soil type when determining the treatment duration. The amount of nutrients, moisture, pH, and cultured bacteria are important but can be controlled. Total treatment duration is determined by multiplying the treatment duration per batch by the number of batches. The duration for a single treatment is usually between 8 and 20 weeks; however, longer durations are not uncommon. The valid range is 1 to 104 weeks.

Safety Level

The safety level will be affected by the contaminant(s) at the site. Safety level refers to those levels as required by the Occupational Safety and Health OSHA, 29 CFR Part 1910. The four levels are designated as A, B, C, and D where "A" is the most protective and "D" is the least protective. A safety level of E is also included to simulate normal construction "no hazard" conditions as prescribed by the EPA. A complete description of-safety 1evels and associated requirements is 1ocated- in the On-Line Help for Safety Levels.

Secondary Parameters

A reasonable cost estimate can be created using only the required parameters. However, if more detailed information is known, the secondary parameters can be used to create a more precise and site-specific estimate. Secondary parameters, unlike the required parameters, have defaults that are determined by the model. The defaults are dictated by the engineering design and model assumptions. The secondary parameter sets are:

- Treatment Cell
- Maintenance

Treatment Cell

The treatment cell parameters are listed and described below.

- Cell Area
- Depth of Contaminated Soil
- Sire of French Drain
- Containment Cover
- Sump Pump Capacity
- Sump Pump Quantity

Cell Area – The model defaults to a square treatment cell. The default surface area of the remediation cell will be calculated in square yards based on two factors: the volume of soil to be treated and the depth of soil placed in the remediation cell. The valid range is 1 to 193,600 square yards. It is important to note that this model uses ex situ or loose soil volume measurements. Quantity estimates based on bank (in situ) volumes must be converted to loose volume by multiplying by the appropriate swell factor.

Depth of Contaminated Soil in the Cell – The depth of contaminated soil in the biodegradation cell depends on the capability of the aerating plow, for this model 1 to 18 inches. The depth of the soil will affect the size of the containment cell, the equipment used, and possibly the duration. The default depth is 12 inches. The valid range is 1 to 18 inches. Note: A six-inch minimum soil depth is recommended. An 18 inch depth, if soil conditions allow, will minimize the required treatment cell area, which will reduce costs.

It is important to note that the cell area and depth of contaminated soil are interrelated. If one of these parameters is changed, the model will automatically re-calculate the other based on the volume of soil per batch.

Size of French Drain – The model includes a French drain for leachate collection. The leachate flows (via gravity) to a low end of the bermed area and is pumped from there. Leachate is pumped back onto the soil for continued remediation. Options for 1eachate holding tanks are available at the assembly level. Costs for leachate treatment and disposal are not included in this model. The default French drain size is 18' x 18'. At sites with predominate dry seasons, leachate collection systems may not be required, as evapotranspiration and periodic covering of the land farm will control excess saturation.

Options:

- 12' x 12"
- 18'x18'
- 24' x 24"
- None

Containment Cover – A containment cover is recommended and is required in some states. A cover forms a barrier over the cell area to limit moisture infiltration into and out of the contaminated soil. The default is to include a cover, with 135-pound tear strength, fiberglass reinforced plastic sheet being the default cover.

Sump Pump Capacity – The default sump pump is a 75 gpm installed sump pump. The model assumes that electrical service is available at the site. Portable, gasoline powered water pumps are also available.

Note: Provisions must be made to remove excess rainwater in the cell. For cost estimating purposes, the water truck used to sprinkle the soil can be used as a pumper truck to remove water to a treatment facility or holding tank.

Options:

- 75 gpm installed
- 100 gpm installed
- 6,000 gph portable gasoline powered
- 8;000 gph portable gasoline powered o 10,000 gpm portable gasoline powered

Sump Pump Quantity – This is the quantity of pumps required. The model defaults to one 75-gpm pump. This parameter may be set to zero if no pumps are required. The valid range is 0 to 99 pumps.

Maintenance

The maintenance parameters are listed and described below.

- Tilling Frequency
- Number of Passes Per Day
- Microorganisms
- Watering Frequency
- Fertilizing Frequency

Tilling Frequency – The tilling frequency affects the amount of aeration. The- model assumes that a D3 dozer with a tiller will be used to till the soil. The default tilling frequency1st 44 days, per month, which equates to one day per week (days per-week, days per month/4.33; rounded up-to the nearest whole number). The-model assumes that the dozer wi11 remain on-site for-the entire project duration if the tilling frequency is greater than two (2) days per week and the time required for each day of tilling is greater than 4 hours. Otherwise, the model assumes that the doter will be removed from the site at the conclusion of each day of tilling. The dozer is assumed to be decontaminated prior to leaving the site. The valid range is 0 to 7 days per week.

Number of Passes Per Day – This is the number of times during each day of tilling that the tiller will pass through the soil. The default is two (2) passes per day. If the tilling frequency (number of days per month of tilling) is decreased, then the number of passes should be increased. The number of passes per day directly impacts the number of hours required for each day of tilling. The number of hours required for each day of tilling depends on the cell area, number of passes per day, and the tillage productivity of the dozer. The model defaults to a minimum of 4 hours of dozer rental for each day of tilling. This 4-hour minimum is assumed to account for equipment mobilization. The valid range is 1 to 10 passes per day.

Microorganisms – Bacteria may be cultured and added to the contaminated soil. Since addition of bacteria is not common in bioremediation, as enhancement of existing bacteria, the default is not to add microorganisms. If microorganisms are added, application rates are 50 pounds per 1,000 cubic yards initially and 25 pounds per 1,000 cubic yards on a monthly basis thereafter.

Watering Frequency - The watering frequency specifies the number of times per month that water is applied to the contaminated area to retain consistent moisture content. Maintenance of soil moisture is vital during excessive dry periods, particularly at sites in low humidity areas. On the other hand, high humidity or excessive rainfall may reduce or eliminate the requirement for watering. The model assumes that the soil moisture content of new soil put into the remediation cell is less than 80%. If the soil becomes too wet, additional plowing to enhance evaporation may be required. Also, in climates where rainfall exceeds the evaporation rate, excessive watering will result in increased amounts of leachate requiring treatment and disposal. The default watering frequency is 4 times per month, which equates to once per week. The model assumes that a water truck will be used. However, a sprinkler system is available at the assembly level. The valid range is 0 to 99 times per month.

Fertilizing Frequency – Nutrients can be added with the water. The addition of nutrients for the microorganisms, primarily in the form of nitrogen and phosphorus, along with the oxygen from soil tilling, are critical to good growth. The nutrient mix will vary from site to site, with the optimum mix determined through pilot studies and geochemical evaluations of the site. However, a default has been determined based on actual field cases. The default is 0.5 pounds of 20:20:20 fertilizer per cubic yard of contaminant. The default fertilizing frequency is once per month. The valid range is 0 to 400 times per-month.

Date 11/04/96 Page 1
Time 11:57

PROJECT SUMMARY REPORT

10ON CMS
HANFORD
Pasco Washington WA
JA LAPIERRE / B BENNETT
11/04/96

Category	Amount
PA/SI	
Site Assessment	8
Studies	0
Remedial Design	0
RA Capital	22,166
Site Work	0
Sampling and Analysis	0
RA Professional Labor	0
Subcontractor Overhead & Profit	3,584
General Conditions	10,189
Studies/Professional Labor Overhead	0
Prime Contractor Home Office	0
Subtotal	$35,939
Prime Contractor	
Profit - (Fee) (0.00%)	0
RA Operations and Maintenance	0
0&M Service Contract	
Overhead, Tax & Profit	0
Subtotal	$35,939
Escalation	2,120
Total Contract Costs	$38,059
Contingencies (0.00%)	0
Project Management (0. 00%)	0
Total Project Costs	$38,059

********** END OF REPORT *********

This System Intended for Government Use Only

Date 11/04/96 Page 1
Time 11:48

PROJECT SUMMARY REPORT

10ON CMS, RUN 2
Pasco Washington WA
JAL & BRB
11/04/96

Category	Amount
PA/SI	
Site Assessment	0
Studies	0
Remedial Design	0
RA Capital	24,199
Site Work	0
Sampling and Analysis	0
RA Professional Labor	0
Subcontractor Overhead & Profit	3,870
General Conditions	10,580
Studies/Professional Labor Overhead	0
Prime Contractor Home Office	0
Subtotal	$38,649
Prime Contractor	
Profit - (Fee) (0.00%)	0
RA Operations and Maintenance	0
0&M Service Contract	
Overhead, Tax & Profit	0
Subtotal	$38,649
Escalation	2,280
Total Contract Costs	$40,929
Contingencies (0.00%)	0
Project Management (0. 00%)	0
Total Project Costs	$40,929

********** END OF REPORT *********

This System Intended For Government Use Only

Date 11/04/96 Page 1
Time 12:06

PROJECT SUMMARY REPORT

100N, CMS RUN 3
RUN 3
Pasco Washington WA
JAL & BRB
11/04/96

Category	Amount
PA/SI	0
Site Assessment	0
Studies	0
Remedial Design	0
RA Capital	42,741
Site Work	0
Sampling and Analysis	0
RA Professional Labor	0
Subcontractor Overhead & Profit	6,552
General Conditions	15,042
Studies/Professional Labor Overhead	0
Prime Contractor Home Office	0
Subtotal	$64,335
Prime Contractor	0
Profit - (Fee) (0.00%)	0
RA Operations and Maintenance	0
0&M Service Contract	
Overhead, Tax & Profit	0
Subtotal	$64,335
Escalation	3,796
Total Contract Costs	$
Contingencies (0.00%)	0
Project Management (0. 00%)	0
Total Project Costs	$68,131

********** END OF REPORT *********

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4.1.3 Attachment 4, Model Assumptions for RACER-In Situ Bioremediation

In Situ Biodegradation (Bioventing)

Bioventing can be particularly effective for removing volatile contaminants muse they are highly susceptible to physical removal. Bioventing has been developed and applied by the petroleum industry to remediate fuel-contaminated sites. This model assumes that the contaminants of concern are petroleum hydrocarbons.

One of the main advantages of aerobic biodegradation of petroleum hydrocarbon contaminants over other techniques is that the contaminants are completely destroyed, as the byproducts axe primarily carbon dioxide, water, and biomass. Biodegradation avoids generating hazardous byproducts and additional waste streams.

The following topics are available for the In Situ Biodegradation (Bioventing) model:

Technical Help

- General Information
- Required Parameters
- Secondary Parameters
- Other Related Costs
- References
- Tables
- Algorithms

System Help

- Button Bar
- Model Processing

General Information

Situ biodegradation involves microbial transformation of organic contaminants to affect cleanup of soils, groundwater, and/or other contaminated media. Biodegradation of organics in soil/groundwater systems is a natural process by which indigenous microorganisms obtain energy and/or carbon through the metabolism of organic contaminants. Various designations are used to describe essentially the same remediation technology:

- In Situ Biodegradation
- In Situ Bioremediation
- In Situ Bioreclamation
- Enhanced Bioreclamation
- Bioremediation or Biodegradation

All of these designations refer to processes where contaminants are degraded by in-place biological processes.

One means of performing in situ biodegradation is through soil venting. Soil venting, also called bioventing, is similar to soil vapor extraction (see the Soil Vapor Extraction model)' except that with bioventing, in situ biodegradation is stimulated intentionally. This process utilizes one or more vacuum extraction wells screened outside the contaminated zone to direct oxygen from the surface through the subsurface. Extracted air can be pulled directly through soil pores from the atmosphere or supplied by one or more injection wells. This procedure physically removes volatile organic compounds (VOCs) in the soil gas and establishes a contaminant gradient between the solid/liquid and gas phases, thereby

allowing continuous removal as contaminants redistribute into the gas phase. Pulling air through the subsurface also provides oxygen that can be used as an electron acceptor in aerobic biodegradation of organics. This oxygen, in combination with moisture, nutrients, and possibly microorganisms supplied by either sprinkler systems or infiltration trenches/galleries, stimulates in situ biodegradation of organic Contaminants.

Bioventing can be used in saturated soil columns the groundwater table is lowered to expose more of the contaminated layer. Air injected into the subsurface is drawn through the contaminated zone to stimulate biodegradation and physically strip volatile contaminants. Water and nutrients are provided via infiltration.

Growth factors, which affect the rate of microbial degradation, include:

- Soil Moisture
- Oxygen Requirements
- Soil pH
- Soil Nutrients
- Soil Temperature

Soil Moisture

Moisture control may take the form of supplemental water to the site (irrigation), removal of excess water (drainage, well points), or other methods (e.g., soil additives). Also, the addition of vegetation to a site will increase evapotranspiration of water and, therefore, assists in retarding the downward migration of water (e.g., leaching). When natural precipitation is insufficient to maintain soil moisture within an optimal range for microbial activity, irrigation may be necessary. Water can be applied by standard irrigation methods (e.g., sub-irrigation or sprinkler irrigation) in the case of shallow contamination not exceeding 10 feet. In the case of deep soil contamination, injection wells may be installed for injection of water with or without nutrients and microbial culture. The ease of controlling moisture depends on how easily water is controlled at the site and on the availability of a suitable water source (e.g., transport distance, drilling of new wells, availability, and cost of energy for pumping). Controls to manage the run-on and runoff at the site are necessary to prevent drainage end erosion problems. Costs for erosion control and runoff can be modeled using the Site Work and Utilities module of the RACER System.

Oxygen Requirements

Aerobic degradation is the most attractive of the processes for microbial transformation of petroleum hydrocarbon contaminants because it proceeds at a more rapid rate and does not produce the noxious byproducts associated with anaerobic decomposition. For petroleum hydrocarbons, approximately 3.5 pounds of oxygen are required per pound of hydrocarbon. For bioventing, however the critical factor is making sure that the vacuum wells are keeping the subsurface aerated. Passive injection vents allow a path for air to be pulled through the subsurface.

Soil pH

Depending on the nature of the hazardous waste components contaminating the soil, it may be advantageous to optimize the soil pH for a particular segment of the microbial community because both microbial structure and activity are affected by the soil pH. Near neutral pH values are most conducive to microbial functioning in general with a range of 7.0 to 8.5 considered acceptable. For this model, it will be assumed that the pH does not need adjusting.

Soil Nutrients

As in the case of all living organisms, indigenous microbial populations must have specific inorganic nutrients (e.g., nitrogen. phosphorus, potassium. calcium, magnesium. etc.) and a carbon and energy source to survive. The nutrients necessary to stimulate in situ biodegradation in the subsurface should be studied and defined in a pilot study. Carbon, nitrogen, and Phosphorus amendments to the soil can be

added at variable rates depending on microorganism requirements. Standard agricultural methods are used-to add nutrients to the soil. Sufficient nitrogen and phosphorus must be reapplied to ensure that these nutrients do not limit the microbial and metabolic activity.

Soil Temperature

Soil temperature is one of the most important factors controlling microbiological activity and the rate of decomposition of organic contaminants. It also influences the rate of volatilization of compounds from the soil. Optimal growth of microbial populations responsible for biodearadation of petroleum products occurs between 20 and 35° C. Because of the insulating properties of plant cover, vegetation plays a significant role in soil temperature. Bare soil unprotected from the sun's direct rays becomes very warm during the hottest part of the day; it also loses its heat rapidly during colder seasons. A well vegetated soil does not become as warm as a bare soil during the summer, and the vegetation acts as an insulator to reduce heat loss from the soil in the winter.

Required Parameters

Required parameters are the minimum amount of information necessary to generate a cost estimate. There are no defaults as the parameter values are specific. A reasonable cost estimate can be generated using only the required parameters. The required parameters include:

- Installation
  - Average Depth to Top of Screen (Vertical Installation)
  - Trench Depth (Horizontal Installation)
  - Screen Length (Vertical and Horizontal Installation)
- Soil Type
- Area of Contaminated Soil
- VEPs
- Blowers
- Startup Period
- O&M Period
- Safety Level

Installation

Installation refers to the type of installation, either vertical or horizontal vapor extraction point (VEP) installation.

Options:

- Vertical
- Horizontal

If vertical installation is selected, the user must provide the average depth to the top of screen, which is used to cost drilling and construction materials. The valid range is 6 to 999 feet. If horizontal installation is selected, the user must provide the trench depth, which is used to cost trenching and construction materials. The valid range is 3 to 30 feet.

The user must also provide the screen length. In the vertical bioventing system, the screen length is designed to span the vertical extent of soil contamination. The total depth of the vertical bioventing well is the sum of the depth to the top of the screen and screen length. However, the total depth of vertical VEP may not exceed 999 feet. In the horizontal installation, the screen length is designed to remediate effectively the entire site. The screen length is based on the radius of influence of the vapor extraction well and area of contaminated soil. The valid range for horizontal screen length is 1 to 999 feet.

Soil Type

The soil properties greatly affect the design of the in situ bioremediation system. The primary controlling soil parameter is soil permeability. Permeability should be sufficient to permit adequate flow of air through the contaminated matrix. The radius of influence of applied vacuum at the vapor extraction point extends over a greater distance in soils with higher permeability. The soil permeability directly relates to the soil particle size. This model classifies soil types into four groups based on particle size. Table 1 shows the range of soil permeability for different soil types.

Options

- Silty Clay, Clay
- Mixed Sandy, Silty, Clayey Soils
- Primarily Sand
- Sand and Gravel

Area of Contaminated Soil

The area of contaminated soil is the appropriate areal extent of the contamination to be remediated by bioremediation. The valid range is 1 to 1,000,000 square feet. This roughly correlates to a rectangular impact zone of 23 acres or 1,000 ft x 1,000 ft. Typically, a site with an impact area as great as this would be addressed in stages or divided into smaller areas and addressed as independent cells. If this is the case. it is advisable to execute multiple runs of the model to account for each cell.

VEPs

The number of VPs are calculated based on the default well spacing, a secondary parameter, using the equations shown in Algorithm 1. The number of VEPS cannot be directly changed on this screen. However, they may be changed at the VEP Design parameters by changing the default VEP spacing or by directly changing the number of VEPs.

Blowers

Represents the default quantity of blowers, which is determined from the secondary parameter, total flow rate (Q). The quantity of blowers cannot be directly changed on this screen. However, the quantity and type of blowers may be changed by editing the VEP Design parameters.

Startup Period

The total treatment duration is divided into startup and O&M. The coats associated with the startup period (e.g. equipment acquisition, installation and optimization) are considered capital costs, and the O&M costs are identified separately. This parameter may be used to identify the startup period (e.g., equipment procurement, installation, and optimization) or it may cover the entire treatment period. The unit of measure for the startup period is weeks'. The valid range for this model is 4 to 999 weeks.

O&M Period

The O&M period may be 0 to 999 months. (Reference Startup Period above) safety Level.

Safety Level

The safety level will be affected by the contaminant(s) at the site. Safety level refers to those levels as required by OSIDA in 29 CFR Part 1910. The four levels are designated as A. B, C, and D; where "A" is the most protective and "D" is the least protective. A safety level of E is also included to simulate normal construction "no hazard" conditions as prescribed by the EPA. A complete description of safety levels and associated requirements is located in the On-Line Help for Safety Levels.

Secondary Parameters

Reasonable cost estimate can be created using only the required parameters. However, if more detailed information is known, secondary parameters can be added to create a more precise and site-specific estimate. Secondary parameters, unlike the required parameters, have defaults that are determined by the model. The defaults are dictated by the engineering design and model assumptions. The secondary parameters are divided into the following four categories:

- VEP Design
- Drill Vertical*
- Trench Horizontal**
- Soil Additives

*These parameters are only available when the type of VEP installation is vertical

**These parameters are only available when the type of VEP installation is horizontal.

VEP Design

The parameters for the design of the bioventing extraction system include:

- VEP Spacing
- Number of VEPs
- Gas Flow Rate
- Total Flow Rate
- Quantity of Blowers
- Type of Blower

VEP Spacing - The design of vapor extraction systems depends primarily on the soil type. The model defaults quantities to the design parameters based on the required parameter. soil type. Since the radius of influence depends on the soil type, the VEPS spacing, number of VEPs, gas flow rate, and blower specifications also depend on the soil type, The model design parameters for different soil types are based on data obtained from CAM RILL soil vapor extraction projects. Table 2 shows the default values for VEP spacing and gas flow rate.

In bioventing, the purpose of vapor extraction is not to cause volatilization of organic compounds, but merely to provide sufficient vacuum to cause the infiltration of ambient air (due to the development of a pressure gradient) into the subsurface soils to promote biorespiration. Therefore, it is not advisable to apply high vacuum at the vapor extraction well because it would cause volatilization of organic compounds, thus, requiring treatment of the extracted subsurface vapors.

Number of VEPs - The number of VEPS are calculated based on well spacing using the equations shown in Algorithm 1. The number of VEPS may be changed directly by the user, or they may be calculated based on the -VEP spacing.

Gas Flow Rate - The gas flow rate is used in the calculation for total flow rate (Q), which determines the default quantity of blowers. Q is calculated from the equation shown in Algorithm 2. The valid range is .01 to 99.99.

Total Flow Rate - The total flow rate, as calculated by the model, is displayed to provide the user with off-gas treatment quantities, which can be input into other models such as carbon adsorption - gas, etc. This field cannot be edited and is displayed for information purposes only.

Quantity of Blowers - The user may change the default quantity of blower6 directly, or have the modal calculate the quantity of blowers. Table 3 shows the model defaults for type of blower and quantity of blowers. The valid range is 1 to 99 blowers.

Note: Because the quantity of blowers is determined from the total flow rate, if the user changes the default VEP spacing (which determines the number of VEPs, also used in the calculation of total flow rate) or changes the gas flow rate (also used in the calculation of total flow rate) and wants to use the default quantity of blowers, the user must re-calculate by clicking the Calculate push button.

Type of Blowers - The user is given the option of the four blowers provided below. Table 3 shows the model defaults for type of blower and quantity of blowers.

Options

- 98 SCAM. I HP
- 127 SUM. 1.5 9P
- 160 SCPM. 2 HP
- 280 SC t. S HP

Drill Vertical

The parameters for drilling vertical VEPs are listed and described below.

- Diameter
- Construction Material
- Drilling Method
- Soil Sample Collection
- Drum Drill Cuttings

Diameter - The modal defaults to 2" diameter vertical VEPS. However, an option of 4" diameter vertical VEPs is al.50 available in the model. The VEP diameter affects the diameter of borehole and cost of construction material and drill cutting containment (drumming).

Options

- 2 inch
- 4 inch

Construction Material - Vertical VEPs are typically constructed of either PVC or stainless steel screen and casing. Primary selection considerations are cost and material compatibility with the contaminant.

Options

- PVC - Schedule 40
- PVC - Schedule 80
- Stainless Steel

The model defaults to Schedule 40 PVC for the construction of all vertical VEPS less than 85 feet deep. However, when the depth of the vertical VEPs is greater than 85 feet, the model defaults to Schedule 80 PVC material.

Drilling Method – The vertical VEPs can be installed using a variety of vertical drilling techniques, depending on site hydrogeology and desired depth of the borehole. The three vertical drilling techniques included in this model are:

- Hollow Stem Auger
- Water/Mud Rotary
- Air Rotary

The model defaults to hollow 6tem auger for 2-inch and 4-inch diameter vertical VEP installation when the well depth is less than 150 feet below ground surface (bgs). The water/mud rotary method is the

model default for drilling when the VEP depth is greater than 150 feet bgs. Air rotary drilling is also available a6 an option. It is assumed that drilling is in an unconsolidated formation. If the subsurface is consolidated, then the user should use water/mud rotary or air rotary rather than hollow stem augers even for depths less than 150 feet bgs. Table 4 gives the diameter of borehole for the different drilling methods.

All connection piping is assumed to be above ground installation. The Piping model should be run if below ground piping is desired. The amount of connection piping defaulted is the radius of influence times the number of VEPS. The amount of manifold pipe will be defaulted at half the length of the connection piping, and is the same material as the connection pipe. A pressure gauge and other piping appurtenances will be defaulted as well. The connection and manifold pipe size defaults for vertical VEPs are shown in Table 5.

Soil Sample Collection - Sample collection during borehole advancement allows characterization of the geology beneath the site and definition of the magnitude and extent of contaminants in the vadose zone. According to the IRP Statement of Work 1991. Soil samples shall be collected every five feet or at each change in lithology, whichever is less for lithologic description. Drill cuttings can be collected as the borehole is advanced for general geologic information. Discrete samples are collected in unconsolidated sediment using a variety of methods including split spoon, Shelby tubes, and the California brass ring.

The model defaults to collection of soil samples with a split spoon sampler with standard penetration tests at five-foot intervals during borehole advancement. Samples are screened with an organic vapor analyzer (OVA) for volatile organics and described for the lithologic log by the geologist supervising drilling.

If laboratory analysis is desired, the user must decide how many soil samples and what type of analysis will be required. The user must then add these soil analyses to the Sampling and Analysis model.

Drum Drill cuttings - The drill cuttings are generally placed in 55-gallon drums and stored until disposal options have been evaluated. The model default is to include drill cuttings containment.

The professional labor hours spent in the field supervising the installation of the vertical VEPs are passed to the RA Professional Labor model. The model makes the following assumptions for staff hydrogeologist hours related to vertical VEP installation:

- If sample collection is included, VEPs are drilled at a rate of 20 feet per hour, plus 2 hours per well for well completion. Total labor hours are for drilling supervision by a staff hydrogeologist.
- If sample collection is not included, VEPs are drilled at a rate of 40 feet per hour, plus 2 hours per well for well completion. Total labor hours are for drilling supervision by a staff hydrogeologist.

Decontamination procedures for the VEPs screen, riser, and caps as well as decontamination of drilling tools (e.g., hollow stem augers) will be conducted prior to and between each borehole/well installation. Procedures consist of steam cleaning with a high-pressure steam-generating pressure washer and detergent, in accordance with AFCEE requirements.

Decontamination procedures for split spoon samplers, bailers, and hand augers were also based on AFCEE requirements and consist of:

- Clean with tap water and detergent using a brush.
- Rinse thoroughly with tap water.
- Rinse with deionized water.
- Rinse twice with pesticide-grade isopropanol.
- Rinse with organic-free deionized water.
- Allow to air dry.

Monitoring wells art usually installed on the periphery of the soil contaminant plume. Monitoring wells are not included in this model, but may be estimated by using the Monitoring model.

Trench Horizontal

Horizontal installation involves excavating a narrow trench and installing a screened or perforated pipe at a common elevation. The model defaults to a horizontal installation method depending on the depth of installation. The model defaults to the use of chain trencher when the depth of installation is less than or equal to 4 feet. The crawler mounted, hydraulic excavator is defaulted when the depth of installation is greater than 4 feet but less than or equal to 20 feet. The Horizontal Dewatering Systems, Inc (IWSI) proprietary method (Patent *4927292) will be defaulted for depths of installation between 21 and 30 feet. The model does not consider the need for cave-in protection when installing bioventing systems in trenches exceeding l0 feet. Additional controls such as a trench box, well points, sheeting, or side sloping maybe required due to soil conditions. If this is the case, refer to the Site Work and Utilities models.

The HDSI proprietary method uses specialized equipment to drill a 14-inch wide hole to set a vertical PVC blank pipe. After drilling, the machine digs in either a forward or backward direction to create a horizontal VEP. As it digs, a high-density polyethylene (HDPE) perforated pipe is laid horizontally. The pipe is simultaneously covered with a filter pack and connected to the vertical PVC pipe.

Note that the trenching methods do not permit collection of discrete soil samples for laboratory analysis. Therefore, the soil sample collection option is not provided for horizontal VEPs installation.

All connection piping is assumed to be aboveground installation. The piping model should be run if below ground piping is desired. The amount of connection piping defaulted is the radius of influence times the number of VEPs. The amount of manifold pipe will be defaulted at half the length of the connection piping and is the same material as the connection pipe. A pressure gauge and other piping appurtenances will be defaulted as well.

The model defaults to 2-inch and 4-inch diameter schedule 40 PVC connection and manifold pipe, respectively when a 2-inch diameter screen pipe is specified. The model defaults to 4-inch and +-inch diameter schedule 40 PVC connection and manifold pipe, respectively when a 4-inch diameter screen pipe is specified, and C-inch and 8-inch diameter schedule 40 PVC connection and manifold pipe. Respectively when a C-inch diameter screen pipe is specified.

The parameters for horizontal installation are listed and described below.

- VEP Diameter
- Contaminant of Trench Cutting

VEP Diameter - The model defaults to 2” diameter horizontal VEPs for depths of installation less than or equal to 10 feet. However, an option of 4" diameter horizontal VEPs is also available in the model.

When the installation depth is greater than 20 feet, the model defaults to installation of horizontal VEPs by the HDSI proprietary method; therefore, the construction materials cannot be edited. Per this construction method, a choice of 4-inch or C-inch diameter perforated HDFE horizontal pipe is available for installation. The model defaults to 4-inch diameter horizontal VEPS for depths of installation greater than 10 feet.

Containment of Trench Cutting - The trench cuttings can be placed in 55-gallon drums and stored until disposal options have been evaluated. If containment is included, this option will be coated. Otherwise, it is assumed that the waste soil is backfilled into the trench to be treated, along with the in situ contaminated soil. The model default is not to include containment of trench cuttings.

Another alternative that is not included in this model would be stockpiling tie waste soil at a location near the bioventing area.

The amount of waste soil to be drummed using the HDSI proprietary method is less than that drummed using conventional excavating equipment. This is due to the minimal disturbance of subsurface soil when using the IWSI method.

The professional labor hours spent in the field supervising the installation of the horizontal VEPS are included with the VEP installation costs. The model makes the following assumptions for staff hydrogeologist hours related to horizontal VEP installation:

- 45 minutes for vertical blank PVC pipe installation of a staff hydrogeologist per VEP.
- 1 minute per 2 feet of horizontal screen section, installation of a staff hydrogeologist per VEP.
- 1.5 hours for loading, moving, and setting up on site.

Decontamination, procedures for the VEP screen, riser, and caps, as well as decontamination of trenching tools, will be conducted prior to and between each VEP installation. Procedures consist of steam cleaning with a high-pressure steam-generating pressure washer and detergent, in accordance with AFCEE requirements.

Monitoring wells are usually Installed = the periphery of the soil contaminant plume. Monitoring wells are not included in this model, but may be estimated by using the Monitoring model.

Soil Additives

The soil additives parameters are Listed and described below.

- Watering
- Nutrients
- Microorganisms

Watering – Moisture and nutrients will generally be delivered to the soil by one of the three methods: spray irrigation (sprinkler system), infiltration gallery, or injection wells. This model assumes that if the watering Qztion is selected, a sprinkler will be wed. The model default is to include watering. The Infiltration Gallery or Injection Wells models may be used to estimate costs for the other options.

Nutrients – The most basic bioremediation processes involve the addition of oxygen and appropriate nutrients, typically nitrogen and phosphorus. The optimum nutrient mix must be determined by laboratory growth studies and geochemical evaluations of the site: however, a default has been determined for a rough estimate of nutrients and quantities. If nutrients are selected, the default is a nitrogen/ phosphorus/potassium (20:20:20) pulverized fertilizer, at an application of Boo lbs/acre. The model default is to include nutrients.

Microorganisms – When naturally occurring microorganisms are few in number or are absent, or when rapid cleanup is desired, acclimated organic matter may be added to the soil to be treated. The acclimated organic matter supplies organisms capable of initiating the degradation process. For this model, it will be assumed that microorganisms will not be added to the subsurface. The applications for the microorganisms, if chosen, will be 0.5 lb bioculture per gallon of water. The monthly application is estimated to be 25 lbs of bacteria per 1.000 cubic yards of waste. This corresponds to 200 gallons of water and bioculture per month per 1.000 cubic yards of contaminated soil.

4.1.4 Attachment 5, Model Assumptions for RACER-In Situ Solidification

In Situ Solidification

Solidification/Stabilization (S/S) is a treatment technology in which chemical agents are mixed with waste to make use of complex chemical and physical actions to improve physical properties and reduce contaminant solubility, toxicity, and/or mobility. S/S is a viable treatment for contaminated materials when the constituents cannot be treated, recovered, or destroyed by other methods because of technical or economical limitations.

The In Situ model does not include excavation, transportation, or disposal of solidified material. Solidification of in-drum waste is not addressed with this model- This model assumes that the site is fully accessible by heavy equipment (e.g., 100-ton crane, large earth moving equipment. etc.). It is also assumed that the site has been properly characterized prior to use of the In Situ Solidification model.

The following topics are available for the In Situ Solidification model:

Technical Help

- General Information
- Required Parameters
- Secondary Parameters
- Other Related Costs
- References
- Tables

System Help

- Button Bar
- Model Processing

To solidification, a reagent is added to transform a liquid, sludge, sediment, roil into a Solid form. Solidification may immobilize the contaminants within the crystalline structure of the solidified material thus reducing the contaminant leaching potential: although this varies depending upon waste, soil, and reagent characteristics. In stabilization, a reagent is added to transform the material so that the hazardous constituents are in the least mobile or toxic form. Solidification is a physical treatment, whereas, stabilization is a chemical treatment. Compatibilities of common reagents with various waste components are shown in Table 1.

A bench-scale laboratory program is usually performed to determine the type and amount of the S/S reagent required to satisfy the regulatory treatment objectives.

S/S is generally most effective for inorganic compounds and radionuclides. Solidification/stabilization is generally effective on certain contaminants, or contaminant groups: volatile and non-volatile metals (with some exceptions, anionic complexes of metals such as chromium, selenium, arsenic, cyanides, strong acids, oxidizing agents, and reducing agents); other inorganics, polychlorinated biphenyls (PCBs), and radionuclides. Treatment of some semivolatile compounds has been documented using S/S, although treatment of volatile organic compounds (VOCs) is currently the focus of research and debate.

This technology can be performed using a variety of equipment. Several methods include Open Pit/Trench/Area Mixing, in Situ/In Drum Mixing, and Ex Situ treatment in a mixing unit. The Open Pit/Trench/Area mixing method requires a reagent to be dumped on top of the waste and mixed with conventional earth saving and earth handling equipment. The In Situ/In Drum method requires a specialized or patented piece of equipment (usually a hollow stem auger or multiple auger rig) that injects and mixes reagent into the waste in place and can be used at depths up to 120 feet below grade. The Ex Situ method requires excavation, conveyance, or pumping of a contaminated medium into a mixing unit where a reagent is added. Treatment would be processed through a pugmill (mixing apparatus). The process modeled herein is the In Situ process using crane-mounted mixing augers. The Ex Situ process may be estimated using the Solidification/Stabilization model.

In most instances, the solidified material can be left in place and capped. However, local and state regulations should be reviewed to evaluate provisions for in-place disposal of solidified material. In Situ S/S eliminates the higher costs and additional hazards associated with excavation, handling and transport of hazardous materials associated with On-Site treatment and/or off-site disposal. In cases where the solidified material cannot be left in place, disposal options should be evaluated prior to technology selection. If land filling is the disposal option of choice, then the effectiveness of the S/S technology to meet the requirements of the Land Disposal Restrictions (LDRs) under the Resource Conservation and Recovery Act (RCRA) should be evaluated prior to proceeding. If the waste contains PCBs, then the waste disposal is regulated by the Toxic Substance Control Act (TSCF). EPA guidelines recommend a minimum unconfined compressive strength (TTCS) of 50 pounds per square inch (psi) for treated waste

that is disposed in landfill with no free liquids phase. For In Situ applications, strength should be adequate to serve the anticipated future uses of the site.

The total cost for this remediation technology will vary depending upon the chemical and physical characteristics of the waste, the site characteristics, and the treatment requirements.

Required parameters are the minimum amount of information required to generate cost estimate. There are no defaults as the values are site-specific. A reasonable cost estimate can be generated from the required parameters. The required parameters include:

- Type of Waste
- Total Volume of Waste*
- Depth of Bore*
- Boring Surface Area*
- Soil Type
- Safety Level

* Note: The user must enter two of these three required parameters. The remaining value is then calculated by the two entered values. The entered values must not allow the calculated value to exceed its valid range.

Type of Waste

The selections for type of waste are solid or sludge. It is assumed that the sludge is pumpable. The type of waste will affect the S/S mix design. It is assumed in the model that the waste is suitable for the S/S process. Waste with high concentrations of organics and other miscellaneous materials (i.e., oil and grease, loess, peat, highly plastic clays) may inhibit the effectiveness of this technology.

Options

- Solid
- Sludge

Total Volume of Waste

The volume of the waste is specified in cubic yards. The volume will be converted to weight since ratios using weight comparisons are most commonly used. The valid range is 1 to 9,999,999 cubic yards. Sludges can be converted from gallons to cubic yards by multiplying the number of gallons by 0.005.

Depth of Bore

This parameter reflects the depth of the contaminated waste to be treated. The depth of waste to be solidified drives the size of the equipment used for treatment. The valid range is 1 to 120 feet.

Boring Surface Area

This is the surface area affected by the boring for the solidification/stabilization process. The boring surface area drives the number of borings required. The valid range is 1 to 9,999,999 square feet.

1 Type

The soil type will affect the size of the boring equipment.

Options

- Silty Clay, Clay
- Mixed Sandy, Silty, Clayey Soils
- Primarily Sand
- Sand & Gravel

Safety Level

The safety level will be affected by the contaminant(s) at the site. Safety level refers to those levels as required by OSHA in 29 CFR Part 1910. The four levels are designated as A, B, C, and D; where

"'A" is the most protective and "D" is the least protective. A safety level of E is also included to simulate normal construction "no hazard" conditions as prescribed by the EPA. A complete description of safety levels and associated requirements is located in the On-Line Help for Safety Levels.

Secondary Parameters

The secondary parameters are listed and described below.

A reasonable cost estimate can be created using only the required parameters. However, if more detailed information is known, the secondary parameters can used to create a more precise and site-specific estimate. Secondary parameters, unlike the required parameters, have defaults that are determined by the model. The defaults are dictated by the engineering design and model assumptions. The secondary parameter sets are:

- Secondary
- Additives

Secondary

The secondary parameters are listed and described below.

- Initial Moisture Content
- Density of Waste
- Auger Diameter

Initial Moisture Content – The initial moisture content varies depending upon the waste medium. The moisture content will aid in determining the mix design for the waste and additives. The default moisture contents are shown in Table 2. The valid range for solid waste is 0 to 30%. For sludge waste, the valid range is 31 to 70%.

Density of Waste – The density of waste is specific to the waste medium and will be presented in pounds per cubic foot (pcf). This will provide information necessary to calculate the mix design and volume expansion encountered after the solidified waste has cured. The unit weight can be adjusted to the field conditions of the waste. The default waste densities are shown in Table 3. The-valid range for solid waste is 60 to 200 pcf. For sludge waste, the valid range is 40 to 200 pcf.

Auger Diameter – The auger diameter refers to the diameter of the boring bit. The auger diameter will default based on soil type and depth of boring. The auger diameter will determine the number of borings required.

Additives

The additives parameters are listed and described below.

- Chemical Additive Ratios
- Calculate Volume of Treated Waste

Chemical Additive Ratios – There are many chemical additives that can be used effectively in the S/S process. However, additive ratios axe highly waste specific and should be determined by beach and pilot testing. The chemical additive ratio defaults provided in this model are rudimentary and are provided only to obtain estimated chemical additive costs. A more precise estimate can be provided upon completion of beach and pilot testing.

This parameter group may include such chemicals as: water, proprietary chemical binders, Portland cement, fly ash, cement kiln dust, hydrated lime, asphalt, bitumen, polyolefins, epoxy, urea formaldehyde,

activated carbon, modified Clay, pumice, blast furnace slag, polycrylares, and polyacrylamides. Mix ratios will be defaulted based on the required parameter input and standard S/S mix designs.

The default additives will include water, proprietary chemical binder, fly ash, kiln dust, and Portland cement. The mix proportions will be weight based and contingent upon the initial moisture. Content and unit weight of the waste. Table 4 provides a list of the default weight of additive to waste ratios Table 5 provides a summary of specific gravity and weight for both chemical additives and waste streams. These defaults are estimated based on information obtained from the EPA SITE program, and conversations with consultants and vendors.

Calculate Volume of Treated Waste - This is a locked field that will display the amount of waste after treatment and curing has been completed. This is displayed for informational purposes only. In general the volume of the treated waste will increase based on the amount of chemical additive that has been added for treatment. This increase in volume will raise the ground surface of the site over the aerial limits of the untreated waste if the treated material is left in place. The-site would require grading end capping based on its future use. If the treated material were to be disposed of in a landfill, the total volume of the treated waste would indicate the amount that is to be disposed of either in a Subtitle "C" (hazardous) or Subtitle "D" (non-hazardous) landfill depending upon the outcome of the Toxicity Characteristic Leaching Procedure (TCLP) analytical results. Groundwater monitoring adjacent to the solidified material may be required and should be estimated using the Monitoring model. Well installation can be estimated using the Groundwater Monitoring Wells model.

4.2 Cost Estimates for Groundwater Alternatives

4.2.1 Costs – Alternative 2

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 2

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.

START-UP CAPITAL COSTS (IN 1997 DOLLARS) IS $63,358

NET PRESENT WORTH OF OPERATIONS & MAINTENANCE AND FUTURE CAPITAL

COSTS FOR 100-NR-2 CMS ALTERNATIVE # 2 IS $699,468

The cash flow is made up of the following:

1. Install Signs Along the River @ 5,076 every 20 Years. Start at year one.
2. Sample Sr-90 to River @ 5,687/yr. for 300 Yrs. Capital Well Replacement Costs of $48,557 every 20 Yrs.
3. Monitor Tritium to River $11,270/yr for 15Yrs.
4. Sample Sr-90 in Aquifer @ 13,893/yr for 300 Yrs. Capital Well Replacement Costs of $291,408 every 20 Yrs.
5. Sample Other Contaminants @ $8,314/yr. for 100 Yrs. Capital Well Replacement Costs of $58,282 every 25 Yrs.

The total inosculated capital costs is $5,068,784

The total inosculated operating cost is $6,874,535

The average annual in osculated operating cost is $6,874,535/300 YRS. = $22,915

The actual average yearly operating costs will vary since projects requiring O&M run for 15,100, & 300 years.

4.2.2 Costs – Alternative 3

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 3

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.

Start-up capital costs (in 1997 dollars) is $8,240,697

Net present worth of operations & maintenance and future capital costs for 100-NR-2 cms alternative #3 is $1,021,528

The cash flow is made up of the following:

1. Install Clino Wall at the River 1 st yr. @ 8,182,415. This is all Capital cost with no Yearly O&M.
2. Sample Sr-90 to River at Clino Wall @ 19,389/Yr. for 300 Yrs. Capital Well Replacement Costs of $321,218 Every 20 Yrs.
3. Monitor Tritium to River $11,270/yr for 15 Yrs.
4. Sample Sr-90 in Aquifer @ $13,893/Yr. for 300 Yrs. Capital Well Replacement Costs of $291,408 Every 20 Yrs.
5. Sample Other Contaminants @ 8,314/yr for 100Yrs. Capital Replacement Well Costs of $58,282 Every 25 Yrs.

The total unescalated capital costs is $16,992,315

The total unescalated operating cost is $10,985,030

The average annual unescalated operating cost is $10,985,030 /300 yrs. = $36,617

The actual average yearly operating costs will vary since projects requiring O&M run for 15,100, & 300 years.

4.2.3 Costs – Alternative 4

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 4

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 270 years. The 3.2 % annual escalation is published by DOE (ERC rates 12/20/96) and is assumed constant for 270 years. The 7 % Discount Rate was obtained from the EPA Hotline (800) 424-9346. The first year is not escalated or discounted.

Start-up capital costs (in 1997 dollars) is $1,754,609

Net present worth of operations & maintenance and future capital

Costs for 100-nr-2 cms alternative # 4 is $12,491,105

The cash flow is made up of the following:

1. Pump & Treat to 200 gpm, O&M @ $674,185/yr for 270 years. Plant & well construct & replacement @ 1, 20, & 50 yrs.
2. Monitor Tritium to River $11,270/yr. for 15 Yrs.
3. Sample Sr-90 in Aquifer @ $30,923/Yr. for 270 Yrs. Capital Well Replacement Costs of $524,535 Every 20 Yrs.
4. Sample Other Contaminants @ $8,314/yr for 100 Yrs. Capital Well Replacement Costs of $58,282 Every 25 Yrs.
5. Monitor Water Levels @ 7,046/yr for 270 Yrs. Capital Well Replacement Costs of $194,228 Every 50 Yrs.

The total unescalated capital costs is $38,160,277

The total unescalated operating cost is $193,282,168

The average annual unescalated operating cost is $193,282,168 /270yrs. = $715,860

The actual average yearly operating costs will vary since projects requiring O&M run for 15,100, & 270 years.

4.2.4 Costs – Alternative 5

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 5

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 270years. The 3.2 % annual escalation is published by DOE (ERC rates 12/20/96) and is assumed constant for 270 years. The 7 % Discount Rate was obtained from the EPA Hotline (800) 424-9346. The first year is not escalated or discounted.

Start-up capital costs (in 1997 dollars) is $4,580,204

Net present worth of operations & maintenance and future capital

Costs for 100-nr-2 cms alternative #5 is $34,585,404

The cash flow is made up of the following:

1. Pump & Treat to 200 gpm, O&M @ $674,185/yr for 270 years. Plant & well construct & replacement @ $1,20 & 50 yrs.
2. Maintain Tritium Hydraulic Control $l2,175/yr. for 15 Yrs. Capital well costs $115,796 at day one.
3. Sample Sr-90 in Aquifer @ $30,923/yr for 270 Yrs. Capital Well Replacement Costs of $524,535 Every 20 Yrs.
4. Sample Other Contaminants @ $8,314/yr for 100 Yrs. Capital Well Replacement Costs of $58,282 Every 25 Yrs.
5. Monitor Water Levels @ $7,046/yr for 270 Yrs. C Capital Well Replacement Costs of $194,228 Every 50 Yrs.
6. Others Pump & Treat to 200 gpm, O&M @ $1,356,033/yr for 90 years. Plant & well construct & replacement @ 1, 20 & 50 yrs. intervals

The total unescalated capital costs is $50,409,080

The total unescalated operating cost is $315,188,703

The average annual unescalated operating cost is $315,188,703 /270yrs. = $1,167,366

The actual average yearly operating costs will vary since projects requiring O&M run for $15,90,100, & 270 years.

4.2.5 Costs – Alternative 6

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 6

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.

Start-up capital costs (in 1997 dollars) is $20,389,389

Net present worth of operations & maintenance and future capital

Costs for 100-nr-2 cms alternative #6 is $36,269,137

The cash flow is made up of the following:

1. Pump & Treat to 135 gpm, O&M @ $589,180/yr for 270 years. Plant & well construct & replacement @ 1, 20, & 50 years.
2. Maintain Tritium Hydraulic Control 11,270/yr for 15 years.
3. Sample Sr-90 in Aquifer @ 21,580/yr for 270 years. Capital Well Replacement Costs of 349,630 Every 20 years.
4. Sample Other Contaminants @ 8,314/yr for 100 years. Capital Well Replacement Costs of 58,282 Every 25 years.
5. Monitor Water Levels @ 7,046/yr for 270 years. Capital Well Replacement Costs of 194,228 Every 50 years.
6. Others Pump & Treat to 200 gpm, O&M @ 1,356,033/yr for 90 years. Plant & well construct & replacement @ 1, 20, & 50 yrs. intervals
7. Install Freeze Wall at the River. O&M 212,463/yr for 300 years. Capital Installation Costs 1st year 16,463,096.

The total unescalated capital costs is $56,753,369

The total unescalated operating cost is $353,590,138

The average annual unescalated operating cost is $353,590,138/ 300yrs. = $1,178,634.

The actual average yearly operating costs will vary since projects requiring O&M run for 15, 90, 100, 270 & 300 years.

4.2.6 Costs – Alternative 7

NET PRESENT WORTH FOR 100-NR-2 CMS ALTERNATIVE 7

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 100 years. The 3.2 % annual escalation is published by DOE (ERC rates 12/20/96) and is assumed constant for 100 years. The 7 % Discount Rate was obtained from the EPA Hotline (800) 424-9346. The first year is not escalated or discounted.

Start-up capital costs (in 1997 dollars) is $22,416,808

Net present worth of operations & maintenance and future capital costs for 100-nr-2 cms alternative # 7 is $114,113,817

The cash flow is made up of the following:

1. Pump & Treat to 250 gpm, O&M @ 4,966,263/yr for 20 years. Original Capital Cost $2,048,414
2. Maintain Tritium Hydraulic Control 2175/yr for 15 years. New Well Capital Costs $115,796
3. Sample Sr-90 in Aquifer @ 13,519/yr for 20 years.
4. Sample Other Contaminants @ 8,314/yr for 100 years. Capital Well Replacement Costs of 58,282 every 25 years.
5. Monitor Water Levels @ 10,404/yr for 100 years. Capital Well Replacement Costs of $294,740 @ 50 years.
6. Others Pump & Treat to 200 gpm, O&M @ 1,356,033/yr for 90 years. Plant & well construct & replacement @ 1, 20, & 50 yrs. intervals
7. Install Soil Flushing. O&M 2,953,284/yr for 20 yr. Capital Installation Costs 1st. year $8,708,080.
8. Install Sheet Piling Wall Original Capital Cost $8,776,437. Remove in 20 years @1,077,752

The total unescalated capital costs is $32,309,602

The total unescalated operating cost is $283,686,469

The average annual unescalated operating cost is $283,686,469138/ 100yrs. = $2,836,864.

The actual average yearly operating costs will vary since projects requiring O&M run for 152,090,100 years.

4.3 Groundwater Alternatives Descriptions 100-NR-1/100-NR-2 CMS

4.3.1 Alternative 1: No Action

Physical Features

None

Notes

- National Contingency Plan requires evaluation of the No Action alternative.
- Columbia River in vicinity of N-Springs currently exceeds MCLs for tritium, strontium, and nitrate.
- Nitrate load to the Columbia River from the N-Area is very small in comparison to the load from irrigation return flows.

Associated Activities

- No cleanup activities at all.
- No institutional controls after DOE releases the property in 2018.

Consequences

- Tritium conc. in to river exceeds MCL for next 10-15 years.
- Tritium conc. in aquifer exceeds MCL for next 25 years.
- Strontium conc. into river exceeds MCL for next 270 years.
- Strontium conc. in aquifer exceeds MCL for next 300 years.
- Other contaminants in aquifer will exceed MCLs for few to 90 years.
- Manganese conc. into river may exceed MCL sat future date for few years.
- Contaminant conc. into river could change without being detected.

4.3.2 Alternative 2: Institutional Controls

NR-1/NR-2CMS GROUNDWATER ALTERNATIVES – DESCRIPTIONS
August 5, 1996

Physical Features

- Monitoring wells.
- Tritium- 4 wells, sample 1/yr, test for tritium, for 15 years.
- Strontium- 9 wells, sample rate varies, test for Sr-90, for 300 years.
- Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years.
- Signs along river.

Notes

- Columbia River in vicinity of N-Springs currently exceeds MCLs for tritium, strontium, and nitrate.

Associated Activities

- Access controls on river shoreline along N-Springs.
- Controls on GW use for 300 years.
- Limits on irrigation in the general area.
- Monitoring for 300 years.
- Regulatory acceptance of institutional controls.

Consequences

- No use of unconfined aquifer allowed for 300 years.
- Must maintain monitoring, institutional controls, etc. for 300 years.
- Risk to ecological receptors along river may occur due to strontium.
- Changing groundwater conditions would be detected by monitoring.
- Tritium and strontium would continue to flow into the Columbia River.

Also:

- Tritium conc. into river exceeds MCL for next 10-15 years.
- Tritium conc. in aquifer exceeds MCL for next 25 years.
- Strontium conc. into river exceeds MCL for next 270 years.
- Strontium conc. in aquifer exceeds MCL for next 300 years.
- Other contaminants in aquifer will exceed MCLs for few to 90 years.
- Manganese conc. in to river may exceed MCL sat future date for few years.

4.3.3 Alternative 3: Permeable Wall and Institutional Controls

NR-1/NR-2 CMS GROUNDWATER ALTERNATIVES – DESCRIPTIONS
(IC for tritium to river and all COCs in aquifer)
August 5, 1996

Physical Features

- Permeable barrier, 2000 ft. long (for strontium) (top of barrier wall at least 10 ft below ground surface).
- Monitoring wells.
  Tritium- 4 wells, sample 1/yr, test for tritium, for 15 years
  Strontium- 2 wells plus 40 sample tubes impermeable wall, sample rate varies, test for Sr-90, for 300 yrs.
  Strontium- 5 wells, once every 2 yrs, test for Sr-90, for 300years
  Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years
- Signs along river

Notes

- Columbia River in vicinity of N-Springs currently exceeds MCLs for tritium, strontium, and nitrate.
- Nitrate load to the Columbia River from the N-Area is very small in comparison to the load from irrigation return flows.
- Permeable wall operates passively; little O&M required.

Associated Activities

- Land use controls for area containing permeable wall.
- Monitoring for permeable barrier integrity for 300 years.
- Institutional controls on GW use for 300 years.
- Institutional controls along river for 15 years, for tritium.
- (assume other COCs pose no risk to river)
- Monitoring north and south of permeable wall for groundwater quality going in to river.
- Regulatory acceptance of institutional controls.

Consequences

- No use of unconfined aquifer allowed for 300 years.
- Must maintain monitoring and institutional controls for 300 years.
- Permeable wall reduces risk to ecological receptors along river that is due to strontium.

Also:

- Tritium conc. into river exceeds MCL for next 10-15 years.
- Tritium conc. in aquifer exceeds MCL for next 25 years.
- Strontium conc. into river will be less than MCL.
- Strontium conc. in aquifer exceeds MCL for next 300 years.
- Other contaminants in aquifer will exceed MCLs for few to 90 years.
- Manganese conc. into river may exceed MCL sat future date for few years.

4.3.4 Alternative 4: Hydraulic Controls and Pump and Treat for Strontium, Institutional Controls for Tritium to River and Other COCs in Aquifer

NR-1/NR-2 CMS GROUNDWATER ALTERNATIVES – DESCRIPTIONS
August 5, 1996

Physical Features

- Sr-90Hyd.Control and P&T:
  9 extraction wells, 5 of 9 new
  3 injection wells, 1 of 3 new
  1 Treat Plant expand existing plant)
  Pumping rate- 15 gpm for 9 extraction wells
- Monitoring wells along river
  Tritium- 4 wells, sample 1/yr, test for tritium, for 15 years
  Strontium- 9 wells, sample rate varies, test for Sr-90, for 270 years
  Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years
  Water levels- 11 wells + 1 river stage, sample 4 wells/year, for 270 years
- Treatment facility at north end of 1301-N trench

Notes

- Hydraulic controls for Sr-90 will partly control tritium to river

Associated Activities

- Institutional controls on GW for 270 years.
- Institutional controls of land use where wells and treatment plant are located.
- Monitor groundwater for 270 years.
- O&M of treatment plant for 270 years.
- O&M of wells and pipelines for 270 years.
- Regulatory acceptance of institutional controls rather than significant expense of remediation.
- Treatment plant residuals disposed at ERDF.

Consequences

- No use of unconfined aquifer allowed for 270 years.
- Must maintain monitoring and institutional controls for 270 years.
- Contaminants north and south of Sr-90 plume would continue going into the river.
- Tritium conc. into river exceeds MCL for next 10-15 years.
- Tritium conc. in aquifer exceeds MCL for next 25 years.
- Strontium conc. into river will be less than MCL.
- Strontium conc. in aquifer exceeds MCL for next 270 years.
- Other contaminants in aquifer will exceed MCLs for few to 90 years.
- Manganese conc. into river may exceed MCL sat future date for few years.

4.3.5 Alternative 5: Hydraulic Controls for Tritium and Strontium to River Pump and Treat Strontium and Other COCs in Aquifer

NR-1/NR-2 CMS GROUNDWATER ALTERNATIVES – DESCRIPTIONS
August 5, 1996

Physical Features

- Sr-90 Hyd. Control and P&T
  9 extraction wells, 5 of 9 new
  3 injection wells, 1 of 3 new
  1 Treat. Plant (expand existing plant and modify for nitrate treat.)
  Pumping rate-six well sat 15 gpm
  three well sat 20 gpm
- Tritium-Hyd. Control
  2 extraction wells, both new
  0 injection wells (use new Sr-90 well)
  0 Treat. Plant
- "Others"-P&T
  8 extraction wells, 4 of 8 new
  3 injection wells, all new
  1 Treat. Plant-new
- Monitoring wells along river
  Strontium- 9 wells, sample rate varies, test for Sr-90, for 300 years
  Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years
  Water levels- 11 wells + 1 river stage, sample 4 wells/year, for 270 years
- Treatment facility at north end of 1301-N trench (Sr and NO3)
- Treatment facility NE of 1324-N for "Others"

Notes

- Hydraulic controls for Sr-90 will partly control tritium to river
- Pump and treat for "Others" will retard their migration to the river

Associated Activities

- Institutional controls on GW for 270 years
- Institutional controls of land use where wells and treatment plant are located
- Monitor groundwater for 270 years
- O&M of wells, pipelines, & treatment plant for strontium for 270 years
- O&M of wells, pipelines, & treatment plant for "Others" for up to 90 years

Consequences

- No use of unconfined aquifer for 270 years
- Must maintain wells, piping systems, and treatment plant for strontium for 270 years
- Wells, piping systems, and treatment plant for "Others" will be shutdown as contaminant concentrations fall below MCLs
- Contaminant migration south of Sr-90 plume would be retarded by the pump and treat actions, so river will be protected
- Tritium conc. in aquifer exceeds MCL for next 25 years

- Strontium conc. in to river will be less than MCL
- Strontium conc. in aquifer exceeds MCL for next 270 years
- Other contaminants in aquifer will exceed MCLs for few years

4.3.6 Alternative 6: Impermeable Barrier for Strontium, Institutional Controls for Tritium, Pump and Treat All Groundwater COCs

NR-1/NR-2 CMS GROUNDWATER ALTERNATIVES – DESCRIPTIONS
August 5, 1996

Physical Features

- Sr-90-P&T
  6 extraction wells, 4 of 6 new
  3-injection wells, 1 of 3 new
  1 Treat. Plant (expand existing plant and modify to treat nitrate)
- "Others"-P&T 8 extraction wells, 4 of 8 new
  3-injection wells, all new
  1 Treat. Plant-new
- Monitoring wells along river
  Tritium- 4 wells, sample 1/yr, test for tritium, for 15 years
  Strontium- 9 wells, sample rate varies, test for Sr-90, for 270 years
  Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years
  Water levels- 11 wells + 1 river stage, sample 4 wells/year, for 270 years
- Treatment facility at north end of 1301-N trench (Sr and NO3)
- Treatment facility NE of 1324-N for "Others"

Notes

- Impermeable barrier for Sr-90 will partly control tritium to river
- Columbia River tritium concentrations near Richland water intake are higher than at the N-Springs area. Health risks under current conditions are acceptable to the City of Richland and the Regulators.

Associated Activities

- Institutional controls on GW for 270 years
- Institutional controls of land use where impermeable barrier, wells and treatment plants are located
- Monitor groundwater for 270 years
- O&M of wells, pipelines, & treatment plant for strontium for 270 years
- O&M of wells, pipelines, & treatment plant for "Others" for up to 90 years

Consequences

- No use of unconfined aquifer for 270 years
- Must maintain wells, piping systems, and treatment plant for strontium for 270 years
- Wells, piping systems, and treatment plant for "Others" will be shutdown as contaminant concentrations fall below MCLs
- Contaminants north and south of Sr-90 plume would continue going into the river.
- Tritium conc. into river exceeds MCL for next 10-15 years
- Tritium conc. in aquifer exceeds MCL for next 25 years
- Strontium conc. into river will be less than MCL
- Strontium conc. in aquifer exceeds MCL for next 270 years
- Other contaminants in aquifer will exceed MCLs for few to 90 years

4.3.7 Alternative 7: Impermeable Barrier for Strontium to River, Impermeable Barrier and Hydraulic Controls for Tritium to River, Soil Flushing for Strontium in the Aquifer, Pump and Treat for Other COCs in Aquifer

100-NR-1/NR-2 CMS Groundwater Alternatives – Descriptions
(May 11, 1997)

Physical Features

- Tritium-Hyd .Control
  2 extraction wells, both new
  0 Treat. Plant
- Soil Flushing
  9 extraction wells, 8 new
  1 Treat. Plant (expand existing plant and modified to treat nitrate)
  3 injection wells, 1 new
- Others-P&T 8 extraction wells, 4 of 8 new
  3 injections wells, all new
  1 Treat. Plant-new
- Monitoring wells along river
  Strontium- 9 wells, sample rate varies, test for Sr-90, for 20 years
  Others- 3 wells, sample 1/yr, test for 5 analytes, for 20 to 100 years
  Water levels- 11 wells + 1 river stage, sample 4 wells/year, for 270 years
- Treatment facility at north end of 1301-N trench
- Treatment facility NE of 1324-N for "Others"
- Operate a sheet pile barrier for 20 years and remove

Notes

- Impermeable barrier and hydraulic controls will control strontium and tritium to river
- Pump and treat for "Others" will retard their migration to the river

Associated Activities

- Institutional controls on groundwater for 100 years
- Institutional controls of land use where well sand treatment plant are located
- Monitor groundwater for 100 years
- O&M of wells, pipelines, & treatment plant for strontium for 20 years
- O&M of wells, pipelines, & treatment plant for "Others" for up to 90 years

Consequences

- No use of unconfined aquifer for 100 years
- Must maintain wells, piping systems, and treatment plant for strontium for 20 years
- Wells, piping system, and treatment plant for "Others" will be shutdown as contaminant concentrations fall below MCLs
- Tritium conc. in aquifer exceeds MCL for next 25 years
- Strontium conc. into river will be less than MCL
  - Strontium conc. in aquifer exceeds MCL for next 20 years
  - Other contaminants in aquifer will exceed MCLs for few years

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100-NR-1
CHAPTER 5.0
COMPARATIVE ANALYSIS OF ALTERNATIVES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 5.0
COMPARATIVE ANALYSIS OF ALTERNATIVES

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CHAPTER 5.0
COMPARATIVE ANALYSIS OF ALTERNATIVES

TABLE OF CONTENTS

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES 5
5.1 Compliance With Applicable or Relevant and Appropriate Requirements (ARARS) 5
5.1.1 Columbia River Protection Standards 5
5.1.2 Cultural and Ecological Resource Protection Standards 5
5.1.3 Waste Management Standards 6
5.1.4 Air Emission Standards 6
5.1.5 Radiation Protection Standards 7
5.1.6 Polychlorinated Biphenyls 7
5.1.7 Asbestos 7
5.1.8 Environment, Safety, Quality, and Health Requirements 8
5.1.9 Draft Radiological Criteria for Decommissioning 9

TABLE

Table 5.1. Summary of Estimated Costs for Alternatives[a] 10

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5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

5.1 Compliance With Applicable or Relevant and Appropriate Requirements (ARARS)

The ARARs are standards, requirements, criteria, or limitations promulgated under Federal or state environmental laws that must be met or waived for actions conducted under Comprehensive Environmental Response, Compensation, and Liability (CERCLA). Only the substantive provisions of requirements that are ARARs must be met (or waived) for actions conducted entirely onsite (CERCLA, Section 121 [d][2]). Such onsite actions are exempted from obtaining Federal, state, and local permits (CERCLA, Section 121 [e][1]). Also, to be considered requirements are nonpromulgated standards, including the U.S Department of Energy (DOE) orders, proposed regulations, and regulatory guidance that may be referenced to the extent necessary for the response action to be adequately protective.

Because no action is being taken, Alternative 1 would not meet ARARs for cleanup. All other alternatives would meet ARARs requiring protection of human health and the environment. Key ARARs for the other alternatives include waste management standards, air emission control standards, radiation control standards, and standards for protection of cultural and ecological resources. Proposed environmental cleanup standards for remediation of the 100-N Area soil (proposed soil cleanup standards of 15 mrem/yr above background and the Model Toxic Control Act [MTCA] Method B) are addressed in the 100-NR-1 and 100-NR-2 CMS; therefore, they are not discussed in this document. Other standards to be met by the response action include various DOE, Federal, and state worker safety standards.

5.1.1 Columbia River Protection Standards

40 CFR 122 addresses technology-based limitations and standards, control of toxic pollutants, and monitoring for discharges to United States waters, including storm water. Public Law 100-605, *Study of the Hanford Reach of the Columbia River*, requires new activities near the Columbia River to minimize direct and adverse effects on the values being studied for the Columbia River.

No wastewater discharges to the Columbia River are planned under any of the alternatives. Erosion and storm water controls would be used as necessary for alternatives involving demolition.

5.1.2 Cultural and Ecological Resource Protection Standards

The *National Historic Preservation Act of 1966* (implemented via 36 CFR 800) requires Federal agencies to evaluate and mitigate adverse effects of Federal activities on any site eligible for inclusion on the National Register of Historic Places. The PA for the maintenance, deactivation, alteration, and demolition of the built environment allows RL to prepare a treatment plan that provides for the mitigation of historic structures at 100-N Area. The PA requires that all mitigation activities identified in the treatment plan must be completed prior to any demolition, alteration or removal of artifacts from the 100-N facilities.

The cultural resource protection requirements apply because of the presence of potentially significant archaeological sites or artifacts in the 100-N Area, and the potential historical significance of facilities in the area. The cultural significance of the 100-N Area facilities has been evaluated and mitigation has been established under the PA. It is unlikely that archaeological sites would be impacted by demolition activities.

The *Native American Graves Protection and Repatriation Act* (43 CFR 10) requires agencies to consult and notify culturally affiliated Tribes when Native American human remains are inadvertently discovered during project activities. The 100-N restoration activities could inadvertently uncover previously disturbed or intact graves associated with archaeological sites.

The President's Executive Order 1300.7 requires agencies to consider impacts of actions on sacred sites. An area at 100-N called *Mooli Mooli* may be a sacred site that will require consultations with affected Tribes.

The *National Archaeological and Historical Preservation Act of 1974* requires action to recover and preserve artifacts in areas where activity may cause irreparable harm, loss, or destruction of significant artifacts. The *Endangered Species Act of 1973* (implemented via 50 CFR 402 and WAC 232-012-297) prohibit activities that threaten the continued existence of listed species or destroy critical habitat. The *Migratory Bird Treaty Act* makes it illegal to remove, capture, or kill any migratory bird, or any part of nests or the eggs of any such birds.

Threatened and endangered species are known to be present in the 100 Area, but no adverse impacts on protected species or critical habitat resulting from implementation of any of the alternatives is anticipated. Facility-specific ecological reviews would be conducted to identify potentially adverse impacts prior to the performance of any demolition work.

5.1.3 Waste Management Standards

The Resource Conservation and Recovery Act (RCRA) regulates management and disposal of hazardous (dangerous) waste. Authority for much of RCRA has been delegated to the State of Washington. Implementing state regulations contained in WAC 173-303 requires identification and appropriate management of dangerous wastes and dangerous components of mixed wastes, and identifies standards for treatment and disposal of these wastes. These requirements are applicable to any existing wastes or any wastes that are generated during Decontamination and Decommissioning (D&D) of the ancillary facilities that are designated, in accordance with WAC 173-303, as a dangerous or mixed waste. Similarly, WAC 173-304 requires identification and appropriate management of solid wastes. It is applicable to any solid waste generated during D&D of the ancillary facilities. Except for Alternative 1, each of the alternatives would generate waste that would be subject to WAC-173-303, -304, and -460.

Performance objectives for land disposal of low-level radioactive waste are provided in 10 CFR 61, Subpart C. Although not applicable to DOE facilities, these standards are relevant and appropriate to any disposal facility for low-level and mixed waste generated during D&D of the ancillary facilities.

All alternatives, except for Alternative 1, would generate solid, dangerous, low-level, and/or mixed waste. For each of these alternatives, actions proposed to manage such waste would satisfy the waste management ARARs and all wastes would be evaluated and managed in compliance with the appropriate requirements. Prior to disposal, dangerous, low-level, or mixed wastes would be managed in a manner that prevents releases or inadvertent exposure to workers, and is protective of the environment. The Environmental Restoration and Disposal Facility (ERDF) is engineered to meet RCRA minimum technological requirements for landfills, including standards for a double liner, a leachate collection system, leak detection, and final cover. The ERDF also meets the appropriate performance standards under 10 CFR 61 for disposal of low-level waste (LLW) and mixed waste. Treatment requirements including land disposal restriction requirements, if any, necessary to dispose of wastes in the ERDF would be identified to meet the ERDF waste acceptance criteria. Treatment may include stabilization, dewatering, encapsulation, or other readily available treatment methods. Packaging and transportation requirements for waste generated during D&D of the ancillary facilities would be identified and implemented prior to movement of any wastes. Any offsite facility receiving dangerous wastes would meet all RCRA administrative and substantive requirements. Any offsite shipment of waste would comply with appropriate U.S. Department of Transportation requirements (49 CFR 171-173).

At this time, no listed dangerous wastes are expected to be generated as a result of implementing any of the alternatives. Wastes designated as characteristic may be generated and would be subject to the dangerous waste management standards in WAC 173-303.

5.1.4 Air Emission Standards

The *Clean Air Act* regulates both toxic and radioactive airborne emissions. Under implementing regulations found in 40 CFR 61, Subpart H, and WAC 246-247, radionuclide airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/year effective dose equivalents to the

hypothetical offsite maximally exposed individual. WAC 246-247 requires verification of compliance, typically through periodic confirmatory air sampling. WAC 173-400 establishes requirements for the control and/or prevention of the emission of air contaminants, including dust.

The radionuclide emission standards would apply to any fugitive, diffuse, and point-source air emissions of radionuclides generated during activities associated with any of the D&D alternatives. If there is a potential for a non-zero radioactive emission, best available radionuclide control technology would be required. If the action would increase emission of toxic air pollutants to the atmosphere above the small quantity emission rates, implementation of best available control technology for toxics would be required. Alternatives 3 and 4 propose using decontamination of surfaces to control radiological contaminants and standard construction techniques to provide dust control during demolition.

Standard construction techniques are used at the ERDF to control fugitive emissions during placement of wastes. The in situ burial operations would also use standard construction techniques to control fugitive emissions during placement of wastes. These methods should adequately control fugitive radionuclide emissions and toxic air pollutants. Therefore, standard construction techniques would be considered the best available radionuclide control technology and the best available control technology for toxics for any of the proposed activities as demonstrated during the 100-N Area treatability study (DOE-RL 1996a).

5.1.5 Radiation Protection Standards

Occupational Radiation Protection (10 CFR 835) establishes radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities. It also requires that measures be taken to maintain radiation exposure as low as reasonably achievable (ALARA). This regulation is applicable to activities considered under each of the four alternatives.

A combination of personal protective equipment, personnel training, physical design features (e.g., confinement, remote handling, shielded containers), and administrative controls (e.g., limiting time in radiation zones) would be used to ensure that the requirements for worker and visitor protection are met by all alternatives. Alternatives 3 and 4 would also meet the requirements to maintain exposure ALARA by decontaminating surfaces prior to demolition and by providing personal protective equipment, training, and administrative controls. For all alternatives, individual monitoring would be performed as necessary to verify compliance with the requirements.

5.1.6 Polychlorinated Biphenyls

The *Toxic Substance Control Act of 1976* (TSCA) and WAC 173-303 regulates the management and disposal of PCBs and PCB waste. The implementing regulations in 40 CFR 761 contain requirements for the management of spills and remediation of materials suspected to contain PCB waste. The ERDF is authorized to accept certain PCB waste for disposal. All waste suspected to contain PCBs would be evaluated to determine whether the waste meets the ERDF waste acceptance criteria. Any PCB waste that does not meet the ERDF waste acceptance criteria would be sent to an onsite PCB storage area meeting the substantive requirements for TSCA storage, and would be transported for disposal at a TSCA-approved disposal facility.

5.1.7 Asbestos

Removal and disposal of asbestos and ACM are regulated under the *Clean Air Act* (40 CFR 61, Subpart M) and Occupational Safety and Health Administration (OSHA) (29 CFR 1910.1101 and WAC 296-62). These regulations provide for special precautions to prevent environmental releases or exposure to workers of airborne emissions of asbestos fibers during removal actions. 40 CFR 61.52 identifies packaging requirements. Alternative 1 would not remove asbestos. If ACM was encountered during routine S&M, as would be conducted under Alternative 2, it would be removed and disposed in accordance with applicable regulations. Alternatives 3 and 4, since they involve decontamination, would

be expected to include actions that would encounter and disturb ACM. These alternatives shall comply with the requirements for management and disposal of asbestos or ACM.

5.1.8 Environment, Safety, Quality, and Health Requirements

Worker protection standards are described in OSHA regulations, national consensus standards, and DOE orders (e.g., 29 CFR 1910, 29 CFR 1926, National Fire Protection Association [NFPA] 1990, WAC 296-62, and DOE Order 5400.5 [DOE 1993b]). Exposure limits, personnel protection requirements, and decontamination methods for hazardous chemicals are established by 29 CFR 1910. Additionally, 29 CFR 1910 requires identification and mitigation of physical hazards to workers posed by a facility, including but not limited to, confined spaces, falling hazards, fire, and electrical shock. The 29 CFR 1926 reference provides requirements for worker safety during construction activities.

The DOE orders establish requirements relating to safety, health, and environmental protection. The substantive requirements of these orders would be met for any S&M or D&D activities. Known and suspected inventories in each building will be screened during the design phase against the criteria in DOE Standard 1027 (DOE 1992a) to determine the appropriate DOE environmental safety and health order requirements. Site- and activity-specific requirements and controls would be identified in final design and work plan documents, including contingency plans and emergency response plans. In addition, the following DOE order requirements have been determined to contain requirements that are to be considered for one or more of the alternatives:

- The requirements in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993b), and limiting exposure of the public to radioactive releases, are relevant and appropriate to all alternatives.
- The requirement in DOE Order 451.1, *National Environmental Policy Act Compliance Program* (DOE 1995), to address *National Environmental Policy Act of 1969* values are relevant and appropriate to all alternatives.
- The requirement in DOE Order 5480.3, *Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances and Hazardous Waste* (DOE 1985), to comply with U.S. Department of Transportation or equivalent packaging standards is relevant and appropriate to each alternative that generates waste for disposal. The requirements of the order for special handling of plutonium-bearing wastes could be relevant and appropriate for Alternatives 3 and 4 if facilities contain plutonium-bearing wastes (which are not likely).
- The requirements in DOE Order 5820.2A, *Radioactive Waste Management* (DOE 1988), for management of LLW are relevant and appropriate to all alternatives except Alternative 1. The requirements for the management of TRU waste would be relevant and appropriate to the demolition alterative if activities to implement the alternative generated one or more packages of waste that contain greater than 100 nCi/g of TRU constituents at the time of assay (although it is not expected that TRU waste will be generated).
- The requirements in DOE Order 5480.20A, *Personnel Selection, Qualification, and Training* (DOE 1994), are relevant and appropriate for all alternatives except Alternative 1 for facilities that are classified as nuclear by the preliminary hazard classification analysis.
- The requirements in DOE Order 5480.23, *Nuclear Safety Analysis Reports* (DOE 1992b), to identify hazards, analyze hazards and accidents, and identify controls and mitigation measures to safely manage the hazards are relevant and appropriate to all alternatives for facilities that are classified as nuclear by the preliminary hazard classification analysis.
- The requirements in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation* (DOE 1993a), to analyze potential hazards from natural phenomena and identify appropriate mitigation measures are relevant and appropriate to all alternatives for facilities that are classified as nuclear by the preliminary hazard classification analysis.

5.1.9 Draft Radiological Criteria for Decommissioning

Two agencies (U.S. Nuclear Regulatory Commission [NRC] and EPA) have proposed standards to establish acceptable levels of residual radioactivity for environmental remediation. These are nonpromulgated standards and are to be considered.

The draft NRC *Radiological Criteria for Decommissioning* (10 CFR 20, proposed revision) provides a regulatory basis to determine the extent to which lands and structures must be remediated before a site can be considered decommissioned.

The draft EPA *Radiation Site Cleanup Regulation* (40 CFR 196, Draft) will set the standards for remediation of soils, groundwater, surface water, and structures at Federal facilities. These proposed standards would not apply to Alternatives 1 and 2, because these alternatives do not decommission or demolish any facilities. Alternatives 3 and 4 would comply with these proposed standards.

5.2 OTHER CONSIDERATIONS

In accordance with DOE Order 451.1 (DOE 1995) and NEPA policy, DOE CERCLA documents are required to incorporate NEPA values such as analysis of cumulative, offsite, ecological, and socioeconomic impacts to the extent practicable.

Cumulative impacts may occur in both the short term and long term because of interrelationships among other activities occurring in the 100 Area. Other activities in the 100 Area include the following:

- Remediation of waste sites and groundwater in the reactor areas
- Safe storage activities for the 105-C Reactor (to be followed by safe storage activities for the other reactors)
- Storage and removal of spent fuel contained in basins at the 100-K Area
- Removal of ancillary facilities in the other reactor areas.

Each of these activities contributes to the goals of 100 Area remediation including protection of the Columbia River. However, due to the increasing scarcity of resources to accomplish the work, each of these activities also competes with the others for priority allocation of funding.

Near-term decontamination and demolition of the facilities addressed in this EE/CA would require significantly greater commitment of budget resources (including disposal costs, workers, equipment and supplies) during the time necessary to accomplish the removal action than would be required to continue S&M. Therefore, in the near term, Alternatives 3 and 4 would impose a greater cumulative burden in terms of additional competition for remediation dollars and work force resources than either Alternatives 1 or 2.

In the long term, the overall cumulative effect of the 100 Area activities is to enhance the protection of workers, the public, and the environment, which is consistent with the values expressed by the regulators, stakeholders, affected tribes, and the public. Long-term S&M will not provide a permanent remedy consistent with these cumulative benefits. In the long term, completion of either Alternatives 3 or 4 would be consistent with and supportive of the overall cumulative benefits that will be derived from the remedial activities in the 100 Area.

Offsite impacts include affects on the public or the environment due to release of contaminants resulting from an activity. Alternatives 1 and 2 are not expected to result in negative offsite impacts in the near term. Continued confinement of hazardous substances in the facilities would become more difficult with time, increasing the potential for offsite impacts. Alternatives 3 and 4 would potentially result in airborne emissions of hazardous substances, but significant or long-term impacts are not expected.

None of the alternatives are expected to affect existing natural resource conditions. Although bald eagles frequent the Columbia River during the winter, there are no identified roosts near the 100-N Area.

Surveys indicate that all proposed activities are unlikely to disturb sensitive plant or animal species. Prior to initiation of any specific field activity, an ecological review of the facility and surrounding area would be conducted to ensure there would be no impacts to natural resources (e.g., migratory birds).

There would be no unmitigated impacts to cultural resources with implementation of any of the alternatives.

Socioeconomic impacts from any of the alternatives would be minimal. The work force required for current S&M activities is small. Personnel required to accomplish either Alternative 3 or Alternative 4 would be selected from the existing S&M and remediation work force at the Hanford Site or would be made available to subcontractors.

In evaluating Alternatives 3 and 4, consideration should be given to potential future land-use planning needs and values expressed by the regulators, stakeholders, public, and the Tribes, with regard to the preferred future use of the 100-N Area.

Table 5.1. Summary of Estimated Costs for Alternatives[a]

Description	Summary Cost Estimates[a]
Alternative 2 - Long Term Surveillance and Maintenance	
Remedial Unit 1	$15,140
Remedial Unit 2	$57,040
Remedial Unit 3	$40,000
Remedial Unit 4	$31,920
Remedial Unit 5	$324,030
Other Facilities	$141,000
Total (annual costs)	$609,130
Alternative 3 - D&D with Disposal at ERDF and Other Landfills	
Remedial Unit 1	$5,541,000
Remedial Unit 2	$2,574,000
Remedial Unit 3	$2,172,000
Remedial Unit 4	$5,553,000
Remedial Unit 5	$12,308,000
Other Facilities	$27,813,000
Total	$55,961,000
Alternative 4 - D&D, ERDF Disposal and In Situ Burial	
Remedial Unit 1	$5,332,000
Remedial Unit 2	$2,115,000
Remedial Unit 3	$1,814,000
Remedial Unit 4	$5,359,000
Remedial Unit 5	$6,210,000
Other Facilities	$20,759,000
Total	$41,589,000

[a]These estimates do not account for escalation or contingency.

100-NR-1
CHAPTER 6.0
RECOMMENDED ALTERNATIVE

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 6.0
RECOMMENDED ALTERNATIVE

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CHAPTER 6.0
RECOMMENDED ALTERNATIVE

TABLE OF CONTENTS

6.0 RECOMMENDED ALTERNATIVE..... 5

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6.0 RECOMMENDED ALTERNATIVE

Based on implementability, short-term effectiveness, and cost, the recommended alternative to address the contaminated ancillary facilities (listed in Table 2.1 of this EE/CA) is to implement Alternative Two, which involves performing S&M until such time that Decontamination and Decommissioning (D&D) work could be planned and executed. At that time, Alternative Four would be implemented, which involves performing D&D work in accordance to the process and priority order established by the attached proposed integration plan (i.e., interfering facilities in RU 1 first, then interfering facilities in RU 4, etc., as listed in Table 2.1). Alternative Four provides a protective, permanent solution and is more effective than Alternative Two; however, in the interim, S&M provides adequate protection until final remedial actions can be scheduled in coordination with the overall 100 Area remedial priorities established in the Tri-Party Agreement based on values expressed by regulators, stakeholders, affected tribes, and the public.

It should be noted that Alternative One is not considered to be effective. Alternative Three provides protection of human health and the environment equal to Alternative Four but it is not cost effective.

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100-NR-1
CHAPTER 7.0
100-N AREA INTEGRATION PLAN FOR D&D & REMEDIAL ACTION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 7.0
100-N AREA INTEGRATION PLAN FOR D&D & REMEDIAL ACTION

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CHAPTER 7.0
100-N AREA INTEGRATION PLAN FOR D&D & REMEDIAL ACTION

TABLE OF CONTENTS

7.0 100-N AREA INTEGRATION PLAN FOR D&D & REMEDIAL ACTION 5
7.1 Introduction 5
7.2 Assumptions 5
7.3 Remediation Prioritization and Sequencing Criteria 6
7.3.1 Remediation Prioritization 6
7.3.2 Sequencing of Work 8
7.3.3 General Work Sequence 10
7.4 Schedule 10
7.5 References 11

FIGURES

Figure 7.1 Remedial Unit Number 1 13
Figure 7.2 Remedial Unit Number 2 14
Figure 7.3 Remedial Unit Number 3 15
Figure 7.4 Remedial Unit Number 4 16
Figure 7.5 Remedial Unit Number 5 17
Figure 7.6 Remedial Unit Number 6 18
Figure 7.7 TSD Waste Sites at the 100-N Area 19
Figure 7.8 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities 20

TABLES

Table 7.1. Comprehensive List of the Waste Sites Grouped by RUs 6
Table 7.2. Priority Ranking for the RUs and the TSD Unit 8
Table 7.3. Interfering Facilities by Remedial Unit 12
Table 7.4 100-N Area Remedial Action Waste Sites 25

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7.0 100-N AREA INTEGRATION PLAN FOR D&D & REMEDIAL ACTION

7.1 Introduction

This appendix (hereafter referred to as the Integration Plan) was developed to ensure that decontamination and demolition (D&D) and remediation activities associated with the 100-N Area would be coordinated and conducted in an efficient manner. The intent of the Integration Plan is to minimize the cost and optimize the efficiency of environmental remediation of contaminated waste sites and the removal of the facilities in the 100-N Area. Integration of 100-N Area D&D and remediation activities has been recognized by the U.S. Department of Energy, Richland Operations Office (RL) and the Washington State Department of Ecology (Ecology) as a critical step in ensuring effective and efficient environmental remediation of the 100-N Area.

The plan includes (1) assumptions used to develop the Integration Plan, (2) the criteria used to group waste sites into remedial units (RUs) and to establish remediation priority of the waste site groups, (3) the general work sequence established for the remediation of the 100-N Area, and (4) the proposed integrated schedule of the D&D of the 100-N facilities and the remediation of the RUs.

The prioritization and sequencing of the waste sites within a RU, and the detailed planning and design for the D&D of facilities and remediation activities are considered beyond the scope of this Integration Plan and will be provided in the remedial design report/remedial action work plan document.

7.2 Assumptions

This section identifies the assumptions used to develop the Integration Plan. They are based on direction and scoping assumptions provided by RL and are based on current project planning strategies for the Environmental Restoration Program. These assumptions are:

- A ten-year duration was used for completion of D&D and remediation activities.
- The proposed schedule presented in the Integration Plan is a duration-only schedule (i.e., does not include specific start or end dates) and allows for flexibility for determining the start of the remedial activities.
- The recommended alternatives, as described in Section 6.0 of the Engineering Evaluation/Cost Analysis (EE/CA) will be implemented to address the 100-N Area ancillary facilities.
- For 100-N Area facilities, the D&D cost estimates, schedule and durations, and waste volume estimates were derived from the U.S. Army Corps of Engineers' Micro Computer-Aided Cost Estimating System (MCACES).
- For waste sites, the cost estimates, schedule and duration, and waste volume estimates were taken from the 100-NR-1 and 100-NR-2 Corrective Measures Study (CMS).
- The Integration Plan only addresses the liquid and solid waste disposal sites in the 100-N Area identified for the remedial action and D&D of the 100-N ancillary facilities.
- The 105-N Reactor Facility and the 109-N Heat Exchanger Facility (hereafter referred to as the Reactor Complex) are not addressed in this Integration Plan. These facilities are part of the Interim Safe Storage (ISS) Project and will be addressed with the long-term disposition of the 100-N Reactor.
- Remediation activities of waste sites in the buffer zone (defined as the facilities needed to support the reactor until the ISS program is implemented and all waste sites within 15.25 m [50 ft] of the 105-N and 109-N facilities) will not be conducted until a decision is made on the future disposition of the 100-N Reactor. The remediation activities will be according to the recommended alternative identified in the 100-NR-1 and 100-NR-2 Record of Decision (ROD). The facilities in the buffer zone will be limited to surveillance and maintenance until a decision is made on the future disposition of the 100-N Reactor. Then, the facilities will be removed according to the recommended alternative identified in this document.

These facilities and waste sites are included in the integrated schedule. This will allow early action on these sites and facilities should the opportunity occur but in no case later than the ISS.

- The Hanford Generating Plant Complex is addressed in the Integration Plan.
- Identification of the waste sites in the Integration Plan was based on the most current information available in the Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units, Draft A, DOE/RL-95-111 (DOE-RL 1996) and 100-NR-1 Treatment, Storage, and Disposal (TSD) Units Corrective Measures Study/Closure Plan, Draft A, DOE/RL-96-39 (DOE-RL 1997). The remediation cost estimates, schedule and durations, and waste volumes for the waste sites were also derived from the current information available in these documents.
- After the 100-NR-1 and 100-NR-2 Operable Units ROD is issued, the remedial design/remedial action process will be used to establish the detailed schedule for the integrated activities and the remedial design report/remedial action work plan will document the negotiated schedule dates.

7.3 Remediation Prioritization and Sequencing Criteria

This section provides the criteria used to establish the remediation prioritization for the waste sites and a sequence in which the work activities could be performed without causing interferences between activities.

7.3.1 Remediation Prioritization

The 100-N Area waste sites have been grouped into six RUs, the treatment, storage, and disposal (TSD) unit, and the Columbia River shoreline. Subdividing the 100-N Area waste sites by geographic location and type of contamination was found to be an effective management tool to plan and implement the remediation activities. In other words, when individual waste sites were in close proximity to one another, a common-sense approach was applied in considering their inclusion in a particular grouping. The contaminants of concern at the 100-N Area waste sites include radionuclides, petroleum hydrocarbons, and inorganic chemicals such as acids, nitrate, chromium, and lead. Grouping the waste sites increased flexibility for scheduling, funding, and contracting. The RUs do not have an established boundary, but are defined as:

Table 7.1. Comprehensive List of the Waste Sites Grouped by RUs

RU 1	Radioactive sites located between the 105-N Reactor and the Columbia River.
RU 2	Petroleum and fuel oil spills and leaks in the vicinity of the 184-N Powerhouse, which is directly east of the 105-N Reactor.
RU 3	A mixture of sites, mostly spills and releases of acids and caustics with potential radioactivity, south of the 105-N Reactor and near the water treatment facilities.
RU 4	A mixture of sites, mostly radioactive or diesel, and fuel oil spills and leaks in the vicinity of the 1310-N Chemical Storage Tank and the oil storage tank farm, north of the 105-N Reactor and near the Columbia River.
RU 5	Sites associated with the Hanford Generating Plant.
RU 6	Miscellaneous solid waste sites not included as part of another RU.
TSD Unit	Group of the four sites designated as TSD units under the Resource Conservation and Recovery Act of 1976 (RCRA).
River Shoreline	The river shoreline area adjacent to the N-Springs Area up to approximately the 123 m (402 ft) elevation. (The river shoreline is not addressed in the Integration Plan. No schedule has been proposed pending selection of the final groundwater remedial action alternative.)

Table 7.1 provides a comprehensive list of the waste sites grouped by RUs, and Figures 7.1 to 7.6 illustrate the RU groupings. The TSD units are shown in Figure 7.7. The remediation prioritization of the six RUs and the TSD unit was based on the following considerations:

- Potential short-term impact to the public and/or the environment.
- Inventory of contaminants.
- Potential of contaminant migration to the groundwater.
- Proximity to the Columbia River.
- Input by RL and regulators.

After evaluating the impacts of these factors, it was determined that, in the short term, there are no significant negative impacts to the public or the environment. This is based on the current administrative and institutional controls that are in place for the purpose of protecting the public and environment. Therefore, the first consideration did not weigh heavily in the prioritization process.

The type and quantity of contaminants were considered when prioritizing remedial units. It was determined that, in general, those sites contaminated with high inventories of radionuclides would receive a higher priority than sites that contain other hazardous substances, such as petroleum-product contamination or acids/caustics. However, because these factors are not considered independently of one another, there may be some sites without radioactive contamination that received a higher priority than some sites with radioactive contamination. Because petroleum is immiscible, petroleum contamination was also considered to be an important factor in determining priorities, particularly in terms of impact on groundwater. Another consideration was the recognition that the TSD units and certain ancillary facilities may be considered contributors to the "skyshine" that exists at the 100-N Area. Skyshine is a phenomena created by 100-N Area facilities and waste sites containing significant inventories of gamma emitting radionuclides (primarily cobalt-60). Skyshine is produced by the interaction of gamma rays with the atmosphere and the subsequent downward scatter of the gamma rays. Skyshine results in an increase in the ambient radiation over background conditions in the 100-N Area. The following TSD units and ancillary facilities have been considered contributors:

- 1304-N Emergency Dump Tank
- 1310-N Liquid and Waste Treatment Facility
- 1314-N Liquid Disposal Building
- 107-N Basin Recirculation Cooling Facility
- 105-N Fuel Basin
- 1301-N Liquid Waste Disposal Facility
- 1325-N Liquid Waste Disposal Facility

The recognition that these units and ancillary facilities could potentially contribute to skyshine supports the prioritization/sequencing criteria established in Section A3.0. The 1301-N and 1325-N facilities are within the TSD unit and the remaining facilities except for the 105-N, which is part of the ISS Program are within RU 1 and RU 4. These three units are the highest priority.

In conjunction with other considerations, waste sites in close proximity to the Columbia River were given a relatively higher priority because of the major importance to the community and public concern about this resource. RL and the regulators have confirmed during a planning meeting that these are valid factors for prioritizing remediation of waste sites.

Based on the considerations described above, the following is the priority ranking for the RUs and the TSD unit:

Table 7.2. Priority Ranking for the RUs and the TSD Unit

Priority	Unit	Reason
1	TSD	Largest radionuclide inventory/regulator input
2	RU 1	Radionuclide inventory/proximity to the Columbia River
3	RU 4	Radionuclide and petroleum inventories/proximity to the Columbia River
4	RU 2	Petroleum inventory/proximity to the Columbia River
5*	RUs 3, 6, and 5	Radionuclide and acid/caustic inventory plus solid waste

Note: Based on the applicable considerations, RUs 3, 6, and 5, scheduled in that order, were determined to be the lower priority units. However, the schedule is flexible to allow for reprioritization of these RUs. Remediation work associated with these units will be scheduled in a way that accomplishes efficient funding and contracting over the designated duration of the project.

7.3.2 Sequencing of Work

In establishing the sequence of work to integrate facility D&D and waste site remediation, several factors were considered: (1) proximity of facilities to waste sites, (2) 100-N Area active facilities and infrastructure requirements, and (3) impact of the ISS Program on the 100-N Reactor and the buffer zone.

7.3.2.1 Proximity of Facilities to Waste Sites

Several facilities in the 100-N Area are in close proximity to or will interfere with waste site remediation. If the selected remedy for the 100-NR-1 and 100-NR-2 operable units is the remove and dispose alternative, the facilities that are located adjacent to, or overlap, the waste site excavation footprint would need to be demolished prior to remediation. The facilities requiring D&D before remediation of a waste site (see Table 7.2) were determined by assuming that excavation of a waste site would be 4.6 m (15 ft) below surrounding grade and would have a safety zone of approximately 7.6 m (25 ft) around the excavation footprint to provide protection from slope failure.

7.3.2.2 Critical Infrastructure Systems

Several facilities in the 100-N Area will remain active to support 100-Area D&D and remediation activities. These facilities will be operated until it is determined that they are no longer needed, at which time they will be decommissioned and demolished. Contaminated ancillary facilities will be decommissioned and demolished according to the decision documented in the Action Memorandum, a CERCLA decision document; a CERCLA decision document is not required for noncontaminated facilities. The noncontaminated facilities will be decommissioned and demolished under the existing NEPA categorical exclusion for decommissioning of small buildings according to 10 CFR 1021, B1.23. CERCLA applies to management of hazardous substances; therefore, no *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) documentation, such as an EE/CA, is required for addressing facilities that contain only nonhazardous substances.

Critical infrastructure systems (e.g., potable and sanitary water lines, electrical power utilities, and fire suppression pipelines), which must be maintained to protect and service active facilities, are expected to be near or within the excavation footprint of waste sites to be remediated. To avoid possible interferences with the remediation work, wherever possible, these utilities will be isolated, rerouted, and/or partially removed prior to remediation of the waste sites. However, it is recognized that some factors associated with the isolation of the infrastructure systems could potentially impact the waste site remediation sequence. These factors are identified below so the potential impacts to remediation of waste sites may be considered in the remedial design.

Electrical

Removal of electrical systems is typically the last isolation activity performed because power would be needed to support the D&D and remediation activities. However, if the underground conduit poses a

threat to workers during excavation to isolate another utility (e.g., raw water), the electrical system would be deactivated first and alternative power supplies (e.g., generators, temporary overhead lines) would be used.

There are two areas of buried conduit banks that could impact the D&D and remediation activities. One area is located between the 1705-N and the 105-NB facilities, north of the 105-N Reactor facility, which feeds the office complex and machine shops in the 1705-N Building. There are no waste sites in the immediate vicinity. However, waste site 100-N-22 is located north of the area and the exact location of the conduit line would need to be determined to ensure that safety would not be jeopardized during excavation of the waste site. The other electrical conduit line begins on the north side of the 183-N, continues around the facility, then branches west toward the clearwell and south to the 1137-N and 163-NA facilities. Waste sites 100-N-27 and UPR-100-N-34 could be impacted by this conduit line.

Fire Protection

Fire protection pipelines, considered the most important underground utility at the site, would be a long-term requirement for the 100-N Area until all the facilities are removed. Once facilities have been decommissioned and demolished to the extent necessary to alleviate the need for fire suppression, the facilities would be isolated/removed from the buried fire line system. Therefore, the only buried fire pipes that could impact remediation are those supporting facilities during S&M. It is expected that D&D and remediation activities will interfere with buried fire lines, during which time acceptable temporary systems may be utilized (e.g., portable wheeled units using dry chemicals or carbon dioxide).

Potable Water and Sanitary Sewer

The 100-N area currently maintains a potable water supply system which serves several facilities. Additionally, several facilities are serviced by sanitary sewer systems. Isolation/removal of these systems would not impact the D&D and remediation activities because temporary sanitary systems (e.g., port-a-systems) would be installed, and bottled drinking water would be supplied.

Railroads

Prior to segregating the rail spur, railroad cars containing the contaminated shipping casks would need to be dispositioned and/or moved out of the area. The rail lines lying on the west side of the 100-N Reactor complex could impact the remediation of waste sites located in RUs 1 and 4. However, at this time there is no justification to keep the rail lines functional, therefore, they would be removed.

Roadways and Paved Areas

It is preferable to use existing paved and gravel roads because construction of new roads would potentially impact cultural and ecological resources. However, if roads interfere with D&D and remediation activities, the roads would be removed. Alternative transportation routes would be selected to minimize impacts to undisturbed areas.

Communications and Alarm Systems

Telephone and Hanford local area network (HLAN) fiber-optics lines are located throughout the 100-N Area and may be rerouted at relatively little expense and with short notice without impact to D&D and remediation activities. The public address system is not considered a critical system since the 105-N Reactor facility is currently being deactivated. An alarm tower on the 184-N facility would remain operable. The alarm system would be relocated prior to D&D of the facility.

7.3.2.3 ISS of the 100-N Reactor and the Buffer Zone

The 105-N Reactor Facility and the 109-N Heat Exchanger Facility are considered part of the ISS Program for the N Reactor. The ISS Program delays remediation of the N Reactor until sometime in the future. Associated with the 105-N and 109-N facilities are three other facilities, the 116-N Air Stack, the 117-N Exhaust Filter House, and the 119-N Stack Air Sampling Monitor Building, which support the

ventilation system for the 105-N and 109-N facilities until the ISS Program is implemented. Additionally, 15 contaminated waste sites have been identified as sites that cannot be remediated until the facilities that interfere with these sites have been decommissioned and demolished. This sequence of D&D and remediation will preserve the integrity of the 105-N and 109-N Reactor buildings. Remediation of the 15 waste sites (in the buffer zone) that are identified in the 100-NR-1 and 100-NR-2 ROD will not be conducted until a decision is made on the future disposition of the 100-N Reactor. Additionally, the 116-N, 117-N, and the 119-N facilities (in the buffer zone) will be limited to surveillance and maintenance until a decision is made on the future disposition of the 100-N Reactor. The facilities will then be removed according to the recommended alternative identified in this document. The facilities and waste sites are included in the integrated schedule. This will allow early action on these sites and facilities should the opportunity occur but in no case later than the ISS.

The buffer zone consists of the waste sites identified below within 15.25 m (50 ft) of the 105-N and 109-N Reactor buildings and the following facilities:

Waste Sites		Facilities
100-N-29[1]	UPR-100-N-10	116-N Air Stack
100-N-30[1]	UPR-100-N-12	117-N Exhaust Filter House
100-N-31	UPR-100-N-3	119-N Stack Air Sampling Monitor Building
100-N-32	UPR-100-N-35	1300-N Emergency Dump Basin
100-N-38	UPR-100-N-39	1303-N Spacer Silos
116-N-4	UPR-100-N-9	
118-N-1	UPR-N-100-7	
UPR-100-N-14		

7.3.3 General Work Sequence

An evaluation of the sequencing factors (which were identified in Sections 3.2.1 through 3.2.3) indicates that initiation of remediation activities is dependent on the reconfiguration of interfering critical infrastructure systems and the D&D of interfering facilities. In addition, the sequence or timing of remediation of a small number of waste sites will be dictated by future decisions regarding the need for various 100-N active support facilities (e.g., water systems, electrical power) and final disposition of the 100-N Reactor. These considerations result in the following general work sequence applicable to each RU:

1. Reconfiguration of interfering critical infrastructure systems.
2. D&D of interfering facilities.
3. Remediation of waste sites.
4. D&D of active facilities.
5. Final remediation of waste sites associated with the active facilities and the 100-N Reactor.

7.4 Schedule

Figure A.8 illustrates the integrated schedule for completing the remediation of the TSD unit, the six RUs (which include waste sites and interfering facilities), and D&D of the facilities independent of waste sites. This integrated schedule was developed based on the prioritization and sequencing discussed in Section A3.0 (e.g., remediation of the TSD unit was identified as the highest priority and therefore appears first on the schedule followed by RU 1, then RU 4). The remediation of the TSD units with the

[1] Waste sites 100-N-29 and 100-N-30 are in close proximity to 116-N-4 and may need to be remediated as part of 116-N-4.

remaining RUs and interfering facilities was determined to encompass the first four years, and the independent facilities and underground piping system remediation was scheduled to begin during year four and continue through year ten.

The sequencing of the interfering facilities and waste sites within the RUs was based on the following logical order:

1. Deactivated interfering facilities
2. Associated waste sites
3. Active facilities
4. Associated waste sites
5. Independent facilities and underground piping systems

The primary driver was to develop a schedule with a relatively even distribution of funding requirements across the remaining six years. Generally, this sequence was followed, except when the independent facilities and underground piping systems were scheduled to accomplish the relatively even funding distributions. Work durations and cost for the TSD units and the RU waste sites were taken from the 100-NR-1 and 100-NR-2 CMS and the 100-NR-1 TSD CMS/CP. Work duration and cost for all the facilities were taken from the MCACES data sheets.

Refined scheduling within these subgroups will be accomplished during detailed remedial design and documented in the remedial design report/remedial action work plan. The schedule assumes a critical path sequencing where first, initial infrastructure requirements, (e.g., isolating or rerouting underground utilities) will be completed at the affected waste site(s) followed by D&D of interfering facilities, and finally waste site remediation.

7.5 References

10 CFR 1021, *National Environmental Policy Act Implementing Procedures*, Code of Federal Regulations, as amended.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. 9601, et seq.

DOE-RL, 1996, *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units*, DOE/RL-95-111, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1997, *100-NR-1 Treatment, Storage, and Disposal (TSD) Units Corrective Measures Study/Closure Plan*, DOE/RL-96-39, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

Table 7.3. Interfering Facilities by Remedial Unit

Remedial Unit 1
1300-N Emergency Dump Basin
105-N to 107-N Pipe Trench
1304-N Emergency Dump Tank
1722-N Decontamination Hot Shop
107-N Recirculation Cooling Building
1303-N Spacer Silos
Remedial Unit 2
184-N Powerhouse
184-NA Powerhouse Annex
184-NB Air Handlers Main Building
184-NC Sample Shack
Remedial Unit 3
163-N Demineralization Water Treatment Plant
183-N Water Filter/Treatment Plant
Remedial Unit 4
13-N Storage Facilities
1310-N Radioactive Liquid and Waste Treatment Facility
1314-N Liquid Disposal Building
1322-N Waste Treatment Pilot Plant Facility
1322-NA Effluent Water Treatment Pilot Plant Annex
116-N Exhaust Air Stack
119-N Stack Air Sampling and Monitoring
Remedial Unit 5
185-N HGP
1716-NE Maintenance Garage
1908-NE HGP Outfall

Note: Remedial Unit 6 and the TSD sites do not contain facilities that would interfere with waste sites.

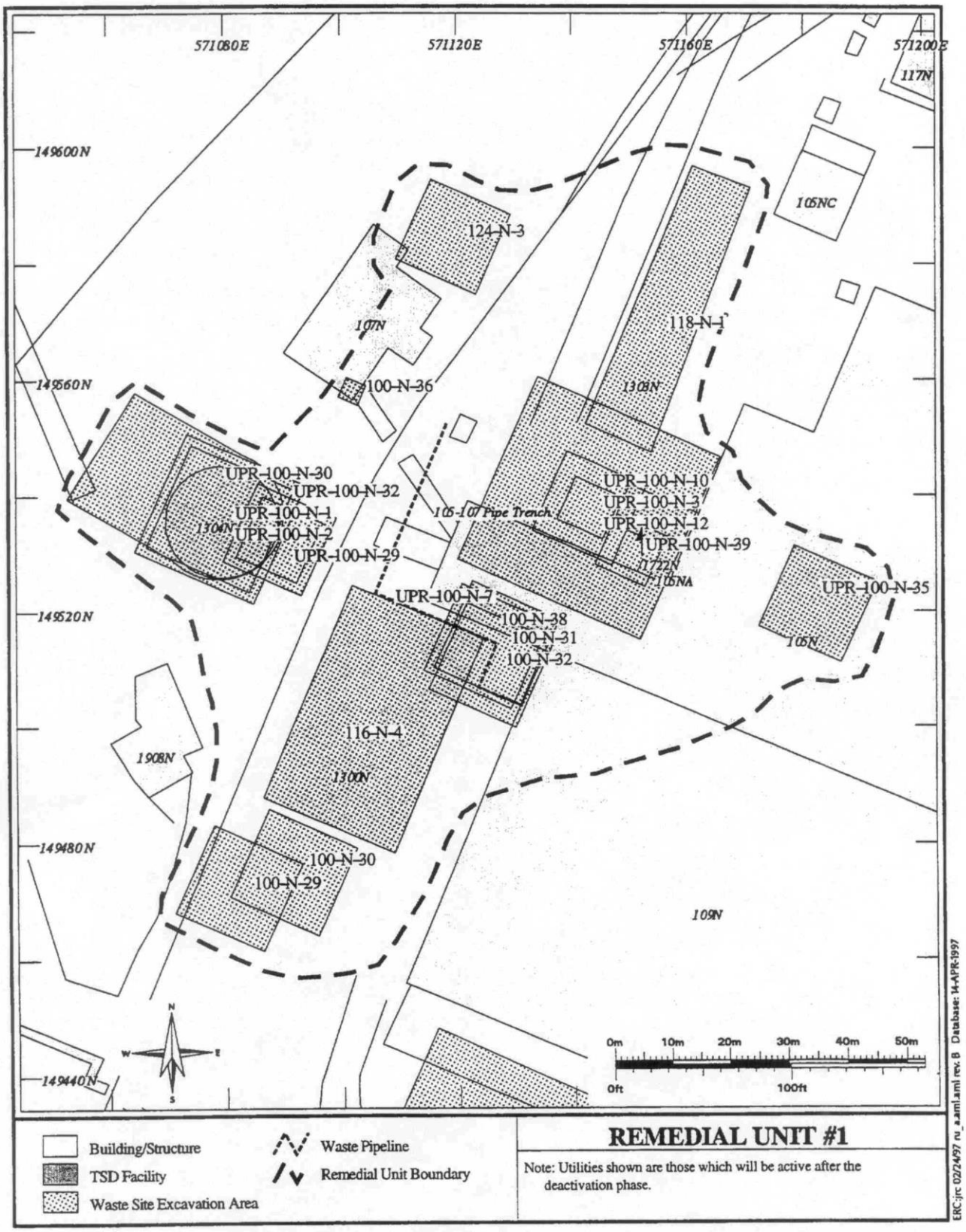

Figure 7.1 Remedial Unit Number 1

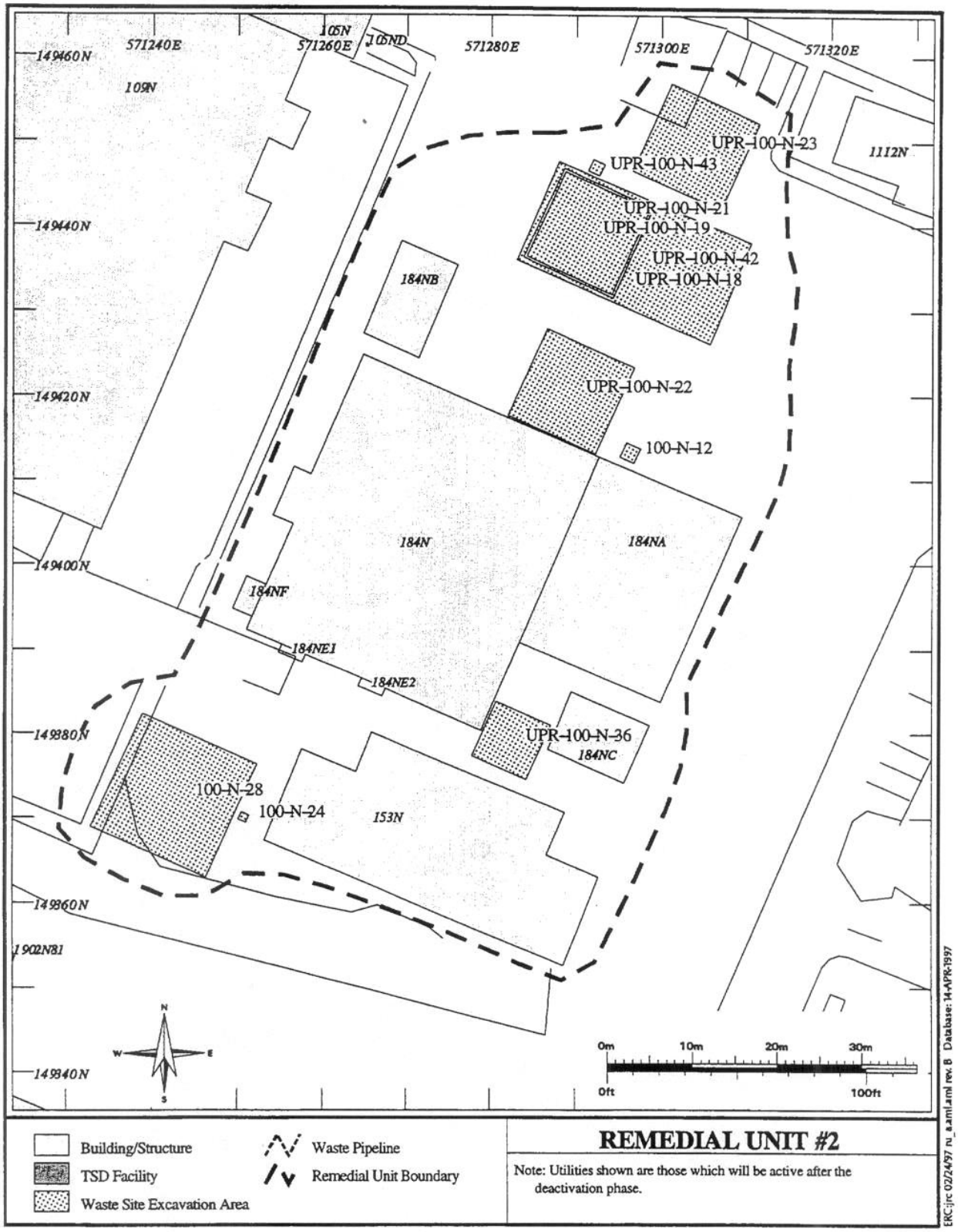

Figure 7.2 Remedial Unit Number 2

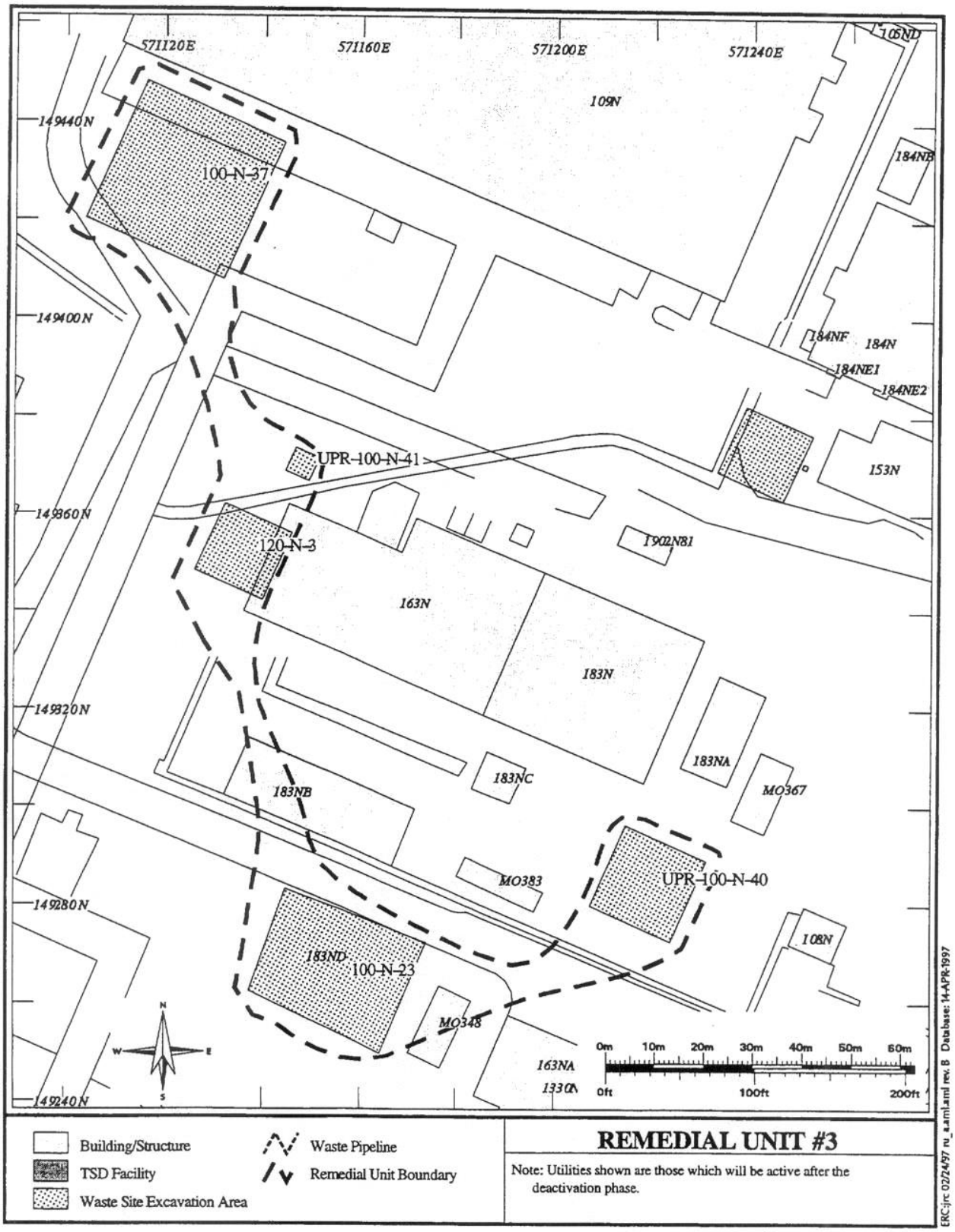

Figure 7.3 Remedial Unit Number 3

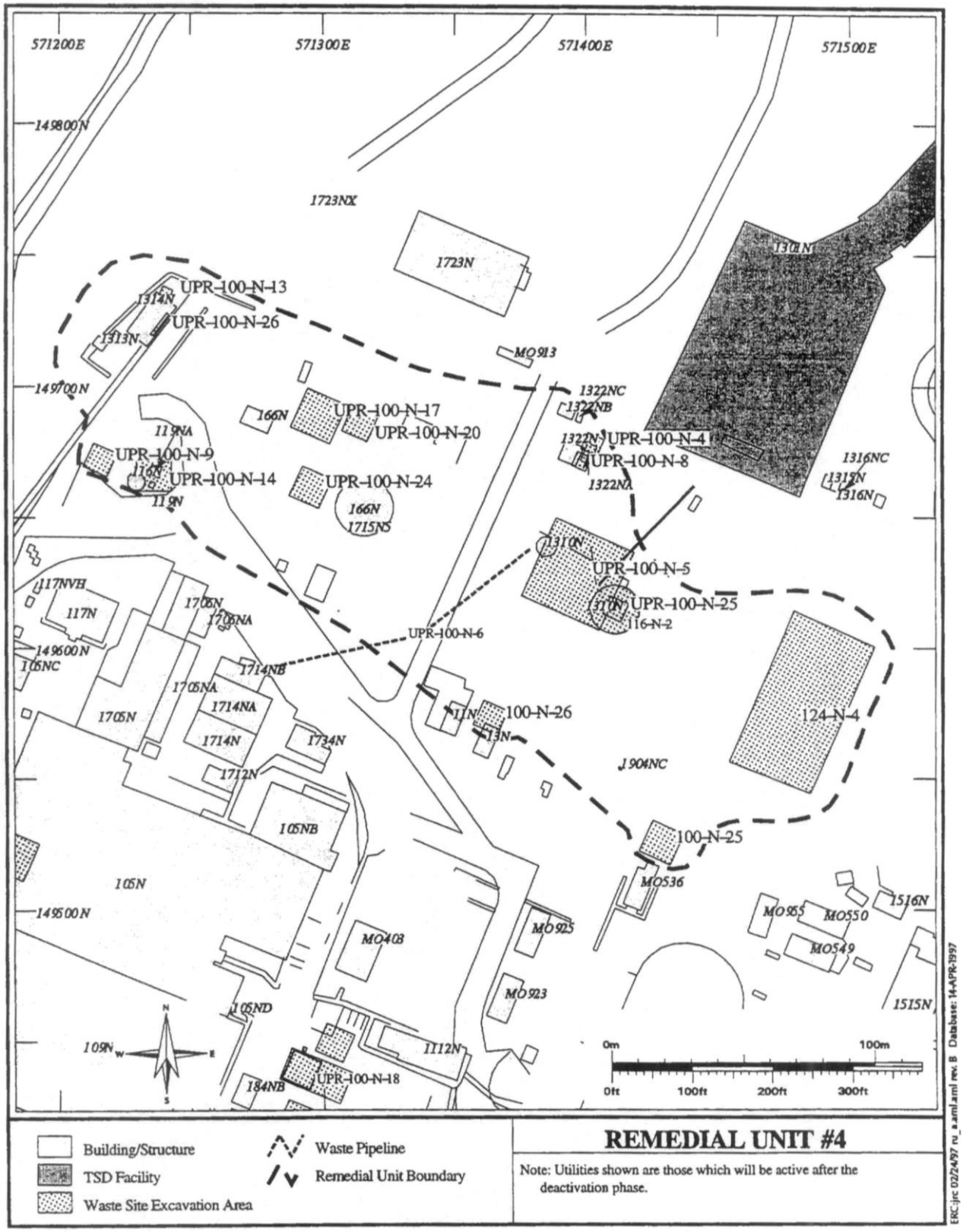

Figure 7.4 Remedial Unit Number 4

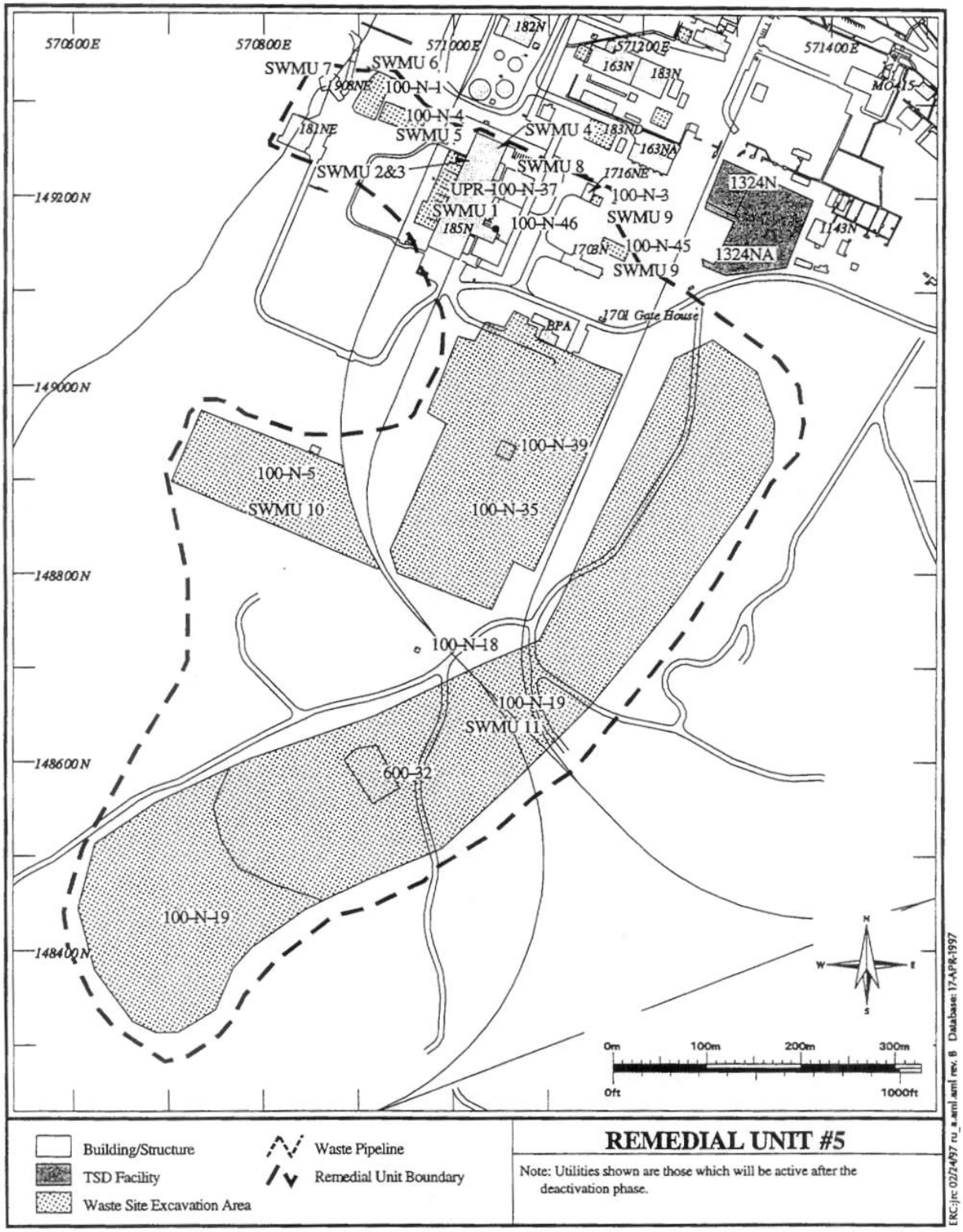

Figure 7.5 Remedial Unit Number 5

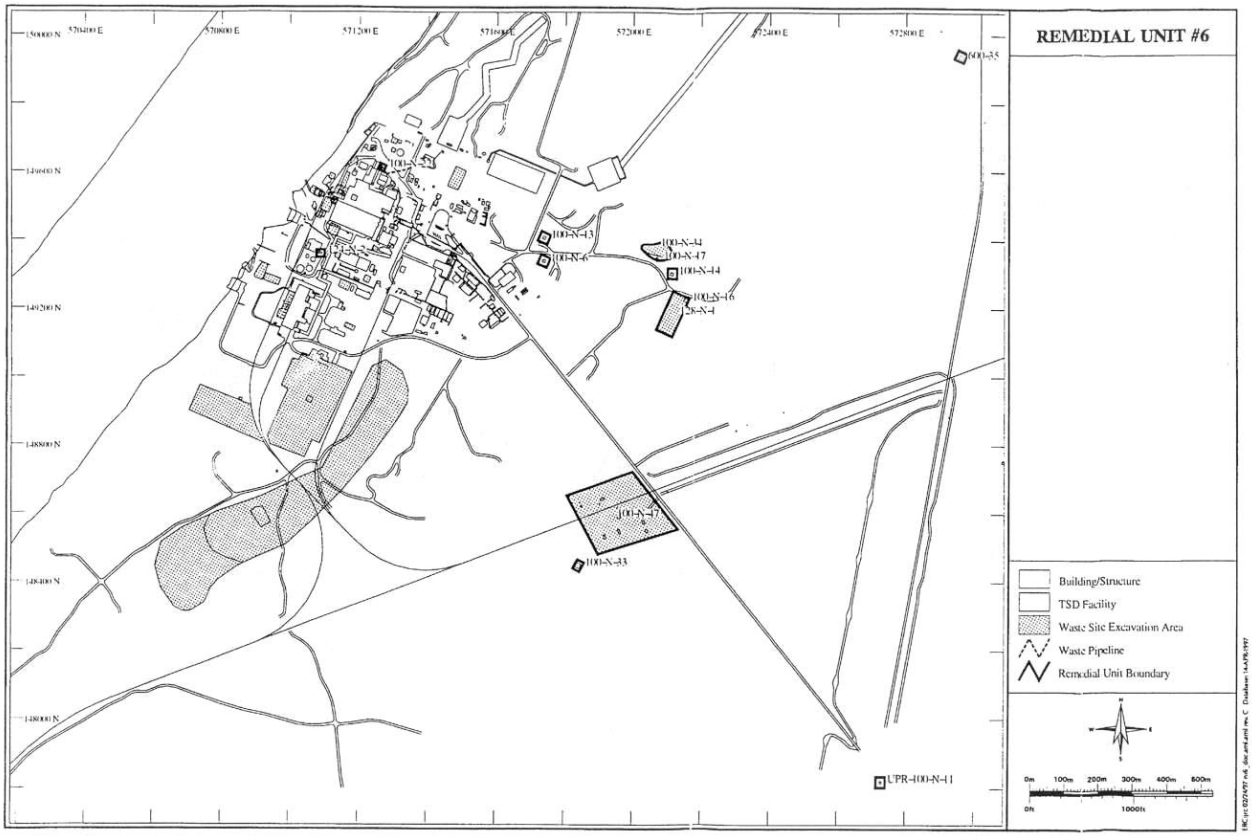

Figure 7.6 Remedial Unit Number 6

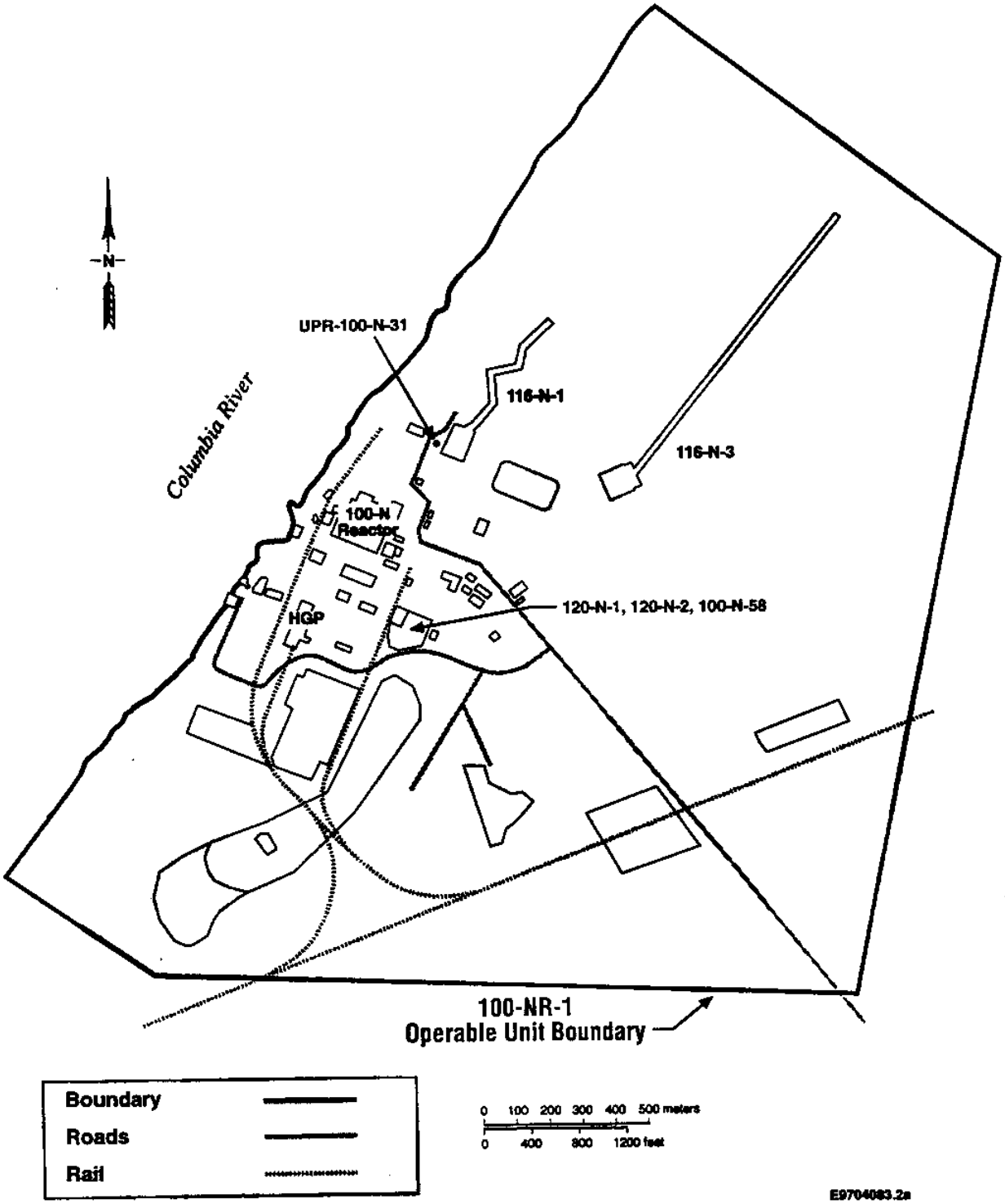

Figure 7.7 TSD Waste Sites at the 100-N Area

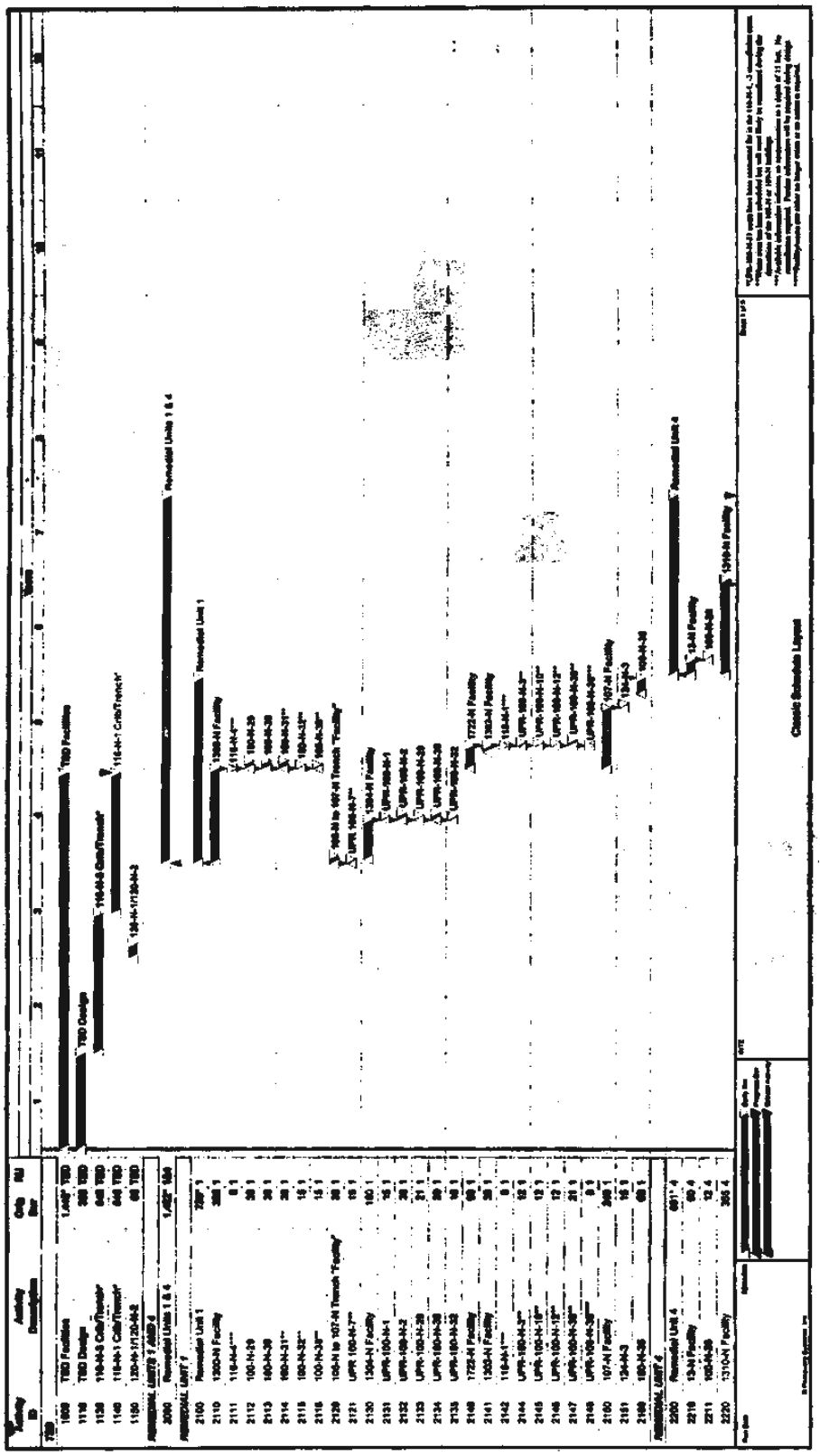

Figure 7.8 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities

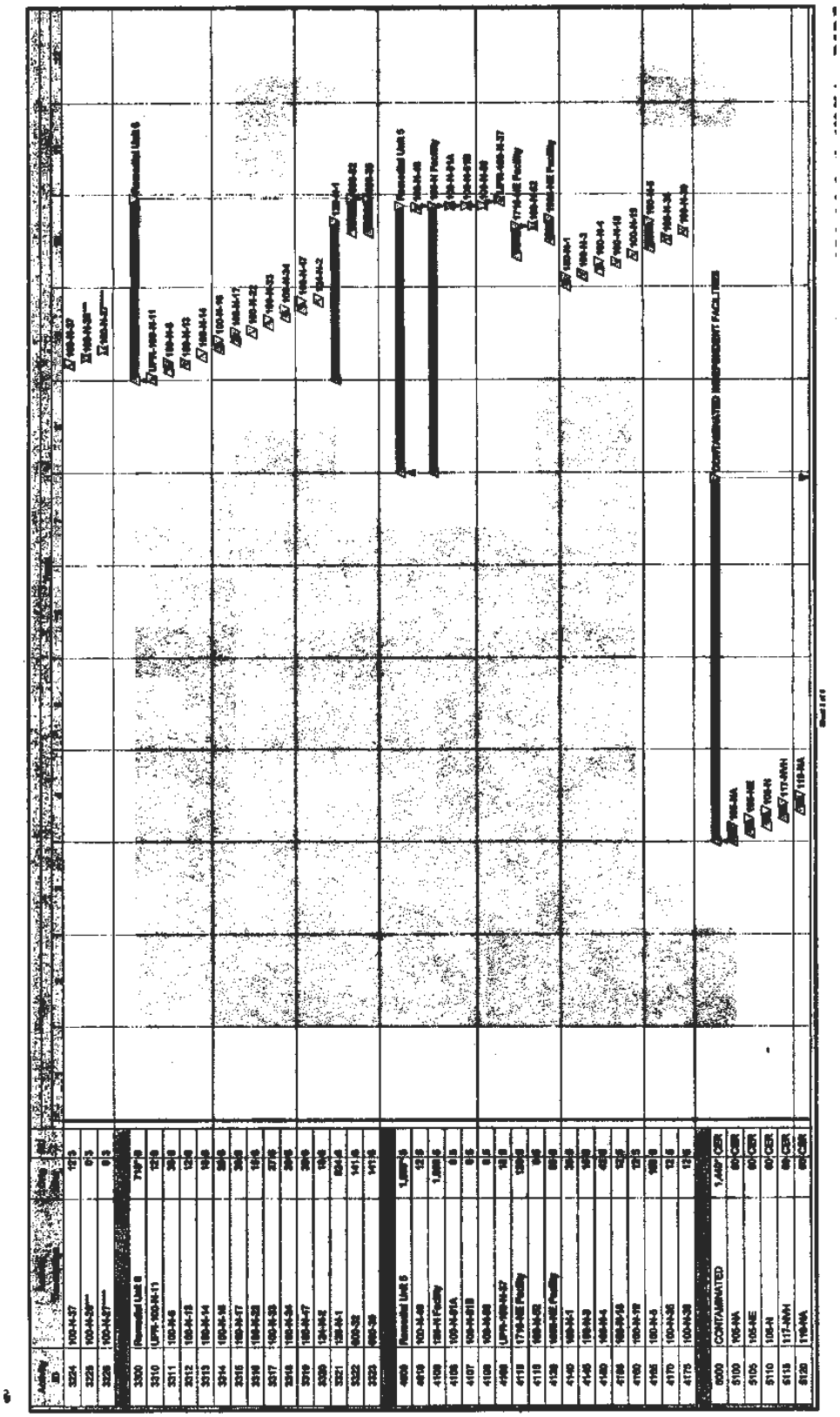

Figure 7.8 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities (con't)

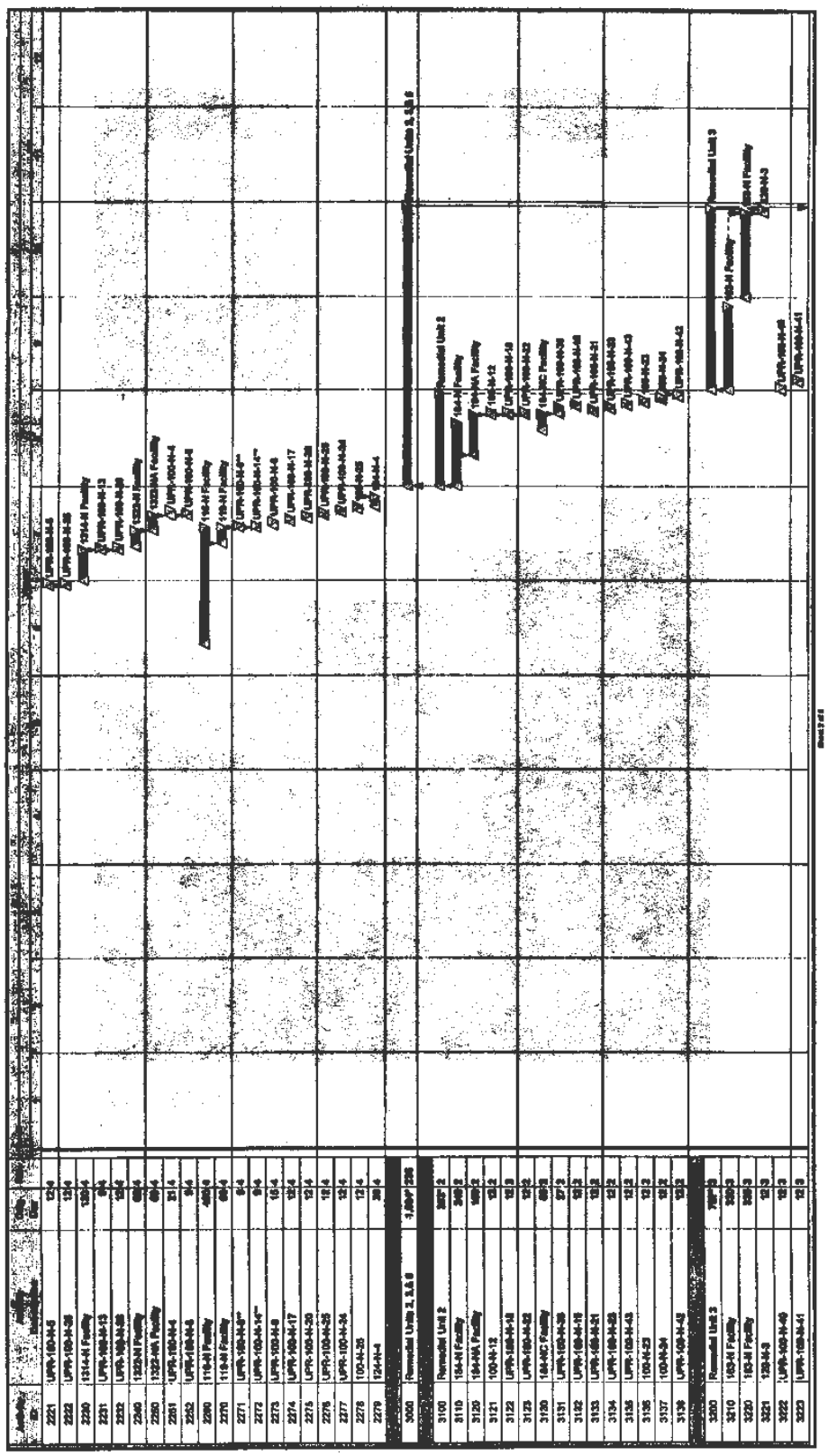

Figure 7.8 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities (con't)

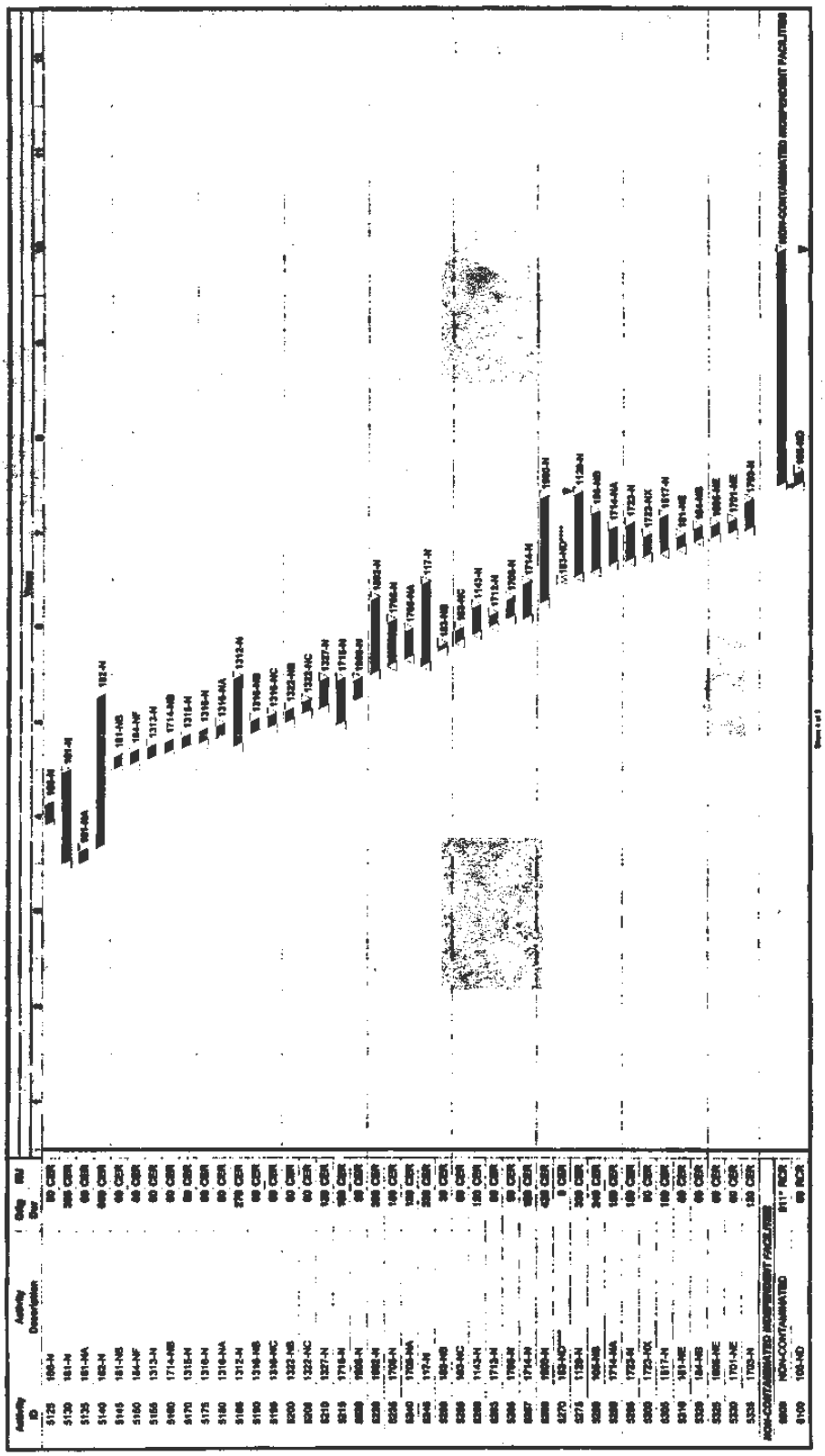

Figure 7.9 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities (con't)

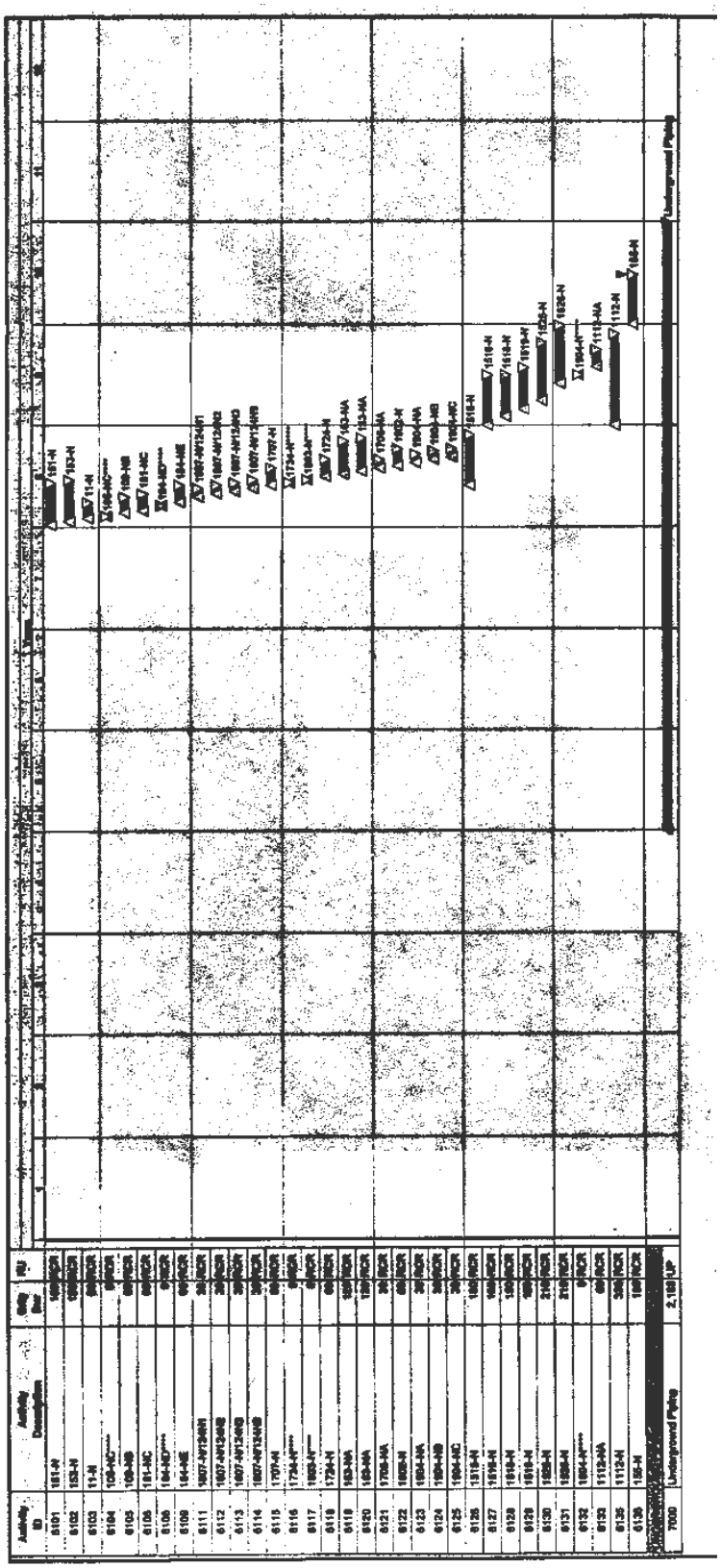

Figure 7.10 Integrated Schedule for the 100-N Area D&D Facilities and Remediation Activities (con't)

Table 7.4 100-N Area Remedial Action Waste Sites

Remedial Unit No. 1	Remedial Unit No. 2	Remedial Unit No. 3	Remedial Unit No. 4	Remedial Unit No. 5	Remedial Unit No. 6	River Shoreline	TSD Facilities
100-N-29[a] 100-N-30[a] 100-N-31[a] 100-N-32[a] 100-N-36 100-N-38[a] 116-N-4[a] 118-N-1[a] 124-N-3 UPR-100-N-1 UPR-100-N-2 UPR-100-N-3[a] UPR-100-N-7[a] UPR-100-N-10[a] UPR-100-N-12[a] UPR-100-N-29 UPR-100-N-30 UPR-100-N-32 UPR-100-N-35[a] UPR-100-N-39[a]	100-N-12 100-N-28 100-N-24 UPR-100-N-18 UPR-100-N-19 UPR-100-N-21 UPR-100-N-22 UPR-100-N-23 UPR-100-N-36 UPR-100-N-42 UPR-100-N-43	100-N-23 100-N-37 120-N-3 UPR-100-N-40 UPR-100-N-41	100-N-25 100-N-26 124-N-4 UPR-100-N-4 UPR-100-N-5 UPR-100-N-6 UPR-100-N-8 UPR-100-N-9[a] UPR-100-N-13 UPR-100-N-14[a] UPR-100-N-17[b] UPR-100-N-20 UPR-100-N-24 UPR-100-N-25 UPR-100-N-26	100-N-1 (SWMU 6) 100-N-3 (SWMU 9) 100-N-4 (SWMU 5) 100-N-5 (SWMU 10) 100-N-18 100-N-19 (SWMU 11) 100-N-35 100-N-39 100-N-45 (SWMU 9) 100-N-46 UPR-100-N-37 (SWMU 1) 1908-NE (SWMU 7)[c] 100-N-50 (SWMU 4)[c] 100-N-51a (SWMU 2)[c] 100-N-51b (SWMU 3)[c] 100-N-52 (SWMU 8)[c]	100-N-6 100-N-13 100-N-14 100-N-16 100-N-17 100-N-22 100-N-33 100-N-34 100-N-47 124-N-2 128-N-1 600-32 600-35 UPR-100-N-11	100-N-65 Shoreline Site	116-N-1 116-N-3 120-N-1 120-N-2 100-N-58 (South Pond) UPR-100-N-31

[a] Buffer zone sites; 13 buffer zone sites in RU 1 out of 15 total sites and 2 buffer zone sites in RU 4 out of a total of 15 sites.

[b] This site has been subdivided into two sites: UPR 100-N-17 is the leak and 100-N-65 is now the petroleum burn pit. 100-N-17 includes 100-N-65.

[c] Waste site contained within a facility.

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100-NR-1
CHAPTER 8.0
HANFORD GENERATING PLANT

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
01/2007	

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CHAPTER 8.0
HANFORD GENERATING PLANT

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CHAPTER 8.0
HANFORD GENERATING PLANT

TABLE OF CONTENTS

8.0 HANFORD GENERATING PLANT 5
8.1 185-N Hanford Generating Plant Turbine Generator Building 5
8.1.1 SWMUs 2, 3, and 4 Located within the 185-N HGP Facility 5
8.1.1.1 SWMU 2, HGP Building Oil Storage 5
8.1.1.2 SWMU 3, HGP Building Floor Drains, Sumps, All Piping to the Settling Pond and Outfall 5
8.1.1.3 SWMU 4, Turbine Oil Filter Unit 5
8.1.2 SWMU 7, 1908-NE HGP Outfall Structure 5
8.1.3 SWMU 8, 1716-NE Maintenance Garage (Storage Garage Building) 5

TABLE

Table 8.1. Suspected Contaminants in 100 N Area Ancillary Facilities 6

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8.0 HANFORD GENERATING PLANT

8.1 185-N Hanford Generating Plant Turbine Generator Building

The 185-N Hanford Generating Plant (HGP) Turbine Generator Building (Remedial Unit 5) is a 19,065-m^2 (205,000-ft^2) facility owned by the Energy Northwest that housed two 430-megawatt, low-pressure steam turbine generators and associated equipment for generating electrical energy from steam supplied by the 100-N Reactor facility. The land under the HGP is owned by U.S. Department of Energy (DOE) and is part of the 100-N Area. The HGP operated continuously from April 1966 to December 1986. In 1996, Tri-Party Agreement Milestone M-16-01A was modified to require the submittal of necessary Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) documentation to support a cleanup decision of the HGP. This document fulfills that milestone. The responsibilities of the cleanup plans are negotiated between Energy Northwest and DOE.

Radiological contamination resulting from transferring 100-N Reactor steam was present in the building. The three Solid Waste Management Units (SWMU) described below are located within of the 185-N HGP facility and are known to be contributors to the hazardous contamination identified in the facility. Additionally, asbestos-containing materials (ACMs) (e.g., insulation used in piping and floor tiles) are expected to have been used in the facility.

8.1.1 SWMUs 2, 3, and 4 Located within the 185-N HGP Facility

8.1.1.1 SWMU 2, HGP Building Oil Storage

Along the interior northwest was of the HGP building is a cinder block building approximately 2.4 by 7.6 m (8 ft by 25 ft). Drums and smaller containers of products (e.g., petroleum, oil, and lubricants) are stored on the floor and shelving. One drum is labeled for used oil. A blind concrete sump (no outlet) is located below the grated floor.

8.1.1.2 SWMU 3, HGP Building Floor Drains, Sumps, All Piping to the Settling Pond and Outfall

Several floor drains in the basement level of the HGP building collect spills, leaks, and any floodwaters and direct them to two main sumps. The sump contents were then discharged to the settling pond (the settling pond is SWMU 6, which is addressed in the 100-NR-1 and 100-NR-2 CMS).

8.1.1.3 SWMU 4, Turbine Oil Filter Unit

The turbine oil cleaning systems are in the basement of the HGP building along the northeast and southeast walls. Each unit consists of a steel tank, 0.7 m^2 by 1.2 m (8 ft^2 by 4 ft) tall as well as a below-grade sump approximately 0.5 m^2 by 1.8 m (6 ft^2 by 6 ft) deep. The tank has a series of filters used when moving the oil from the turbines and is surrounded by a concrete berm that is approximately 15 cm (6 in.) high.

8.1.2 SWMU 7, 1908-NE HGP Outfall Structure

The 1908-NE HGP Outfall Structure is a reinforced concrete, box-shaped structure that extends deep into the ground. This facility was used as a sump for several discharge lines and to drop the liquid discharge level for overflow to the river. An unknown amount of radioactive contamination exists within the structure because the discharge lines were associated with the reactor operations. The structure is no longer operational. The 1908-NE HGP Outfall Structure is also identified as SWMU 7.

8.1.3 SWMU 8, 1716-NE Maintenance Garage (Storage Garage Building)

The 1716-NE Maintenance Garage is an approximately 190-m^2 (2,100-ft^2), 5-m (17-ft) tall, structural-steel-frame building with metal siding and insulated wall panels. The garage is similar in design to a commercial gas station with a front office area, four vehicle bays with roll-up doors, and a back room in the northeast corner used to store paint and maintenance supplies, used oil, and solvents. The back room contains unknown amounts of miscellaneous hazardous materials and is known as SWMU 8. The facility is no longer used.

Table 8.1. Suspected Contaminants in 100 N Area Ancillary Facilities

RU	Facility	Hazardous Substances
Ancillary Facilities that Interfere with Waste Site Remediation		
RU-1	105-N to 107-N Pipe Trench	Radioactive contamination
RU-1	107-N Basin Recirculation/Cooling Building	Radioactive contamination Miscellaneous chemicals Potential mercury (gauges, switches, drains) Lead (shielding/bricks) PCBs (in light ballasts and gear oils) Oil/petroleum products Potential asbestos
RU-1	1300-N Emergency Dump Basin	Radioactive contamination Potential asbestos (insulation)
RU-1	1304-N Emergency Dump Tank	Radioactive contamination
RU-1	1722-N Decontamination Building	Potential radioactive contamination Potential miscellaneous chemicals Potential solvents Potential asbestos
RU-1	1303-N Spacer Silos	Radioactive contamination Potential lead (paint shielding)
RU-2	184-N Power House	Oil/petroleum products Asbestos (insulation) Potential radioactive contamination Potential lead Potential solvents Mercury (gauges, switches, drains)
RU-2	184-NA Power House Annex	Oil/petroleum products Asbestos (insulation) Potential radioactive contamination
RU-2	184-NB Air Handler Main Building	Miscellaneous chemicals Potential radioactive contamination Potential asbestos
RU-3	163-N Demineralized Water Plant	Oil/petroleum products Radioactive contamination Miscellaneous chemicals Potential mercury Potential asbestos (insulation)
RU-4	116-N Ventilation Stack	Radioactive contamination Asbestos

RU	Facility	Hazardous Substances
Ancillary Facilities that Interfere with Waste Site Remediation		
RU-4	119-N Air Sample Facility	Radioactive contamination Potential miscellaneous chemicals Potential asbestos
RU-4	13-N Storage Facility	Potential radioactive contamination Potential lead (paint) Miscellaneous chemicals
RU-4	1310-N Radioactive Liquid and Waste Treatment Facility	Radioactive contamination Asbestos (insulation) Miscellaneous chemicals Lead (shielding/bricks)
RU-4	1314-N Liquid Disposal Building	Lead (shielding/bricks) Solvents Radioactive contamination Potential asbestos (insulation)
RU-4	1322-N Waste Treatment Pilot Facility	Lead (shielding/bricks) Potential solvents Radioactive contamination Potential asbestos (insulation)
RU-4	1322-NA Effluent Water Pilot Plant	Lead (shielding/bricks) Potential solvents Asbestos (insulation) Radioactive contamination
RU-5	185-HGP Turbine Generator Plant	Oil/petroleum products Potential PCB (gear oil) Potential radioactive contamination Asbestos (insulation) Mercury (gauges, switches) Lead
RU-5	1908-NE HGP Outfall	Potential radioactive contamination
RU-5	1716-NE Maintenance Garage	Miscellaneous chemical solvents Oil/petroleum products Lead (paint) Potential asbestos
100-N Facilities that do not Interfere with Waste Site Remediation		
	105-NA Emergency Diesel Enclosure	Oil/petroleum products Potential radioactive contamination Potential asbestos (insulation)

RU	Facility	Hazardous Substances
Ancillary Facilities that Interfere with Waste Site Remediation		
	105-NE Fission Products Trap	Radiological contamination Potential oil/petroleum products Potential mercury Asbestos Potential solvents Potential miscellaneous chemicals Potential lead (shielding)
	108-N Chemical Unloading Facility	Miscellaneous chemicals Potential oil/petroleum products Potential radioactive contamination Lead piping Potential asbestos (insulation)
	117-NVH Valve Control House	Radioactive contaminations Solvents Potential asbestos (insulation)
	119-NA Stack Air Sampling and Monitoring	Potential radioactive contamination Potential miscellaneous chemicals Potential asbestos (insulation)
	166-N Fuel Oil Storage Building	Asbestos (insulation) Oil petroleum products Potential PCB (light ballasts) Potential miscellaneous chemicals
	181-N River Pump house	Oil/petroleum products Potential asbestos (insulation)
	181-NA Pump house Guard Tower	Oil/petroleum products Potential asbestos (insulation)
	181-NB #3 Diesel Pump house	Oil/petroleum products Asbestos (insulation)
	182-N High Lift Pump house	Oil/petrolcurn products Asbestos (insulation) Mercury (switches, gauges) Potential radioactive contamination Potential solvents
	184-NF Chemical Injection	Miscellaneous chemicals
	1312-N Liquid Effluent Retention Facility	Potential radioactive contamination
	1313-N Change Control Building	Radioactive contamination Potential miscellaneous chemicals Potential asbestos (insulation) Potential oil products

RU	Facility	Hazardous Substances
Ancillary Facilities that Interfere with Waste Site Remediation		
	1315-N Diversion Valve House	Radioactive contamination Potential oil/petroleum products Potential asbestos
	1316-N Valve House	Radioactive contamination Potential oil/petroleum products Potential asbestos
	1316-NA Valve Vault	Radioactive contamination Potential oil/petroleum products Potential asbestos
	1316-NB Magnetic Flow meter Vault	Radioactive contamination Potential oil/petroleum products Potential asbestos
	1316-NC Turbine Meter Vault	Radioactive contamination
	1322-NB Crib Effluent Iodine Monitoring Building	Lead (shielding/pigs) Mercury (gauges, switches) Miscellaneous chemicals Radioactive contamination Potential asbestos
	1322-NC Crib Sample Pump Pit	Potential solvents Radioactive contamination Potential asbestos
	1327-N Diversion Valve House	Radioactive contaminants Potential oil/petroleum products Potential asbestos
	1715-N Oil Tanks	Oil/petroleum products Potential radioactive contamination
	1802-N Pipe Trestle (109-N to 185-N Building)	Asbestos Potential radioactive contamination
	1900-N Water Supply Tanks	Asbestos (insulation) Potential radioactive contamination
	1908-N Outfall Structure	Potential radioactive contamination
	181-NE HGP River Pump House	Oil/petroleum products Potential asbestos (insulation)
	1714-NB Warehouse	Potential oil/petroleum products Potential asbestos Potential radioactive contamination Potential solvents

RU	Facility	Hazardous Substances
Ancillary Facilities that Interfere with Waste Site Remediation		
	1712-N Insulator Shop	Miscellaneous chemicals Lead (paint) Solvents Potential asbestos
	1703-N Patrol Headquarters	Asbestos (insulation)
	1701-NE Gatehouse	Potential asbestos (insulation)
	1605-NE Observation Post	Potential asbestos (insulation)
	117-N Ventilation Filter Facility	Radioactive contamination

1301-N LIQUID WASTE DISPOSAL FACILITY
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 1301-N Liquid Waste Disposal Facility **December 15, 2016**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	12/15/2016	8C.2016.Q3
1.0 Part A Form	12/15/2016	8C.2016.Q3
2.0 Unit Description	08/2004	
3.0 Groundwater Monitoring	08/2004	
4.0 Closure Activities	03/31/2005	
5.0 Postclosure Plan	08/2004	

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PART V, CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
1301-N LIQUID WASTE DISPOSAL FACILITY

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
12/15/2016	8C.2016.Q3
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PART V, CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
1301-N LIQUID WASTE DISPOSAL FACILITY

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PART V, CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
1301-N LIQUID WASTE DISPOSAL FACILITY

The 1301-N Liquid Waste Disposal Facility is an inactive Treatment, Storage, and Disposal (TSD) unit that is currently undergoing closure activities. This TSD unit was operated as a liquid waste disposal facility for dangerous waste. This permit sets forth the closure requirements for this unit.

V.2.A COMPLIANCE WITH PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit (Permit) as specified in Permit Attachment 3, Permit Applicability Matrix, including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-specific Permit Conditions are enforceable in their entirety.

In the event that the Part V-Unit-Specific Conditions for Closure Unit 2, 1301-N Liquid Waste Disposal Facility conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Closure Unit 2, 1301-N Liquid Waste Disposal Facility prevail.

CLOSURE UNIT 2

Chapter 1.0	Part A Form, Revision 9, dated September 30, 2016
Chapter 2.0	Unit Description, dated August 2004
Chapter 3.0	Groundwater Monitoring, dated August 2004
Chapter 4.0	Closure Activities, dated March 31, 2005
Chapter 5.0	Post-Closure Plan, dated August 2004

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1301-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 2.0
UNIT DESCRIPTION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/2004	

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CHAPTER 2.0
UNIT DESCRIPTION

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CHAPTER 2.0
UNIT DESCRIPTION

TABLE OF CONTENTS

2.0 UNIT DESCRIPTION 5
2.1 Regulatory Background 5
2.2 Closure Plan and Corrective Measures Study Integration 5
2.3 Closure Performance Standards 7
2.3.1 Minimize the Need for Further Maintenance 7
2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment 7
2.3.3 Return Land to Appearance and Use of Surrounding Area 7
2.4 General Description of Units 7
2.4.1 Topographical Maps 8
2.4.2 Floodplain 8
2.4.3 Traffic 8
2.4.4 General Hydrogeologic Conditions 8
2.4.5 Physical Dimensions of the Units 8
2.4.6 Design Capacity 8
2.4.7 Ancillary Equipment 8
2.4.8 Containment Systems 8
2.4.9 Structures and Piping Requiring Removal or Characterization as Clean 8
2.4.10 Security 9
2.5 Waste Characteristics 9
2.5.1 Liquid Waste Discharges 9
2.5.2 Liquid Waste Discharge Chronology 10

FIGURES

Figure 2.1. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation 14
Figure 2.2. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation 15

TABLES

Table 2.1. 1301-N and 1325-N Effluent Analysis 11
Table 2.2. Chronology of Liquid Waste Discharges 13

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2.0 UNIT DESCRIPTION

The closure plan for the 1301-N Liquid Waste Disposal Facility (1301-N), also known by the designation 116-N-1, and for the 1325-N Liquid Waste Disposal Facility (1325-N), also known by the designation 116-N-3. The 1301-N and 1325-N terminology will be used throughout this appendix because the Liquid Waste Disposal Facilities are identified as such in their interim status Part A Permit Applications. These radioactive dangerous waste units operated as soil column disposal units, most recently under the authority of the *Washington Administrative Code* (WAC) 173-303. Closure of these units will commence pursuant to WAC 173-303-610 and the Hanford Facility Dangerous Waste Permit (Permit). Modification of the Permit to include this closure plan is scheduled to occur in calendar year 1999. However, because of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) milestone that requires one document be submitted to address the four treatment, storage, and disposal (TSD) units this closure plan will be incorporated into the Permit Modification in December 1998.

This closure plan is part of the 100-NR-1 Treatment, Storage, and Disposal Corrective Measures Study (DOE/RL-96-39, Rev. 1A). Approval of this closure plan will be obtained through the Permit modification process. Contaminated groundwater associated with 1301-N and 1325-N TSD operations is defined as the 100-NR-2 Operable Unit (OU). Remedial alternatives associated with contaminated groundwater are defined in the 100-NR-1/NR-2 Treatment, Storage, and Disposal Corrective Measures Study. Chosen remedial actions for 100-NR-2 groundwater will be defined in a separate Record of Decision (ROD) and, again, incorporated into the Permit through Permit modification. Actual closure activities necessary to close these units are not known at this time because the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) alternative selection process has not been completed. Therefore, this closure plan contains closure activities that may be required for the range of 1301-N and 1325-N remedial alternatives presented in Permit Attachment 41, Chapter 5.0. This range includes two closure options available to dangerous waste units under WAC 173-303 and the Permit: modified closure or landfill closure.

2.1 Regulatory Background

The 1301-N and 1325-N units are operated by the U.S. Department of Energy (DOE), Richland Operations Office (RL), and co-operated by Bechtel Hanford, Inc. Although the U.S. Government holds legal title to this facility, the RL, for purposes of regulation under WAC 173-303, is considered the legal owner of the facility under existing U.S. Environmental Protection Agency (EPA) interpretive regulations (51 Federal Register 7722).

The Part A, Form 3, dangerous waste permit application documentation for 1301-N originally was submitted to the Washington State Department of Ecology (Ecology) and the EPA in August 1986. Documentation for the 1325-N Liquid Waste Disposal Facility originally was submitted in February 1987.

The Part A identifies the listed waste spent solvent, methanol (F003), as being disposed to 1301-N and 1325-N. Any media or debris that came into contact with wastewaters disposed to these units may also, by definition, be considered to be a listed dangerous waste in lieu of an approved contained-in determination. The reason this is not stated definitively is because, federally, F003 spent solvents are no longer listed if they do not exhibit the characteristic of ignitability (40 CFR 261.3[a][2][iii]), however, a similar 'exclusion' does not exist in State regulation.

Soil samples taken from the 1325-N Trench resulted in non-detectable levels of methanol. The values reported for the nondetects range from 5.0 to 5.4 mg/kg and are well below the Model Toxics Control Act Method B cleanup of 400 mg/kg. Sampling of the 1301-N Crib was not conducted since it is considered to be analogous with the 1325-N Trench. In December 2000, Washington State Department of Ecology granted a contained-in determination for the soils located within the 1325-N and 1301-N Liquid Waste Disposal Facilities.

2.2 Closure Plan and Corrective Measures Study Integration

Closure of the 1301-N and 1325-N units will occur under the authority of WAC 173-303.

These units are also defined under the 100-NR-1 OU and are part of DOE/RL-96-39, Rev. 1A. Integrated TSD and OU closure actions will be necessary to remediate contaminated soil and groundwater. Actions taken to remediate these TSDs will comply with the provisions of both CERCLA and Resource Conservation and Recovery Act (RCRA). The CERCLA public involvement, including public notice and opportunity to comment, has been enhanced to concurrently satisfy the RCRA closure process. The remedy selected under CERCLA will be incorporated into the Hanford Facility RCRA Permit as the RCRA closure action after issuance of the public notice and comment process.

The CERCLA ROD was issued subsequent to the Hanford Facility RCRA Permit modification. Should the CERCLA ROD contain provisions inconsistent with the approved RCRA modifications, the Hanford Facility RCRA Permit will be again modified to reconcile these differences during the next permit modification cycle.

Closure options available under WAC 173-303-610 and the Permit are as follows:

Clean closure - requires that groundwater be uncontaminated by dangerous waste constituents (as evidenced through compliance with WAC 173-303-645) and that soils contain concentrations of dangerous waste constituents below *Model Toxics Control Act* (MTCA) Method B direct soil exposure and groundwater protection levels (WAC 173-303-610[2][b][I] and Permit Condition II.K.1). This closure option is compatible with both exposure scenarios presented in DOE/RL-96-39, Rev. 1A, rural-residential and the modified Columbia River Comprehensive Impact Assessment (CRCIA) Ranger/Industrial Scenario because it allows for unrestricted use of the units after closure. Because it is unclear at this time whether the groundwater under 1301-N and 1325-N has been contaminated with dangerous waste constituents from past operation of these units, as defined under WAC 173-303-645, this closure option has not been identified as available to 1301-N and 1325-N in this closure plan. Should a clean soil column be attained and future groundwater monitoring indicate levels of dangerous waste constituents are below MTCA Method B levels, this option will be revisited through Permit modification.

Modified closure - requires that soil concentrations of dangerous waste constituents not exceed MTCA Method C direct soil exposure and groundwater protection levels. Groundwater may or may not be contaminated by dangerous waste constituents (Permit Condition II.K.3). This closure option is only compatible with modified CRCIA ranger/industrial uses of the land (as defined for the purposes of Permit Attachment 41) because institutional controls would be required in order to limit access to the contaminated media.

Landfill closure - required when soils contain concentrations of dangerous waste constituents above MTCA Method C direct soil exposure and groundwater protection levels. Groundwater may or may not be contaminated by dangerous waste constituents (Permit Condition II.K.4). This closure option is only compatible with modified CRCIA ranger/industrial uses of the land because capping and other institutional controls would be required in order to limit access to the contaminated media.

Closure option decisions at 1301-N and 1325-N will be driven by decisions made pursuant to a CERCLA ROD for these units. Remedial alternatives compared in Permit Attachment 41 encompass modified and landfill closure options available under WAC 173-303-610 and the Permit. Therefore, information is contained in Permit Attachment 41 that address compliance with all potential closure options. Remedial alternatives compared are presented below:

- No Action under a rural residential or modified CRCIA ranger/industrial exposure scenario. (RRES-1), (MCRIS-1)
- Remove/Treat if Required/Dispose/Backfill under a residential or modified CRCIA ranger/industrial exposure scenario. (RRES-6), (MCRIS-6)
- Remove to 3.0 m (10 ft) below ground surface (bgs)/Treat if Required/Dispose/Backfill/Cap for Groundwater Protection under a modified CRCIA ranger/industrial exposure scenario. (MCRIS-7)
- Remove to 3.0 m (10 ft) bgs/Treat if Required/Dispose/Vitrify for Groundwater Protection/Backfill under a modified CRCIA ranger/industrial exposure scenario (MCRIS-8).

The RRES-1 and MCRIS-1 Alternatives are presented in DOE/RL-96-39, Rev. 1A for baseline comparison but are not considered viable alternatives for 1301-N and 1325-N. MCRIS-6 and MCRIS-8 Alternatives may result in a modified closure decision, depending upon the concentrations of dangerous waste constituents left in the units after excavation is completed. Landfill closure is precluded by the RRES-6, MCRIS-6, and MCRIS-8 Alternatives because they do not include placement of a final cover over the units. The MCRIS-7 Alternative may result in a modified closure or landfill closure decision depending upon the concentrations of dangerous waste constituents left after excavation. Although unlikely, a modified closure option may still be viable for the MCRIS-7 Alternative because capping of these units may be required for purposes unrelated to closure of these units under WAC 173-303-610, i.e., protection of the groundwater from radiological contaminants remaining in soils below 3.0 m (10 ft).

2.3 Closure Performance Standards

The closure performance standards of WAC 173-303-610(2) require that the owner/operator of a TSD unit close the unit in a manner that (1) minimizes the need for further maintenance; (2) controls, minimizes, or eliminates postclosure escape of dangerous waste to the extent necessary to protect human health and the environment; and (3) returns the land to the appearance and use of surrounding land areas.

2.3.1 Minimize the Need for Further Maintenance

The extent of future site maintenance depends on the closure option chosen for 1301-N and 1325-N (i.e., modified, or landfill closure). Maintenance, monitoring, and inspections necessary to minimize the need for further maintenance of the units under a modified or landfill closure option are defined in Permit Attachment 41, Chapter 5.0.

2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment

Closure activities defined in Permit Attachment 41, Chapter 4.0 will ensure the control of dangerous waste during closure activities. Because these activities cannot be fully defined until a remedial alternative is chosen through a ROD and remedial design is defined, these activities describe a range of activities that may be undertaken in order to achieve modified or landfill closure. Closure activities will meet the remedial action objectives for soils as defined in Permit Attachment 41, Chapter 3.0. Remedial action objectives for contaminated groundwater associated with 1301-N and 1325-N operations are defined in Permit Attachment 41, Chapter 4.0. These objectives are designed to protect both human health and the environment.

2.3.3 Return Land to Appearance and Use of Surrounding Area

The appearance and use of 1301-N and 1325-N after closure will be consistent with the future use of the 100-N Area. Permit Attachment 41 defines two possible exposure scenarios: rural-residential and modified CRCIA ranger/industrial. All alternatives include the commitment to revegetate the surface soils.

2.4 General Description of Units

This section provides a general description of the 1301-N and 1325-N Liquid Waste Disposal Facilities. This description is intended to provide an overview of these units.

The 1301-N and 1325-N surface soils and subsoils, including the UPR-100-N-31 spill, and associated structures and piping that have been contaminated by dangerous waste constituents from these units are subject to this WAC 173-303 closure action.

The 1301-N and 1325-N units were the primary Liquid Waste Disposal Facilities for the N Reactor. Wastes disposed included reactor coolant, spent fuel storage basin, and periphery cooling systems bleed off. Also included were reactor primary coolant loop decontamination rinse solution and discharges from building drains containing radioactive wastes generated in reactor support facilities. The 1301-N unit was operated from December 1963 until September 1985. The 1325-N unit was operated from October 1983 until April 1991. From October 1983 to September 1985, both units were in operation.

For a general discussion on the N Reactor facility background and more in-depth description of these units, refer to DOE/RL-96-39, Rev. 1A, Section 2.0.

2.4.1 Topographical Maps

General topographical maps for the area surrounding the 1301-N and 1325-N units are provided in Figures 2.1 and 2.2.

2.4.2 Floodplain

The U.S. Army Corp of Engineers has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to a maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 41 million L/s (1.4 million ft^3/s). The floodplain associated with the probable maximum flood is shown in Permit Attachment 33 (DOE/RL-91-28), General Information Portion, §2.2.1.4, Flood Plain Area. The 1301-N and 1325-N units would not be affected by the probable maximum flood.

2.4.3 Traffic

The majority of traffic inside the Hanford Site boundaries consists of light-duty vehicles used to transport employees to work areas. The 1301-N and 1325-N units are located within the Hanford Controlled Access Area where roadways cannot be accessed by the general public. These facilities are isolated from the nearest public highway, State Highway 24, by approximately 6 km (4 mi). Vehicle traffic around the units is restricted and is minimal, as the area is enclosed by a fenced with locked gates and is posted as a radiation zone. DOE/RL-96-39, Rev. 1A, Section 2.4 provides additional details about the current postings on the perimeter fence.

2.4.4 General Hydrogeologic Conditions

DOE/RL-96-39, Rev. 1A, Section 2.3.2 provides information on the geology and hydrogeology underlying the 1301-N and 1325-N units.

2.4.5 Physical Dimensions of the Units

The 1301-N unit consists of a 16-m by 3.7-m (52- by 12-ft) weir box inside a 38- by 88-m (125-by 290-ft) rectangular basin (crib). A zigzag extension trench, approximately 490 m (1,600 ft) long, 15 m (50 ft) wide, and 3.7 m (12 ft) deep, was added to the crib.

The 1325-N unit includes a concrete header box inside a 73- by 76-m (240- by 250-ft) rectangular basin (crib). A straight extension trench, approximately 914 m (3,000 ft) long, 16.8 m (55 ft) wide, and 3.0 m (10 ft) deep, was also added to this crib.

2.4.6 Design Capacity

Both the 1301-N and 1325-N Liquid Waste Disposal Facilities were designed with a discharge capacity of 11,400 L/min (3,000 gal/min). The average flow rate was approximately 6,400 L/min (1,700 gal/min).

2.4.7 Ancillary Equipment

The 1301-N and 1325-N units are passive liquid waste disposal facilities that do not rely on active systems for operations support. The units consist of transfer piping, concrete effluent distribution structures, and soils to distribute liquid wastes.

2.4.8 Containment Systems

The 1301-N and 1325-N units do not include any containment systems.

2.4.9 Structures and Piping Requiring Removal or Characterization as Clean

The structures in the 1301-N and 1325-N Liquid Waste Disposal Facilities include concrete structures and earthen basins and trenches. The 1301-N unit consists of a 16- by 3.7-m (52- by 12-ft) weir box, a 38- by 88-m (125- by 290-ft) rectangular basin (crib), and a zigzag extension trench, approximately 490 m

(1,600 ft) long, 15 m (50 ft) wide, and 3.7 m (12 ft) deep.

The 1325-N unit includes a concrete header box, a 73- by 76-m (240- by 250-ft) rectangular basin (crib), a tie-in structure, and a straight extension trench, approximately 914 m (3,000 ft) long, 16.8 m (55 ft) wide, and 3.0 m (10 ft) deep.

Figure 2.1 shows the pipelines to be removed or characterized as clean between the 1722-N Building and 1301-N and between 1310-N and 1301-N. Figure 2.2 shows the piping between the 1301-N Crib and the 1325-N Crib.

Refer to Permit Attachment 41, Chapter 4.0, Closure Activities, for a more in-depth discussion on the removal of structures.

2.4.10 Security

The entire Hanford Site is a controlled-access area. The Hanford Site maintains around-the-clock surveillance to restrict unauthorized access for the protection of the public and of government property, classified information, and special nuclear materials. The Hanford Patrol maintains a continuous presence of protective force personnel to provide Hanford Site security.

Within the Hanford Site are operational areas, including 100-N, to which access is restricted. There is a staffed checkpoint at the Wye Barricade through which access to the 100-N Area is allowed only to authorized personnel. Authorized personnel are those individuals with a DOE-issued security identification badge indicating the appropriate authorization. Such personnel are subject to a search of items carried into or out of controlled areas.

2.5 Waste Characteristics

2.5.1 Liquid Waste Discharges

The wastes disposed in 1301-N and 1325-N were generated from N Reactor operations. The waste streams included the following:

- Reactor coolant system bleed off.
- Spent fuel storage basin cooling water overflow.
- Reactor periphery cooling systems bleed off.
- Reactor primary coolant loop decontamination rinse solution.
- Building drains serving reactor support facilities.

The combination of these waste streams resulted in an average flow of approximately 6,400 L/min (1,700 gal/min). Results of influent sampling and analysis (Table 2.1) did not indicate the characteristics of a dangerous waste.

Reactor primary coolant system. The reactor primary coolant system was supplied by demineralized water with chemicals added for water quality control (QC). Ammonium hydroxide was used for pH control and was injected at a concentration of approximately 40 ppm to maintain a pH of 10.2 to 10.4 standard units. Hydrazine was introduced for oxygen control at a concentration of 0.04 ppm.

Fuel storage basin cooling water. The spent fuel storage basin was supplied by filtered water with chlorine added as an algaecide. A trace amount of residual chlorine was maintained to ensure complete treatment.

Reactor periphery cooling systems. Reactor periphery cooling systems that discharged bleed-off wastes to 1301-N and 1325-N include the following:

- Graphite and shield cooling.
- Reactor control rod cooling.
- Reactor secondary coolant loop.

As with other reactor, cooling systems, bleed off and spillage from the periphery cooling systems resulted in small continuous discharge.

Graphite and Shield Cooling. The graphite and shield cooling system was supplied by demineralized water with chemicals added for water QC. Ammonium hydroxide was injected at a concentration of approximately 40 ppm to maintain a pH of 10.0 to 10.2 standard units. Hydrazine was injected for oxygen control at a concentration of 0.04 ppm.

Reactor Control Rod Cooling. The reactor control rod cooling system was supplied by demineralized water with chemicals added for water QC. Ammonium hydroxide was injected at a concentration of approximately 40 ppm to maintain a pH of 7.0 standard units. Hydrazine is injected for oxygen control at a concentration of 0.15 ppm.

Reactor Secondary Coolant Loop. The reactor secondary coolant loop was supplied by demineralized water with chemicals added for water QC. Morpholine was injected at a concentration of approximately 4 ppm to maintain a pH of 8.6 to 9.2 standard units. Hydrazine was injected for oxygen control at a concentration of 1 ppm or less.

Reactor primary coolant loop decontamination. The reactor primary coolant loop was decontaminated every 2 to 4 years. The decontamination solution consisted of 79,500 L (21,000 gal) TURCO 4512-A™ (70% phosphoric acid) and 136 to 181 kg (300 to 400 lb) of diethylthiourea. This solution was diluted to an 8 wt% phosphoric acid solution as it entered the reactor coolant loop.

After the pH of the rinsate was verified between 6.0 and 9.0 standard units, the final rinse solution containing approximately 378,500 L (100,000 gal) of demineralized water was discharged. The calculated phosphoric acid released per decontamination was 5.7 L (1.5 gal), and the calculated amount of diethylthiourea was 2.3 g (0.0051 lb).

Building drains. The radioactive drain system collected radioactive water from throughout the 109-N and 105-N Buildings. Pump leakage, system bleed off from the reactor primary and periphery cooling systems, laboratories, decontamination activities, and other routine activities were drained to 1301-N and 1325-N via this system.

Three of the waste streams exhibited characteristics of a dangerous waste at the point of generation. These were leaks and spills from the auxiliary power battery lockers, hydrazine mixing spills, and laboratory wastes. Each of these wastes contained contaminants that are designated dangerous wastes under WAC 173-303-090. However, sampling of the 1301-N and 1325-N influent (Table 2.1) did not identify characteristics of a dangerous waste at the point of discharge into 1301-N and 1325-N.

Wastes from Chemical Analyses. Chemical analyses were performed in laboratories to determine hydrazine, ammonia, chloride, and fluoride concentrations in reactor coolant. Waste characterization indicated that approximately 9,800 L/yr (2,600 gal/yr) contained constituents designated as dangerous wastes under WAC 173-303-090.

Auxiliary Power Battery Lockers. Spills and leaks from the auxiliary power battery lockers contributed 300 to 450 L/yr (80 to 120 gal/yr) of waste from nickel-cadmium and lead-acetate batteries. It is estimated that approximately 40% of the spilled material was from nickel-cadmium batteries and 60% from lead-acetate batteries.

Hydrazine Mixing and Injection Area Floor Drains. Hydrazine spills from mixing and injection activities entered the radioactive drain system. Spills were very small in volume and, in the case of the mixed solution, were extremely dilute.
Approximately 160 kg (350 lb) of hydrazine was spilled yearly in this manner.

2.5.2 Liquid Waste Discharge Chronology

A chronology of liquid waste discharges to 1301-N and 1325-N is provided in Table 2.2.

Table 2.1. 1301-N and 1325-N Effluent Analysis

Parameter (MDL)	Sample			
	1	2	3	Average
pH (standard units)	6.58	6.56	6.97	6.70
Conductivity (micromhos)	148	155	190	164
Mercury (.001 ppm)	ND	ND	ND	ND
Ethylene glycol (10 ppm)	ND	ND	ND	ND
Enhanced thiourea (.2 ppm)	ND	ND	ND	ND
TOC (1 ppm)	0.0018	0.002	0.002	0.0019
Cyanide (.01 ppm)	ND	ND	ND	ND
Barium (.006 ppm)	0.03	0.027	0.027	0.028
Cadmium (.002 ppm)	ND	ND	ND	ND
Chromium (.01 ppm)	ND	ND	ND	ND
Lead (.03 ppm)	ND	ND	ND	ND
Silver (.01 ppm)	ND	ND	ND	ND
Sodium (.1 ppm)	1.831	1.819	1.781	1.810
Nickel (.01 ppm)	ND	ND	ND	ND
Copper (.01 ppm)	ND	ND	ND	ND
Vanadium (.005 ppm)	ND	ND	ND	ND
Antimony (.1 ppm)	ND	ND	ND	ND
Aluminum (.15 ppm)	ND	ND	ND	ND
Manganese (.005 ppm)	ND	ND	ND	ND
Potassium (.1 ppm)	0.647	0.608	0.606	0.620
Iron (.05 ppm)	0.081	0.077	0.050	0.069
Beryllium (.005 ppm)	ND	ND	ND	ND
Osmium (.3 ppm)	ND	ND	ND	ND
Strontium (.3 ppm)	ND	ND	ND	ND
Zinc (.005 ppm)	ND	ND	ND	ND
Calcium (.05 ppm)	14.40	13.97	14.05	14.14
Nitrate (.5 ppm)	ND	ND	ND	ND
Sulphate (.5 ppm)	12.41	11.53	11.97	11.97
Fluoride (.5 ppm)	ND	ND	ND	ND
Chloride (.5 ppm)	1.57	1.48	1.53	1.53
Phosphate (1 ppm)	ND	ND	ND	ND
Phosphorus Pesticides (.005 ppm)	ND	ND	ND	ND
Chlorinated Pesticides (.001 ppm)	ND	ND	ND	ND
Enhanced ABN List	ND	ND	ND	ND
Citrus Red (1 ppm)	ND	ND	ND	ND
Arsenic (.005 ppm)	ND	ND	ND	ND
Ammonium Ion (.05 ppm)	ND	ND	ND	ND

Table 2.1. 1301-N and 1325-N Effluent Analysis

Parameter (MDL)	Sample			
	1	2	3	Average
Coliform (3 MPN)	---	0.023	0.009	0.016
Selenium (.005 ppm)	ND	ND	ND	ND
Thallium (.01 ppm)	ND	ND	ND	ND

ND = Not Detected MDL = Minimum Detection Limit Data obtained from samples taken August 1985 Diediker and Hall. (1987)

1

Table 2.2. Chronology of Liquid Waste Discharges

Year	Liquid Waste Discharge to 1301-N Liquid Waste Disposal Facility (L/day)	Liquid Waste Discharge to 1325-N Liquid Waste Disposal Facility (L/day)
1964	9,462,500*	0
1965	9,462,500*	0
1966	9,462,500*	0
1967	9,462,500*	0
1968	9,462,500*	0
1969	9,462,500*	0
1970	9,462,500*	0
1971	9,462,500*	0
1972	9,462,500*	0
1973	8,702,000	0
1974	9,500,000	0
1975	9,500,000	0
1976	9,900,000	0
1977	14,500,000	0
1978	12,500,000	0
1979	13,500,000	0
1980	12,500,000	0
1981	10,500,000	0
1982	10,500,000	0
1983	6,942,000	1,960,000
1984	8,100,000	1,900,000
1985	7,200,000	2,800,000
1986	0	7,250,000
1987	0	2,100,000
1988	0	1,660,000
1989	0	1,660,000
1990	0	1,660,000
1991+	0	0

[1]WHC-SD-ER-TA-001, Rev. 0 (WHC 1991).

*There are no reliable data available for average flow rates and effluent discharge rates for 1301-N. Estimates based on discharge volumes from 1973 to 1976 were used for 1964 through 1972. Data for 1973 through 1989 were taken from the yearly effluent release reports.

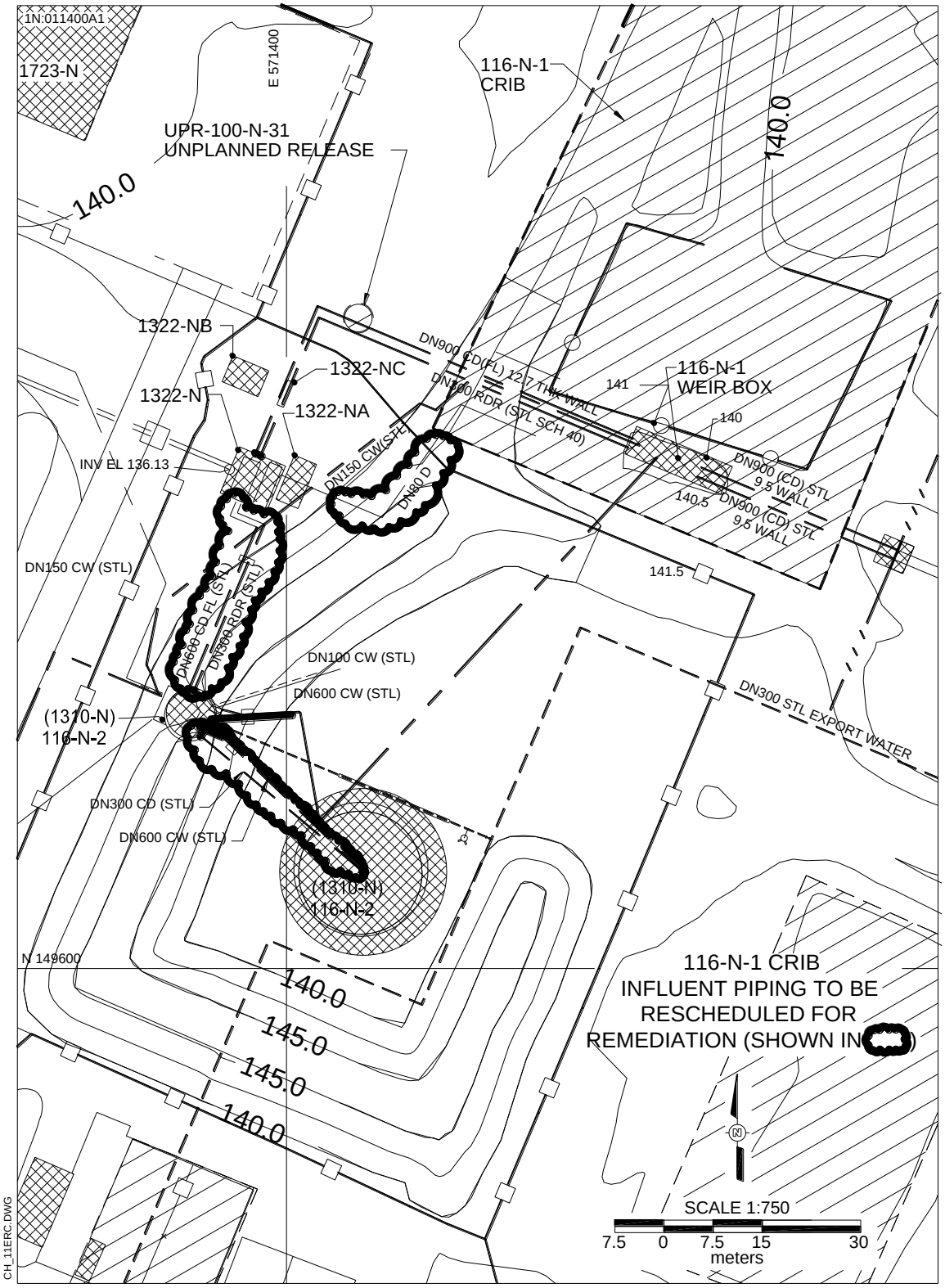

Figure 2.1. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation

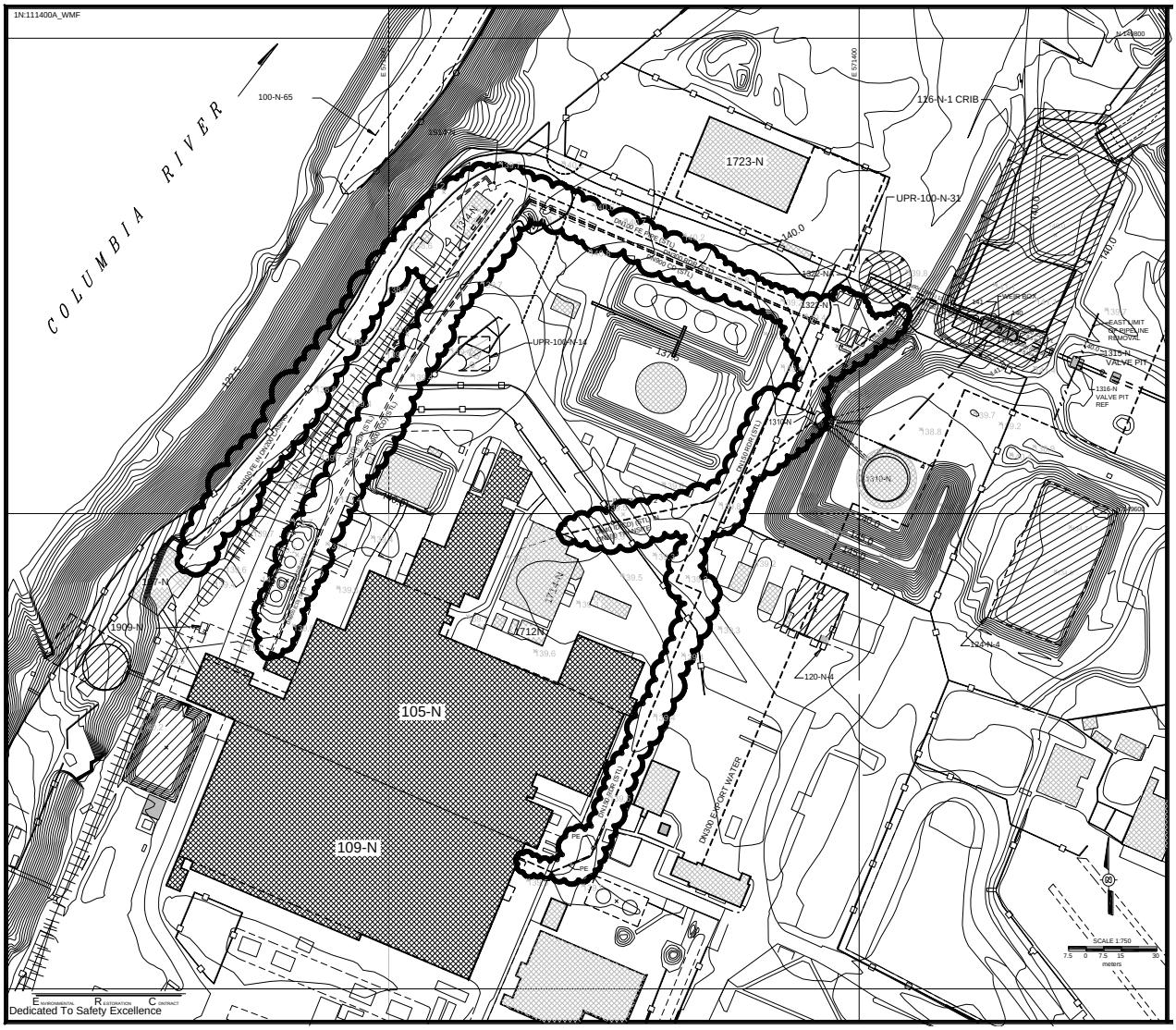

Figure 2.2. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation

Legend

116- N-1 Crib influent piping to be rescheduled for remediation

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1301-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/2004	

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CHAPTER 3.0
GROUNDWATER MONITORING

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CHAPTER 3.0
GROUNDWATER MONITORING

TABLE OF CONTENTS

3.0 GROUNDWATER MONITORING 5
3.1 Aquifer Identification 5
3.2 Interim Status Groundwater Monitoring 5
3.2.1 Well Location and Design 6
3.2.2 Sampling and Analysis Plan 6
3.2.3 Quality Assurance and Quality Control 8
3.3 Results of Groundwater Monitoring 10
3.3.1 Potentiometric Level 10
3.3.2 Groundwater Quality 10
3.4 Groundwater Monitoring During Closure 11
3.4.1 Monitoring Program 11
3.4.2 Inspection, Maintenance, and Replacement of Wells 11

FIGURES

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for the 1324-N and 1324-NA Units 7
Figure 3.2. Proposed RCRA Groundwater Monitoring Network for the 1301 N and 1325 N Units 9
Figure 3.3. Water Level Changes in Groundwater Below 1301-N and 1325-N 12

TABLES

Table 3.1. Proposed RCRA Groundwater Monitoring Networks for the 1301 N and 1325-N Liquid Waste Disposal Facilities 8
Table 3.2. Constituent List for 1301-N and 1325-N 10

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3.0 GROUNDWATER MONITORING

3.1 Aquifer Identification

The unconfined aquifer in the 100-N Area is located primarily in the upper part of the Ringold Formation (sands and gravels) and is approximately 12 to 15 m (40 to 50 ft) thick. The base of the aquifer is believed to be a laterally continuous clay-rich unit containing a series of paleosols. Lithologies in this unit range from clay and silt to sand. Most of the wells in the 100-N Area did not penetrate through the clay layer; therefore, the thickness of the clay-rich unit is unknown at most locations.

The water table is approximately 21 to 23 m (69 to 75 ft) below land surface near 1301-N and approximately 23 m (75 ft) below land surface near 1325-N. Water levels have returned to these "pre-Hanford" levels after years of groundwater mounding caused by artificial recharge from the units and other effluent disposal in the 100-N Area.

A representative range of transmissivity estimates for the unconfined aquifer in the 100-N Area is 93 to 560 m2/day (1,000 to 6,030 ft2/day) throughout most of that area. Wells in the northwest portion seem to show a higher transmissivity (up to 1,900 m2/day [20,500 ft2/day]). These values correspond to horizontal hydraulic conductivity of 6 to 37 m/day (20 to 121 ft/day), and 120 m/day (394 ft/day) in the northwest portion. Specific yield is estimated at 0.1 to 0.3.

Hartman and Lindsey (1993) describe the hydrogeology of the 100-N Area in more detail.

3.2 Interim Status Groundwater Monitoring

Groundwater monitoring began at 1301-N and 1325-N in December 1987. The original monitoring networks were modified over the years as water levels declined and new wells were installed to replace dry wells.

After the first year of groundwater monitoring at 1301-N, specific conductance in one downgradient well was found to be elevated above background (i.e., upgradient) levels. A groundwater quality assessment program was initiated (Gilmore and Jensen 1989). The assessment program found no evidence that dangerous waste or dangerous waste constituents from 1301-N had entered the groundwater (Hartman 1992). Rather, the elevated specific conductance was caused by sulfate/sodium-contaminated groundwater coming from the nearby 1324-N/NA site. In 1992, the groundwater monitoring program at 1301-N reverted to an indicator parameter monitoring program, as described in 40 CFR 265.93(d)(6). An additional upgradient well was added to the network to reflect the influence of 1324-N/NA. New critical mean values were established for indicator parameters, and the site remains in indicator evaluation status.

Some contamination has been detected in the groundwater under or near the 1301-N and 1325-N units. Two dangerous waste constituents, nitrate and chromium, were found to be at levels above the maximum containment levels (MCL) (Hartman and Dresel, 1997). Nitrate levels above the MCL of 44 mg/L were observed in well 199-N-3 and 199-N-32 in 1996. Well 199-N-3 monitors the 1301-N unit and well 199-N-32 monitors the 1325-N unit. Nitrate values from nearby wells monitoring the same interval are not above the MCL. Chromium concentrations above the MCL of 0.1 mg/L have been observed in wells 199-N-33 and well 199-N-80 in 1996. Well 199-N-33 monitors the 1325-N unit. The 1996 data from well 199-N-33 is considered anomalous. Well 199-N-80 monitors the bottom zone of the unconfined aquifer and is located downgradient from 1301-N. Wells monitoring the upper part of the unconfined aquifer for 1301-N do not have values of chromium above the MCLs. Although contamination has been detected as described, the interim status groundwater monitoring configuration did not identify these constituents as releases attributable to operation of, or residual contamination in, the 1301-N and 1325-N units through statistical analysis of upgradient versus downgradient wells.

The 1325-N unit has been monitored under an indicator evaluation program throughout its history of *Resource Conservation and Recovery Act of 1976* (RCRA) monitoring. Wells were added or deleted from the network to reflect changing conditions.

Groundwater is monitored under several programs in addition to the RCRA in the 100-N Area. The most significant programs in terms of numbers of wells and analytes are those of the RCRA, sitewide surveillance, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Sampling and analysis for RCRA, CERCLA, and sitewide surveillance monitoring have been coordinated for several years to avoid duplication. However, this coordination did not include the planning stages of the monitoring programs.

In an attempt to reduce redundancy further and make monitoring more efficient, representatives of the various contractors involved in 100-N groundwater monitoring held a series of workshops to consolidate and streamline monitoring. Monitoring networks were redesigned to disseminate information for all programs as efficiently as possible, and constituent lists were trimmed to the constituents of concern. Sampling frequency also decreased in some cases. Sampling trips and analytical costs are divided among data users. Borghese et al. (1996) describe the well and constituent lists for the combined program. That document does not include requirements for sampling and analysis protocols, QC, or statistical evaluations. Hartman (1996a) presents a revised groundwater-monitoring plan for the RCRA program, and this is summarized in the following section.

3.2.1 Well Location and Design

The monitoring network for 1301-N includes two upgradient wells and three downgradient wells (Figure 3.1, Table 3.1). All of the wells monitor the unconfined aquifer. As-built diagrams are included in Hartman (1996a). One of the downgradient wells, 199-N-105A, is an extraction well for the CERCLA pump-and-treat system. This well is screened across the entire thickness of the uppermost aquifer (7.3 m [24 ft]) instead of just the top 3.0 to 4.6 m (10 to 15 ft) of the aquifer like the other wells. Because it is an extraction well, 199-N-105A will pull in water from beneath a large area of the 1301-N Trench, making it a useful monitoring well

The construction of some of the 1301-N wells does not meet Washington Administrative Code (WAC) requirements (Table 3.1). Wells 199-N-2 and 199-N-3 have perforated, carbon steel casing and no annular seals. However, these wells appear to yield representative data, and installing new wells is not warranted. Ecology has accepted the data from these and other wells since RCRA monitoring began at the 100-N Area in 1987.

The monitoring network for 1325-N will include one upgradient and three downgradient wells (refer to Figure 3.1 and Table 3.1). Treated water from the CERCLA pump-and-treat system is injected into well 199-N-29 near the 1325-N. Well 199-N-28 is used by the RCRA program to monitor potential effects of injected water; it is not being used in statistical evaluations.

3.2.2 Sampling and Analysis Plan

The *Groundwater Monitoring Plan for the 1301-N, 1325-N, and 1324-N/NA Sites* (Hartman 1996b) describes the sampling and analysis plan for RCRA monitoring. Groundwater is sampled for the constituents listed in Table 3.2. Indicator parameters are analyzed semiannually; additional parameters are analyzed annually.

Groundwater sampling procedures, sample collection documentation, and chain-of-custody requirements are described in Environmental Investigation Instructions (EII) (WHC-CM-7-7), The Environmental Activities Procedural Manual (WHC-CM-7-8), and in the Quality Assurance Project Plan for Groundwater Monitoring Activities Managed by Westinghouse Hanford Company (WHC 1995). Work by other contractors is conducted to their equivalent approved standard operating procedures. Procedures for field measurements (pH, conductivity, turbidity) are specified in WHC-CM-7-8 and in the user's manuals for the meters used. Analytical methods are selected from those provided in Test Methods for Evaluating Solid Wastes (EPA 1990) as specified by WHC (1995) or its most recent revision.

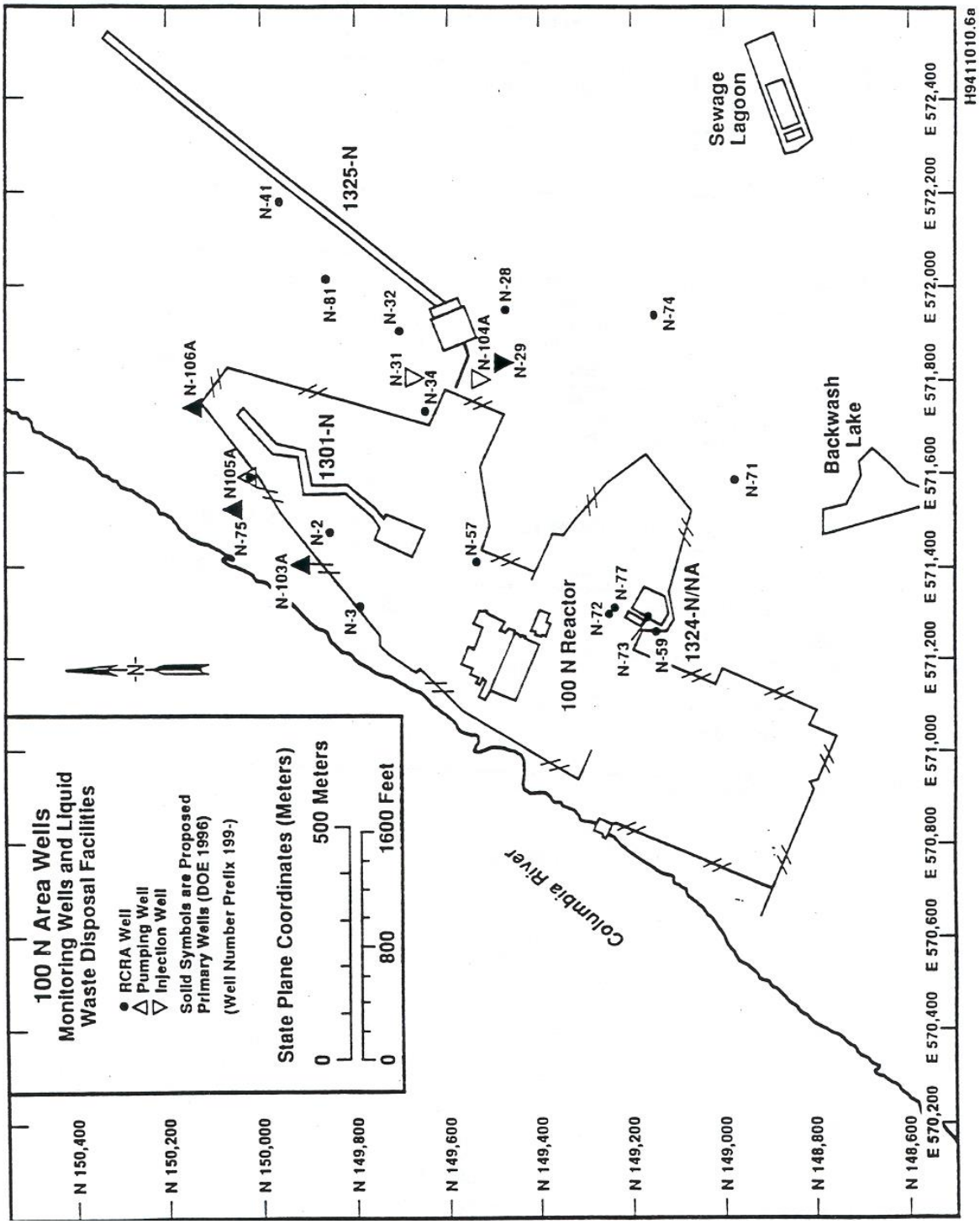

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for the 1324-N and 1324-NA Units

3.2.3 Quality Assurance and Quality Control

Quality assurance (QA) requirements are defined in the *Westinghouse Hanford Company Quality Assurance Manual* (WHC-CM-4-2) or equivalent procedures, and Article 31 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994). Additional requirements for QA and QC are included in WHC (1995) or its' most recent revision.

Table 3.1. Proposed RCRA Groundwater Monitoring Networks for the 1301 N and 1325-N Liquid Waste Disposal Facilities

Well Number	Proposed Network	Drill Date	Elev. T.O.C.[a] (m)	Casing/Screen Materials	Screened or perf'd depth[b] (m)	Depth to Water[c] (m)
199-N-2	1301-N	1964	140.129	Carbon steel/ perf'd casing; no annular seal	10.7 - 28.0	21.010(6/96)
199-N-3	1301-N	1964	140.015	Carbon steel/ perf'd casing; no annular seal	10.4 - 27.7	20.793(6/96)
199-N-28	1325-N[d]	1983	141.647	Carbon steel/ stainless steel w/ packer; surface seal	14.32 - 25.3	23.311(9/94)
199-N-32	1325-N	1983	140.990	Carbon steel/ stainless steel w/ packer; surface seal	13.4 - 24.1	22.357(3/96)
199-N-34	1301-N	1983	140.247	Carbon steel/ stainless steel w/ packer; surface seal	10.4 - 23.5	21.732(3/96)
199-N-41	1325-N	1984	139.626	Carbon steel/ stainless steel w/ packer; surface seal	16.2 - 22.3	21.193(3/96)
199-N-57	1301-N	1987	139.671	Stainless steel/ stainless steel; full annular seal	17.7 - 22.3	20.708(3/96)
199-N-74	1325-N	1991	139.482	Stainless steel/ stainless steel; full annular seal	18.0 - 24.4	20.537(6/96)
199-N-81	1325-N	1993	142.067	Stainless steel/stainless steel	21.3 - 27.4	22.552(3/96)
199-N-105A	1301-N	1995	140.655	Stainless steel/ stainless steel; full annular seal	21.0 - 28.7	21.220(7/95)

[a] Surveyed to North American Vertical Datum of 1988.
[b] Approximate depth below land surface; converted from feet.
[c] Depth below top of casing; converted from feet.
[d] Well 199-N-28 to be used for supplemental information; no statistical evaluations.

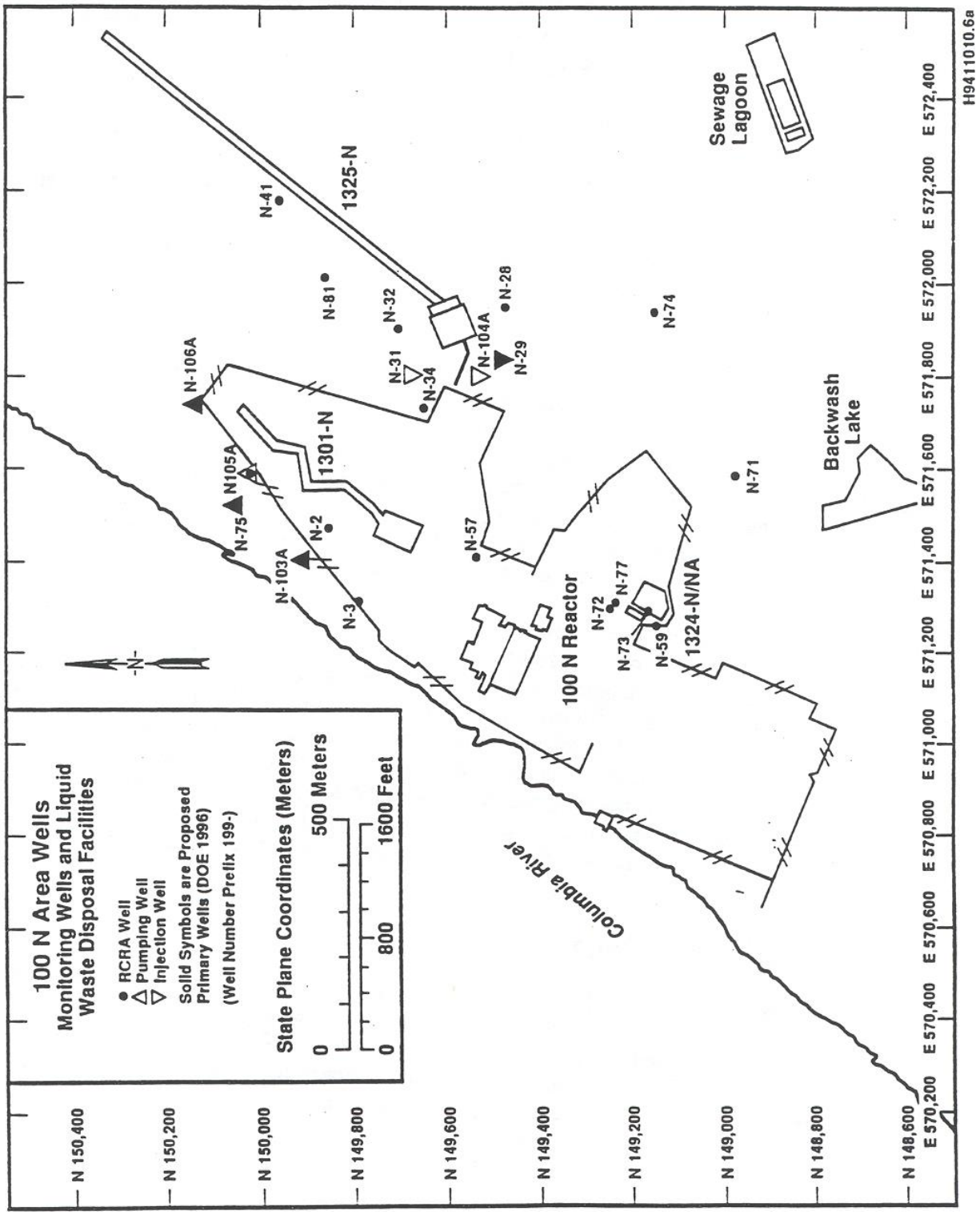

Figure 3.2. Proposed RCRA Groundwater Monitoring Network for the 1301 N and 1325 N Units

Table 3.2. Constituent List for 1301-N and 1325-N

Analyzed Semiannually	Analyzed Annually
Contamination Indicator Parameters (Quadruplicate samples):	ICP Metals (filtered)
Specific conductance (field)	Anions
pH (field)	Alkalinity
Total Organic Carbon	
Total Organic Halogen	
Turbidity (field)	

ICP = Inductively Coupled Plasma

3.3 Results of Groundwater Monitoring

3.3.1 Potentiometric Level

At various times in the history of waste disposal at the 100-N Area, groundwater mounds formed beneath 1301-N and 1325-N. Changes in water levels are illustrated in Figure 3.2. Water levels have returned to "pre-Hanford" levels in the 100-N Area but are still affected by changes in river stage and, recently, by the operation of pumping and injection wells.

Water levels are measured in all wells before sampling. Many of the wells in the 100-N Area are also measured as part of the site-wide semiannual water level program (Serkowski et al. 1995). The Environmental Restoration Contractor has equipped about 20 wells with pressure transducers and data loggers. Any of the data described above can be used to construct water table maps to aid in determining groundwater flow directions.

During average or low river stage, natural groundwater flow is toward the northwest beneath 1301-N. When river stage is high, the gradient is reversed, and there is a potential for water to flow out of the river into the aquifer. Groundwater flow beneath 1325-N is toward the north regardless of river stage.

A groundwater pump-and-treat system has been in operation in the 100-N Area since August 1995. DOE-RL (1996b) reports the results of an evaluation of the first phase of the system's operation. Data from a network of transducers were used to construct water table maps and estimate capture zones.

Pumping of wells between 1301-N and the Columbia River has created a groundwater depression. Groundwater flows toward the pumping wells from the river and from beneath 1301-N. Treated water is injected into a well near 1325-N.

Vertical groundwater gradients are not well defined in the 100-N Area. There is no significant difference in head between wells completed at the top and bottom of the unconfined aquifer. There does appear to be an upward gradient immediately adjacent to the river. Water levels in deeper wells were consistently higher than shallow wells or the river, indicating an upward gradient (Gilmore et al. 1991).

3.3.2 Groundwater Quality

Groundwater quality in the unconfined aquifer beneath the 100-N Area has been affected by 1301-N, 1325-N, and the 1324-NA Percolation Pond. In addition, various leaks and spills may have affected soil or groundwater chemistry (DOE-RL 1991). Data from RCRA sampling and analysis are reported electronically in the Hanford Environmental Information System database. Interpretation of the data is included in annual reports (Hartman 1996a).

The indicator parameters at the 1301-N and 1325-N units are specific conductance, pH, total organic carbon (TOC), and total organic halogens (TOX) (40 CFR 265.92[b][3]). Groundwater is also analyzed for other constituents that were discharged to the 1301-N and 1325-N units during their use. These analytes include nitrate, chromium, phosphate, lead, and cadmium. Samples have also been analyzed for mercury and volatile organics in the past. Chromium, lead, and cadmium (in filtered samples), phosphate,

or volatile organics have not been detected in 1301-N or 1325-N groundwater in significant concentrations. Nitrate increased in some wells near 1301-N and 1325-N during 1995, exceeding the drinking water standard in wells 199-N-2 and 199-N-3. One well southwest (upgradient) of 1301-N also had nitrate above the standard. Concentrations decreased in wells 199-N-2 and 199-N-3 in early 1996, but increased in excess of the drinking water standard in well 199-N-32. The source of nitrate is unknown.

While the 1301-N and 1325-N units were in use, they introduced radioactive constituents, primarily tritium and strontium-90, to the groundwater. These are not considered dangerous waste constituents under interim status RCRA regulations, but were monitored by RCRA in the past because they are the primary contaminants originating from the units.

3.4 Groundwater Monitoring During Closure

3.4.1 Monitoring Program

Groundwater monitoring will be done in accordance with the existing groundwater-monitoring program (Borghese, et. al 1996).

3.4.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

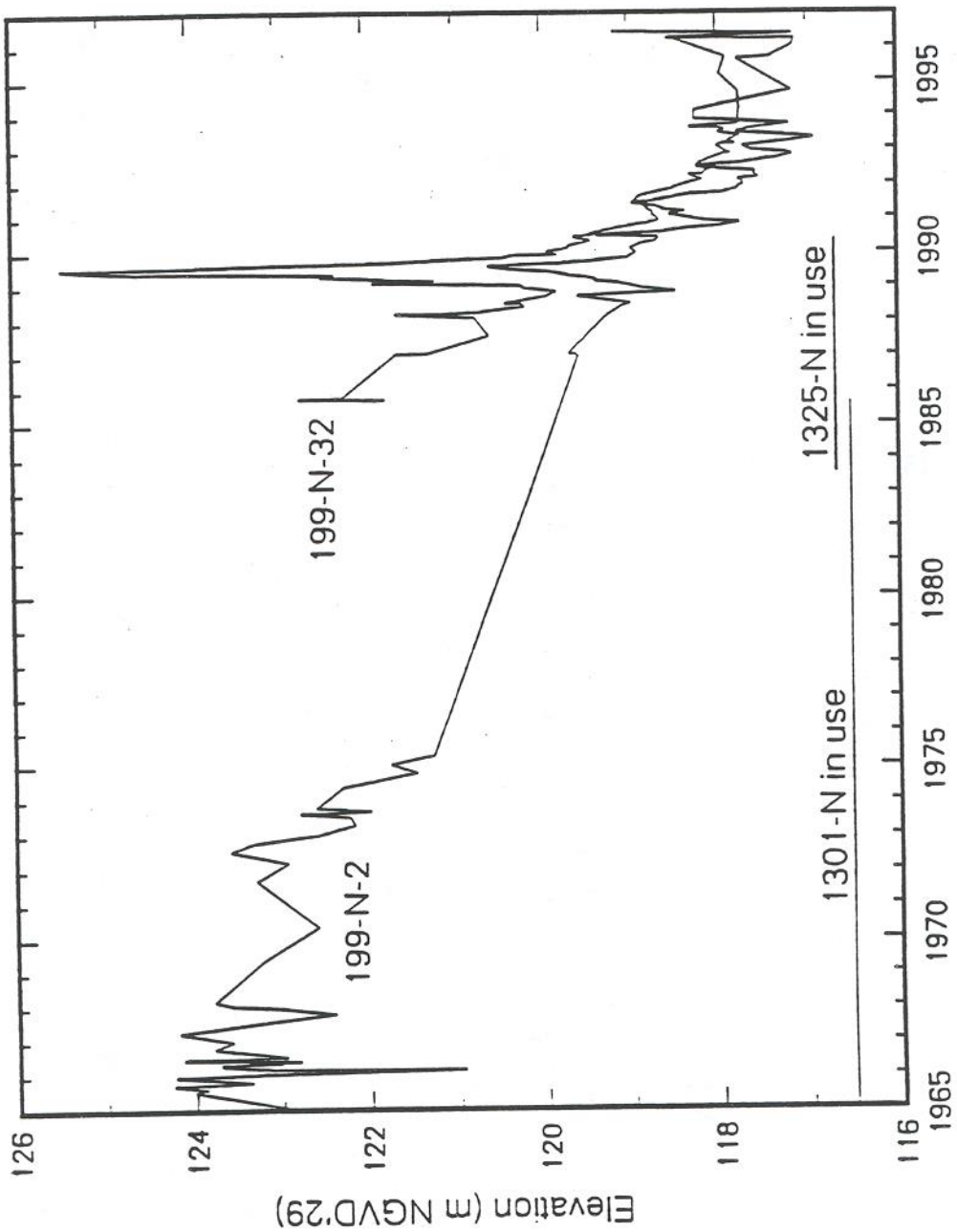

Figure 3.3. Water Level Changes in Groundwater Below 1301-N and 1325-N

1301-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 4.0
CLOSURE ACTIVITIES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
03/31/2005	

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CHAPTER 4.0
CLOSURE ACTIVITIES

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CHAPTER 4.0
CLOSURE ACTIVITIES

TABLE OF CONTENTS

4.0 CLOSURE ACTIVITIES 5
4.1 Removal of Structures 5
4.1.1 Earthen Structures 5
4.1.2 Concrete Structures 5
4.2 Piping Removal or Characterization as Clean 6
4.3 Sampling and Analysis Activities 6
4.3.1 Past Soil Characterization Data 6
4.3.2 Characterization Activities to Determine Closure Option 7
4.3.3 Piping Characterization 8
4.4 Waste Management 8
4.5 Modified Closure Institutional Control Requirements 8
4.6 Final Cover Requirements for Landfill Closure 9
4.7 Personnel Training 9
4.8 Closure Contact 9
4.9 Closure Schedule 9
4.10 Amendment of Closure Plan 9
4.11 Certification of Closure 10
4.12 Survey Plat and Notice in Deed 10

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4.0 CLOSURE ACTIVITIES

The physical activities required to close 1301-N and 1325-N Liquid Waste Disposal Facilities in accordance with WAC 173-303-610 and the Permit will be integrated with the Record of Decision (ROD) for DOE/RL 96-39, Rev. 1A. The ROD and the remedial design for the selected alternative will specify further the closure activities that will be required for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action. Closure activities necessary to comply with dangerous waste regulations and the Permit will need to be consistent with CERCLA activities. CERCLA activities will be required to include elements necessary for closure of a dangerous waste unit. The Closure Plan presents the physical remedial activities and the sampling and analysis required to comply with WAC 173-303-610 and the Permit for each of the remedial alternatives presented in Attachment 41, Chapter 2.0, §2.2.

The closure activities are discussed in this section to highlight the site-specific elements of removal or characterization as clean of structures and piping for the 1301-N and 1325-N Liquid Waste Disposal Facilities. The other closure activities are not well defined for these sites at present but will be developed during the remedial design phase. Additional details about the alternatives can be found in DOE/RL-96-39, Rev. 1A, Section 5.2.

4.1 Removal of Structures

The structures in 1301-N and 1325-N Liquid Waste Disposal Facilities include concrete structures and earthen basins, trenches, fencing and signage surrounding the units, and ancillary surface structures such as valve houses associated with piping. The 1301-N and 1325-N Liquid Waste Disposal Facilities structures are discussed in Permit Attachment 41, Chapter 2.0

4.1.1 Earthen Structures

The contaminated soil in the earthen structures will be excavated by conventional earthmoving techniques. Removal technologies are described in DOE/RL-96-39, Rev. 1A, Section 5.1.3. Differing amounts of contaminated soils will be generated depending upon the remedial alternative selected for 1301 N and 1325 N. Alternatives that include soil removal are described in DOE/RL-96-39, Rev. 1A, Sections 5.2.1.5 through 5.2.1.8 for a residential exposure scenario and in DOE/RL-96-39, Rev. 1A, Sections 5.2.2.5 through 5.2.2.8 for a modified Columbia River Comprehensive Impact Assessment (CRCIA) ranger/industrial exposure scenario. After loading into containers, contaminated soils will be treated if necessary and/or disposed in an approved disposal facility on the Hanford Site. Particular attention will be given to the protection of workers and the environment from exposure to airborne contaminants during excavation and container loading. Dust mitigating measures, such as water sprays and chemical fixatives, may be employed to control fugitive dust emissions. The as low as reasonably achievable review will consider the use of shielding and/or remote handling techniques to reduce worker exposures from direct ionizing radiation.

The 1301-N Liquid Waste Disposal Facility demolition waste volumes are discussed in DOE/RL-96-39, Rev. 1A, Sections 4.5.1.1 and 4.5.1.2 for the earthen crib structure and DOE/RL-96-39, Rev. 1A, Sections 4.5.2.1 and 4.5.2.2 for the trench. The 1325-N unit demolition volumes are presented in DOE/RL-96-39, Rev. 1A, Sections 4.5.3.1 and 4.5.3.2 for the crib, and in Sections 4.5.4.1 and 4.5.4.2 for the trench. Waste volume tabulations are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

4.1.2 Concrete Structures

Alternatives that include removal of concrete structures are described in the DOE/RL-96-39, Rev. 1A, Sections 5.2.1.3 through 5.2.1.8, for a residential exposure scenario, and in Sections 5.2.2.3 through 5.2.2.8 for a modified CRCIA ranger/industrial exposure scenario. The concrete weir box in the 1301-N Crib will be removed as contaminated waste. Demolition of the structure may be necessary or advantageous prior to removal. Dust controls will be employed to control fugitive emissions during any demolition. The demolition waste volume of the weir box is discussed in DOE/RL-96-39, Rev. 1A, Section 4.5.1.3.

The concrete cover support beams and cover panels over the 1301-N Trench and 1325-N Crib and trench will be removed as intact components, if possible. Demolition activities, if required, will be minimized to maintain control of airborne releases and to simplify soil excavation in the trench. As with the earthen structure removal, particular attention will be given to the control of fugitive dusts and worker exposures to direct ionizing radiation. The demolition waste volume of the cover system is discussed in DOE/RL-96-39, Rev. 1A, Section 4.5.2.3for 1301-N Liquid Waste Disposal Facility, and in DOE/RL-96-39, Rev. 1A, Section 4.5.4.3 for 1325 N. Waste volume tabulations are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

Demolition debris and solid wastes in the cribs and trenches potentially include demolished concrete, wooden poles, and netting. These materials will be removed during crib and trench excavation operations and disposed with the contaminated soils.

4.2 Piping Removal or Characterization as Clean

The remediation of 1301-N and 1325-N Liquid Waste Disposal Facilities includes the excavation and removal of the contaminated piping systems that have not been characterized and determined to be clean (i.e., contain no dangerous waste constituents above residential the Model Toxic Control Act (MTCA) B concentrations) between N Reactor and the cribs. Alternatives that include removal of piping are described in DOE/RL-96-39, Rev. 1A, Sections 5.2.1.3 through 5.2.1.8, for a residential exposure scenario, and in DOE/RL-96-39, Rev. 1A, Sections 5.2.2.3 through 5.2.2.8 for a modified CRCIA ranger/industrial exposure scenario. Two figures illustrate the potential extent of piping removal. Permit Attachment 41, Chapter 2.0, Figure 2.1 shows the pipelines to be removed between the 1722-N Building and 1301-N and between 1310-N and 1301-N. Permit Attachment 41, Chapter 2.0, Figure 2.2 shows the piping between the 1301-N Crib and the 1325-N Crib. Pipe lengths and map references are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

The buried pipelines will be unearthed by conventional excavation equipment. The exposed piping may be segmented for removal manually or by remote methods, depending on contact radiation exposures. Contamination controls will focus on the drainage of residual fluids in the piping prior to, and during, segmentation and on the control of airborne contamination during cutting and pipe handling operations. After the piping has been removed, the pipe bedding soil will be surveyed for residual contamination, excavated, and disposed as necessary.

4.3 Sampling and Analysis Activities

4.3.1 Past Soil Characterization Data

Data used to characterize the vadose zone soils were obtained from six boreholes drilled and sampled to support the 1301-N and 1325-N Liquid Waste Disposal Facilities limited field investigation (DOE/RL-96-39, Rev. 1A). DOE/RL-96-39, Rev. 1A, Figure 2-32 shows the locations of these boreholes. Two of the boreholes are adjacent to 1301-N Liquid Waste Disposal Facility (199-N-107A and 199-N-108A), one is next to 1325-N Liquid Waste Disposal Facility (199-N-109A), and three are located northwest of 1301-N Liquid Waste Disposal Facility (199-N-75, 199-N-76, and 199-N-80) between that facility and the river. Samples were obtained from near the surface to a depth of up to 30.2 m (99 ft). All of these data are presented in the limited field investigation.

In addition to the boreholes, sediment samples were collected from the 116-N-1 Crib. Data from these samples were not used in this evaluation because of insufficient QC associated with the sample collection process. Other soil samples have been collected from this vicinity, but most have only been analyzed for radionuclides.

Data from the characterization samples are summarized in Appendix A of the 1301-N and 1325-N limited field investigation. These data indicate that chromium is the only metal of concern in vadose zone soils at 1301-N Liquid Waste Disposal Facility below 3.0/4.6 m (10/15 ft). Chromium exceeded background concentrations in data associated with 1301-N Liquid Waste Disposal Facility. Mercury is the only other metal that is included in the contaminants of concern (COCs), but no data from the boreholes at 1301-N and 1325-N Liquid Waste Disposal Facilities are available to evaluate the presence or absence of this

analyte in vadose zone soils. Therefore, it is retained as a COC in surface soils (0 to 3.0/4.6 m [10/15 ft]). In DOE/RL-96-39, Rev. 1A, Appendix G, mercury will not reach groundwater in 1,000 years. Therefore is not considered to be a constituent of concern for groundwater protection below 3.0/4.6 m (10/15 ft). Evaluation of nitrate concentrations in the soil is similarly limited because of a paucity of data, so that substance has been retained as a COC. Nitrate is a mobile constituent, and a nitrate plume exists in the groundwater. Therefore, nitrate is considered a COC for both surface and subsurface soils.

Data from the three boreholes located outside of these facilities indicate that no metals are above background values. One sample from the 150- to 180-cm (5- to 6-ft) interval in borehole 199-N-76 was analyzed for mercury, and its value is well below typical background concentrations. These data indicate that metals deposited in the treatment, storage, and disposal facilities (TSD) did not migrate laterally in the vadose zone any substantial distance.

Sampling during remediation did not detect the presence of methanol in the soil. The Washington State Department of Ecology (Ecology) granted a contained-in determination for methanol in December 2000. The limited field investigation sampling was not analyzed for the presence of methanol, and methanol was not listed as detected in any other sampling efforts. Acetone, however, was detected in three samples collected from boreholes outside of the facilities, at concentrations up to 51 ppb. Organic analytes were not analyzed in samples collected within and adjacent to the TSD units; however, field screening using an organic vapor monitor did not detect any organic compounds. Acetone is a common laboratory contaminant, and most of the data reported by the laboratory either are at detection limit or are associated with a blank that contained detectable amounts of acetone. These circumstances cast doubt on the presence of detectable quantities of acetone in the wells outside the bounds of the TSD unit.

Additional sampling was performed in 1998 and is documented in the *Data Summary Report* (BHI 1999). Characterization of the sites was conducted through sampling in accordance with the *Sampling Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation Closeout* (DOE 2000a).

4.3.2 Characterization Activities to Determine Closure Option

A s*ampling and analysis plan* (DOE 2000a) has been developed to support site closure. As presented in Section 4.3 and in DOE/RL-96-39, Rev. 1A, Table 4-17, dangerous waste constituents are retained as constituents of concern in both surface soils and subsurface soils. All alternatives (other than the No-Action Alternative) will result in the removal of dangerous waste constituents above 3.0 m (10 ft) bgs for the modified CRCIA ranger/industrial exposure scenario and 4.6 m (15 ft) bgs for the rural-residential scenario. This will result in removal of all soils that could be contaminated at levels that present a direct exposure hazard as defined in MTCA. Verification sampling to determine MTCA direct soil exposure standard compliance will therefore not be required unless some areas around the units are not excavated and removed to the 3.0m and 4.6m level. Verification sampling will be performed on contaminants that may be present below 3.0 m or 4.6 m for the purposes of determining compliance with groundwater protection standards.

The Data Quality Objectives (DQO) process was used (BHI 2000) to define the extent and type of sampling and analysis required during excavation and closure. This effort will define sampling issues, which may include analytes of interest, sample location, number of samples, number and frequency of field Quality Control (QC) samples (i.e., trip blanks, equipment blanks, splits, and duplicates), sampling methodology, analytical methods, laboratory protocols, laboratory validation, data error tolerances, and data evaluation methods. This DQO effort will culminate in an Ecology-approved sampling and analysis plan.

Alternative-specific sampling and analysis activities are as follows:

RRES-6 and MCRIS-6 - The Remove/Treat if Required/Dispose/Backfill (Removal) alternatives will require sampling and analysis at the end of excavation to determine that, at a minimum, a modified closure option has been attained. Dangerous waste constituents must be below MTCA Method C direct soil exposure and groundwater protection standards in order to preclude landfill closure and placement of a cover. Dangerous waste constituents must be below MTCA B direct soil exposure and groundwater protection standards in order to achieve remediation under RRES-6.

MCRIS-7 - The Remove 3.0 m (10 ft) bgs/Treat if Required/Dispose/Backfill/Capping alternative will result in the placement of a WAC 173-303 compliant cover should dangerous waste constituents be left in place above MTCA Method C levels. Concentrations of dangerous waste constituents remaining under the units would be irrelevant to the need for placement of a landfill cover; however, to determine whether other landfill postclosure requirements should be imposed at one or both units, concentrations of constituent would need to be defined. Sampling would be required after excavation and/or prior to backfilling and placement of the cap for this alternative.

MCRIS-8 - Sampling and analysis would be required for the Remove 3.0 m (10 ft) bgs/Treat if Required/Dispose/Vitrify (Vitrification) alternative to define the extent of contamination of the dangerous waste constituents needing treatment. Sampling after vitrification may be required in order to determine the effectiveness of the treatment for dangerous waste constituents.

In addition to the sampling described above, sampling may be performed during excavation to help define extent of contamination, to guide field activities, and for waste characterization to determine ex situ treatment and disposal requirements.

4.3.3 Piping Characterization

Should a determination be made that piping associated with the 1301-N and 1325-N Liquid Waste Disposal Facilities may be able to meet clean closure standards and be left in place, such a determination will be submitted to Ecology for their concurrence. This determination may be based on process knowledge, sampling, or both.

4.4 Waste Management

Closure of the 1301-N and 1325-N Liquid Waste Disposal Facilities in accordance with the remedial alternatives identified will generate low-level radioactive or mixed waste in the form of contaminated soils and debris. Disposal of these wastes will be performed at the Environmental Restoration Disposal Facility or the W-025 Trench, both located on the 200 Area Plateau of the Hanford Site, in compliance with WAC 173-303 for any dangerous or mixed waste that will be generated. If generated wastes do not meet the acceptance criteria for these units, such as compliance with land disposal restrictions (40 CFR 268), a disposal plan will be developed to determine appropriate treatment or disposal options for these wastes. Waste generated as part of this remediation activity will be managed and disposed of in such a way as to ensure protection of human health and the environment.

Waste generation, management, and disposal will be conducted in accordance with operational procedures and with all State, Federal, and U.S. Department of Energy (DOE) Orders and regulations dealing with waste, including agreements with the public and stakeholders.

4.5 Modified Closure Institutional Control Requirements

Should a modified closure option be determined for 1301-N and/or 1325-N Liquid Waste Disposal Facilities, institutional controls in accordance with Permit Condition II.K.3.a and WAC 173-340-440 shall be adhered to. Institutional controls consist of physical measures and administrative and legal mechanisms. Possible methods of controlling access to contaminated sites include placement of signs, entry control such as locked fencing, artificial or natural barriers, and active surveillance. Measures to be used depend on specific site conditions and degree of hazard associated with contamination left at the end of remediation activities. Because of this, specific institutional controls cannot be detailed until after selection of an alternative and incorporation of design elements during the remedial design phase.

A notice in deed and survey plat will be submitted to the Benton County Auditor as described in Section 4.12.

4.6 Final Cover Requirements for Landfill Closure

Should dangerous waste contaminants be left within the soil column above MTCA Method C levels, a landfill cover would need to be designed and constructed over the unit(s). Specific design aspects associated with a landfill cover would require development after the ROD and during the remedial design phase associated with 1301-N and 1325-N Liquid Waste Disposal Facilities.

4.7 Personnel Training

Training will be provided to site personnel in accordance with the 1301-N and 1325-N Liquid Waste Disposal Facilities training plan contained in DOE/RL-96-39, Rev. 1A, Attachment A-4. This training will be effective until the postclosure period. At that point, the personnel training information contained in Attachment 41, Chapter 5.0, §5.4 will supplement training of personnel for postclosure care activities.

4.8 Closure Contact

The DOE-RL will be the official contact for 1301-N and 1325-N Liquid Waste Disposal Facilities during the postclosure period at the following address:

Director, Office of Environmental Services *
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

*or its equivalent should there be a future reorganization at DOE-RL

4.9 Closure Schedule

Closure activities (actual cleanup) for 116-N-3 will begin in July 2000.

At the completion of 116-N-3, closure activities at 116-N-1 will begin. Approximately 600 feet (Permit Attachment 41, Chapter 2.0, Figure 2.1) of piping that is associated with the 116-N-1 TSD Waste Site and the 116-N-2 Facility and support facilities (1322-NA, NB, NC) will be deferred until decontamination and decommissioning (D&D) of these facilities. This deferral is due to safety concerns with remediating the piping and the radiological dose exposure to remedial action workers. Remediation will require excavation of the earthen berm at the 116-N-2 Facility, which provides radiological shielding.

Additionally, approximately 5,600 feet (Permit Attachment 41, Chapter 2.0, Figure 2.2) of piping that is associated with 116-N-1, 105-N and 109-N Facilities (part of the N Reactor Facility Complex) will be deferred until D&D activities of the 105-N Reactor Facility Complex. This deferral is also due to safety concerns with remediating the piping. Remediation will require excavation up to foundation walls of these facilities, thus, jeopardizing the integrity of the facilities. The pipelines intersect and/or follow active underground power lines and potable water lines. Finally, remediation will block the access routes to the ongoing pump-and-treat operations at the 100-N Springs and other active facilities in the 100-N Area.

The approximate duration of completion for both TSD units is 6 years, not including for the piping that will be deferred. The D&D of the 116-N-2 Facility and support facilities and removal of the deferred piping is planned for startup in the fiscal year 2004. The deferred piping associated with the 105-N and 109-N Facilities will be remediated as part of D&D of the 105-N Reactor Facility Complex in accordance with Tri-Party Agreement Milestone M-093-20.

The corrective action schedule of compliance for UPR-100-N-31 will be the same as the closure schedule.

4.10 Amendment of Closure Plan

The 1301-N and 1325-N Liquid Waste Disposal Facilities closure plan will be amended whenever changes in closure activities or postclosure requirements occur and prior to certification of closure and

postclosure, respectively, that would constitute a Class 1, 2, or 3 modification to the Permit (WAC 173-303-830).

4.11 Certification of Closure

In accordance with WAC 173-303-610(6), within 60 days of closure of 1301-N and 1325-N Liquid Waste Disposal Facilities, RL will submit to Ecology a certification of closure signed by both RL and an independent registered professional engineer. The certification will specify that the units have been closed in accordance with specifications contained within the approved closure plan, as amended, and as contained in the Permit.

4.12 Survey Plat and Notice in Deed

A survey plat will be submitted by RL to the Benton County Planning Department no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). Also, a notice in deed will be submitted by RL to the Auditor of the Benton County no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). After submitting this notice, a certification signed by the Permittees will be submitted to Ecology stating that notification has been recorded along with a copy of the notice in deed. The notice in deed will specify the type, location, and quantity of dangerous wastes remaining after closure actions have been completed.

1301-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 5.0
POSTCLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/2004	

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CHAPTER 5.0
POSTCLOSURE PLAN

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CHAPTER 5.0
POSTCLOSURE PLAN

TABLE OF CONTENTS

5.0 POSTCLOSURE PLAN 5
5.1 Modified Postclosure Institutional Controls and Periodic Assessments 5
5.1.1 Periodic Assessments 5
5.1.2 Inspections 5
5.2 Landfill Postclosure Requirements 6
5.3 Groundwater Monitoring Postclosure Requirements 6
5.3.1 Postclosure Groundwater Monitoring 6
5.3.2 Inspection, Maintenance, and Replacement of Wells 6
5.4 Personnel Training During Postclosure 7
5.4.1 Surveillance Personnel 7
5.4.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel 7
5.4.3 Additional Training Descriptions for Landfill Closure 7
5.5 Security 8
5.5.1 24-Hour Surveillance System 8
5.5.2 Barrier, Means to Control Entry, and Warning Signs 8
5.6 Postclosure Contact 8
5.7 Certification of Postclosure 8

TABLE

Table 5.1. Minimum Inspection Schedule for 1301 N and 1325 N 6

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5.0 POSTCLOSURE PLAN

Postclosure requirements will be applicable to 1301-N and 1325-N. Because it is uncertain, whether postclosure requirements would involve modified closure requirements or landfill requirements, actions necessary to comply with both closure options are presented.

5.1 Modified Postclosure Institutional Controls and Periodic Assessments

Institutional controls under a modified closure option will consist of continued restrictions to access and use of groundwater and may consist of access controls to surface soils or deeper soils such as a fence. Institutional controls will be defined after remedial alternative selection. Inspections and maintenance of institutional controls and monitoring will be requirements of postclosure under a modified closure option.

5.1.1 Periodic Assessments

Periodic assessments shall include a compliance-monitoring plan in accordance with Permit Condition II.K.3.b and WAC 173-340-410. The compliance-monitoring plan will address the assessment requirements, which include protection and confirmation monitoring. This will include at least one assessment activity that is to take place after a period of five years from the completion of closure. The assessment activity will demonstrate whether the soils and groundwater have been maintained at or below the allowed concentrations for a modified closure as defined in Permit Condition II.K.3. The compliance plan will identify the nature and date of the assessment activities and will include a timetable for performance of these activities. This information will be contained in the Comprehensive Environmental Response, Compensation, and Liability (CERCLA) Operation and Maintenance Plan and its supporting documents.

Should the required assessment activities identify contamination above the allowable limits (i.e., landfill closure levels specified in Permit Condition II.K.4.), the unit must be further remediated or the postclosure plan must be modified to include activities to be undertaken at the unit to meet landfill closure and postclosure requirements. Should the required assessment activities demonstrate that contamination has diminished or remained the same, the Permittees may request that Washington State Department of Ecology (Ecology) reduce or eliminate the assessment activities and/or institutional controls.

As allowed by WAC 173-340-410, such monitoring may be combined with other plans. It is the intention that protection and confirmation sampling of groundwater be achieved through implementation of the dangerous waste final status groundwater monitoring plan to be written prior to, and implemented upon, the effective date of the Permit modification adding 1301-N and 1325-N to the Permit (anticipated to occur in 1999).

In addition to groundwater monitoring, compliance monitoring for institutional controls will include routine visual inspections and evaluations. Visual inspections shall consist of examinations of soil cover surfaces for signs of deterioration and improper usage of the surface area (e.g., buildings, impervious surfaces such as concrete or asphalt). An evaluation of existing data from the groundwater monitoring system should also be performed, as well as any other activities that would help assess the integrity of the cover.

5.1.2 Inspections

Inspections of institutional controls and groundwater monitoring systems under a modified closure option will be required. Groundwater monitoring postclosure inspection requirements will be identical to those under a landfill closure option and are contained in Section 5.2. Because the exact nature of institutional controls that may be utilized at 1301-N and 1325-N depend upon the remedial alternative chosen, site conditions, further characterization efforts, and the success of remedial actions taken, a list of potential inspection items is contained in Table 5.1. Frequency of inspection of these potential items is also contained in this table. These inspections may be implemented in checklist form. Such a checklist could specify entering checklist performance and results in the appropriate inspection logbook.

5.1.2.1 Inspection Logbook

Inspectors will be trained in accordance with the postclosure personnel training plan contained in Section 5.4. The inspector will record any damage to the area and/or maintenance needs as well as the weather conditions at the time of inspection. Separate logbook entries will be signed and dated. Performance of any related inspection checklists will be documented in the logbook. Maintenance actions will be started and should be completed within 90 days. Logbook entries will document the correction of the problem or the status of corrective actions. Entries should also uniquely identify, where possible, work documents that actually performed the activities.

5.1.2.2 Security Control Devices

The 1301-N and 1325-N units are currently surrounded by a fence with locked gate access. If fences are removed to accommodate remedial activities, they will be replaced with an appropriate physical barrier, if required, in accordance with institutional controls defined after remedial alternative selection.

Table 5.1. Minimum Inspection Schedule for 1301 N and 1325 N

Item(s)	Inspection Frequency		
	Monthly	Quarterly	Annually
Security control devices			X
Erosion damage	X (until vegetative cover is established)	X (thereafter)	
Cover settlement and displacement		X	
Condition of vegetative cover	X (first 2-3 years)	X (thereafter)	
Well condition and purge water collection system		X	
Benchmark integrity			X

5.1.2.3 Erosion Damage and General Integrity

Should surface ground covers or other earthen barriers be utilized as part of the modified closure institutional controls for 1301-N and 1325-N, inspection of these systems for erosion control and general integrity will be performed. Inspection frequency will be quarterly and will be performed by physically walking over the site to check visually for wind and water erosion, subsidence, displacement, and general site integrity. Any site damage noted during inspections will be recorded in the field logbook and reported to the appropriate maintenance authority.

5.2 Landfill Postclosure Requirements

Should a landfill cover be required, an inspection and maintenance plan will be developed during remedial design for the 1301-N and 1325-N cover systems.

5.3 Groundwater Monitoring Postclosure Requirements

5.3.1 Postclosure Groundwater Monitoring

During the postclosure period, monitoring of groundwater will continue according to the existing groundwater-monitoring program (Borghese et. al., 1996). The detection-monitoring program in accordance with WAC 173-303-645(9) is scheduled for implementation when the 1301-N and 1325-N units are incorporated in the Permit.

5.3.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to

approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

5.4 Personnel Training During Postclosure

This section describes the training of personnel required to complete postclosure care requirements contained in this closure plan and the Permit. It is intended to supplement the training plan currently in place and identified in DOE/RL 96-39, Rev. 1A, Attachment A-4. A brief description of how training will be designed to meet job tasks is presented below.

5.4.1 Surveillance Personnel

The following outline provides potential information on classroom or on-the-job training that surveillance personnel will complete before conducting independent site surveillance at 1301-N and 1325-N during a postclosure period. Only those that are applicable to the selected closure option will be used:

- Site surface inspections. (water and wind erosion, settlement and displacement, vegetative cover)
- Security inspections.
- Location, integrity, and inspection of benchmarks, if appropriate.
- Location, integrity, and inspection of groundwater wells.
- Erosion damage.
- Cover settlement and displacement.
- Vegetative cover condition.

5.4.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel

After closure of 1301-N and 1325-N, the sampling and analysis task leader or delegate (samplers) will be responsible for:

- Monitoring and reporting on groundwater well security and maintenance.
- Collecting groundwater level data.
- Collecting, packaging, and shipping groundwater samples to field and offsite laboratories.
- Sampling and monitoring equipment operation and maintenance.
- Providing sample chain of custody to the laboratory.

The training of the sampling and analysis task leader and sampling personnel will receive either classroom instruction or on-the-job training. Sampling and analysis personnel will be trained to perform these functions in accordance with the *Hanford Analytical Services Quality Assurance Requirements Documents* (DOE-RL 1996d). A person successfully completing the required training courses will be qualified as a groundwater sampler and/or task leader. All personnel will undergo training and at least an annual review for required courses.

5.4.3 Additional Training Descriptions for Landfill Closure

Training descriptions for additional tasks associated with a landfill closure are as follows:

- Site Cover Inspections – This on-the-job training program is established to ensure that the surveillance personnel know what to inspect after the closure of 1301-N and 1325-N. It will include how to inspect for obvious signs of erosion, proper drainage, settlement, and sedimentation. In addition, personnel will be informed as to what constitutes proper vegetation coverage.

Additional on-the-job or classroom training under a landfill closure option includes the following:

- Site Security Inspections – Personnel will be instructed on how to inspect for obvious signs of a security breach. Signs may include cut fencing, unlocked gates, or cut chains.
- Location, Integrity, and Inspection of Benchmarks – Personnel will be shown the location of benchmarks and report any obvious signs of destruction or deterioration.

5.5 Security

5.5.1 24-Hour Surveillance System

The 1301-N and 1325-N units are located within the 100 Area of the Hanford Site. The 100 Area will remain an area controlled by RL for the near future due to the decommissioning and deactivation of facilities associated with and including the 100-N Reactor. These areas will be under 24-hour surveillance by Hanford Patrol Protective Force personnel.

5.5.2 Barrier, Means to Control Entry, and Warning Signs

Roadways to the unit and site access will remain administratively restricted to use by authorized personnel only. Posted federal warning signs restrict access to the 100-N Area from the Columbia River. Further institutional and administrative measures controlling TSD unit site access may be initiated for the site commensurate with the future use of the property.

5.6 Postclosure Contact

The RL will be the official contact for the 1301-N and/or 1325-N units during the postclosure period at the following address:

Director, Office of Environmental Services*
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352
*or its equivalent should there be a future reorganization at DOE-RL

5.7 Certification of Postclosure

No later than 60 days after completion of the postclosure care period, RL will submit to Ecology a certification of completion of postclosure care. This certification, stating that postclosure care for the unit was performed in accordance with the approved closure plan, will be signed by RL and an independent registered professional engineer. The certification will be submitted by registered mail or an equivalent delivery service. Documentation supporting the independent registered professional engineer's certification will be supplied upon request of the regulatory authority.

1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 1324-N Impoundment & 1324-NA Percolation Pond **December 15, 2016**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	12/15/2016	8C.2016.Q3
1.0 Part A Form	12/15/2016	8C.2016.Q3
2.0 Unit Description	08/2004	
3.0 Groundwater Monitoring	06/30/2008	
4.0 Closure Activities	08/2004	
5.0 Postclosure Plan	08/2004	

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PART V, CLOSURE UNIT 3 UNIT-SPECIFIC CONDITIONS
1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
12/15/2016	8C.2016.Q3
6/30/2008	

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PART V, CLOSURE UNIT 3 UNIT-SPECIFIC CONDITIONS
1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND

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PART V, CLOSURE UNIT 3 UNIT-SPECIFIC CONDITIONS
1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND

The 1324-N Surface Impoundment & 1324-NA Percolation Pond is an inactive Treatment, Storage, and Disposal (TSD) unit that is currently undergoing closure activities. This TSD unit was operated as a liquid waste disposal facility for dangerous waste. This permit sets forth the closure requirements for this unit.

V.3.A COMPLIANCE WITH PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit (Permit) as specified in Permit Attachment 3, Permit Applicability Matrix, including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-specific Permit Conditions are enforceable in their entirety.

In the event that the Part V-Unit-Specific Conditions for Closure Unit 3, 1324-N Surface Impoundment & 1324-NA Percolation Pond conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Closure Unit 3, 1324-N Surface Impoundment & 1324-NA Percolation Pond prevail.

CLOSURE UNIT 3

Chapter 1.0	Part A Form, Revision 5, dated September 30, 2016
Chapter 2.0	Unit Description, dated August 2004
Chapter 3.0	Groundwater Monitoring, dated June 30, 2008
Chapter 4.0	Closure Activities, dated August 2004
Chapter 5.0	Post-Closure Plan, dated August 2004

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1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND
CHAPTER 2.0
UNIT DESCRIPTION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/2004	

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CHAPTER 2.0
UNIT DESCRIPTION

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CHAPTER 2.0
UNIT DESCRIPTION

TABLE OF CONTENTS

2.0 UNIT DESCRIPTION 5
2.1 Regulatory Background 5
2.2 Closure Plan and Corrective Measures Study Integration 5
2.3 Closure Performance Standards 6
2.3.1 Minimize the Need for Further Maintenance 6
2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment 6
2.3.3 Return Land to Appearance and Use of Surrounding Area 6
2.4 General Description of Units 6
2.4.1 Topographical Maps 7
2.4.2 Floodplain 7
2.4.3 Traffic 7
2.4.4 General Hydrogeologic Conditions 7
2.4.5 Physical Dimensions of the Waste Units 7
2.4.6 Design Capacity 8
2.4.7 Ancillary Equipment 8
2.4.8 Containment Systems 8
2.4.9 Structures and Piping Requiring Removal or Characterization as Clean 8
2.4.10 Security 8
2.5 Waste Characteristics 8
2.5.1 Liquid Waste Discharges 8
2.5.2 Liquid Waste Discharge Chronology 8

TABLES

Table 2.1. 163-N Demineralization Plant Regeneration Effluent Waste Analysis Cation Regeneration Cycle 9
Table 2.2. 163-N Demineralization Plant Regeneration Effluent Waste Analysis Anion Regeneration Cycle 10
Table 2.3. 183-N Filtered Water Plant Backwash Effluent Analysis 12
Table 2.4. Chronology of Liquid Waste Discharges 13

ABBREVIATIONS AND ACRONYMS

CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CMS	corrective measures study
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ICP	inductively coupled plasma
LWDF	liquid waste disposal facility
MTCA	*Model Toxics Control Act*
OU	operable unit
Permit	Hanford Facility Dangerous Waste Permit
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1980*
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
SEPA	State Environmental Policy Act
TOX	total organic halogen
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*

2.0 UNIT DESCRIPTION

Attachment 42 presents the closure plan for the 1324-N Surface Impoundment (1324-N), also known by the designation 120-N-2, and for the 1324-NA Percolation Pond (1324-NA), also known by the designation 120-N-1. The 1324-N and 1324-NA terminology will be used throughout this appendix because the liquid waste disposal facilities are identified as such in their Part A, Form 3, Permit. These nonradioactive dangerous waste units operated as treatment and disposal units under the authority of the *Washington Administrative Code* (WAC) 173-303. Closure of these units will commence pursuant to WAC 173-303-610 and the Hanford Facility Dangerous Waste Permit (Permit). Modification of the Permit to include this closure plan is anticipated to occur in calendar year 1998.

Soil data obtained during previous sampling efforts do not identify dangerous waste constituents above *Model Toxics Control Act* (MTCA) Method B residential standards. Thus, the soil column meets clean closure standards pursuant to Permit condition II.K.1. However, groundwater contaminated by sulfate will require closure of these units under a modified closure option in accordance with Permit Condition II.K.3.

2.1 Regulatory Background

The 1324-N and 1324-NA units are operated by U.S. Department of Energy (DOE), Richland Operations Office (RL) and co-operated by Bechtel Hanford, Inc. Although the U.S. Government holds legal title to this facility, the RL, for purposes of regulation under WAC 173-303, is considered the legal owner of the facility under existing U.S. Environmental Protection Agency (EPA) interpretive regulations (51 Federal Register 7722).

The Part A, Form 3, dangerous waste permit application documentation for these units was originally submitted to the Washington State Department of Ecology (Ecology) and the EPA in August 1986.

The Part A for the 1324-NA Percolation Pond defined this unit, during operation, as a treatment (through soil column neutralization) and disposal unit for acid and caustic waste. The 1324-N Surface Impoundment, a lined unit, was defined solely as a neutralization treatment unit during its operation. Three revisions of Part A have been submitted since that time. The latest revisions of these Part A's are contained in Attachment 42, Chapter 1.0. In addition, a State Environmental Policy Act (SEPA) checklist, pursuant to WAC 197-11-960, will be approved prior to incorporation of this closure plan into the Permit. A draft SEPA checklist is provided in DOE/RL-96-39, Rev. 1, Attachment B-3).

The Hanford Site Dangerous Waste Permit contains a schedule for incorporation of closure plans into the Permit. The closure plan for 1324-N and 1324-NA is scheduled for incorporation in 1998.

2.2 Closure Plan and Corrective Measures Study Integration

Closure of the 1324-N and 1324-NA units (collectively referred to as 1324-N and 1324-NA, but including the South Settling Pond and associated soils, structures, and piping) will occur under the authority of WAC 173-303. These units are also defined under the 100-NR-1 Operable Unit (OU) and are part of DOE/RL-96-39, Rev. 1, Treatment, Storage, and Disposal Corrective Measures Study.

DOE/RL-96-39, Rev. 1, Section 2.5.5 concludes that no contaminants of concern associated with operation of these units remain in the soil above MTCA Method B residential levels. Information in the closure plan supports this determination and is in Attachment 42, Chapter 4.0, Section 4.3. However, a sulfate plume attributable to operation of these units exists with concentrations above the secondary drinking water standard as described in the DOE/RL-96-39, Rev. 1. The presence of this sulfate plume will require closure of 1324-N and 1324-NA under a modified closure option. Integrated TSD and OU closure actions will be necessary to return the area *to the appearance and use of the surrounding land areas to the degree possible given the nature of the previous dangerous waste activity* (WAC 173-303-610[2][a][(iii]) and to remediate the groundwater.

Actions to accomplish this may include characterization to determine that piping and/or structures are clean, removing structures and piping associated with the units, backfilling, regrading and revegetating

the area, and implementing groundwater remedial technologies for cleanup of the sulfate plume. Attachment 42, Chapter 4.0 provides details of the closure activities and includes characterization data, cleanup standards, and actions to be taken to accomplish the closure activities.

Actions taken to remediate these TSDs will comply with the provisions of both CERCLA and RCRA. The CERCLA public involvement, including public notice and opportunity to comment, has been enhanced to concurrently satisfy the RCRA closure process. The remedy selected under CERCLA will be incorporated into the Hanford Facility RCRA Permit as the RCRA closure action after issuance of the public notice and comment process.

It is anticipated that the CERCLA ROD will be issued subsequent to the RCRA permit modification. Should the CERCLA ROD contain provisions inconsistent with the approved RCRA modifications, the Hanford Facility RCRA Permit will be again modified to reconcile these differences during the next permit modification cycle.

2.3 Closure Performance Standards

The closure performance standards of WAC 173-303-610(2) require that the owner/operator of a TSD unit close the unit in a manner that: (1) minimizes the need for further maintenance; (2) controls, minimizes, or eliminates postclosure escape of dangerous waste to the extent necessary to protect human health and the environment; and (3) returns the land to the appearance and use of surrounding land areas.

2.3.1 Minimize the Need for Further Maintenance

The 1324-N and 1324-NA units will achieve clean closure of the soil column; therefore, further maintenance will not be needed for surface activities after certification of closure. The existing groundwater-monitoring program (Borghese, et. al, 1996) will be continued upon the effective date of the Permit modification adding these units. This system will be operated to minimize maintenance activities.

2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment

Because no dangerous waste or constituents above levels that are considered protective of human health and the environment exist in the soil column at these units prior to closure activities, this closure performance standard is not applicable to this media. Groundwater is administratively restricted from access as a drinking water source by RL and will continue to be restricted until decisions regarding remediation of the sulfate plume are made in a final ROD for the 100-NR-2 OU.

2.3.3 Return Land to Appearance and Use of Surrounding Area

The appearance and use of 1324-N and 1324-NA after closure will be consistent with the future use of the 100-N Area. Structures and piping that do not meet clean closure standards will be removed. Earthen basins will be backfilled, regraded, and revegetated in a manner consistent with the prior site condition.

2.4 General Description of Units

This section provides a general description of the 1324-NA Percolation Pond and 1324-N Surface Impoundment. This description is intended to provide an overview of these units.

1324-N, 1324-NA, the South Settling Pond (100-N-58), and soils contained within the current fence line surrounding these units are subject to this WAC 173-303 closure action. Pipelines associated with dangerous waste discharges from generating units to the ponds/surface impoundment are within this closure scope as well.

A chronology of events associated with these units is contained in Table 2-6 of DOE/RL-96-39, Rev. 1. A brief description of the units that are the subject of this closure plan is presented below.

From August 1977 until spring 1983, the 1324-N Settling Pond system consisted of the North and South Settling Ponds and the 1324-NA Percolation Pond. These ponds received both the corrosive regeneration wastes from the 163-N Demineralization Plant and the nondangerous filter backwash waste stream. Plugging of the settling ponds may have caused some flooding on the northern side of the units as described in DOE/RL-96-39, Rev. 1, Section 2.4.4.

Because all ponds received corrosive dangerous wastes after the effective date of regulation for TSD units (November 19, 1980), they are all subject to closure under dangerous waste regulations. The settling ponds, however, have never been described in the Part A, Form 3 that would define them as interim status TSD units.

The 1324-NA is a large, unlined, inactive pond that was used to treat corrosive wastes. The pond was placed in service in August 1977 and was used to treat corrosive regeneration wastes from the 163-N Demineralization Plant and to dispose of nondangerous filter backwash water from the 183-N Filtered Water Plant. The corrosive wastes were treated in the Percolation Pond by the alternate addition of acidic cation column regeneration wastes and alkaline anion column regeneration wastes and were concomitantly disposed of through percolation throughout the soil column.

1324-N is an inactive basin that was used as a neutralization pond for the corrosive wastes generated from the 163-N Demineralization Plant. The addition of sulfuric acid and sodium hydroxide in series into this unit resulted in a neutralized nondangerous wastewater. This wastewater was then routed to 1324-N. The 1324-N basin had a double liner as well as leak detection and leachate collection system. This site appears as an unlined basin next to the 1324-NA site today.

For a general discussion on the unit background and an in-depth description of 1324-N, 1324-NA, the South Settling Pond, and associated piping, refer to DOE/RL-96-39, Rev. 1, Section 2.4.4.

2.4.1 Topographical Maps

The topographical map for 1324-N and 1324-NA is provided in Figure 2-30 of DOE/RL-96-39, Rev. 1.

2.4.2 Floodplain

The U.S. Army Corp of Engineers (Jamison 1982) has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to a maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 41 million L/s (1.4 million ft^3/s). The 1324-N and 1324-NA units are located above the 100-year floodplain.

2.4.3 Traffic

The majority of traffic inside the Hanford Site boundaries consists of light-duty vehicles used to transport employees to work areas. The 1324-N and 1324-NA units are located within the Hanford Controlled Access Area where roadways cannot be accessed by the general public. These units are isolated from the nearest public highway, State Highway 24, by approximately 6 km (4 mi). Vehicle traffic around the units is restricted and is minimal. Access to the units is prevented by a locked, 2.4-m (8-ft) chain link fence topped with barbed wire.

2.4.4 General Hydrogeologic Conditions

DOE/RL-96-39, Rev. 1, Section 2.4 provides information on the geology and hydrogeology underlying 1324-N and 1324-NA.

2.4.5 Physical Dimensions of the Waste Units

The 1324-NA Percolation Pond is a rectangular basin, 3.7 m (12 ft) deep, with outer dimensions of 95 m by 61 m (310 ft by 200 ft).

1324-N is a basin with outer dimensions of approximately 43 m by 23 m (140 ft by 75 ft) at grade, sloping to 24 m by 4.6 m (80 ft by 15 ft) at approximately 4.6 m (15 ft) below grade.

2.4.6 Design Capacity

Both 1324-N and 1324-NA units were designed with a 24-hour period discharge capacity of 1,050 L/min (277 gal/min).

2.4.7 Ancillary Equipment

The 1324-N and 1324-NA units are passive liquid waste handling/disposal units, which do not rely on active systems for operations support. The units consist of transfer piping, structures, and soil.

2.4.8 Containment Systems

The 1324-NA unit does not include containment systems. Diking exists between units. The 1324-N unit contains a double lining of 45-mil Hypalon and leak detection systems to contain disposed liquids and prevent percolation into the underlying soils.

2.4.9 Structures and Piping Requiring Removal or Characterization as Clean

Structures requiring removal include a sampling building, valve pits, leak detection systems, and the liners. Associated piping is described in DOE/RL-96-39, Rev. 1, Section 2.4.4.

2.4.10 Security

The entire Hanford Site is a controlled-access area. The Hanford Site maintains around-the-clock surveillance to restrict unauthorized access for the protection of the public and of government property, classified information, and special nuclear materials. The Hanford Patrol maintains a continuous presence of protective force personnel to provide Hanford Site security.

Within the Hanford Site are operational areas, including 100-N, to which access is restricted. There is a staffed checkpoint at the Wye Barricade through which access to the 100-N Area is allowed only to authorized personnel. Authorized personnel are those individuals with a DOE-issued security identification badge indicating the appropriate authorization. Such personnel are subject to a search of items carried into or out of controlled areas.

2.5 Waste Characteristics

2.5.1 Liquid Waste Discharges

The hazardous wastes treated in 1324-NA were produced by the regeneration of ion exchange columns in the 163-N Demineralizer Plant. The wastes consisted of acid and caustic regeneration fluids and process and cooling water flushes. The pH of the demineralized water plant wastes varied from less than 1.0 to 14 standard units. These discharges qualified as corrosive dangerous wastes defined in WAC 173-303-090(a)(i) when pH was less than 2.0, or greater than/equal to 12.5. The regeneration solutions would have contained a variety of metal constituents as a result of concentration on the ion exchange media. These metals were not detected at levels that would regulate them as characteristic waste (WAC 173-303-090).

Tables 2.1 and 2.2 contain the results of chemical analyses performed on the cation and anion regeneration wastes respectively. The analyses indicate that the discharges were corrosive dangerous wastes, but did not qualify as dangerous wastes under any of the other criteria. Table 2.3 contains analyses of the 183-N Filtered Water Plant backwash effluent, the nondangerous wastewater also discharged to 1324-N and 1324-NA.

2.5.2 Liquid Waste Discharge Chronology

A chronology of liquid waste discharges to the 1324-N/NA units is provided in Table 2.4.

Table 2.1. 163-N Demineralization Plant Regeneration Effluent Waste Analysis Cation Regeneration Cycle

Parameter (MDL)	Sample			
	1	2	3	Average
pH (standard units)	0.894	0.936	0.922	0.917
Conductivity (micromhos)	37000	40100	35000	37367
Mercury (.001 ppm)	ND	ND	ND	ND
Ethylene glycol (10 ppm)	ND	ND	ND	ND
Enhanced thiourea (.2 ppm)	ND	ND	ND	ND
TOC (1 ppm)	0.0013	0.0019	0.0018	0.0016
Cyanide (.01 ppm)	ND	ND	ND	ND
Barium (.006 ppm)	0.03	0.023	0.020	0.024
Cadmium (.002 ppm)	0.003	0.002	0.003	0.003
Chromium (.01 ppm)	ND	ND	ND	ND
Lead (.03 ppm)	ND	ND	ND	ND
Silver (.01 ppm)	ND	ND	ND	ND
Sodium (.1 ppm)	12.2	16.5	9.6	12.8
Nickel (.01 ppm)	ND	ND	ND	ND
Copper (.01 ppm)	ND	ND	ND	ND
Vanadium (.005 ppm)	0.025	0.027	0.020	0.024
Antimony (.1 ppm)	ND	ND	ND	ND
Aluminum (.15 ppm)	0.725	0.842	0.655	0.741
Manganese (.005 ppm)	0.027	0.035	0.027	0.030
Potassium (.1 ppm)	12.2	15.5	14.8	14.2
Iron (.05 ppm)	1.1	1.2	1.0	1.1
Beryllium (.005 ppm)	ND	ND	ND	ND
Osmium (.3 ppm)	ND	ND	ND	ND
Strontium (.3 ppm)	1.3	1.4	1.2	1.3
Zinc (.005 ppm)	0.016	0.024	0.067	0.036
Calcium (.05 ppm)	282.6	347.4	324.9	318.3
Nitrate (.5 ppm)	1.0	0.5	0.8	0.8
Sulphate (.5 ppm)	2310	4271	2952	3201
Fluoride (.5 ppm)	ND	ND	ND	ND
Chloride (.5 ppm)	2.0	1.8	1.9	1.9
Phosphate (1 ppm)	ND	ND	ND	ND
Phosphorus Pesticides (.005 ppm)	ND	ND	ND	ND
Chlorinated Pesticides (.001 ppm)	ND	ND	ND	ND
Enhanced ABN List	ND	ND	ND	ND
Citrus Red (1 ppm)	ND	ND	ND	ND
Arsenic (.005 ppm)	ND	ND	ND	ND
Ammonium Ion (.05 ppm)	ND	ND	ND	ND
Coliform (3 MPN)	ND	ND	ND	ND
Selenium (.005 ppm)	ND	ND	ND	ND

Parameter (MDL)	Sample			
	1	2	3	Average
Thallium (.01 ppm)	ND	ND	ND	ND
Enhanced VOA (10 ppm)	26	28	26	27

ND = Not Detected MDL = Minimum Detection Limit Data obtained from samples taken August 1985, DOE-RL (1994)

Table 2.2. 163-N Demineralization Plant Regeneration Effluent Waste Analysis Anion Regeneration Cycle

Parameter (MDL)	Sample			
	1	2	3	Average
pH (standard units)	13.72	13.74	13.77	13.74
Conductivity (micromhos)	62000	60000	70000	64000
Mercury (.001 ppm)	0.0001	0.0001	0.0001	0.0001
Ethylene glycol (10 ppm)	ND	ND	ND	ND
Enhanced thiourea (.2 ppm)	ND	ND	ND	ND
TOC (1 ppm)	462	499	456	472
Cyanide (.01 ppm)	0.01	0.015	ND	0.013
Barium (.006 ppm)	ND	ND	ND	ND
Cadmium (.002 ppm)	ND	ND	ND	ND
Chromium (.01 ppm)	ND	ND	ND	ND
Lead (.03 ppm)	ND	ND	ND	ND
Silver (.01 ppm)	ND	ND	ND	ND
Sodium (.1 ppm)	26910	28200	26330	27150
Nickel (.01 ppm)	ND	ND	ND	ND
Copper (.01 ppm)	ND	ND	ND	ND
Vanadium (.005 ppm)	ND	ND	ND	ND
Antimony (.1 ppm)	ND	ND	ND	ND
Aluminum (.15 ppm)	ND	ND	ND	ND
Manganese (.005 ppm)	ND	ND	ND	ND
Magnesium (5 ppm)	ND	ND	ND	ND
Potassium (.1 ppm)	26.5	27.2	26.3	26.7
Iron (.05 ppm)	ND	ND	ND	ND
Beryllium (.005 ppm)	ND	ND	ND	ND
Osmium (.3 ppm)	ND	ND	ND	ND
Strontium (.3 ppm)	ND	ND	ND	ND
Zinc (.005 ppm)	ND	ND	ND	ND
Calcium (.05 ppm)	ND	ND	ND	ND
Nitrate (.5 ppm)	1.0	1.4	0.9	1.1
Sulphate (.5 ppm)	30.9	30.6	30.6	30.7
Fluoride (.5 ppm)	ND	ND	ND	ND
Chloride (.5 ppm)	2.5	2.3	2.3	2.4
Phosphate (1 ppm)	ND	ND	ND	ND
Phosphorus Pesticides (.005 ppm)	ND	ND	ND	ND

Parameter (MDL)	Sample			
	1	2	3	Average
Chlorinated Pesticides (.001 ppm)	ND	ND	ND	ND
Enhanced ABN List	ND	ND	ND	ND
Citrus Red (1 ppm)	ND	ND	ND	ND
Arsenic (.005 ppm)	ND	ND	ND	ND
Ammonium Ion (.05 ppm)	2.3	2.7	2.8	2.6
Coliform (3 MPN)	---	0.023	0.009	0.016
Selenium (.005 ppm)	ND	ND	ND	ND
Thallium (.01 ppm)	ND	ND	ND	ND
Enhanced VOA (10 ppm)	26	28	26	27

ND = Not Detected

MDL = Minimum Detection Limit

Data obtained from samples taken August 1987.

DOE-RL (1994)

Table 2.3. 183-N Filtered Water Plant Backwash Effluent Analysis

Parameter (MDL)	Sample			
	1	2	3	Average
pH (standard units)	7.08	7.65	7.64	7.46
Conductivity (micromhos)	160	150	150	153
Mercury (.001 ppm)	ND	ND	ND	ND
Ethylene glycol (10 ppm)	ND	ND	ND	ND
Enhanced thiourea (.2 ppm)	ND	ND	ND	ND
TOC (1 ppm)	0.002	0.002	0.002	0.002
Cyanide (.01 ppm)	ND	ND	ND	ND
Barium (.006 ppm)	0.03	0.031	0.030	0.030
Cadmium (.002 ppm)	0.004	0.002	0.002	0.003
Chromium (.01 ppm)	ND	ND	ND	ND
Lead (.03 ppm)	ND	ND	ND	ND
Silver (.01 ppm)	ND	ND	ND	ND
Sodium (.1 ppm)	2.202	2.287	2.186	2.225
Nickel (.01 ppm)	ND	ND	ND	ND
Copper (.01 ppm)	ND	ND	ND	ND
Vanadium (.005 ppm)	ND	ND	ND	ND
Antimony (.1 ppm)	ND	ND	ND	ND
Aluminum (.15 ppm)	0.392	0.389	0.376	0.386
Manganese (.005 ppm)	0.020	0.015	0.014	0.016
Potassium (.1 ppm)	0.799	0.814	0.762	0.792
Iron (.05 ppm)	ND	ND	ND	ND
Beryllium (.005 ppm)	ND	ND	ND	ND
Osmium (.3 ppm)	ND	ND	ND	ND
Strontium (.3 ppm)	ND	ND	ND	ND
Zinc (.005 ppm)	ND	ND	ND	ND
Calcium (.05 ppm)	17.34	17.72	17.02	17.36
Nitrate (.5 ppm)	0.789	0.50	0.50	0.596
Sulphate (.5 ppm)	18.9	20.98	19.11	19.66
Fluoride (.5 ppm)	ND	ND	ND	ND
Chloride (.5 ppm)	2.846	2.671	2.901	2.806
Phosphate (1 ppm)	ND	ND	ND	ND
Phosphorus Pesticides (.005 ppm)	ND	ND	ND	ND
Chlorinated Pesticides (.001 ppm)	ND	ND	ND	ND
Enhanced ABN List	ND	ND	ND	ND
Citrus Red (1 ppm)	ND	ND	ND	ND
Arsenic (.005 ppm)	ND	ND	ND	ND
Ammonium Ion (.05 ppm)	ND	ND	ND	ND
Coliform (3 MPN)	0.24	2.4	2.4	1.68
Selenium (.005 ppm)	ND	ND	ND	ND

Thallium (.01 ppm)	ND	ND	ND	ND
Enhanced VOA (10 ppm)	---	0.24	0.25	0.25

ND = Not Detected MDL = Minimum Detection Limit Data obtained from samples taken August 1985, DOE-RL (1994)

Table 2.4. Chronology of Liquid Waste Discharges

Year	Liquid Waste Discharge to 1324-N and 1324-NA (L/day)
1964	0
1965	0
1966	0
1967	0
1968	0
1969	0
1970	0
1971	0
1972	0
1973	0
1974	0
1975	0
1976	0
1977	1,703,250
1978	1,703,250
1979	1,703,250
1980	1,703,250
1981	1,703,250
1982	1,703,250
1983	1,703,250
1984	1,703,250
1985	1,703,250
1986	1,703,250
1987	1,703,250
1988	1,703,250
1989	1,703,250
1990	1,703,250
1991+	0

WHC (1991)

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1324-N SURFACE INPOUNDMENT & 1324-NA PERCOLATION POND
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
06/30/2008	

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CHAPTER 3.0
GROUNDWATER MONITORING

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CHAPTER 3.0
GROUNDWATER MONITORING

TABLE OF CONTENTS

3.0 GROUNDWATER MONITORING 5
3.1 Aquifer Identification 5
3.2 Interim Status Groundwater Monitoring 5
3.2.1 Well Location and Design 6
3.2.2 Sampling and Analysis Plan 6
3.2.3 Quality Assurance and Quality Control 8
3.3 Results of Groundwater Monitoring 8
3.3.1 Potentiometric Levels 8
3.3.2 Groundwater Quality 10
3.4 Groundwater Monitoring During Closure 10
3.4.1 Corrective Action Program 10
3.4.2 Inspection, Maintenance, and Replacement of Wells 10

FIGURES

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond 7
Figure 3.2. Water Level Changes in Groundwater Below 1324-N and 1324-NA 9

TABLES

Table 3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond 8
Table 3.2. Constituent List for 1324-N Surface Impoundment & 1324-NA Percolation Pond 8

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3.0 GROUNDWATER MONITORING

3.1 Aquifer Identification

The unconfined aquifer in the 100-N Area is located primarily in the upper part of the Ringold Formation (sands and gravels) and is approximately 12 to 15 m (40 to 50 ft) thick. The base of the aquifer is believed to be a laterally continuous clay-rich unit containing a series of paleosols. Lithologies in this unit range from clay and silt to sand. Most of the wells in the 100-N Area were completed at the water table; therefore, the thickness of the clay-rich unit is not known at all locations.

The water table is approximately 22 m (72 ft) below land surface near the 1324-N and 1324-NA units. Water levels have returned to "pre-Hanford" levels after years of groundwater mounding caused by artificial recharge from the 1324-NA and other effluent disposal in the 100-N Area.

A representative range of transmissivity estimates for the unconfined aquifer in the 100-N Area is 93 to 560 m^2/day (1,000 to 6,030 ft^2/day) throughout most of the 100-N Area. Wells in the northwest seem to show a higher transmissivity (up to 1,900 m^2/day [20,500 ft^2/day]). These values correspond to horizontal hydraulic conductivity of 6 to 37 m/day (20 to 121 ft/day), 120 m/day (394 ft/day) in the northwest. Specific yield is estimated at 0.1 to 0.3. Hartman and Lindsey (1993) describe the hydrogeology of the 100-N Area in more detail.

3.2 Interim Status Groundwater Monitoring

The 1324-N and the 1324-NA areas are monitored together because of their proximity to one another and their similar waste histories. Groundwater monitoring began at the 1324-N and 1324-NA units in December 1987. The original monitoring network was modified over the years as water levels declined and new wells were installed to replace dry wells.

After the first year of groundwater monitoring at the 1324-N/NA site, statistical evaluations were performed according to 40 *Code of Federal Regulations* (CFR) 265.93. Results indicated that specific conductance in all of the downgradient wells was significantly elevated above background (i.e., upgradient) levels. This was not unexpected, because the effluent discharged to the units had high specific conductance. A groundwater quality assessment program was initiated (Gilmore 1989) in conjunction with the program for the nearby 1301-N Liquid Waste Disposal Facility. The assessment program found no evidence that dangerous waste constituents had entered the groundwater (Hartman 1992). Sulfate and sodium were elevated, but these were not historically defined as dangerous waste constituents under the interim status program defined by 40 CFR 265.

The 1324-N and 1324-NA monitoring program did not immediately revert to an indicator evaluation program. Total organic halogen (TOX) had become elevated in two of the downgradient wells. The assessment program was revised to investigate the cause of the elevated TOX (Hartman 1993). The revised program indicated the presence of chloroform, probably from reaction of chlorine with organic material disposed in a French drain near the units (Hartman 1996c). The TOX and chloroform levels decreased, and the units reverted to indicator evaluation monitoring in early 1996 (Hartman 1996c).

Groundwater is monitored under several programs in addition to the *Resource Conservation and Recovery Act of 1976* (RCRA) in the 100-N Area. The most significant in terms of number of wells and analytes are the RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs, and sitewide surveillance. Sampling and analysis for RCRA, CERCLA, and sitewide surveillance monitoring have been coordinated for several years to avoid duplication. However, this coordination did not include the planning stages of the monitoring programs.

In an attempt to reduce redundancy further and make monitoring more efficient, representatives of the various contractors involved in 100-N groundwater monitoring held a series of workshops to consolidate and streamline monitoring. Monitoring networks were redesigned to provide the most information for all programs most efficiently, and constituent lists were trimmed to the constituents of concern. Sampling frequency also decreased in some cases. Sampling trips and analytical costs are divided among data

users. Borghese et al. (1996) describe the well and constituent lists for the combined program. That document does not include requirements for sampling and analysis protocols, quality control (QC), or statistical evaluations. Hartman (1996b) presents a revised groundwater-monitoring plan for the RCRA program as summarized in the following section.

3.2.1 Well Location and Design

The monitoring network for the 1324-N/NA site includes one upgradient well and four downgradient wells (Figure 3.1, Table 3.1). Well 199-N-59 was installed when the local water table was higher than it is now. The well is now nearly dry and can only be sampled when the water table is seasonally high as controlled by the Columbia River stage. Well 199-N-165 will replace it. The new well will be located approximately 10 ft from the existing well, and no characterization is planned. The new well will be deeper in order to obtain samples during every sample event, but the well will be screened at the top of the uppermost aquifer, as are all the other wells monitoring this Treatment, Storage, and Disposal (TSD) unit. The schedule for construction is in June 2008. All wells monitor the unconfined aquifer, and are constructed to WAC 173-160 standards. As-built diagrams are included in Hartman (1996b).

3.2.2 Sampling and Analysis Plan

The *Groundwater Monitoring Plan for the 1301-N, 1324-N/NA, and 1325-N Sites* (Hartman 1996b) describes the interim status sampling and analysis plan for RCRA monitoring. Groundwater is analyzed for the constituents listed in Table B-6. Indicator parameters are analyzed semiannually; additional parameters are analyzed annually.

Groundwater sampling procedures, sample collection documentation, and chain-of-custody requirements are described in Environmental Investigation Instructions (EII) (WHC-CM-7-7), The Environmental Activities Procedural Manual (WHC-CM-7-8), and in the Quality Assurance Project Plan for Groundwater Monitoring Activities Managed by Westinghouse Hanford Company (WHC 1995). Work by other contractors is conducted to their equivalent approved standard operating procedures. Procedures for field measurements (pH, conductivity, turbidity) are specified in WHC-CM-7-8 and in the user's manuals for the meters used. Analytical methods are selected from those provided in Test Methods for Evaluating Solid Wastes (EPA 1990) as specified by WHC (1995) or its most recent revision.

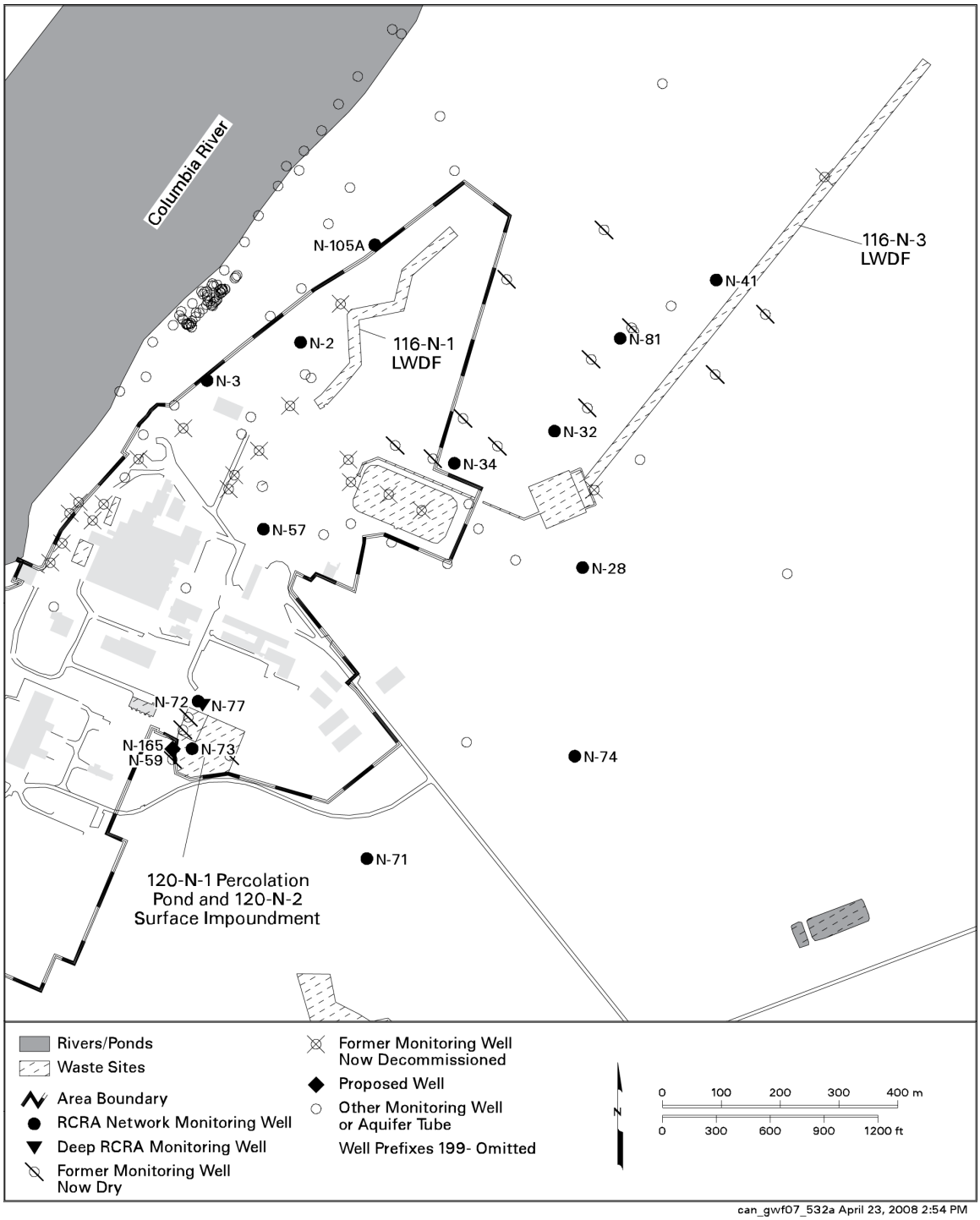

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond

Table 3.1. Proposed RCRA Groundwater Monitoring Network for 1324-N Surface Impoundment & 1324-NA Percolation Pond

Well number	Drill date	Elev. top of casing[1] (m)	Casing/screen materials	Screened or perforated depth[2] (m)	Depth to water[3] (m)
199-N-165	2008	TBD	Stainless steel/stainless steel	TBD	TBD
199-N-71	1991	141.121	Stainless steel/ stainless steel	19.5 - 25.9	22.314(3/96)
199-N-72	1991	139.889	Stainless steel/ stainless steel	18.6 - 25.0	21.080(3/96)
199-N-73	1991	141.194	Stainless steel/ stainless steel	19.8 - 26.2	22.171(6/96)
199-N-77	1992	141.06	Stainless steel/ stainless steel	25.6 - 29.0	22.231(3/96)

[1] Surveyed to North American Vertical Datum of 1988
[2] Approximate depth below land surface; converted from feet
[3] Depth below top of casing; converted from feet

Table 3.2. Constituent List for 1324-N Surface Impoundment & 1324-NA Percolation Pond

Analyzed Semiannually	Analyzed Annually
Contamination Indicator Parameters (Quadruplicate samples): Specific conductance (field)pH (field)Total Organic Carbon Total Organic Halogen Turbidity (field)	ICP1 Metals (filtered) Anions Alkalinity

[1] ICP = Inductively Coupled Plasma

3.2.3 Quality Assurance and Quality Control

Quality assurance (QA) requirements are defined in the *Westinghouse Hanford Company Quality Assurance Manual* (WHC-CM-4-2) or equivalent procedures, and Article 31 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994). Additional requirements for QA and QC are included in WHC (1995) or its' most recent revision.

3.3 Results of Groundwater Monitoring

3.3.1 Potentiometric Levels

Water levels are measured in all wells before sampling. Many of the wells in the 100-N Area are also measured as part of the sitewide semiannual water level program (Serkowski et al. 1995). About 20 wells are equipped with pressure transducers and data loggers. Any of the data described above can be used to construct water table maps to aid in determining groundwater flow directions.

At various times in the history of waste disposal at the 100-N Area, groundwater mounds formed beneath the 1324-NA Percolation Pond and other effluent disposal sites. Changes in water levels are illustrated in Figure 3.2. Water levels have returned to "pre-Hanford" levels in the 100-N Area but are still affected by changes in river stage. Groundwater flow beneath the 1324-N and 1324-NA units currently is toward the Columbia River.

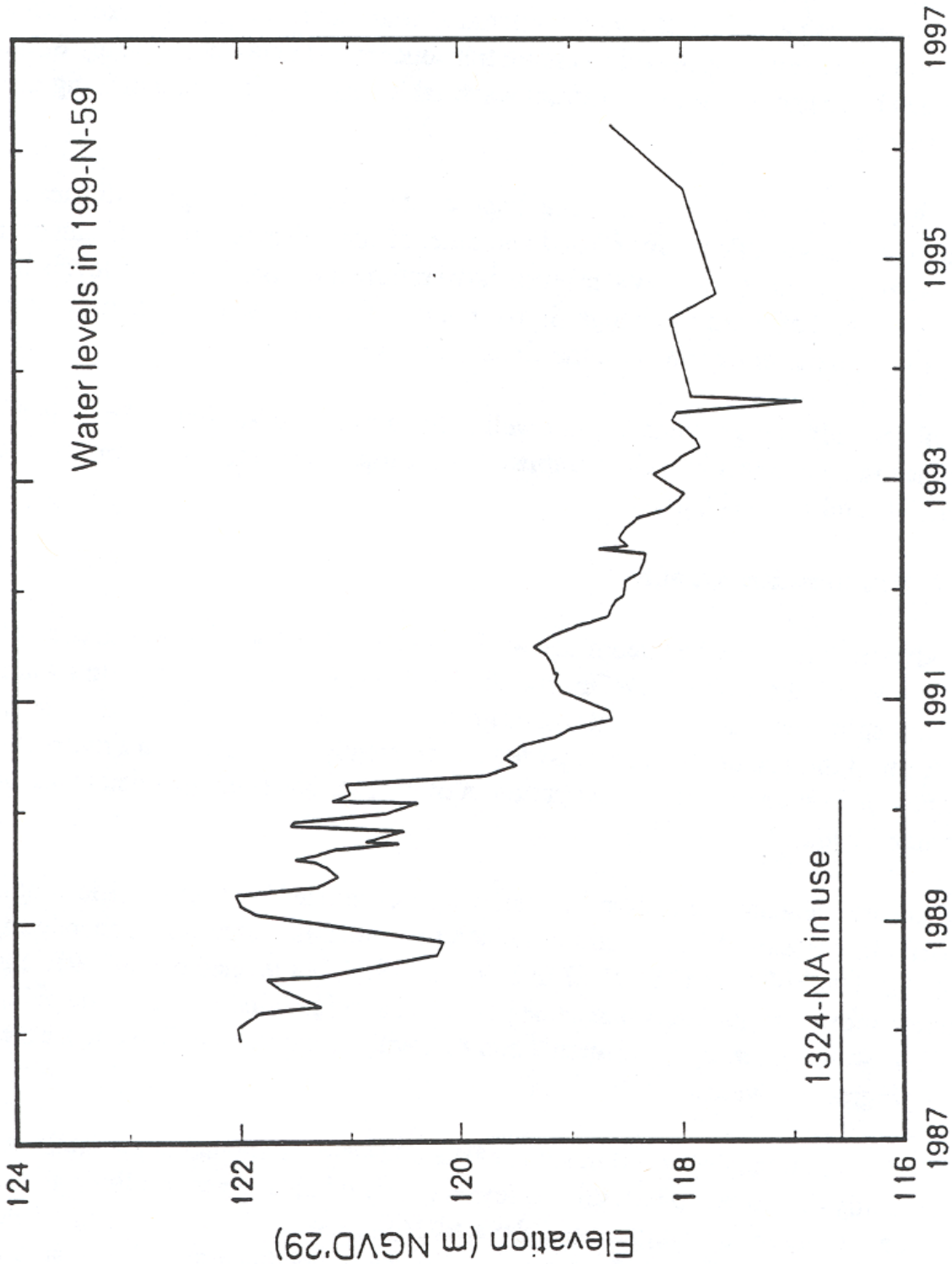

Figure 3.2. Water Level Changes in Groundwater Below 1324-N and 1324-NA

Vertical groundwater gradients are not well defined in the 100-N Area. There is no significant difference in head between wells completed at the top and bottom of the unconfined aquifer near the 1324-N and 1324-NA units.

3.3.2 Groundwater Quality

The 1301-N Liquid Waste Disposal Facility, 1325-N Liquid Waste Disposal Facility, and 1324-NA Percolation Pond have affected groundwater quality in the unconfined aquifer beneath the 100-N Area. In addition, various leaks and spills may have affected soil or groundwater chemistry (DOE RL 1991). Data from RCRA sampling and analysis are reported electronically in the Hanford Environmental Information System database. Interpretation of the data has been included in annual reports (Hartman 1996a).

Groundwater beneath the 1324-N/NA units is characterized by high specific conductance, primarily because of elevated sulfate and sodium. Specific conductance increased in wells 199-N-72, 199-N-73, and 199-N-77 in 1993 and 1994, but leveled off in 1995. Sulfate and sodium concentrations follow the same pattern as specific conductance. The pH in 1324-N and 1324-NA wells generally is between 8 and 8.2, with no significant difference between upgradient and downgradient wells.

The TOX was slightly elevated in some of the 1324-N/NA downgradient wells in 1992-93, but subsequently decreased to background levels (usually below detection limits). A revised assessment program investigated the elevated TOX, and results indicated that chloroform was the cause of the TOX. A French drain, used to dispose of nondangerous chlorinated water, is located near the 1324-NA pond and was probably the cause of the chloroform (i.e., chlorine interacting with organic material). Hartman (1996c) presents results of TOX assessment.

3.4 Groundwater Monitoring During Closure

3.4.1 Corrective Action Program

The presence of a sulfate plume attributable to past operations at 1324-N and 1324-NA will require that a corrective action program (WAC 173-303-645[11]) be implemented upon the effective date of the modification to the Permit adding these closure units. Groundwater monitoring will be done in accordance with the existing groundwater-monitoring program (Borghese, et. al., 1996). A corrective action program to remove or treat the sulfate will be determined in a final Record of Decision ROD for the 100-NR-2 Operating Unit (OU).

3.4.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND
CHAPTER 4.0
CLOSURE ACTIVITIES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
8/2004	

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CHAPTER 4.0
CLOSURE ACTIVITIES

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CHAPTER 4.0
CLOSURE ACTIVITIES

TABLE OF CONTENTS

4.0 CLOSURE ACTIVITIES 5
4.1 Removal of Structures 5
4.2 Piping Removal or Characterization as Clean 5
4.3 Evaluation of Soil Data 5
4.3.1 Sampling and Analysis 5
4.3.2 Assessment of Contamination 6
4.3.3 Summary and Recommendations 9
4.4 Waste Management 9
4.5 Site Restoration 9
4.6 Personnel Training 9
4.7 Closure Contact 9
4.8 Closure Schedule 9
4.9 Amendment of Closure Plan 11
4.10 Certification of Closure 11
4.11 Survey Plat and Notice in Deed 11

FIGURES

Figure 4.1. Sample Locations for 1324-N and 1324-NA Soil Data 7
Figure 4.2. Closure Schedule for 1324-N and 1324-NA 10

TABLES

Table 4.1. Statistical Summary of Data from 1324-N/1324-NA/South Settling Pond Treatment, Storage and Disposal unit (TSD) 8
Table 4.2. Comparison of TSD Soil Data to Background 8

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4.0 CLOSURE ACTIVITIES

The physical activities required to close 1324-N and 1324-NA in accordance with WAC 173-303-610 and the Permit will be integrated with the Record of Decision (ROD) for DOE/RL-96-39, Rev. 1 and the 100-NR-1/100-NR-2 corrective measure study. Closure activities necessary to comply with dangerous waste regulations and the Permit will need to be consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities. CERCLA activities will be required to include elements necessary for closure of a dangerous waste unit.

4.1 Removal of Structures

There will be no remediation excavation in the 1324-N/NA earthen basins for closure, but the Hypalon™ liner and leak detection systems in the 1324-N Surface Impoundment will be removed, using conventional excavation equipment, and disposed as noncontaminated waste. In addition, the sampling shed and perimeter fence will be removed. The structures are discussed in DOE/RL-96-39, Rev. 1, Section 2.4.4. DOE/RL-96-39, Rev. 1, Figure 2-29 shows the surface impoundment, sampling shed and perimeter fence.

The Hypalon™ liner, sampling shed, perimeter fence, and signage will be demolished and removed using conventional demolition/earthmoving equipment. The demolished components will be disposed of in an appropriate non-hazardous disposal facility or recycled as scrap, as appropriate.

4.2 Piping Removal or Characterization as Clean

Should a determination be made that piping associated with the units may be able to meet clean closure standards and be left in place, the determination will then be submitted to the Washington State Department of Ecology (Ecology) for its concurrence. This determination may be based on process knowledge, sampling, or both. Specific sampling requirements will be developed after the ROD and during the remedial design phase of the remedial action. Where piping cannot be determined to be clean, the influent pipelines between the 163-N facility and the 1324-N/NA units will be excavated and removed for disposal as scrap metal destined for recycling. Should piping not be appropriate for recycling, it will be sampled to determine its regulatory status and treated and disposed of accordingly. This piping is shown in DOE/RL-96-39, Rev. 1, Figure 2-28. DOE/RL-96-39, Rev. 1, Appendix D provides the reference maps and estimated pipe lengths.

If removal of the buried pipelines is required, they will be unearthed by conventional excavation equipment. The exposed piping will be segmented for removal manually or with the excavation equipment. Contamination controls will focus on the drainage of residual fluids in the piping prior to, and during, segmentation and on the control of airborne contamination during cutting and pipe handling operations. After the piping has been removed, the pipe bedding soil will be surveyed for residual contamination, excavated, and disposed as necessary.

4.3 Evaluation of Soil Data

4.3.1 Sampling and Analysis

Soil samples associated with the vadose zone at 1324-N and 1324-NA were collected from two boreholes and one test pit in late 1992 and early 1993. The test pit was excavated in the 1324-NA percolation pond, and samples were collected from the surface to 21.3 m (70 ft) in 1.5-m (5-ft) intervals. Samples from borehole 199-N-88 were collected from the surface to 21.9 m (72 ft), and samples from borehole 199-N-89 were collected from the surface to 23.2 m (76 ft). All the borehole samples were collected in approximately 1.5-m (5-ft) intervals, and composited over 0.15- to 0.76-m (0.5- to 2.5-ft) intervals. A total of 53 samples were collected from the three areas. Figure 4.1 contains a map showing the sample locations.

Data for ICP metals, mercury, cyanide, pH, and anions are presented in DOE/RL-96-39, Rev. 1, Attachment B-4. Analyses for organic constituents were also performed, but none of these were present above detection limits; thus, they will not be discussed further. The following sections use these data to

evaluate whether the activities that occurred at 1324-N and 1324-NA have impacted the vadose zone soils.

Samples collected from the test pit and borehole 199-N-88 provide data on vadose zone soil composition beneath 1324-NA and the South Settling Pond, respectively. If significant amounts of contamination were deposited in the vadose zone under these two ponds, the data presented here would likely show evidence of this contamination. Borehole 199-N-89 is located to the northwest of 1324-N. Because of the boreholes location, using data from it to assess dangerous waste in the vadose zone is questionable.

4.3.2 Assessment of Contamination

In order to evaluate if 1324-N and 1324-NA have released contamination into the vadose zone, the data described above were statistically summarized and compared to background levels for the Hanford Site. Background is allowed as a default cleanup level in most environmental regulations (e.g., WAC 173-303, WAC-173-340), which recognize that background levels are rarely detrimental to human health or the environment and that remediating to levels below background concentrations is futile. The comparison with background values follows the methodology recommended by Ecology (Ecology 1992).

Table 4.1 lists the upper 95% confidence limit on the mean of the data from the units, as well as other statistical values. The data were determined to follow a log normal distribution, so the statistics were calculated on that basis.

Table 4.2 presents the evaluation of the data compared to background, using the three-part test recommended by Ecology. The data pass the first part of the test, which compares the background value at the 90th percentile to the 95% upper confidence level on the mean of the waste site data. Using this comparison, the data are below background for all analytes.

The second and third parts of the Ecology test evaluate frequency and magnitude of exceedences of the data above comparison criteria levels (background, in this case). The allowable frequency of exceedences for comparison to background is determined by using the binomial theorem to calculate the probability that a single sample is greater than background at a probability of 0.10. This calculation requires knowledge of the percentile chosen for background (0.90), the number of samples from the units (53), and the exceedence frequency (0.10). Using this criterion, a maximum of eight exceedences is allowed. Copper is the only analyte that has a significant number of exceedences (seven samples; see Table 4.2), and it is below the maximum number permitted.

The third part of the Ecology test requires that the largest value from the waste site data be less than two times the cleanup level. As seen in DOE/RL-96-39, Rev. 1, Attachment B-4, none of the analytes exceed this criterion.

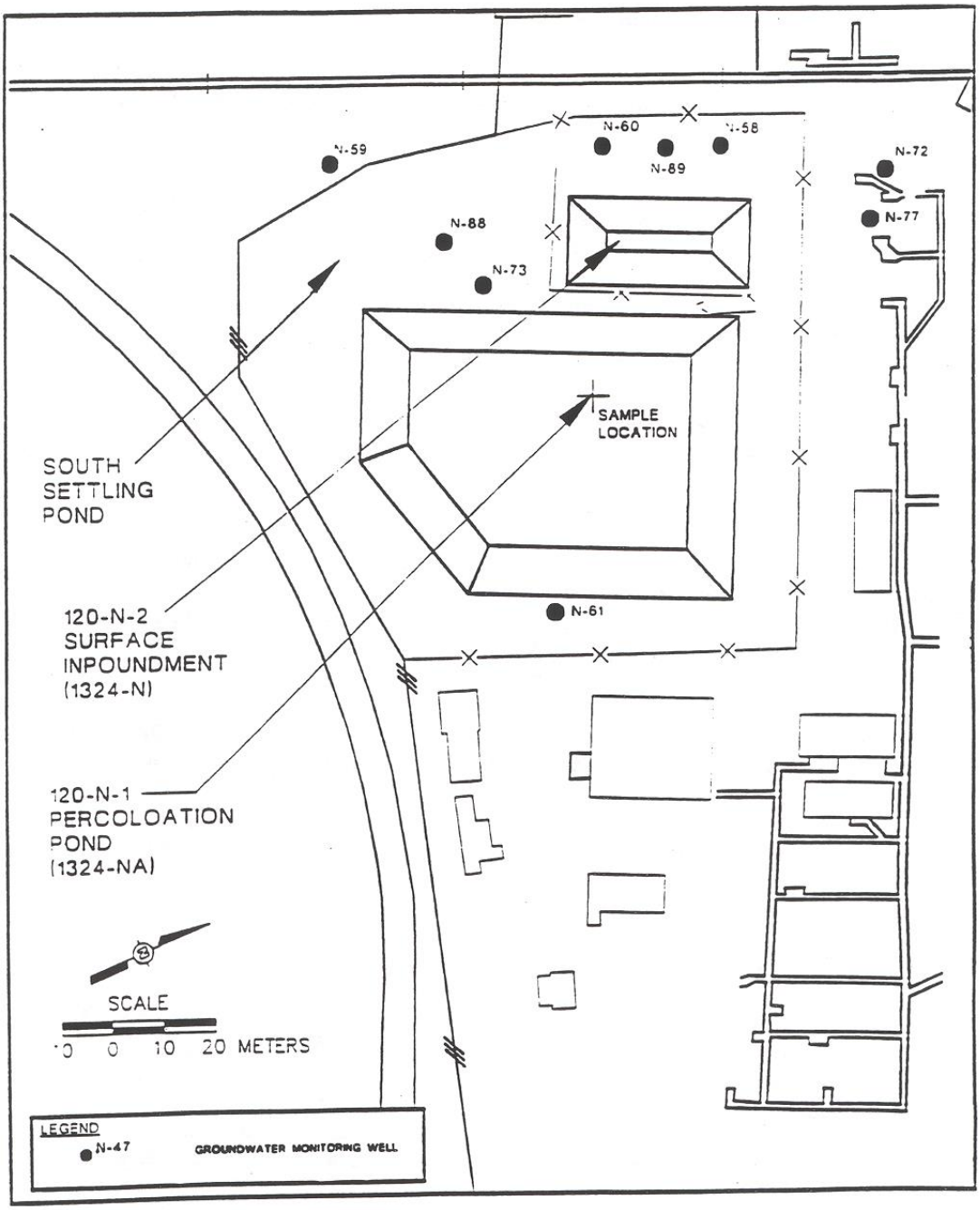

Figure 4.1. Sample Locations for 1324-N and 1324-NA Soil Data

Table 4.1. Statistical Summary of Data from 1324-N/1324-NA/South Settling Pond Treatment, Storage and Disposal Unit (TSD)

	Geo. Mean	Min	Max	N	90th Percentile	95% UCL on Mean
Antimony[a]	3.04	1.70	6.35	53	5.14	3.66
Arsenic	1.05	0.37	3.5	53	2.03	1.37
Barium	48.43	16.80	93.7	53	72.61	54.99
Chromium	4.56	0.65	14.6	53	13.28	8.23
Cobalt	8.12	1.05	15.8	53	16.09	10.78
Copper	14.06	2.60	31.5	53	27.36	18.45
Fluoride	1.14	0.30	3.2	53	2.17	1.47
Lead	2.76	1.50	6.4	53	4.54	3.28
Manganese	213	73.80	702	53	341.81	250
Mercury	0.038	0.02	0.37	53	0.10	0.061
PH	8.10	5.6	9.8	53	9.76	8.42
Nickel	7.40	2.08	17.6	53	12.13	8.77
Selenium[a]	0.60	0.21	2.5	53	1.17	0.79
Sulfate	32.81	6.00	135	53	77.37	49.41
Vanadium	33.02	3.70	81.1	53	80.45	50.96
Zinc	34.74	6.80	94.4	53	67.80	45.66

[a] Background values for these analytes were below detection limit; highest detection limit reported by the laboratory is used. UCL = Upper Confidence Limit

Table 4.2. Comparison of TSD Soil Data to Background

	Average	Upper 95 UCL on Mean	Background, 90th percentile	# of data > BG	% of data > BG	Max value/ background
Antimony	3.29	3.66	11.1	0	0.0	0.57
Arsenic	1.20	1.37	6.47	0	0.0	0.54
Barium	50.68	54.99	132	0	0.0	0.71
Chromium	6.00	8.23	18.5	0	0.0	0.79
Cobalt	9.07	10.78	15.7	1	1.9	1.01
Copper	15.70	18.45	22	7	13.2	1.43
Fluoride	1.28	1.47	2.81	3	5.7	1.14
Lead	2.99	3.28	10.2	0	0.0	0.63
Manganese	227	250	512	1	1.9	1.37
Mercury	0.05	0.06	0.33	1	1.9	1.12
Nickel	7.92	8.77	19.1	0	0.0	0.92
Selenium	0.70	0.79	5	0	0.0	0.50
Sulfate	40.69	49.41	237	0	0.0	0.57
Vanadium	39.40	50.96	85.1	0	0.0	0.95
Zinc	38.85	45.66	67.8	4	7.5	1.39

UCL = Upper Confidence Limit

4.3.3 Summary and Recommendations

The data presented here strongly indicate that the vadose zone under 1324-N, 1324-NA, and the South Settling Pond has concentrations of metals indistinguishable from background compositions. The data used to lead to this conclusion were obtained from samples located in areas expected to record adverse impacts from the units. An exception to this is the lack of data from samples that may have been influenced by an overflow of the North Settling Pond. There are some indications that this event may have occurred and that standing water was present in the northern portion of the units. To evaluate any impacts from an event of this kind, two samples will be collected from the northern part of the units and analyzed for metals, pH, and sulfate. The location of the samples will be determined and agreed upon by all parties involved in the closure decisions.

4.4 Waste Management

Closure of the 1324-N and 1324-NA units may generate small quantities of clean or contaminated nonradioactive debris. Disposal of these wastes will be dependent upon their level of contamination. It is doubtful that dangerous waste will be generated during cleanup of these units, however, should dangerous waste be generated, its management will occur in compliance with WAC 173-303. Waste generated as part of this closure activity will be managed and disposed of in such a way as to ensure protection of human health and the environment.

Waste generation, management, and disposal will be conducted in accordance with operational procedures and with all State, Federal, and U.S. Department of Energy (DOE) Orders and regulations dealing with waste, including agreements with the public and stakeholders.

4.5 Site Restoration

After the system structures and piping have been removed or they have been characterized as clean, the earthen basins will be backfilled, regraded, and revegetated in a manner consistent with the prior site condition.

4.6 Personnel Training

No radioactive or dangerous waste constituent hazards are expected to be encountered during closure activities at 1324-N and 1324-NA, nor are dangerous wastes expected to be generated. However, should hazards be encountered or dangerous waste be generated that were not anticipated, training will be provided to site personnel in accordance with the site-specific training plan contained in DOE/RL-96-39, Rev. 1, Attachment B-5.

Training required during closure activities for personnel involved in the groundwater-monitoring program are the same as those identified in Attachment 42, Chapter 5.0, §5.5 the Postclosure Plan.

4.7 Closure Contact

The DOE-RL will be the official contact during the postclosure period at the following address:

Director, Office of Environmental Services*
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

*or its equivalent should there be a future reorganization at DOE-RL

4.8 Closure Schedule

The closure schedule for 1324-N (120-N-2) and 1324-NA (120-N-1) is presented in Figure 4.2. Closure activities (actual cleanup) for the 120-N-1 and 120-N-2 will begin in July 2001 and will continue for an approximate duration of 15 months. The corrective action schedule of compliance for 100-N-58 will be the same as the closure schedule.

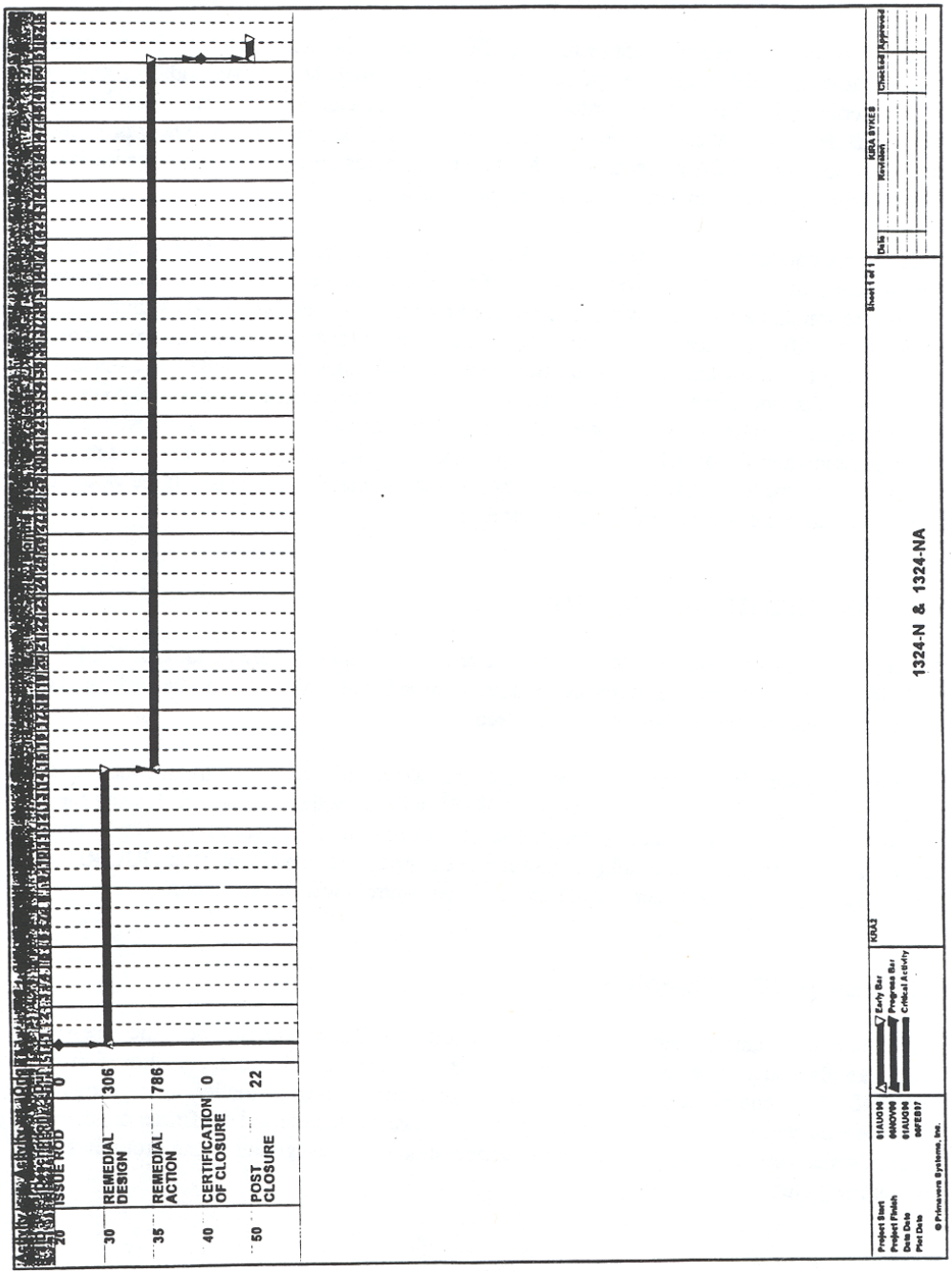

Figure 4.2. Closure Schedule for 1324-N and 1324-NA

4.9 Amendment of Closure Plan

The 1324-N and 1324-NA closure plan will be amended whenever changes in closure activities or postclosure requirements occur and prior to certification of closure and postclosure, respectively, that would constitute a Class 1, 2, or 3 modification to the Permit (WAC 173-303-830).

4.10 Certification of Closure

In accordance with WAC 173-303-610(6), within 60 days of closure of 1324-N and 1324-NA, RL will submit to Ecology a certification of closure signed by both RL and an independent registered professional engineer. The certification will specify that the units have been closed in accordance with specifications contained within the approved closure plan as contained in the Permit.

4.11 Survey Plat and Notice in Deed

A survey plat will be submitted by RL to the Benton County Planning Department no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). Also, a notice in deed will be submitted by RL to the Auditor of the Benton County no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). After submitting this notice, a certification signed by the Permittees will be submitted to Ecology stating that notification has been recorded along with a copy of the notice in deed. The notice in deed will specify the type, location, and quantity of dangerous wastes remaining after closure actions have been completed.

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1324-N SURFACE IMPOUNDMENT & 1324-NA PERCOLATION POND
CHAPTER 5.0
POSTCLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
8/2004	

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CHAPTER 5.0
POSTCLOSURE PLAN

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CHAPTER 5.0
POSTCLOSURE PLAN

TABLE OF CONTENTS

5.0 POSTCLOSURE PLAN 5
5.1 Institutional Controls 5
5.2 Periodic Assessments 5
5.3 Groundwater Monitoring Postclosure Requirements 5
5.3.1 Postclosure Groundwater Monitoring 5
5.3.2 Inspection, Maintenance, and Replacement of Wells 5
5.4 Corrective Action Plan 6
5.5 Personnel Training During Postclosure 6
5.5.1 Surveillance Personnel 6
5.5.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel 6
5.6 Security 6
5.6.1 24-Hour Surveillance System 6
5.6.2 Barrier, Means to Control Entry, and Warning Signs 7
5.7 Postclosure Contact 7
5.8 Certification of Postclosure 7

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5.0 POSTCLOSURE PLAN

Modified postclosure requirements will be applicable to 1324-N and 1324-NA. Permit condition II.K.3. allows a modified closure option for a unit if it can meet Model Toxic Control Act (MTCA) Method C cleanup levels. The soil column has been demonstrated to be able to meet clean closure standards under MTCA Method B. However, sulfate concentrations exceed MTCA Method C groundwater protection standards because MTCA Method B and Method C standards are identical when the basis is a federal drinking water standard, as is the case with sulfate.

Units where contamination exceeds MTCA Method C may be required to close as a landfill (Permit Condition II.K.4). However, as part of this postclosure plan, DOE/RL-96-39, Rev. 1, Attachment B-6 presents a demonstration that a landfill cover is not required over the 1324-N and 1324-NA units and therefore modified closure is the appropriate closure option for these units. The amount of clean soil meeting MTCA Method B cleanup standards that will remain at the closed 1324-N and 1324-NA units would prevent a downward driving force of precipitation that could contribute to further degradation of the groundwater. DOE/RL-96-39, Rev. 1, Attachment B-6 shows that precipitation would not reach groundwater for over 200 years. Because the soil column has been determined to be clean, and no downward driving force for further groundwater contamination exists, there would be no need for a landfill cover system at 1324-N and 1324-NA.

5.1 Institutional Controls

No soil contamination that would present a hazard from direct exposure remains at 1324-N and 1324-NA. Therefore, no measures are required to prohibit or limit access at the surface. For example, fences or barriers will not be required.

Institutional controls are required to be maintained in order to ensure that groundwater is not used as a drinking water source. Because U.S. Department of Energy – Richland Office (DOE-RL) will maintain control over this site for the near future, it is not anticipated that additional actions will be required to limit controls over groundwater usage. Should groundwater use restrictions be required after DOE-RL relinquishment of the area, appropriate institutional controls will be established.

5.2 Periodic Assessments

Periodic assessments are required by Permit Condition II.K.3.b. The first periodic assessment will take place after a period of five years from the completion of closure. As allowed by WAC 173-340-410, a compliance-monitoring plan for protection and confirmation monitoring during the five-year period may be combined with other plans. Protection and confirmation sampling of groundwater will be achieved through implementation of the dangerous waste groundwater-monitoring plan.

5.3 Groundwater Monitoring Postclosure Requirements

5.3.1 Postclosure Groundwater Monitoring

During the postclosure period, monitoring of groundwater will continue under a corrective action program in accordance with WAC 173-303-645(11). A groundwater-monitoring plan will be developed for 1324-N and 1324-NA and implemented prior to incorporation of this postclosure plan into the Permit.

5.3.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

5.4 Corrective Action Plan

Because the groundwater monitoring data continues to show exceedences of sulfate concentrations above the secondary drinking water standard (250 mg/L), corrective action to remove or treat the sulfate will be required. Corrective actions will be determined in a Record of Decision (ROD) for the 100-NR-2 Operating Unit (OU). The sulfate plume is described in the DOE/RL-95-111, *Corrective Measures Study for the 100-NR-1 and 100-NR-2 Operable Units*, Section 3.3.3.2, Nature and Extent of Contamination. Alternatives for its remediation are presented and analyzed in DOE/RL-95-111, Sections 5 through 7. A Proposed Plan and ROD for the 100-NR-2 OU will determine any corrective actions required to remediate the sulfate plume.

5.5 Personnel Training During Postclosure

This section describes the training of personnel required to complete postclosure care requirements contained in this closure plan and the Permit. It is intended to supplement the training plan currently in place and identified in DOE/RL-96-39, Rev. 1, Attachment B-4. A brief description of how training will be designed to meet job tasks is presented below.

5.5.1 Surveillance Personnel

The following outline provides potential information on classroom or on-the-job training that surveillance personnel will complete before conducting independent site surveillance at 1324-N and 1324-NA during a postclosure period.

- Security inspections.
- Location, integrity, and inspection of benchmarks, if appropriate.
- Location, integrity, and inspection of groundwater wells.
- Erosion damage.
- Vegetative cover condition.

5.5.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel

This section describes the training of the groundwater sampling and analysis task leader and sampling personnel required to complete postclosure care requirements as contained in this postclosure plan. A brief description of how training will be designed to meet job tasks is presented below.

The sampling and analysis task leader or delegate and samplers will be responsible for:

- Monitoring and reporting on groundwater well security and maintenance.
- Collecting groundwater level data.
- Collecting, packaging, and shipping groundwater samples to field and offsite laboratories.
- Sampling and monitoring equipment operation and maintenance.
- Providing sample chain of custody to the laboratory.

The training of the sampling and analysis task leader and sampling personnel will receive either classroom instruction or on-the-job training. Sampling and analysis personnel will be trained to perform these functions in accordance with the *Hanford Analytical Services Quality Assurance Requirements Documents* (DOE-RL 1996b). A person successfully completing the required training courses will be qualified as a groundwater sampler and/or task leader. All personnel will undergo training and at least an annual review for required courses.

5.6 Security

5.6.1 24-Hour Surveillance System

The 100 Area will remain an area controlled by the DOE-RL for the near future. These areas will be under 24-hour surveillance by Hanford Patrol protective force personnel.

5.6.2 Barrier, Means to Control Entry, and Warning Signs

No direct exposure hazards remain at 1324-N and 1324-NA. However, roadways to the unit and site access will remain administratively restricted to use by authorized personnel only. Access to the 100-N Area from the Columbia River is restricted by posted federal warning signs.

5.7 Postclosure Contact

The DOE-RL will be the official contact during the postclosure period at the following address:

Director, Office of Environmental Services *
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

*or its equivalent should there be a future reorganization at DOE-RL

5.8 Certification of Postclosure

No later than 60 days after completion of the postclosure care period, the DOE-RL will submit to Ecology a certification of completion of postclosure care. This certification, stating that postclosure care for the unit was performed in accordance with the approved closure plan, will be signed by DOE-RL and an independent registered professional engineer. The certification will be submitted by registered mail or an equivalent delivery service. Documentation supporting the independent registered professional engineer's certification will be supplied upon request of the regulatory authority.

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1325-N LIQUID WASTE DISPOSAL FACILITY
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 1325-N Liquid Waste Disposal Facility **December 15, 2016**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	12/15/2016	8C.2016.Q3
1.0 Part A Form	12/15/2016	8C.2016.Q3
2.0 Unit Description	08/2004	
3.0 Groundwater Monitoring	08/2004	
4.0 Closure Activities	03/31/2005	
5.0 Postclosure Plan	08/2004	

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1325-N LIQUID WASTE DISPOSAL FACILITY
PART V, CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
12/15/2016	8C.2016.Q3
09/30/2005	

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PART V, CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
1325-N LIQUID WASTE DISPOSAL FACILITY

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PART V, CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
1325-N LIQUID WASTE DISPOSAL FACILITY

The 1325-N Liquid Waste Disposal Facility is an inactive Treatment, Storage, and Disposal (TSD) unit that is currently undergoing closure activities. This TSD unit was operated as a liquid waste disposal facility for dangerous waste. This permit sets forth the closure requirements for this unit.

V.1.A COMPLIANCE WITH PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility Resource Conservation and Recovery Act (RCRA Permit (Permit) as specified in Permit Attachment 3, Permit Applicability Matrix, including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-specific Permit Conditions are enforceable in their entirety.

In the event that the Part V-Unit-Specific Conditions for Closure Unit 1, 1325-N Liquid Waste Disposal Facility conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Closure Unit 1, 1325-N Liquid Waste Disposal Facility prevail.

CLOSURE UNIT 1

Chapter 1.0	Part A Form, Revision 9, dated September 30, 2016
Chapter 2.0	Unit Description, dated August 2004
Chapter 3.0	Groundwater Monitoring, dated August 2004
Chapter 4.0	Closure Activities, dated March 31, 2005
Chapter 5.0	Post-Closure Plan, dated August 2004

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1325-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 2.0
UNIT DESCRIPTION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
8/2004	

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CHAPTER 2.0
UNIT DESCRIPTION

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CHAPTER 2.0
UNIT DESCRIPTION

TABLE OF CONTENTS

2.0 UNIT DESCRIPTION 5
2.1 Regulatory Background 5
2.2 Closure Plan and Corrective Measures Study Integration 6
2.3 Closure Performance Standards 7
2.3.1 Minimize the Need for Further Maintenance 7
2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment 7
2.3.3 Return Land to Appearance and Use of Surrounding Area 7
2.4 General Description of Units 7
2.4.1 Topographical Maps 8
2.4.2 Floodplain 8
2.4.3 Traffic 8
2.4.4 General Hydrogeologic Conditions 8
2.4.5 Physical Dimensions of the Units 8
2.4.6 Design Capacity 8
2.4.7 Ancillary Equipment 8
2.4.8 Containment Systems 9
2.4.9 Structures and Piping Requiring Removal or Characterization as Clean 9
2.4.10 Security 9
2.5 Waste Characteristics 9
2.5.1 Liquid Waste Discharges 9
2.5.2 Liquid Waste Discharge Chronology 11

FIGURES

Figure 2.1. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation 15
Figure 2.2. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation 16

TABLES

Table 2.1. 1301-N and 1325-N Effluent Analysis 12
Table 2.2. Chronology of Liquid Waste Discharges 14

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2.0 UNIT DESCRIPTION

The closure plan for the 1301-N Liquid Waste Disposal Facility (1301-N), also known by the designation 116-N-1, and for the 1325-N Liquid Waste Disposal Facility (1325-N), also known by the designation 116-N-3. The 1301-N and 1325-N terminology will be used throughout this appendix because the Liquid Waste Disposal Facilities are identified as such in their interim status Part A Permit Applications. These radioactive dangerous waste units operated as soil column disposal units, most recently under the authority of the *Washington Administrative Code* (WAC) 173-303. Closure of these units will commence pursuant to WAC 173-303-610 and the Hanford Facility Dangerous Waste Permit (Permit). Modification of the Permit to include this closure plan is scheduled to occur in calendar year 1999. However, because of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) milestone that requires one document be submitted to address the four treatment, storage, and disposal units this closure plan will be incorporated into the Permit Modification in December 1998.

This closure plan is part of the 100-NR-1 Treatment, Storage, and Disposal Corrective Measures Study (DOE/RL-96-39, Rev. 1A). Approval of this closure plan will be obtained through the Permit modification process. Contaminated groundwater associated with 1301-N and 1325-N Treatment, Storage and Disposal (TSD) operations is defined as the 100-NR-2 Operable Unit (OU). Remedial alternatives associated with contaminated groundwater are defined in the 100-NR-1/NR-2 Treatment, Storage, and Disposal Corrective Measures Study. Chosen remedial actions for 100-NR-2 groundwater will be defined in a separate Record of Decision (ROD) and, again, incorporated into the Permit through Permit modification. Actual closure activities necessary to close these units are not known at this time because the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) alternative selection process has not been completed. Therefore, this closure plan contains closure activities that may be required for the range of 1301-N and 1325-N remedial alternatives presented in Permit Attachment 41, Chapter 5.0. This range includes two closure options available to dangerous waste units under WAC 173-303 and the Permit: modified closure or landfill closure.

2.1 Regulatory Background

The 1301-N and 1325-N units are operated by the U.S. Department of Energy (DOE), Richland Operations Office (RL), and co-operated by Bechtel Hanford, Inc. Although the U.S. Government holds legal title to this facility, the RL, for purposes of regulation under WAC 173-303, is considered the legal owner of the facility under existing U.S. Environmental Protection Agency (EPA) interpretive regulations (51 Federal Register 7722).

The Part A, Form 3, dangerous waste permit application documentation for 1301-N originally was submitted to the Washington State Department of Ecology (Ecology) and the EPA in August 1986. Documentation for the 1325-N Liquid Waste Disposal Facility originally was submitted in February 1987.

The Part A identifies the listed waste spent solvent, methanol (F003), as being disposed to 1301-N and 1325-N. Any media or debris that came into contact with wastewaters disposed to these units may also, by definition, be considered to be a listed dangerous waste in lieu of an approved contained-in determination. The reason this is not stated definitively is because, federally, F003 spent solvents are no longer listed if they do not exhibit the characteristic of ignitability (40 CFR 261.3[a][2][iii]), however, a similar 'exclusion' does not exist in State regulation.

Soil samples taken from the 1325-N Trench resulted in non-detectable levels of methanol. The values reported for the nondetects range from 5.0 to 5.4 mg/kg and are well below the Model Toxics Control Act (MTCA) Method B cleanup of 400 mg/kg. Sampling of the 1301-N Crib was not conducted since it is considered to be analogous with the 1325-N Trench. In December 2000, Washington State Department of Ecology granted a contained-in determination for the soils located within the 1325-N and 1301-N Liquid Waste Disposal Facilities.

2.2 Closure Plan and Corrective Measures Study Integration

Closure of the 1301-N and 1325-N units will occur under the authority of WAC 173-303. These units are also defined under the 100-NR-1 OU and are part of DOE/RL-96-39, Rev. 1A. Integrated TSD and OU closure actions will be necessary to remediate contaminated soil and groundwater. Actions taken to remediate these TSDs will comply with the provisions of both CERCLA and RCRA. The CERCLA public involvement, including public notice and opportunity to comment, has been enhanced to concurrently satisfy the RCRA closure process. The remedy selected under CERCLA will be incorporated into the Hanford Facility RCRA Permit as the RCRA closure action after issuance of the public notice and comment process.

The CERCLA ROD was issued subsequent to the Hanford Facility RCRA Permit modification. Should the CERCLA ROD contain provisions inconsistent with the approved RCRA modifications, the Hanford Facility RCRA Permit will be again modified to reconcile these differences during the next permit modification cycle.

Closure options available under WAC 173-303-610 and the Permit are as follows:

Clean closure - requires that groundwater be uncontaminated by dangerous waste constituents (as evidenced through compliance with WAC 173-303-645) and that soils contain concentrations of dangerous waste constituents below *Model Toxics Control Act* (MTCA) Method B direct soil exposure and groundwater protection levels (WAC 173-303-610[2][b][I] and Permit Condition II.K.1). This closure option is compatible with both exposure scenarios presented in DOE/RL-96-39, Rev. 1A, rural-residential and the modified Columbia River Comprehensive Impact Assessment (CRCIA) Ranger/Industrial Scenario because it allows for unrestricted use of the units after closure. Because it is unclear at this time whether the groundwater under 1301-N and 1325-N has been contaminated with dangerous waste constituents from past operation of these units, as defined under WAC 173-303-645, this closure option has not been identified as available to 1301-N and 1325-N in this closure plan. Should a clean soil column be attained and future groundwater monitoring indicate levels of dangerous waste constituents are below MTCA Method B levels, this option will be revisited through Permit modification.

Modified closure - requires that soil concentrations of dangerous waste constituents not exceed MTCA Method C direct soil exposure and groundwater protection levels. Groundwater may or may not be contaminated by dangerous waste constituents (Permit Condition II.K.3). This closure option is only compatible with modified CRCIA ranger/industrial uses of the land (as defined for the purposes of Permit Attachment 41) because institutional controls would be required in order to limit access to the contaminated media.

Landfill closure - required when soils contain concentrations of dangerous waste constituents above MTCA Method C direct soil exposure and groundwater protection levels. Groundwater may or may not be contaminated by dangerous waste constituents (Permit Condition II.K.4). This closure option is only compatible with modified CRCIA ranger/industrial uses of the land because capping and other institutional controls would be required in order to limit access to the contaminated media.

Closure option decisions at 1301-N and 1325-N will be driven by decisions made pursuant to a CERCLA ROD for these units. Remedial alternatives compared in Permit Attachment 41 encompass modified and landfill closure options available under WAC 173-303-610 and the Permit. Therefore, information is contained in Permit Attachment 41 that address compliance with all potential closure options. Remedial alternatives compared are presented below:

- No Action under a rural residential or modified CRCIA ranger/industrial exposure scenario (RRES-1), (MCRIS-1)
- Remove/Treat if Required/Dispose/Backfill under a residential or modified CRCIA ranger/industrial exposure scenario (RRES-6), (MCRIS-6)

- Remove to 3.0 m (10 ft) below ground surface (bgs)/Treat if Required/Dispose/Backfill/Cap for Groundwater Protection under a modified CRCIA ranger/industrial exposure scenario (MCRIS-7)
- Remove to 3.0 m (10 ft) bgs/Treat if Required/Dispose/Vitrify for Groundwater Protection/Backfill under a modified CRCIA ranger/industrial exposure scenario (MCRIS-8).

The RRES-1 and MCRIS-1 Alternatives are presented in DOE/RL-96-39, Rev. 1A for baseline comparison but are not considered viable alternatives for 1301-N and 1325-N. MCRIS-6 and MCRIS-8 Alternatives may result in a modified closure decision, depending upon the concentrations of dangerous waste constituents left in the units after excavation is completed. Landfill closure is precluded by the RRES-6, MCRIS-6, and MCRIS-8 Alternatives because they do not include placement of a final cover over the units. The MCRIS-7 Alternative may result in a modified closure or landfill closure decision depending upon the concentrations of dangerous waste constituents left after excavation. Although unlikely, a modified closure option may still be viable for the MCRIS-7 Alternative because capping of these units may be required for purposes unrelated to closure of these units under WAC 173-303-610, i.e., protection of the groundwater from radiological contaminants remaining in soils below 3.0 m (10 ft).

2.3 Closure Performance Standards

The closure performance standards of WAC 173-303-610(2) require that the owner/operator of a TSD unit close the unit in a manner that (1) minimizes the need for further maintenance; (2) controls, minimizes, or eliminates postclosure escape of dangerous waste to the extent necessary to protect human health and the environment; and (3) returns the land to the appearance and use of surrounding land areas.

2.3.1 Minimize the Need for Further Maintenance

The extent of future site maintenance depends on the closure option chosen for 1301-N and 1325-N (i.e., modified, or landfill closure). Maintenance, monitoring, and inspections necessary to minimize the need for further maintenance of the units under a modified or landfill closure option are defined in Permit Attachment 41, Chapter 5.0.

2.3.2 Control Dangerous Waste Escape to Protect Human Health and the Environment

Closure activities defined in Permit Attachment 41, Chapter 4.0 will ensure the control of dangerous waste during closure activities. Because these activities cannot be fully defined until a remedial alternative is chosen through a ROD and remedial design is defined, these activities describe a range of activities that may be undertaken in order to achieve modified or landfill closure. Closure activities will meet the remedial action objectives for soils as defined in Permit Attachment 41, Chapter 3.0. Remedial action objectives for contaminated groundwater associated with 1301-N and 1325-N operations are defined in Permit Attachment 41, Chapter 4.0. These objectives are designed to protect both human health and the environment.

2.3.3 Return Land to Appearance and Use of Surrounding Area

The appearance and use of 1301-N and 1325-N after closure will be consistent with the future use of the 100-N Area. Permit Attachment 41 defines two possible exposure scenarios: rural-residential and modified CRCIA ranger/industrial. All alternatives include the commitment to revegetate the surface soils.

2.4 General Description of Units

This section provides a general description of the 1301-N and 1325-N Liquid Waste Disposal Facilities. This description is intended to provide an overview of these units.

The 1301-N and 1325-N surface soils and subsoils, including the UPR-100-N-31 spill, and associated structures and piping that have been contaminated by dangerous waste constituents from these units are subject to this WAC 173-303 closure action.

The 1301-N and 1325-N units were the primary Liquid Waste Disposal Facilities for the N Reactor. Wastes disposed included reactor coolant, spent fuel storage basin, and periphery cooling systems bleed off. Also included were reactor primary coolant loop decontamination rinse solution and discharges from building drains containing radioactive wastes generated in reactor support facilities. The 1301-N unit was operated from December 1963 until September 1985. The 1325-N unit was operated from October 1983 until April 1991. From October 1983 to September 1985, both units were in operation.

For a general discussion on the N Reactor facility background and more in-depth description of these units, refer to DOE/RL-96-39, Rev. 1A, Section 2.0.

2.4.1 Topographical Maps

General topographical maps for the area surrounding the 1301-N and 1325-N units are provided in Figures 2.1 and 2.2.

2.4.2 Floodplain

The U.S. Army Corp of Engineers has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to a maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 41 million L/s (1.4 million ft^3/s). The floodplain associated with the probable maximum flood is shown in Permit Attachment 33 (DOE/RL-91-28), General Information Portion, §2.2.1.4, Flood Plain Area. The 1301-N and 1325-N units would not be affected by the probable maximum flood.

2.4.3 Traffic

The majority of traffic inside the Hanford Site boundaries consists of light-duty vehicles used to transport employees to work areas. The 1301-N and 1325-N units are located within the Hanford Controlled Access Area where roadways cannot be accessed by the general public. These facilities are isolated from the nearest public highway, State Highway 24, by approximately 6 km (4 mi). Vehicle traffic around the units is restricted and is minimal, as the area is enclosed by a fenced with locked gates and is posted as a radiation zone. DOE/RL-96-39, Rev. 1A, Section 2.4 provides additional details about the current postings on the perimeter fence.

2.4.4 General Hydrogeologic Conditions

DOE/RL-96-39, Rev. 1A, Section 2.3.2 provides information on the geology and hydrogeology underlying the 1301-N and 1325-N units.

2.4.5 Physical Dimensions of the Units

The 1301-N unit consists of a 16-m by 3.7-m (52- by 12-ft) weir box inside a 38- by 88-m (125-by 290-ft) rectangular basin (crib). A zigzag extension trench, approximately 490 m (1,600 ft) long, 15 m (50 ft) wide, and 3.7 m (12 ft) deep, was added to the crib.

The 1325-N unit includes a concrete header box inside a 73- by 76-m (240- by 250-ft) rectangular basin (crib). A straight extension trench, approximately 914 m (3,000 ft) long, 16.8 m (55 ft) wide, and 3.0 m (10 ft) deep, was also added to this crib.

2.4.6 Design Capacity

Both the 1301-N and 1325-N Liquid Waste Disposal Facilities were designed with a discharge capacity of 11,400 L/min (3,000 gal/min). The average flow rate was approximately 6,400 L/min (1,700 gal/min).

2.4.7 Ancillary Equipment

The 1301-N and 1325-N units are passive liquid waste disposal facilities that do not rely on active systems for operations support. The units consist of transfer piping, concrete effluent distribution structures, and soils to distribute liquid wastes.

2.4.8 Containment Systems

The 1301-N and 1325-N units do not include any containment systems.

2.4.9 Structures and Piping Requiring Removal or Characterization as Clean

The structures in the 1301-N and 1325-N Liquid Waste Disposal Facilities include concrete structures and earthen basins and trenches. The 1301-N unit consists of a 16- by 3.7-m (52- by 12-ft) weir box, a 38- by 88-m (125- by 290-ft) rectangular basin (crib), and a zigzag extension trench, approximately 490 m (1,600 ft) long, 15 m (50 ft) wide, and 3.7 m (12 ft) deep.

The 1325-N unit includes a concrete header box, a 73- by 76-m (240- by 250-ft) rectangular basin (crib), a tie-in structure, and a straight extension trench, approximately 914 m (3,000 ft) long, 16.8 m (55 ft) wide, and 3.0 m (10 ft) deep.

Figure 2.1 shows the pipelines to be removed or characterized as clean between the 1722-N Building and 1301-N and between 1310-N and 1301-N. Figure 2.2 shows the piping between the 1301-N Crib and the 1325-N Crib.

Refer to Permit Attachment 41, Chapter 4.0, Closure Activities, for a more in-depth discussion on the removal of structures.

2.4.10 Security

The entire Hanford Site is a controlled-access area. The Hanford Site maintains around-the-clock surveillance to restrict unauthorized access for the protection of the public and of government property, classified information, and special nuclear materials. The Hanford Patrol maintains a continuous presence of protective force personnel to provide Hanford Site security.

Within the Hanford Site are operational areas, including 100-N, to which access is restricted. There is a staffed checkpoint at the Wye Barricade through which access to the 100-N Area is allowed only to authorized personnel. Authorized personnel are those individuals with a DOE-issued security identification badge indicating the appropriate authorization. Such personnel are subject to a search of items carried into or out of controlled areas.

2.5 Waste Characteristics

2.5.1 Liquid Waste Discharges

The wastes disposed in 1301-N and 1325-N were generated from N Reactor operations. The waste streams included the following:

- Reactor coolant system bleed off.
- Spent fuel storage basin cooling water overflow.
- Reactor periphery cooling systems bleed off.
- Reactor primary coolant loop decontamination rinse solution.
- Building drains serving reactor support facilities.

The combination of these waste streams resulted in an average flow of approximately 6,400 L/min (1,700 gal/min). Results of influent sampling and analysis (Table 2.1) did not indicate the characteristics of a dangerous waste.

Reactor primary coolant system. The reactor primary coolant system was supplied by demineralized water with chemicals added for water quality control (QC). Ammonium hydroxide was used for pH control and was injected at a concentration of approximately 40 ppm to maintain a pH of 10.2 to 10.4 standard units. Hydrazine was introduced for oxygen control at a concentration of 0.04 ppm.

Fuel storage basin cooling water. The spent fuel storage basin was supplied by filtered water with chlorine added as an algaecide. A trace amount of residual chlorine was maintained to ensure complete treatment.

Reactor periphery cooling systems. Reactor periphery cooling systems that discharged bleed-off wastes to 1301-N and 1325-N include the following:

- Graphite and shield cooling.
- Reactor control rod cooling.
- Reactor secondary coolant loop.

As with other reactor, cooling systems, bleed off and spillage from the periphery cooling systems resulted in small continuous discharge.

Graphite and Shield Cooling. The graphite and shield cooling system was supplied by demineralized water with chemicals added for water QC. Ammonium hydroxide was injected at a concentration of approximately 40 ppm to maintain a pH of 10.0 to 10.2 standard units. Hydrazine was injected for oxygen control at a concentration of 0.04 ppm.

Reactor Control Rod Cooling. The reactor control rod cooling system was supplied by demineralized water with chemicals added for water QC. Ammonium hydroxide was injected at a concentration of approximately 40 ppm to maintain a pH of 7.0 standard units. Hydrazine is injected for oxygen control at a concentration of 0.15 ppm.

Reactor Secondary Coolant Loop. The reactor secondary coolant loop was supplied by demineralized water with chemicals added for water QC. Morpholine was injected at a concentration of approximately 4 ppm to maintain a pH of 8.6 to 9.2 standard units. Hydrazine was injected for oxygen control at a concentration of 1 ppm or less.

Reactor primary coolant loop decontamination. The reactor primary coolant loop was decontaminated every 2 to 4 years. The decontamination solution consisted of 79,500 L (21,000 gal) TURCO 4512-A™ (70% phosphoric acid) and 136 to 181 kg (300 to 400 lb) of diethylthiourea. This solution was diluted to an 8 wt% phosphoric acid solution as it entered the reactor coolant loop.

After the pH of the rinsate was verified between 6.0 and 9.0 standard units, the final rinse solution containing approximately 378,500 L (100,000 gal) of demineralized water was discharged. The calculated phosphoric acid released per decontamination was 5.7 L (1.5 gal), and the calculated amount of diethylthiourea was 2.3 g (0.0051 lb).

Building drains. The radioactive drain system collected radioactive water from throughout the 109-N and 105-N Buildings. Pump leakage, system bleed off from the reactor primary and periphery cooling systems, laboratories, decontamination activities, and other routine activities were drained to 1301-N and 1325-N via this system.

Three of the waste streams exhibited characteristics of a dangerous waste at the point of generation. These were leaks and spills from the auxiliary power battery lockers, hydrazine mixing spills, and laboratory wastes. Each of these wastes contained contaminants that are designated dangerous wastes under WAC 173-303-090. However, sampling of the 1301-N and 1325-N influent (Table 2.1) did not identify characteristics of a dangerous waste at the point of discharge into 1301-N and 1325-N.

Wastes from Chemical Analyses. Chemical analyses were performed in laboratories to determine hydrazine, ammonia, chloride, and fluoride concentrations in reactor coolant. Waste characterization indicated that approximately 9,800 L/yr (2,600 gal/yr) contained constituents designated as dangerous wastes under WAC 173-303-090.

Auxiliary Power Battery Lockers. Spills and leaks from the auxiliary power battery lockers contributed 300 to 450 L/yr (80 to 120 gal/yr) of waste from nickel-cadmium and lead-acetate batteries. It is estimated that approximately 40% of the spilled material was from nickel-cadmium batteries and 60% from lead-acetate batteries.

Hydrazine Mixing and Injection Area Floor Drains. Hydrazine spills from mixing and injection activities entered the radioactive drain system. Spills were very small in volume and, in the case of the mixed solution, were extremely dilute. Approximately 160 kg (350 lb) of hydrazine was spilled yearly in this manner.

2.5.2 Liquid Waste Discharge Chronology

A chronology of liquid waste discharges to 1301-N and 1325-N is provided in Table 2.2.

Table 2.1. 1301-N and 1325-N Effluent Analysis

Parameter (MDL)	Sample			
	1	2	3	Average
pH (standard units)	6.58	6.56	6.97	6.70
Conductivity (micromhos)	148	155	190	164
Mercury (.001 ppm)	ND	ND	ND	ND
Ethylene glycol (10 ppm)	ND	ND	ND	ND
Enhanced thiourea (.2 ppm)	ND	ND	ND	ND
TOC (1 ppm)	0.0018	0.002	0.002	0.0019
Cyanide (.01 ppm)	ND	ND	ND	ND
Barium (.006 ppm)	0.03	0.027	0.027	0.028
Cadmium (.002 ppm)	ND	ND	ND	ND
Chromium (.01 ppm)	ND	ND	ND	ND
Lead (.03 ppm)	ND	ND	ND	ND
Silver (.01 ppm)	ND	ND	ND	ND
Sodium (.1 ppm)	1.831	1.819	1.781	1.810
Nickel (.01 ppm)	ND	ND	ND	ND
Copper (.01 ppm)	ND	ND	ND	ND
Vanadium (.005 ppm)	ND	ND	ND	ND
Antimony (.1 ppm)	ND	ND	ND	ND
Aluminum (.15 ppm)	ND	ND	ND	ND
Manganese (.005 ppm)	ND	ND	ND	ND
Potassium (.1 ppm)	0.647	0.608	0.606	0.620
Iron (.05 ppm)	0.081	0.077	0.050	0.069
Beryllium (.005 ppm)	ND	ND	ND	ND
Osmium (.3 ppm)	ND	ND	ND	ND
Strontium (.3 ppm)	ND	ND	ND	ND
Zinc (.005 ppm)	ND	ND	ND	ND
Calcium (.05 ppm)	14.40	13.97	14.05	14.14
Nitrate (.5 ppm)	ND	ND	ND	ND
Sulphate (.5 ppm)	12.41	11.53	11.97	11.97
Fluoride (.5 ppm)	ND	ND	ND	ND
Chloride (.5 ppm)	1.57	1.48	1.53	1.53
Phosphate (1 ppm)	ND	ND	ND	ND
Phosphorus Pesticides (.005 ppm)	ND	ND	ND	ND
Chlorinated Pesticides (.001 ppm)	ND	ND	ND	ND
Enhanced ABN List	ND	ND	ND	ND
Citrus Red (1 ppm)	ND	ND	ND	ND
Arsenic (.005 ppm)	ND	ND	ND	ND
Ammonium Ion (.05 ppm)	ND	ND	ND	ND

Table 2.1. 1301-N and 1325-N Effluent Analysis

Parameter (MDL)	Sample			
	1	2	3	Average
Coliform (3 MPN)	---	0.023	0.009	0.016
Selenium (.005 ppm)	ND	ND	ND	ND
Thallium (.01 ppm)	ND	ND	ND	ND

ND = Not Detected MDL = Minimum Detection Limit Data obtained from samples taken August 1985 Diediker and Hall. (1987)

1

Table 2.2. Chronology of Liquid Waste Discharges

Year	Liquid Waste Discharge to 1301-N Liquid Waste Disposal Facility (L/day)	Liquid Waste Discharge to 1325-N Liquid Waste Disposal Facility (L/day)
1964	9,462,500*	0
1965	9,462,500*	0
1966	9,462,500*	0
1967	9,462,500*	0
1968	9,462,500*	0
1969	9,462,500*	0
1970	9,462,500*	0
1971	9,462,500*	0
1972	9,462,500*	0
1973	8,702,000	0
1974	9,500,000	0
1975	9,500,000	0
1976	9,900,000	0
1977	14,500,000	0
1978	12,500,000	0
1979	13,500,000	0
1980	12,500,000	0
1981	10,500,000	0
1982	10,500,000	0
1983	6,942,000	1,960,000
1984	8,100,000	1,900,000
1985	7,200,000	2,800,000
1986	0	7,250,000
1987	0	2,100,000
1988	0	1,660,000
1989	0	1,660,000
1990	0	1,660,000
1991+	0	0

[1]WHC-SD-ER-TA-001, Rev. 0 (WHC 1991).*There are no reliable data available for average flow rates and effluent discharge rates for 1301-N. Estimates based on discharge volumes from 1973 to 1976 were used for 1964 through 1972. Data for 1973 through 1989 were taken from the yearly effluent release reports. LWDF = liquid waste disposal facility

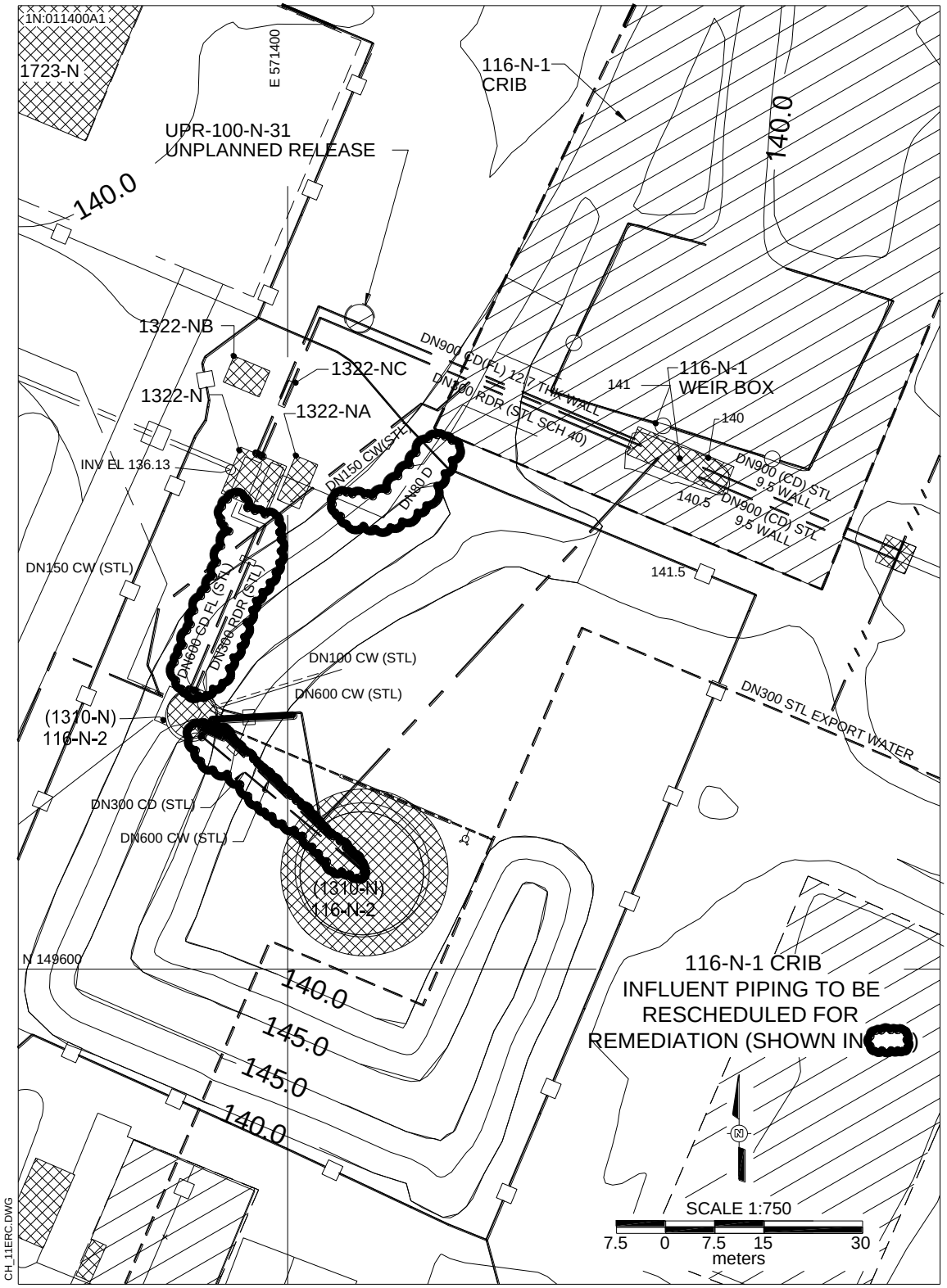

Figure 2.1. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation

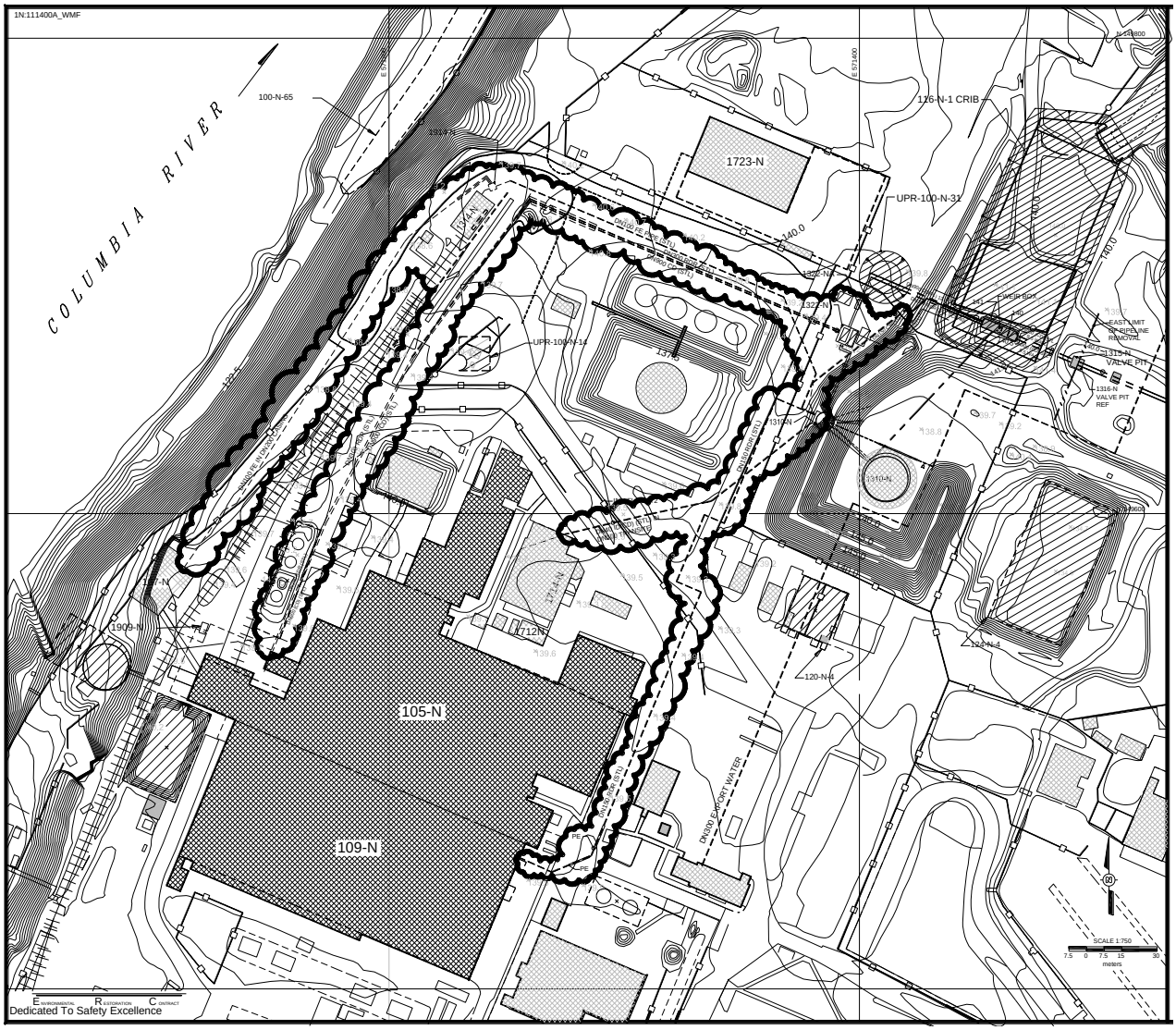

Figure 2.2. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation

Legend

116-N-1 Crib influent piping to be rescheduled for remediation

1325-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
8/2004	

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CHAPTER 3.0
GROUNDWATER MONITORING

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CHAPTER 3.0
GROUNDWATER MONITORING

TABLE OF CONTENTS

3.0 GROUNDWATER MONITORING 5
3.1 Aquifer Identification 5
3.2 Interim Status Groundwater Monitoring 5
3.2.1 Well Location and Design 6
3.2.2 Sampling and Analysis Plan 6
3.2.3 Quality Assurance and Quality Control 8
3.3 Results of Groundwater Monitoring 10
3.3.1 Potentiometric Level 10
3.3.2 Groundwater Quality 10
3.4 Groundwater Monitoring During Closure 11
3.4.1 Monitoring Program 11
3.4.2 Inspection, Maintenance, and Replacement of Wells 11

FIGURES

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for the 1324-N and 1324-NA Units 7
Figure 3.2. Proposed RCRA Groundwater Monitoring Network for the 1301 N and 1325 N Units 9
Figure 3.3. Water Level Changes in Groundwater Below 1301-N and 1325-N 12

TABLES

Table 3.1. Proposed RCRA Groundwater Monitoring Networks for the 1301 N and 1325-N Liquid Waste Disposal Facilities 8
Table 3.2. Constituent List for 1301-N and 1325-N 10

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3.0 GROUNDWATER MONITORING

3.1 Aquifer Identification

The unconfined aquifer in the 100-N Area is located primarily in the upper part of the Ringold Formation (sands and gravels) and is approximately 12 to 15 m (40 to 50 ft) thick. The base of the aquifer is believed to be a laterally continuous clay-rich unit containing a series of paleosols. Lithologies in this unit range from clay and silt to sand. Most of the wells in the 100-N Area did not penetrate through the clay layer; therefore, the thickness of the clay-rich unit is unknown at most locations.

The water table is approximately 21 to 23 m (69 to 75 ft) below land surface near 1301-N and approximately 23 m (75 ft) below land surface near 1325-N. Water levels have returned to these "pre-Hanford" levels after years of groundwater mounding caused by artificial recharge from the units and other effluent disposal in the 100-N Area.

A representative range of transmissivity estimates for the unconfined aquifer in the 100-N Area is 93 to 560 m2/day (1,000 to 6,030 ft2/day) throughout most of that area. Wells in the northwest portion seem to show a higher transmissivity (up to 1,900 m2/day [20,500 ft2/day]). These values correspond to horizontal hydraulic conductivity of 6 to 37 m/day (20 to 121 ft/day), and 120 m/day (394 ft/day) in the northwest portion. Specific yield is estimated at 0.1 to 0.3.

Hartman and Lindsey (1993) describe the hydrogeology of the 100-N Area in more detail.

3.2 Interim Status Groundwater Monitoring

Groundwater monitoring began at 1301-N and 1325-N in December 1987. The original monitoring networks were modified over the years as water levels declined and new wells were installed to replace dry wells.

After the first year of groundwater monitoring at 1301-N, specific conductance in one downgradient well was found to be elevated above background (i.e., upgradient) levels. A groundwater quality assessment program was initiated (Gilmore and Jensen 1989). The assessment program found no evidence that dangerous waste or dangerous waste constituents from 1301-N had entered the groundwater (Hartman 1992). Rather, the elevated specific conductance was caused by sulfate/sodium-contaminated groundwater coming from the nearby 1324-N/NA site. In 1992, the groundwater monitoring program at 1301-N reverted to an indicator parameter monitoring program, as described in 40 CFR 265.93(d)(6). An additional upgradient well was added to the network to reflect the influence of 1324-N/NA. New critical mean values were established for indicator parameters, and the site remains in indicator evaluation status.

Some contamination has been detected in the groundwater under or near the 1301-N and 1325-N units. Two dangerous waste constituents, nitrate and chromium, were found to be at levels above the MCL (Hartman and Dresel, 1997). Nitrate levels above the Maximum Containment Levels (MCL) of 44 mg/L were observed in well 199-N-3 and 199-N-32 in 1996. Well 199-N-3 monitors the 1301-N unit and well 199-N-32 monitors the 1325-N unit. Nitrate values from nearby wells monitoring the same interval are not above the MCL. Chromium concentrations above the MCL of 0.1 mg/L have been observed in wells 199-N-33 and well 199-N-80 in 1996. Well 199-N-33 monitors the 1325-N unit. The 1996 data from well 199-N-33 is considered anomalous. Well 199-N-80 monitors the bottom zone of the unconfined aquifer and is located downgradient from 1301-N. Wells monitoring the upper part of the unconfined aquifer for 1301-N do not have values of chromium above the MCLs. Although contamination has been detected as described, the interim status groundwater monitoring configuration did not identify these constituents as releases attributable to operation of, or residual contamination in, the 1301-N and 1325-N units through statistical analysis of upgradient versus downgradient wells.

The 1325-N unit has been monitored under an indicator evaluation program throughout its history of *Resource Conservation and Recovery Act of 1976* (RCRA) monitoring. Wells were added or deleted from the network to reflect changing conditions.

Groundwater is monitored under several programs in addition to the RCRA in the 100-N Area. The most significant programs in terms of numbers of wells and analytes are those of the RCRA, sitewide surveillance, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Sampling and analysis for RCRA, CERCLA, and sitewide surveillance monitoring have been coordinated for several years to avoid duplication. However, this coordination did not include the planning stages of the monitoring programs.

In an attempt to reduce redundancy further and make monitoring more efficient, representatives of the various contractors involved in 100-N groundwater monitoring held a series of workshops to consolidate and streamline monitoring. Monitoring networks were redesigned to disseminate information for all programs as efficiently as possible, and constituent lists were trimmed to the constituents of concern. Sampling frequency also decreased in some cases. Sampling trips and analytical costs are divided among data users. Borghese et al. (1996) describe the well and constituent lists for the combined program. That document does not include requirements for sampling and analysis protocols, Quality Control (QC), or statistical evaluations. Hartman (1996a) presents a revised groundwater-monitoring plan for the RCRA program, and this is summarized in the following section.

3.2.1 Well Location and Design

The monitoring network for 1301-N includes two upgradient wells and three downgradient wells (Figure 3.1, Table 3.1). All of the wells monitor the unconfined aquifer. As-built diagrams are included in Hartman (1996a). One of the downgradient wells, 199-N-105A, is an extraction well for the CERCLA pump-and-treat system. This well is screened across the entire thickness of the uppermost aquifer (7.3 m [24 ft]) instead of just the top 3.0 to 4.6 m (10 to 15 ft) of the aquifer like the other wells. Because it is an extraction well, 199-N-105A will pull in water from beneath a large area of the 1301-N Trench, making it a useful monitoring well

The construction of some of the 1301-N wells does not meet Washington Administrative Code (WAC) requirements (Table 3.1). Wells 199-N-2 and 199-N-3 have perforated, carbon steel casing and no annular seals. However, these wells appear to yield representative data, and installing new wells is not warranted. The Washington State Department of Ecology (Ecology) has accepted the data from these and other wells since RCRA monitoring began at the 100-N Area in 1987.

The monitoring network for 1325-N will include one upgradient and three downgradient wells (refer to Figure 3.1 and Table 3.1). Treated water from the CERCLA pump-and-treat system is injected into well 199-N-29 near the 1325-N. Well 199-N-28 is used by the RCRA program to monitor potential effects of injected water; it is not being used in statistical evaluations.

3.2.2 Sampling and Analysis Plan

The *Groundwater Monitoring Plan for the 1301-N, 1325-N, and 1324-N/NA Sites* (Hartman 1996b) describes the sampling and analysis plan for RCRA monitoring. Groundwater is sampled for the constituents listed in Table 3.2. Indicator parameters are analyzed semiannually; additional parameters are analyzed annually.

Groundwater sampling procedures, sample collection documentation, and chain-of-custody requirements are described in Environmental Investigation Instructions (EII) (WHC-CM-7-7), The Environmental Activities Procedural Manual (WHC-CM-7-8), and in the Quality Assurance Project Plan for Groundwater Monitoring Activities Managed by Westinghouse Hanford Company (WHC 1995). Work by other contractors is conducted to their equivalent approved standard operating procedures. Procedures for field measurements (pH, conductivity, turbidity) are specified in WHC-CM-7-8 and in the user's manuals for the meters used. Analytical methods are selected from those provided in Test Methods for Evaluating Solid Wastes (EPA 1990) as specified by WHC (1995) or its most recent revision.

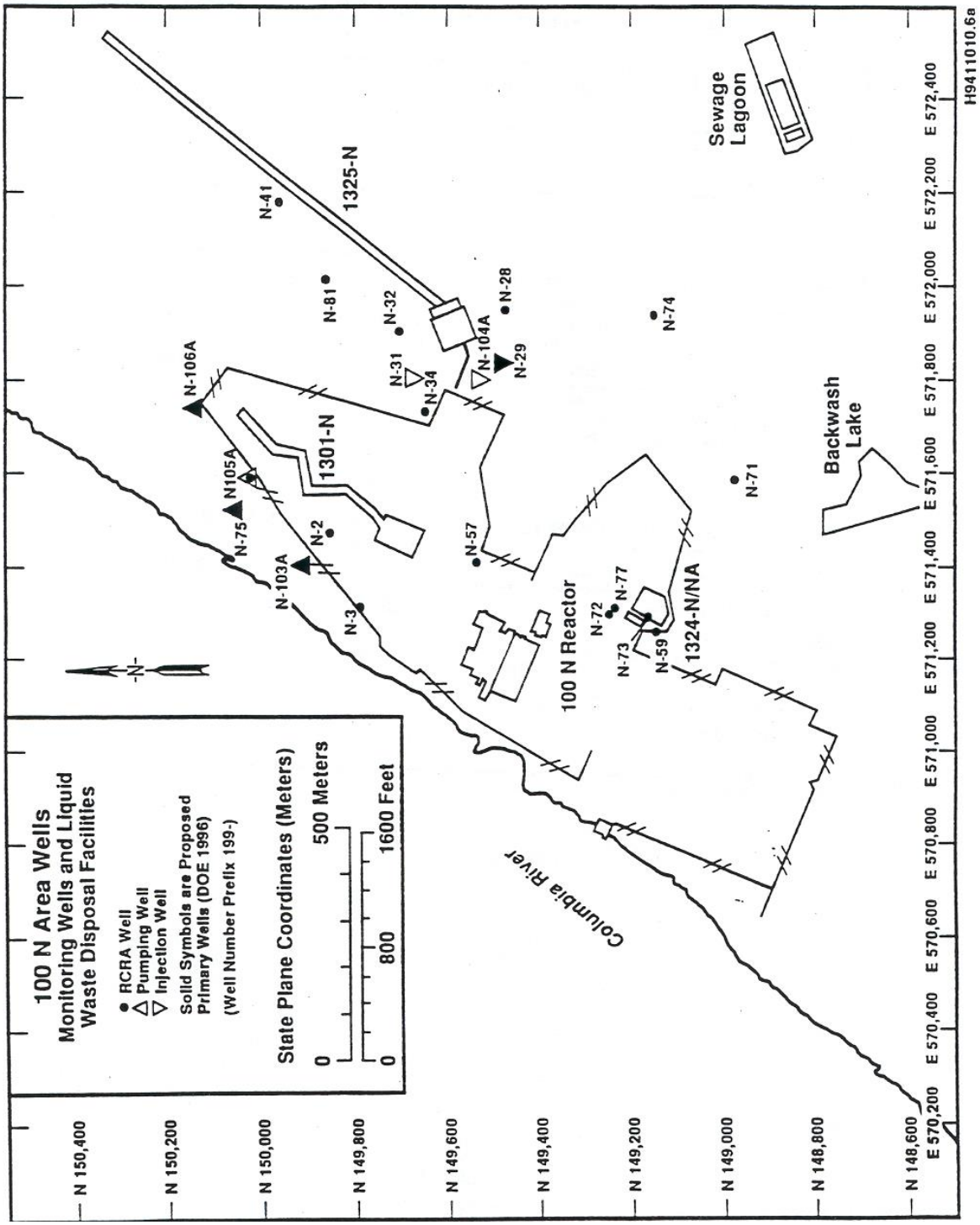

Figure 3.1. Proposed RCRA Groundwater Monitoring Network for the 1324-N and 1324-NA Units

3.2.3 Quality Assurance and Quality Control

Quality assurance (QA) requirements are defined in the *Westinghouse Hanford Company Quality Assurance Manual* (WHC-CM-4-2) or equivalent procedures, and Article 31 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994). Additional requirements for QA and QC are included in WHC (1995) or its' most recent revision.

Table 3.1. Proposed RCRA Groundwater Monitoring Networks for the 1301 N and 1325-N Liquid Waste Disposal Facilities

Well Number	Proposed Network	Drill Date	Elev. T.O.C.[a] (m)	Casing/Screen Materials	Screened or perf'd depth[b] (m)	Depth to Water[c] (m)
199-N-2	1301-N	1964	140.129	Carbon steel/ perf'd casing; no annular seal	10.7 - 28.0	21.010(6/96)
199-N-3	1301-N	1964	140.015	Carbon steel/ perf'd casing; no annular seal	10.4 - 27.7	20.793(6/96)
199-N-28	1325-N[d]	1983	141.647	Carbon steel/ stainless steel w/ packer; surface seal	14.32 - 25.3	23.311(9/94)
199-N-32	1325-N	1983	140.990	Carbon steel/ stainless steel w/ packer; surface seal	13.4 - 24.1	22.357(3/96)
199-N-34	1301-N	1983	140.247	Carbon steel/ stainless steel w/ packer; surface seal	10.4 - 23.5	21.732(3/96)
199-N-41	1325-N	1984	139.626	Carbon steel/ stainless steel w/ packer; surface seal	16.2 - 22.3	21.193(3/96)
199-N-57	1301-N	1987	139.671	Stainless steel/ stainless steel; full annular seal	17.7 - 22.3	20.708(3/96)
199-N-74	1325-N	1991	139.482	Stainless steel/ stainless steel; full annular seal	18.0 - 24.4	20.537(6/96)
199-N-81	1325-N	1993	142.067	Stainless steel/stainless steel	21.3 - 27.4	22.552(3/96)
199-N-105A	1301-N	1995	140.655	Stainless steel/ stainless steel; full annular seal	21.0 - 28.7	21.220(7/95)

a Surveyed to North American Vertical Datum of 1988.
b Approximate depth below land surface; converted from feet.
c Depth below top of casing; converted from feet.
d Well 199-N-28 to be used for supplemental information; no statistical evaluations.

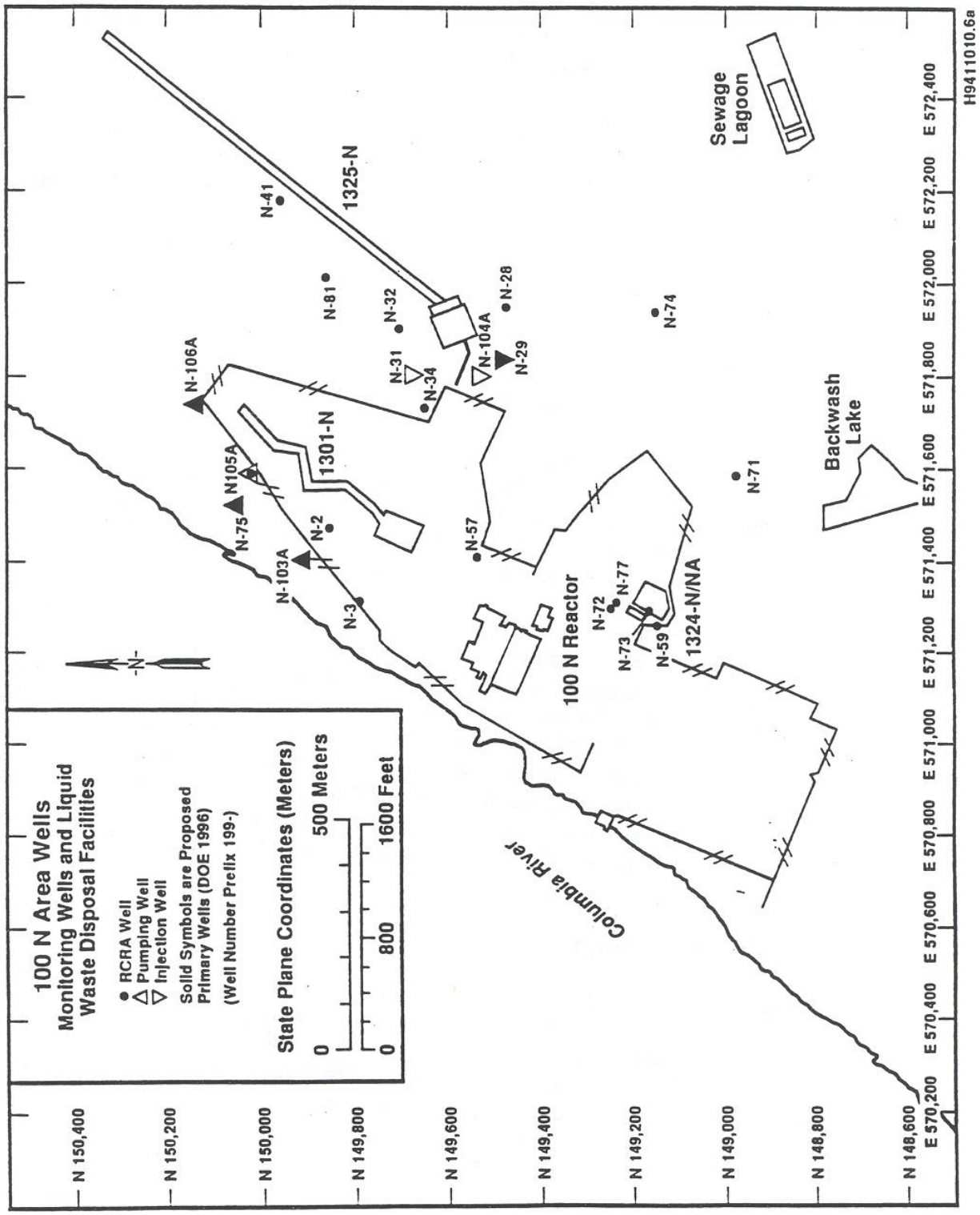

Figure 3.2. Proposed RCRA Groundwater Monitoring Network for the 1301 N and 1325 N Units

Table 3.2. Constituent List for 1301-N and 1325-N

Analyzed Semiannually	Analyzed Annually
Contamination Indicator Parameters (Quadruplicate samples):	ICP Metals (filtered)
Specific conductance (field)	Anions
pH (field)	Alkalinity
Total Organic Carbon	
Total Organic Halogen	
Turbidity (field)	

ICP = Inductively Coupled Plasma

3.3 Results of Groundwater Monitoring

3.3.1 Potentiometric Level

At various times in the history of waste disposal at the 100-N Area, groundwater mounds formed beneath 1301-N and 1325-N. Changes in water levels are illustrated in Figure 3.2. Water levels have returned to "pre-Hanford" levels in the 100-N Area but are still affected by changes in river stage and, recently, by the operation of pumping and injection wells.

Water levels are measured in all wells before sampling. Many of the wells in the 100-N Area are also measured as part of the site-wide semiannual water level program (Serkowski et al. 1995). The Environmental Restoration Contractor has equipped about 20 wells with pressure transducers and data loggers. Any of the data described above can be used to construct water table maps to aid in determining groundwater flow directions.

During average or low river stage, natural groundwater flow is toward the northwest beneath 1301-N. When river stage is high, the gradient is reversed, and there is a potential for water to flow out of the river into the aquifer. Groundwater flow beneath 1325-N is toward the north regardless of river stage.

A groundwater pump-and-treat system has been in operation in the 100-N Area since August 1995. DOE-RL (1996b) reports the results of an evaluation of the first phase of the system's operation. Data from a network of transducers were used to construct water table maps and estimate capture zones.

Pumping of wells between 1301-N and the Columbia River has created a groundwater depression. Groundwater flows toward the pumping wells from the river and from beneath 1301-N. Treated water is injected into a well near 1325-N.

Vertical groundwater gradients are not well defined in the 100-N Area. There is no significant difference in head between wells completed at the top and bottom of the unconfined aquifer. There does appear to be an upward gradient immediately adjacent to the river. Water levels in deeper wells were consistently higher than shallow wells or the river, indicating an upward gradient (Gilmore et al. 1991).

3.3.2 Groundwater Quality

Groundwater quality in the unconfined aquifer beneath the 100-N Area has been affected by 1301-N, 1325-N, and the 1324-NA Percolation Pond. In addition, various leaks and spills may have affected soil or groundwater chemistry (DOE-RL 1991). Data from RCRA sampling and analysis are reported electronically in the Hanford Environmental Information System database. Interpretation of the data is included in annual reports (Hartman 1996a).

The indicator parameters at the 1301-N and 1325-N units are specific conductance, pH, total organic carbon (TOC), and total organic halogens (TOX) (40 CFR 265.92[b][3]). Groundwater is also analyzed for other constituents that were discharged to the 1301-N and 1325-N units during their use. These analytes include nitrate, chromium, phosphate, lead, and cadmium. Samples have also been analyzed for mercury and volatile organics in the past.

Chromium, lead, and cadmium (in filtered samples), phosphate, or volatile organics have not been detected in 1301-N or 1325-N groundwater in significant concentrations. Nitrate increased in some wells near 1301-N and 1325-N during 1995, exceeding the drinking water standard in wells 199-N-2 and 199-N-3. One well southwest (upgradient) of 1301-N also had nitrate above the standard. Concentrations decreased in wells 199-N-2 and 199-N-3 in early 1996, but increased in excess of the drinking water standard in well 199-N-32. The source of nitrate is unknown.

While the 1301-N and 1325-N units were in use, they introduced radioactive constituents, primarily tritium and strontium-90, to the groundwater. These are not considered dangerous waste constituents under interim status RCRA regulations, but were monitored by RCRA in the past because they are the primary contaminants originating from the units.

3.4 Groundwater Monitoring During Closure

3.4.1 Monitoring Program

Groundwater monitoring will be done in accordance with the existing groundwater-monitoring program (Borghese, et. al 1996).

3.4.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

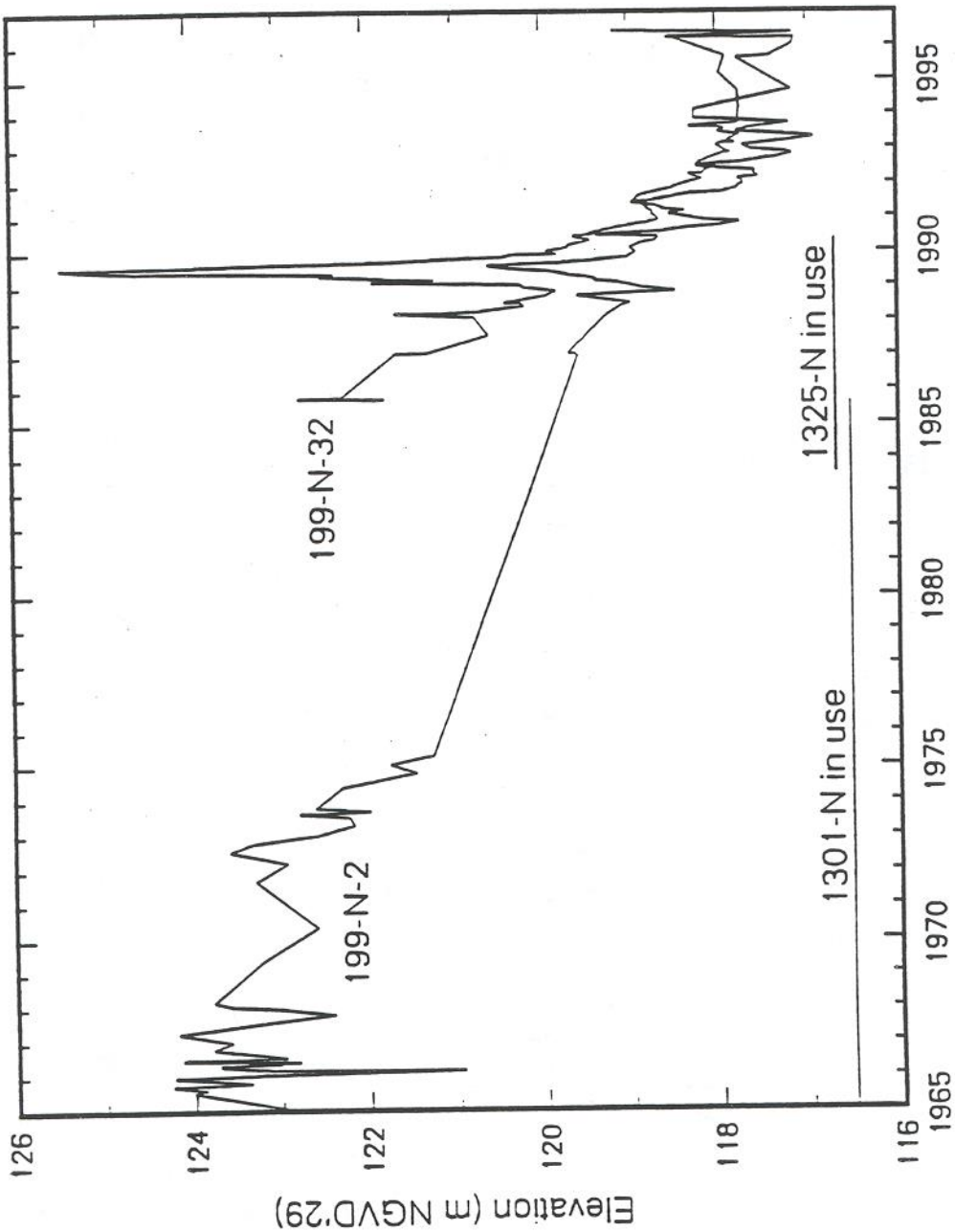

Figure 3.3. Water Level Changes in Groundwater Below 1301-N and 1325-N

1325-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 4.0
CLOSURE ACTIVITIES

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
3/31/2005	

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CHAPTER 4.0
CLOSURE ACTIVITIES

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CHAPTER 4.0
CLOSURE ACTIVITIES

TABLE OF CONTENTS

4.0 CLOSURE ACTIVITIES 5
4.1 Removal of Structures 5
4.1.1 Earthen Structures 5
4.1.2 Concrete Structures 5
4.2 Piping Removal or Characterization as Clean 6
4.3 Sampling and Analysis Activities 6
4.3.1 Past Soil Characterization Data 6
4.3.2 Characterization Activities to Determine Closure Option 7
4.3.3 Piping Characterization 8
4.4 Waste Management 8
4.5 Modified Closure Institutional Control Requirements 8
4.6 Final Cover Requirements for Landfill Closure 9
4.7 Personnel Training 9
4.8 Closure Contact 9
4.9 Closure Schedule 9
4.10 Amendment of Closure Plan 10
4.11 Certification of Closure 10
4.12 Survey Plat and Notice In Deed 10

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4.0 CLOSURE ACTIVITIES

The physical activities required to close 1301-N and 1325-N Liquid Waste Disposal Facilities in accordance with WAC 173-303-610 and the Permit will be integrated with the Record of Decision (ROD) for DOE/RL 96-39, Rev. 1A. The ROD and the remedial design for the selected alternative will specify further the closure activities that will be required for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action. Closure activities necessary to comply with dangerous waste regulations and the Permit will need to be consistent with CERCLA activities. CERCLA activities will be required to include elements necessary for closure of a dangerous waste unit. The Closure Plan presents the physical remedial activities and the sampling and analysis required to comply with WAC 173-303-610 and the Permit for each of the remedial alternatives presented in Attachment 41, Chapter 2.0, §2.2.

The closure activities are discussed in this section to highlight the site-specific elements of removal or characterization as clean of structures and piping for the 1301-N and 1325-N Liquid Waste Disposal Facilities. The other closure activities are not well defined for these sites at present but will be developed during the remedial design phase. Additional details about the alternatives can be found in DOE/RL-96-39, Rev. 1A, Section 5.2.

4.1 Removal of Structures

The structures in 1301-N and 1325-N Liquid Waste Disposal Facilities include concrete structures and earthen basins, trenches, fencing and signage surrounding the units, and ancillary surface structures such as valve houses associated with piping. The 1301-N and 1325-N Liquid Waste Disposal Facilities structures are discussed in Permit Attachment 41, Chapter 2.0

4.1.1 Earthen Structures

The contaminated soil in the earthen structures will be excavated by conventional earthmoving techniques. Removal technologies are described in DOE/RL-96-39, Rev. 1A, Section 5.1.3. Differing amounts of contaminated soils will be generated depending upon the remedial alternative selected for 1301 N and 1325 N. Alternatives that include soil removal are described in DOE/RL-96-39, Rev. 1A, Sections 5.2.1.5 through 5.2.1.8 for a residential exposure scenario and in DOE/RL-96-39, Rev. 1A, Sections 5.2.2.5 through 5.2.2.8 for a modified Columbia River Comprehensive Impact Assessment (CRCIA) ranger/industrial exposure scenario. After loading into containers, contaminated soils will be treated if necessary and/or disposed in an approved disposal facility on the Hanford Site. Particular attention will be given to the protection of workers and the environment from exposure to airborne contaminants during excavation and container loading. Dust mitigating measures, such as water sprays and chemical fixatives, may be employed to control fugitive dust emissions. The as low as reasonably achievable review will consider the use of shielding and/or remote handling techniques to reduce worker exposures from direct ionizing radiation.

The 1301-N Liquid Waste Disposal Facility demolition waste volumes are discussed in DOE/RL-96-39, Rev. 1A, Sections 4.5.1.1 and 4.5.1.2 for the earthen crib structure and DOE/RL-96-39, Rev. 1A, Sections 4.5.2.1 and 4.5.2.2 for the trench. The 1325-N unit demolition volumes are presented in DOE/RL-96-39, Rev. 1A, Sections 4.5.3.1 and 4.5.3.2 for the crib, and in Sections 4.5.4.1 and 4.5.4.2 for the trench. Waste volume tabulations are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

4.1.2 Concrete Structures

Alternatives that include removal of concrete structures are described in the DOE/RL-96-39, Rev. 1A, Sections 5.2.1.3 through 5.2.1.8, for a residential exposure scenario, and in Sections 5.2.2.3 through 5.2.2.8 for a modified CRCIA ranger/industrial exposure scenario. The concrete weir box in the 1301-N Crib will be removed as contaminated waste. Demolition of the structure may be necessary or advantageous prior to removal. Dust controls will be employed to control fugitive emissions during any demolition. The demolition waste volume of the weir box is discussed in DOE/RL-96-39, Rev. 1A, Section 4.5.1.3.

The concrete cover support beams and cover panels over the 1301-N Trench and 1325-N Crib and trench will be removed as intact components, if possible. Demolition activities, if required, will be minimized to maintain control of airborne releases and to simplify soil excavation in the trench. As with the earthen structure removal, particular attention will be given to the control of fugitive dusts and worker exposures to direct ionizing radiation. The demolition waste volume of the cover system is discussed in DOE/RL-96-39, Rev. 1A, Section 4.5.2.3for 1301-N Liquid Waste Disposal Facility, and in DOE/RL-96-39, Rev. 1A, Section 4.5.4.3 for 1325 N. Waste volume tabulations are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

Demolition debris and solid wastes in the cribs and trenches potentially include demolished concrete, wooden poles, and netting. These materials will be removed during crib and trench excavation operations and disposed with the contaminated soils.

4.2 Piping Removal or Characterization as Clean

The remediation of 1301-N and 1325-N Liquid Waste Disposal Facilities includes the excavation and removal of the contaminated piping systems that have not been characterized and determined to be clean (i.e., contain no dangerous waste constituents above residential Model Toxic Control Act (MTCA) B concentrations) between N Reactor and the cribs. Alternatives that include removal of piping are described in DOE/RL-96-39, Rev. 1A, Sections 5.2.1.3 through 5.2.1.8, for a residential exposure scenario, and in DOE/RL-96-39, Rev. 1A, Sections 5.2.2.3 through 5.2.2.8 for a modified CRCIA ranger/industrial exposure scenario. Two figures illustrate the potential extent of piping removal. Permit Attachment 41, Chapter 2.0, Figure 2.1 shows the pipelines to be removed between the 1722-N Building and 1301-N and between 1310-N and 1301-N. Permit Attachment 41, Chapter 2.0, Figure 2.2 shows the piping between the 1301-N Crib and the 1325-N Crib. Pipe lengths and map references are provided in DOE/RL-96-39, Rev. 1A, Appendix D.

The buried pipelines will be unearthed by conventional excavation equipment. The exposed piping may be segmented for removal manually or by remote methods, depending on contact radiation exposures. Contamination controls will focus on the drainage of residual fluids in the piping prior to, and during, segmentation and on the control of airborne contamination during cutting and pipe handling operations. After the piping has been removed, the pipe bedding soil will be surveyed for residual contamination, excavated, and disposed as necessary.

4.3 Sampling and Analysis Activities

4.3.1 Past Soil Characterization Data

Data used to characterize the vadose zone soils were obtained from six boreholes drilled and sampled to support the 1301-N and 1325-N Liquid Waste Disposal Facilities limited field investigation (DOE/RL-96-39, Rev. 1A). DOE/RL-96-39, Rev. 1A, Figure 2-32 shows the locations of these boreholes. Two of the boreholes are adjacent to 1301-N Liquid Waste Disposal Facility (199-N-107A and 199-N-108A), one is next to 1325-N Liquid Waste Disposal Facility (199-N-109A), and three are located northwest of 1301-N Liquid Waste Disposal Facility (199-N-75, 199-N-76, and 199-N-80) between that facility and the river. Samples were obtained from near the surface to a depth of up to 30.2 m (99 ft). All of these data are presented in the limited field investigation.

In addition to the boreholes, sediment samples were collected from the 116-N-1 Crib. Data from these samples were not used in this evaluation because of insufficient quality control (QC) associated with the sample collection process. Other soil samples have been collected from this vicinity, but most have only been analyzed for radionuclides.

Data from the characterization samples are summarized in Appendix A of the 1301-N and 1325-N limited field investigation. These data indicate that chromium is the only metal of concern in vadose zone soils at 1301-N Liquid Waste Disposal Facility below 3.0/4.6 m (10/15 ft). Chromium exceeded background concentrations in data associated with 1301-N Liquid Waste Disposal Facility.

Mercury is the only other metal that is included in the contaminants of concern (COCs), but no data from the boreholes at 1301-N and 1325-N Liquid Waste Disposal Facilities are available to evaluate the presence or absence of this analyte in vadose zone soils. Therefore, it is retained as a COC in surface soils (0 to 3.0/4.6 m [10/15 ft]). In DOE/RL-96-39, Rev. 1A, Appendix G, mercury will not reach groundwater in 1,000 years. Therefore is not considered to be a constituent of concern for groundwater protection below 3.0/4.6 m (10/15 ft). Evaluation of nitrate concentrations in the soil is similarly limited because of a paucity of data, so that substance has been retained as a COC. Nitrate is a mobile constituent, and a nitrate plume exists in the groundwater. Therefore, nitrate is considered a COC for both surface and subsurface soils.

Data from the three boreholes located outside of these facilities indicate that no metals are above background values. One sample from the 150- to 180-cm (5- to 6-ft) interval in borehole 199-N-76 was analyzed for mercury, and its value is well below typical background concentrations. These data indicate that metals deposited in the Treatment, Storage, and Disposal (TSD) did not migrate laterally in the vadose zone any substantial distance.

Sampling during remediation did not detect the presence of methanol in the soil. The Washington State Department of Ecology (Ecology) granted a contained-in determination for methanol in December 2000. The limited field investigation sampling was not analyzed for the presence of methanol, and methanol was not listed as detected in any other sampling efforts. Acetone, however, was detected in three samples collected from boreholes outside of the facilities, at concentrations up to 51 ppb. Organic analytes were not analyzed in samples collected within and adjacent to the TSD units; however, field screening using an organic vapor monitor did not detect any organic compounds. Acetone is a common laboratory contaminant, and most of the data reported by the laboratory either are at detection limit or are associated with a blank that contained detectable amounts of acetone. These circumstances cast doubt on the presence of detectable quantities of acetone in the wells outside the bounds of the TSD unit.

Additional sampling was performed in 1998 and is documented in the *Data Summary Report* (BHI 1999). Characterization of the sites was conducted through sampling in accordance with the *Sampling Analysis Plan for the 100-NR-1 Treatment, Storage, and Disposal Units During Remediation Closeout* (DOE 2000a).

4.3.2 Characterization Activities to Determine Closure Option

A s*ampling and analysis plan* (DOE 2000a) has been developed to support site closure. As presented in Section 4.3 and in DOE/RL-96-39, Rev. 1A, Table 4-17, dangerous waste constituents are retained as constituents of concern in both surface soils and subsurface soils. All alternatives (other than the No-Action Alternative) will result in the removal of dangerous waste constituents above 3.0 m (10 ft) bgs for the modified CRCIA ranger/industrial exposure scenario and 4.6 m (15 ft) bgs for the rural-residential scenario. This will result in removal of all soils that could be contaminated at levels that present a direct exposure hazard as defined in MTCA. Verification sampling to determine MTCA direct soil exposure standard compliance will therefore not be required unless some areas around the units are not excavated and removed to the 3.0m and 4.6m level. Verification sampling will be performed on contaminants that may be present below 3.0 m or 4.6 m for the purposes of determining compliance with groundwater protection standards.

The Data Quality Objectives (DQO) process was used (BHI 2000) to define the extent and type of sampling and analysis required during excavation and closure. This effort will define sampling issues, which may include analytes of interest, sample location, number of samples, number and frequency of field QC samples (i.e., trip blanks, equipment blanks, splits, and duplicates), sampling methodology, analytical methods, laboratory protocols, laboratory validation, data error tolerances, and data evaluation methods. This DQO effort will culminate in an Ecology-approved sampling and analysis plan.

Alternative-specific sampling and analysis activities are as follows:

RRES-6 and MCRIS-6 - The Remove/Treat if Required/Dispose/Backfill (Removal) alternatives will require sampling and analysis at the end of excavation to determine that, at a minimum, a modified closure option has been attained. Dangerous waste constituents must be below MTCA Method C direct soil exposure and groundwater protection standards in order to preclude landfill closure and placement of a cover. Dangerous waste constituents must be below MTCA B direct soil exposure and groundwater protection standards in order to achieve remediation under RRES-6.

MCRIS-7 - The Remove 3.0 m (10 ft) bgs/Treat if Required/Dispose/Backfill/Capping alternative will result in the placement of a WAC 173-303 compliant cover should dangerous waste constituents be left in place above MTCA Method C levels. Concentrations of dangerous waste constituents remaining under the units would be irrelevant to the need for placement of a landfill cover; however, to determine whether other landfill postclosure requirements should be imposed at one or both units, concentrations of constituent would need to be defined. Sampling would be required after excavation and/or prior to backfilling and placement of the cap for this alternative.

MCRIS-8 - Sampling and analysis would be required for the Remove 3.0 m (10 ft) bgs/Treat if Required/Dispose/Vitrify (Vitrification) alternative to define the extent of contamination of the dangerous waste constituents needing treatment. Sampling after vitrification may be required in order to determine the effectiveness of the treatment for dangerous waste constituents.

In addition to the sampling described above, sampling may be performed during excavation to help define extent of contamination, to guide field activities, and for waste characterization to determine ex situ treatment and disposal requirements.

4.3.3 Piping Characterization

Should a determination be made that piping associated with the 1301-N and 1325-N Liquid Waste Disposal Facilities may be able to meet clean closure standards and be left in place, such a determination will be submitted to Ecology for their concurrence. This determination may be based on process knowledge, sampling, or both.

4.4 Waste Management

Closure of the 1301-N and 1325-N Liquid Waste Disposal Facilities in accordance with the remedial alternatives identified will generate low-level radioactive or mixed waste in the form of contaminated soils and debris. Disposal of these wastes will be performed at the Environmental Restoration Disposal Facility or the W-025 Trench, both located on the 200 Area Plateau of the Hanford Site, in compliance with WAC 173-303 for any dangerous or mixed waste that will be generated. If generated wastes do not meet the acceptance criteria for these units, such as compliance with land disposal restrictions (40 CFR 268), a disposal plan will be developed to determine appropriate treatment or disposal options for these wastes. Waste generated as part of this remediation activity will be managed and disposed of in such a way as to ensure protection of human health and the environment.

Waste generation, management, and disposal will be conducted in accordance with operational procedures and with all State, Federal, and U.S. Department of Energy (DOE) Orders and regulations dealing with waste, including agreements with the public and stakeholders.

4.5 Modified Closure Institutional Control Requirements

Should a modified closure option be determined for 1301-N and/or 1325-N Liquid Waste Disposal Facilities, institutional controls in accordance with Permit Condition II.K.3.a and WAC 173-340-440 shall be adhered to. Institutional controls consist of physical measures and administrative and legal mechanisms. Possible methods of controlling access to contaminated sites include placement of signs, entry control such as locked fencing, artificial or natural barriers, and active surveillance. Measures to be used depend on specific site conditions and degree of hazard associated with contamination left at the end of remediation activities. Because of this, specific institutional controls cannot be detailed until after selection of an alternative and incorporation of design elements during the remedial design phase.

A notice in deed and survey plat will be submitted to the Benton County Auditor as described in Section 4.12.

4.6 Final Cover Requirements for Landfill Closure

Should dangerous waste contaminants be left within the soil column above MTCA Method C levels, a landfill cover would need to be designed and constructed over the unit(s). Specific design aspects associated with a landfill cover would require development after the ROD and during the remedial design phase associated with 1301-N and 1325-N Liquid Waste Disposal Facilities.

4.7 Personnel Training

Training will be provided to site personnel in accordance with the 1301-N and 1325-N Liquid Waste Disposal Facilities training plan contained in DOE/RL-96-39, Rev. 1A, Attachment A-4. This training will be effective until the postclosure period. At that point, the personnel training information contained in Attachment 41, Chapter 5.0, §5.4 will supplement training of personnel for postclosure care activities.

4.8 Closure Contact

The DOE-RL will be the official contact for 1301-N and 1325-N Liquid Waste Disposal Facilities during the postclosure period at the following address:

Director, Office of Environmental Services *
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

*or its equivalent should there be a future reorganization at DOE-RL

4.9 Closure Schedule

Closure activities (actual cleanup) for 116-N-3 will begin in July 2000.

At the completion of 116-N-3, closure activities at 116-N-1 will begin. Approximately 600 feet (Permit Attachment 41, Chapter 2.0, Figure 2.1) of piping that is associated with the 116-N-1 TSD Waste Site and the 116-N-2 Facility and support facilities (1322-NA, NB, NC) will be deferred until decontamination and decommissioning (D&D) of these facilities. This deferral is due to safety concerns with remediating the piping and the radiological dose exposure to remedial action workers. Remediation will require excavation of the earthen berm at the 116-N-2 Facility, which provides radiological shielding.

Additionally, approximately 5,600 feet (Permit Attachment 41, Chapter 2.0, Figure 2.2) of piping that is associated with 116-N-1, 105-N and 109-N Facilities (part of the N Reactor Facility Complex) will be deferred until D&D activities of the 105-N Reactor Facility Complex. This deferral is also due to safety concerns with remediating the piping. Remediation will require excavation up to foundation walls of these facilities, thus, jeopardizing the integrity of the facilities. The pipelines intersect and/or follow active underground power lines and potable water lines. Finally, remediation will block the access routes to the ongoing pump-and-treat operations at the 100-N Springs and other active facilities in the 100-N Area.

The approximate duration of completion for both TSD units is 6 years, not including for the piping that will be deferred. The D&D of the 116-N-2 Facility and support facilities and removal of the deferred piping is planned for startup in the fiscal year 2004. The deferred piping associated with the 105-N and 109-N Facilities will be remediated as part of D&D of the 105-N Reactor Facility Complex in accordance with Tri-Party Agreement Milestone M-093-20.

The corrective action schedule of compliance for UPR-100-N-31 will be the same as the closure schedule.

4.10 Amendment of Closure Plan

The 1301-N and 1325-N Liquid Waste Disposal Facilities closure plan will be amended whenever changes in closure activities or postclosure requirements occur and prior to certification of closure and postclosure, respectively, that would constitute a Class 1, 2, or 3 modification to the Permit (WAC 173-303-830).

4.11 Certification of Closure

In accordance with WAC 173-303-610(6), within 60 days of closure of 1301-N and 1325-N Liquid Waste Disposal Facilities, RL will submit to Ecology a certification of closure signed by both RL and an independent registered professional engineer. The certification will specify that the units have been closed in accordance with specifications contained within the approved closure plan, as amended, and as contained in the Permit.

4.12 Survey Plat and Notice In Deed

A survey plat will be submitted by RL to the Benton County Planning Department no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). Also, a notice in deed will be submitted by RL to the Auditor of the Benton County no later than 60 days after certification of closure of each unit in accordance with WAC 173-303-610(10). After submitting this notice, a certification signed by the Permittees will be submitted to Ecology stating that notification has been recorded along with a copy of the notice in deed. The notice in deed will specify the type, location, and quantity of dangerous wastes remaining after closure actions have been completed.

1325-N LIQUID WASTE DISPOSAL FACILITY
CHAPTER 5.0
POSTCLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
8/2004	

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CHAPTER 5.0
POSTCLOSURE PLAN

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CHAPTER 5.0
POSTCLOSURE PLAN

TABLE OF CONTENTS

5.0 POSTCLOSURE PLAN 5
5.1 Modified Postclosure Institutional Controls and Periodic Assessments 5
5.1.1 Periodic Assessments 5
5.1.2 Inspections 5
5.2 Landfill Postclosure Requirements 6
5.3 Groundwater Monitoring Postclosure Requirements 6
5.3.1 Postclosure Groundwater Monitoring 6
5.3.2 Inspection, Maintenance, and Replacement of Wells 6
5.4 Personnel Training During Postclosure 7
5.4.1 Surveillance Personnel 7
5.4.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel 7
5.4.3 Additional Training Descriptions for Landfill Closure 7
5.5 Security 8
5.5.1 24-Hour Surveillance System 8
5.5.2 Barrier, Means to Control Entry, and Warning Signs 8
5.6 Postclosure Contact 8
5.7 Certification of Postclosure 8

TABLE

Table 5.1. Minimum Inspection Schedule for 1301 N and 1325 N 6

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5.0 POSTCLOSURE PLAN

Postclosure requirements will be applicable to 1301-N and 1325-N. Because it is uncertain, whether postclosure requirements would involve modified closure requirements or landfill requirements, actions necessary to comply with both closure options are presented.

5.1 Modified Postclosure Institutional Controls and Periodic Assessments

Institutional controls under a modified closure option will consist of continued restrictions to access and use of groundwater and may consist of access controls to surface soils or deeper soils such as a fence. Institutional controls will be defined after remedial alternative selection. Inspections and maintenance of institutional controls and monitoring will be requirements of postclosure under a modified closure option.

5.1.1 Periodic Assessments

Periodic assessments shall include a compliance-monitoring plan in accordance with Permit Condition II.K.3.b and WAC 173-340-410. The compliance-monitoring plan will address the assessment requirements, which include protection and confirmation monitoring. This will include at least one assessment activity that is to take place after a period of five years from the completion of closure. The assessment activity will demonstrate whether the soils and groundwater have been maintained at or below the allowed concentrations for a modified closure as defined in Permit Condition II.K.3. The compliance plan will identify the nature and date of the assessment activities and will include a timetable for performance of these activities. This information will be contained in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Operation and Maintenance Plan and its supporting documents.

Should the required assessment activities identify contamination above the allowable limits (i.e., landfill closure levels specified in Permit Condition II.K.4.), the unit must be further remediated or the postclosure plan must be modified to include activities to be undertaken at the unit to meet landfill closure and postclosure requirements. Should the required assessment activities demonstrate that contamination has diminished or remained the same, the Permittees may request that Ecology reduce or eliminate the assessment activities and/or institutional controls.

As allowed by WAC 173-340-410, such monitoring may be combined with other plans. It is the intention that protection and confirmation sampling of groundwater be achieved through implementation of the dangerous waste final status groundwater monitoring plan to be written prior to, and implemented upon, the effective date of the Permit modification adding 1301-N and 1325-N to the Permit (anticipated to occur in 1999).

In addition to groundwater monitoring, compliance monitoring for institutional controls will include routine visual inspections and evaluations. Visual inspections shall consist of examinations of soil cover surfaces for signs of deterioration and improper usage of the surface area (e.g., buildings, impervious surfaces such as concrete or asphalt). An evaluation of existing data from the groundwater monitoring system should also be performed, as well as any other activities that would help assess the integrity of the cover.

5.1.2 Inspections

Inspections of institutional controls and groundwater monitoring systems under a modified closure option will be required. Groundwater monitoring postclosure inspection requirements will be identical to those under a landfill closure option and are contained in Section 5.2. Because the exact nature of institutional controls that may be utilized at 1301-N and 1325-N depend upon the remedial alternative chosen, site conditions, further characterization efforts, and the success of remedial actions taken, a list of potential inspection items is contained in Table 5.5. Frequency of inspection of these potential items is also contained in this table. These inspections may be implemented in checklist form. Such a checklist could specify entering checklist performance and results in the appropriate inspection logbook.

5.1.2.1 Inspection Logbook

Inspectors will be trained in accordance with the postclosure personnel training plan contained in Section 5.4. The inspector will record any damage to the area and/or maintenance needs as well as the weather conditions at the time of inspection. Separate logbook entries will be signed and dated. Performance of any related inspection checklists will be documented in the logbook. Maintenance actions will be started and should be completed within 90 days. Logbook entries will document the correction of the problem or the status of corrective actions. Entries should also uniquely identify, where possible, work documents that actually performed the activities.

5.1.2.2 Security Control Devices

The 1301-N and 1325-N units are currently surrounded by a fence with locked gate access. If fences are removed to accommodate remedial activities, they will be replaced with an appropriate physical barrier, if required, in accordance with institutional controls defined after remedial alternative selection.

Table 5.1. Minimum Inspection Schedule for 1301 N and 1325 N

Item(s)	Inspection Frequency		
	Monthly	Quarterly	Annually
Security control devices			X
Erosion damage	X (until vegetative cover is established)	X (thereafter)	
Cover settlement and displacement		X	
Condition of vegetative cover	X (first 2-3 years)	X (thereafter)	
Well condition and purge water collection system		X	
Benchmark integrity			X

5.1.2.3 Erosion Damage and General Integrity

Should surface ground covers or other earthen barriers be utilized as part of the modified closure institutional controls for 1301-N and 1325-N, inspection of these systems for erosion control and general integrity will be performed. Inspection frequency will be quarterly and will be performed by physically walking over the site to check visually for wind and water erosion, subsidence, displacement, and general site integrity. Any site damage noted during inspections will be recorded in the field logbook and reported to the appropriate maintenance authority.

5.2 Landfill Postclosure Requirements

Should a landfill cover be required, an inspection and maintenance plan will be developed during remedial design for the 1301-N and 1325-N cover systems.

5.3 Groundwater Monitoring Postclosure Requirements

5.3.1 Postclosure Groundwater Monitoring

During the postclosure period, monitoring of groundwater will continue according to the existing groundwater-monitoring program (Borghese et. al., 1996). The detection-monitoring program in accordance with WAC 173-303-645(9) is scheduled for implementation when the 1301-N and 1325-N units are incorporated in the Permit.

5.3.2 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled, the wellhead and associated structures are inspected. Problems with the pump or with the sample (e.g., excessive turbidity) are also noted. Repairs are made according to

approved contractor procedures. Subsurface inspection and maintenance is performed on a 3- to 5-year schedule, or as needed to repair problems identified during sampling.

If a monitoring well becomes unsuitable for use, the monitoring program will be reevaluated to determine if a new or existing well should be substituted.

5.4 Personnel Training During Postclosure

This section describes the training of personnel required to complete postclosure care requirements contained in this closure plan and the Permit. It is intended to supplement the training plan currently in place and identified in DOE/RL 96-39, Rev. 1A, Attachment A-4. A brief description of how training will be designed to meet job tasks is presented below.

5.4.1 Surveillance Personnel

The following outline provides potential information on classroom or on-the-job training that surveillance personnel will complete before conducting independent site surveillance at 1301-N and 1325-N during a postclosure period. Only those that are applicable to the selected closure option will be used:

- Site surface inspections. (water and wind erosion, settlement and displacement, vegetative cover)
- Security inspections.
- Location, integrity, and inspection of benchmarks, if appropriate.
- Location, integrity, and inspection of groundwater wells.
- Erosion damage.
- Cover settlement and displacement.
- Vegetative cover condition.

5.4.2 Groundwater Sampling and Analysis Task Leader and Sampling Personnel

After closure of 1301-N and 1325-N, the sampling and analysis task leader or delegate (samplers) will be responsible for:

- Monitoring and reporting on groundwater well security and maintenance.
- Collecting groundwater level data.
- Collecting, packaging, and shipping groundwater samples to field and offsite laboratories.
- Sampling and monitoring equipment operation and maintenance.
- Providing sample chain of custody to the laboratory.

The training of the sampling and analysis task leader and sampling personnel will receive either classroom instruction or on-the-job training. Sampling and analysis personnel will be trained to perform these functions in accordance with the *Hanford Analytical Services Quality Assurance Requirements Documents* (DOE-RL 1996d). A person successfully completing the required training courses will be qualified as a groundwater sampler and/or task leader. All personnel will undergo training and at least an annual review for required courses.

5.4.3 Additional Training Descriptions for Landfill Closure

Training descriptions for additional tasks associated with a landfill closure are as follows:

Site Cover Inspections – This on-the-job training program is established to ensure that the surveillance personnel know what to inspect after the closure of 1301-N and 1325-N. It will include how to inspect for obvious signs of erosion, proper drainage, settlement, and sedimentation. In addition, personnel will be informed as to what constitutes proper vegetation coverage.

Additional on-the-job or classroom training under a landfill closure option includes the following:

Site Security Inspections – Personnel will be instructed on how to inspect for obvious signs of a security

breach. Signs may include cut fencing, unlocked gates, or cut chains.

Location, Integrity, and Inspection of Benchmarks – Personnel will be shown the location of benchmarks and report any obvious signs of destruction or deterioration.

5.5 Security

5.5.1 24-Hour Surveillance System

The 1301-N and 1325-N units are located within the 100 Area of the Hanford Site. The 100 Area will remain an area controlled by RL for the near future due to the decommissioning and deactivation of facilities associated with and including the 100-N Reactor. These areas will be under 24-hour surveillance by Hanford Patrol Protective Force personnel.

5.5.2 Barrier, Means to Control Entry, and Warning Signs

Roadways to the unit and site access will remain administratively restricted to use by authorized personnel only. Posted federal warning signs restrict access to the 100-N Area from the Columbia River. Further institutional and administrative measures controlling TSD unit site access may be initiated for the site commensurate with the future use of the property.

5.6 Postclosure Contact

The RL will be the official contact for the 1301-N and/or 1325-N units during the postclosure period at the following address:

Director, Office of Environmental Services*
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

*or its equivalent should there be a future reorganization at DOE-RL

5.7 Certification of Postclosure

No later than 60 days after completion of the postclosure care period, RL will submit to Ecology a certification of completion of postclosure care. This certification, stating that postclosure care for the unit was performed in accordance with the approved closure plan, will be signed by RL and an independent registered professional engineer. The certification will be submitted by registered mail or an equivalent delivery service. Documentation supporting the independent registered professional engineer's certification will be supplied upon request of the regulatory authority.

207-A SOUTH RETENTION BASINS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 207-A South Retention Basins **October 6, 2016**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	10/06/2016	8C.2016.6F
1.0 Part A Form		
2.0 Reserved		
3.0 Reserved		
4.0 Closure Plan	10/06/2016	8C.2016.6F
5.0 Reserved		

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207-A SOUTH RETENTION BASINS
CLOSURE UNIT GROUP 5 CONDITIONS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/06/2016	8C.2016.6F

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CLOSURE UNIT GROUP 5 CONDITIONS
207-A SOUTH RETENTION BASINS

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CLOSURE UNIT GROUP 5 CONDITIONS
207-A SOUTH RETENTION BASINS

UNIT DESCRIPTION

The 207-A South Retention Basins (207-A SRB) are inactive dangerous waste management units (surface impoundments). The United States Department of Energy (USDOE) used 207-A SRB to temporarily store, sample, and analyze 242-A Evaporator process condensate before discharging it to the 216-A-37-1 Crib. The 207-A SRB first received process condensate (mixed waste) from the 242-A Evaporator in March 1977. Discharge to the 207-A SRB ceased in April 1989. The 207-A SRB no longer receives or stores waste.

The 207-A SRB is located in the 200 East Area of the Hanford Site, near the east perimeter fence, directly east of the 242-A Evaporator. The 207-A SRB consists of three concrete cells, which are each generally trapezoidal in shape. Each cell has a 264,979 liter (70,000 gallon) design capacity. The bottom dimension of each cell is 16.8 meters (55 feet) long, 3 meters (10 feet) wide at the bottom, and 2.1 meters (7 feet) deep. A Hypalon® liner was installed beneath the concrete. The cells were covered with an elastomeric coating in 1982 to minimize the process condensate from potentially penetrating the concrete.

LIST OF CHAPTERS SPECIFIC TO CLOSURE UNIT GROUP 5

Chapter 1	Part A Form
Chapter 3	Groundwater Monitoring – Reserved
Chapter 4	Closure Plan
Chapter 5	Postclosure Plan – Reserved

DEFINITIONS

Reserved

ACRONYMS

207-A SRB	207-A South Retention Basins
HFFACO	Hanford Federal Facility Agreement and Consent Order
MTCA	Model Toxics Control Act
RCRA	Resource Conservation and Recovery Act of 1976
SEPA	State Environmental Policy Act
TA	Temporary Authorization
USDOE	United States Department of Energy
WAC	Washington State Administrative Code

V.5.A COMPLIANCE WITH PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit (Permit), as specified in Permit Attachment 9, Permit Applicability Matrix, including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-group Permit Conditions are enforceable in their entirety. In the event that the Part V-Unit-Group Conditions for Closure Unit Group 5, 207-A South Retention Basin

conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-group conditions will prevail for Closure Unit Group 5, 207-A SRB.

V.5.B CLOSURE

V.5.B.1 The Permittees will comply with all requirements set forth in the Chapter 4, Closure Plan, and close the 207-A SRB in accordance with the Chapter 4, Closure Plan. (WAC 173-303-610)

V.5.B.2 Upon receipt of the final laboratory analytical report, the Permittees will use the data analysis function to generate the Data Analysis Report from the Visual Sample Plan, in order to demonstrate whether sampling assumptions in the Chapter 4, Closure Plan, Appendix A, were met. The Permittees will provide the Data Analysis Report to Ecology within 30 days of the effective date of this permit modification. If sampling assumptions were not met, the Permittees must submit a permit modification request, in accordance with Permit Condition I.C.3, to amend the closure plan to include a revised sampling design. The permit modification request must be submitted within 60 days of submittal of the Visual Sample Plan Data Analysis Report to Ecology.

V.5.B.3 If a temporary loading stockpile (not a staging pile or waste pile) is used to load containers with waste from closure activities, soil samples are required to be taken from within the loading stockpile footprint to confirm no new area of contamination (AOC) has been created. Analytical results of any sampling must be submitted with the closure certification, in accordance with the Chapter 4, Closure Plan.

V.5.B.4 If all contaminated soils cannot be removed at closure, a modified closure plan must be submitted to Ecology within 30 days of the determination that clean closure cannot be achieved. The modified closure plan must be submitted in accordance with Permit Condition I.C.3.

V.5.B.5 If the 207-A SRB cannot be clean closed, a contingent plan, a post-closure plan and groundwater monitoring plan must be submitted to Ecology within 90 days of the determination that the unit cannot be clean closed. Post-closure plan and groundwater monitoring plan submissions are permit modifications that must be submitted in accordance with Permit Condition I.C.3.

207-A SOUTH RETENTION BASINS
CHAPTER 4.0
CLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/06/2016	8C.2016.6F

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CHAPTER 4
207-A SOUTH RETENTION BASINS (S-2-7) CLOSURE PLAN

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CHAPTER 4
207-A SOUTH RETENTION BASINS (S-2-7) CLOSURE PLAN

TABLE OF CONTENTS

4.1 Introduction 7
4.1.1. Physical Description 7
4.1.2. Process Information 9
4.1.3. Waste Inventory and Characteristics 12
4.1.4. Security Information 12
4.2 Groundwater Monitoring 12
4.3 Closure Performance Standards 12
4.4 Closure Strategy 13
4.4.1. Previous Closure Activities 13
4.4.2. Clean Closure Strategy 14
4.5 Closure Activities 14
4.5.1. 207-A SRB Demolition and Disposal 15
4.5.1.1. Mobilization and Site Preparation 15
4.5.1.2. 207-A SRB Storage Cell Walls Demolition 15
4.5.1.3. Miscellaneous Piping and Soil 15
4.5.1.4. 207-A SRB Storage Cell Floors 16
4.5.1.5. Decontamination 16
4.5.1.6. Completion Criteria 16
4.5.2. Waste Management 16
4.5.2.1. Projected Waste Streams 16
4.5.2.2. Waste Management and Characterization 17
4.5.2.3. Waste Handling, Storage, and Packaging 17
4.5.2.4. Waste Treatment 19
4.5.2.5. Waste Minimization and Recycling 19
4.5.3. Air Emissions 19
4.5.4. Health and Safety Requirements 20
4.5.5. State Environmental Policy Act and Cultural and Ecological Resources 22
4.6 Soil Verification Sampling and Analysis 22
4.6.1. Closure Sampling and Analysis Plan 22
4.6.1.1. Target Analytes 22

4.6.1.2. Verification Sampling Schedule 22
4.6.1.3. Sample Management 22
4.6.2. Sampling Design 22
4.6.2.1. Sampling Methods and Handling 24
4.6.2.2. Analytical Methods 27
4.6.2.3. Quality Control 28
4.6.2.4. Data Verification 30
4.6.2.5. Data Validation and Assessment 30
4.6.2.6. Verification of VSP Input Parameters 30
4.6.2.7. Documents and Records 31
4.6.2.8. Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed 32
4.7 Closure Plan Modification 32
4.8 Schedule for Closure 32
4.9 Certification of Closure 33
4.10 Post-Closure Plan 34
4.11 Amendment of Closure Plan 34
4.12 References 34
Appendix A i

FIGURES

Figure 1. Timeline for the 207-A South Retention Basins 9
Figure 2. 207-A South Retention Basins in the 200 East Area 10
Figure 3. Simplified Diagram of the 207-A South Retention Basins 11

TABLES

Table 1. Training Matrix for the 207-A SRB DWMU 21
Table 2. Target Analyte List 23
Table 3. Visual Sample Plan Parameter Inputs 25
Table 4. Sample Preservation, Container, and Holding Time for Soil Samples. 27
Table 5. Soil Analytical Performance Requirements 28
Table 6. Project Quality Control Sampling Summary 29
Table 7. Closure Activity Description 33

TERMS

ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
CAS	Chemical Abstracts Service
DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
GPS	global positioning system
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
HHE	human health and the environment
IQRPE	Independent Qualified Registered Professional Engineer
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
N/A	not applicable
NRB	North Retention Basin
OU	operable unit
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RI	remedial investigation
SAF	Sampling Authorization Form
SAP	sampling and analysis plan
SEPA	State Environmental Policy Act
SRB	South Retention Basin
TA	Temporary Authorization
TPA	Tri-Party Agreement
TSD	treatment, storage, and/or disposal
VSP	Visual Sample Plan

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4.1 INTRODUCTION

The purpose of this plan is to describe the closure process for the 207-A South Retention Basins Closure Unit Group 5, hereinafter called 207-A South Retention Basins (207-A SRB). This closure process will include the demolition and removal of the 207-A SRB and soil sampling to verify soils meet clean closure standards.

The 207-A SRB, consists of three inactive storage cells, which are classified as surface impoundments. The 207-A SRB was used for storage of 242-A Evaporator process condensate for sampling and analysis before the condensate was discharged to the 216-A-37-1 Crib for disposal to the soil column. The 207-A SRB began storage operations in 1977. 242-A Evaporator discharge to the 207-A SRB was terminated on April 12, 1989, and it has been inactive since that date. Because the 242-A Evaporator process condensate was designated as dangerous waste under Washington Administrative Code (WAC) 173-303, a *Dangerous Waste Permit Application Part A Form*, for the 207-A SRB, hereinafter called the Part A, was submitted to the Washington State Department of Ecology (Ecology) in 1988 with the latest revision on January 27, 2016. The Part A is located in Chapter 1.0 of Closure Unit Group 5. Figure 1 provides a timeline that summarizes the operations and regulatory milestone associated with the 207-A SRB. Operations milestones are shown below the timeline, and regulatory milestones are shown above the timeline (Figure 1).

The dangerous wastes, including the dangerous waste components of any mixed waste, in the 242-A Evaporator Process Condensate are regulated under the applicable *Resource Conservation and Recovery Act of 1976* (RCRA) final status standards in 40 CFR 264. Authority to apply RCRA standards and regulations is provided to the State of Washington through the Hazardous Waste Management Act (HWMA) Chapter 70.105 Revised Code of Washington (RCW), and implemented through the Dangerous Waste Regulations, Chapter 173-303 Washington Administrative Code. The radionuclides in the mixed waste may include "source, special nuclear, and byproduct materials" as defined in the *Atomic Energy Act of 1954* (AEA). The AEA states that these radionuclide materials are regulated at U.S. Department of Energy (USDOE) facilities exclusively by USDOE, acting pursuant to its AEA authority. These radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the State of Washington under RCRA and HWMA.

4.1.1. Physical Description

The 207-A SRB is located in the 200 East Area (Figure 2) directly east of the 242-A Evaporator. The 207-A SRB, also known as Process Condensate Basins 1, 2, and 3 (i.e., PC-1, PC-2, and PC-3), began operations in March 1977. The 207-A SRB consists of three separate open liquid effluent storage cells constructed of concrete that operated as surface impoundments. Figure 3 provides a simplified diagram of the 207-A SRB.

The overall surface dimension of the 207-A SRB is 39.6 meters (130 ft) by 27.7 meters (91 ft) which includes a 1.2 meter (4 ft) wide dike around the perimeter of the 207-A SRB and between the storage cells. Each of the three storage cells had a 264,979 L (70,000 gal) design capacity for a total capacity of 794,937 L (210,000 gal). Each storage cell is approximately 11.6 meters (38 ft) wide by 25.3 meters (83 ft) long at the top with walls having a 2:1 slope downward for 4.3 meters (14 ft) to a bottom that is 16.8 m (55 ft) long, 3.0 m (10 ft) wide bottom. The cross section of the storage cells is thus generally trapezoidal in shape, with the bottom of each cell sloping toward a drain located at the north end of the cell. (The drain is about 0.6 m (2 ft) from the north end of the floor mid-way across the width). The drain lines from the storage cells go into a pump pit (valve box) to the north of the 207-A SRB. The discharge line to the 216-A-37-1 Crib exits from the west side of the pump pit and then turns south and runs along the west side of the 207-A SRB. The inlet to each storage cell enters via the center of the north wall about 0.5 m (1.5 ft) above the floor. The storage cells are 2.1 m (7 ft) deep having 1.5 meters (5 ft) of liquid capacity and 0.6 meters (2 ft) of freeboard. Initially a Hypalon® liner provided liquid retention in

the storage cells. In 1982 concrete walls and floors were placed over the liner and provided with an elastomeric coating to minimize the process condensate from potentially penetrating the concrete.

Per drawing H-2-90783, a pump pit (also described as a control box or diversion box) is situated approximately halfway between the 207-A SRB and the 207-A North Retention Basin (207-A NRB). This pump pit controlled the flow and discharge of process condensate from the 242-A Evaporator to the 207-A SRB and the flow and discharge of steam condensate from the 242-A Evaporator to the 207-A NRB. The pump pit also controlled the discharge of process condensate from the 207-A SRB to the 216-A-37-1 Crib. The piping running between the pump pit and the 207-A SRB storage cells is part of the 207-A SRB dangerous waste management unit (treatment, storage, and disposal unit [TSD]). Piping from the 242-A Evaporator to the pump pit, piping running between the pump pit and the 207-A NRB, and piping running out from the pump pit to the 216-A-37-1 crib, are not part of the 207-A SRB.

Construction details shown on drawings H-2-90783 and H-2-90784 indicate that the liner and concrete were integrated to avoid preferential pathways to the soil column.

The construction of the 207-A SRB was done as follows (per instructions on drawings H-2-90783 and H-2-90784):

- The site was excavated to the appropriate grade and a Hypalon® liner was installed. A berm was created around the outer edge of the basins. Backfill was placed as required where excavations were done for piping associated with the basins. Where pipng entered or exited the basins, the liner was cut to allow the piping to pass through, but was repaired to create a seal around the penetration.
- Concrete was poured to create the sides and bottoms of the basins. The joints between the concrete were filled with a self-expanding cork meeting specifications HH-F-34F, Type II, Class C.
- Waterstops consisting of 6-inch dumbbells of styrene butadiene rubber were placed in joints in the concrete to prevent the passage of water.
- The surface of the concrete was cleaned and sandblasted when the concrete had cured. A two-part elastomeric coating was placed on the sides and bottoms of the basins.

This method of construction provides integration of the liner, concrete, and elastomeric membrane to create a structure which is designed to avoid preferential pathways to the soil column. The 207-A SRB unit group boundary, (shown on the Part A as the “TSD Unit Boundary”), was established as the exterior walls of the concrete basin structure.

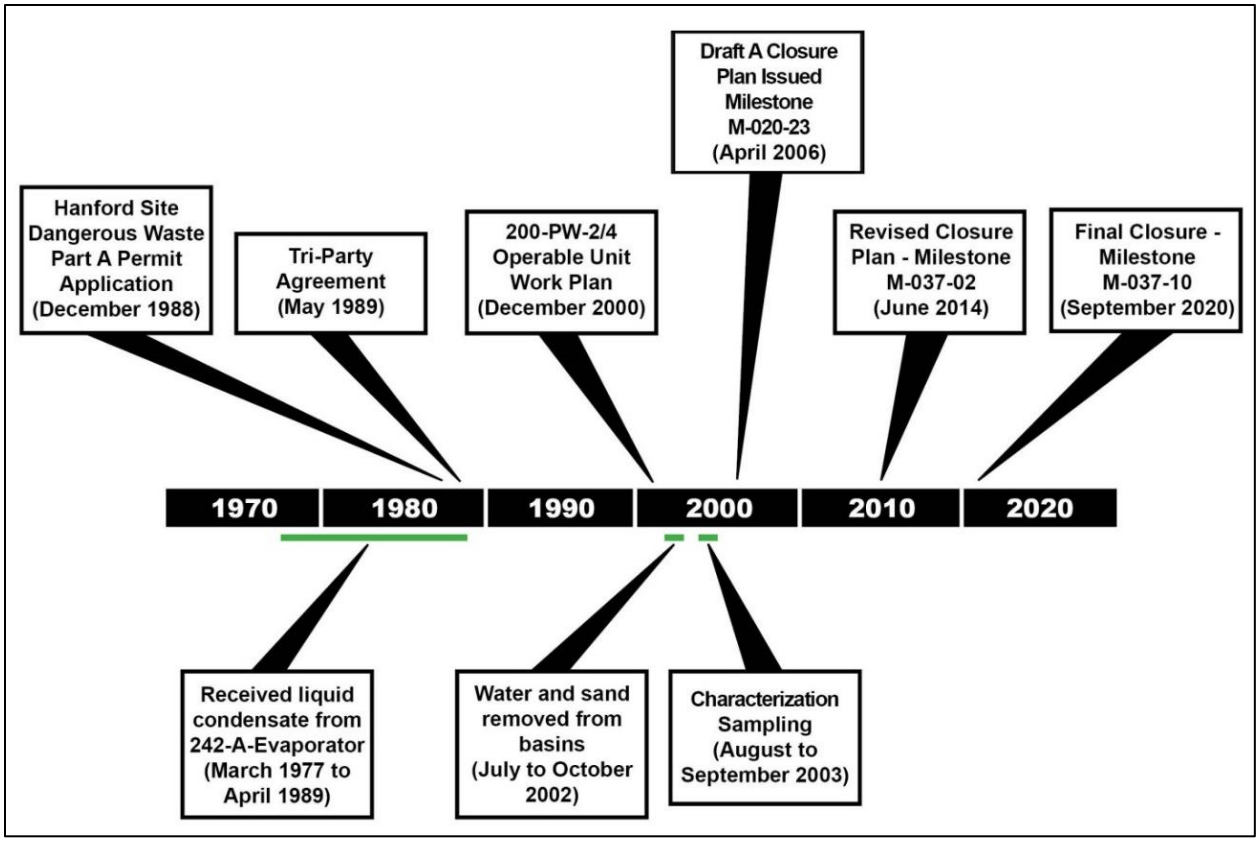

Figure 1. Timeline for the 207-A South Retention Basins

4.1.2. Process Information

The 207-A SRB storage cells operated as a surface impoundments for temporary storage of 242-A Evaporator process condensate, while the condensate awaited sampling and analysis. Waste was pumped from the 242-A Evaporator through transfer piping to the 207-A SRB. Waste generally was stored in the storage cells only long enough to obtain sample results for process control. The pumps located at a pump pit between the 207-A NRB and the 207-A SRB were used to transfer the stored effluent to the 216-A-37-1 Crib for disposal to the soil column. No waste treatment or disposal occurred at the 207-A SRB.

Waste processed by the 242-A Evaporator is received from the double-shell tank (DST) system as an aqueous, mixed waste solution. Slurry and process condensate are the two aqueous mixed waste streams generated at the 242-A Evaporator. The slurry is returned to the DST system. The process condensate is condensed vapor from the evaporation process. Between March 1977 and April 1989, process condensate was transferred to the 207-A SRB for temporary storage and sampling before it was disposed to the soil column via the 216-A-37-1 Crib.

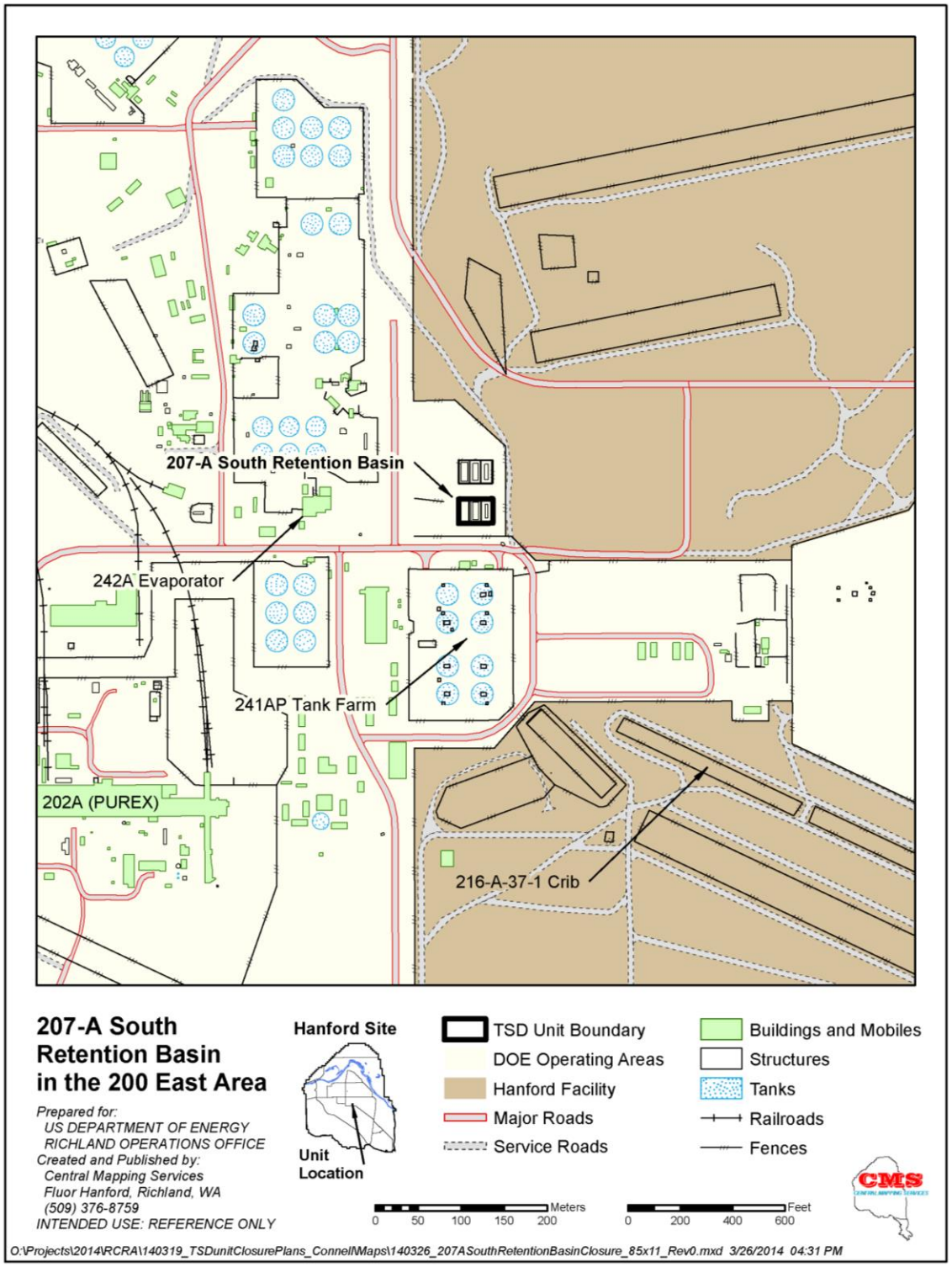

Figure 2. 207-A South Retention Basins in the 200 East Area

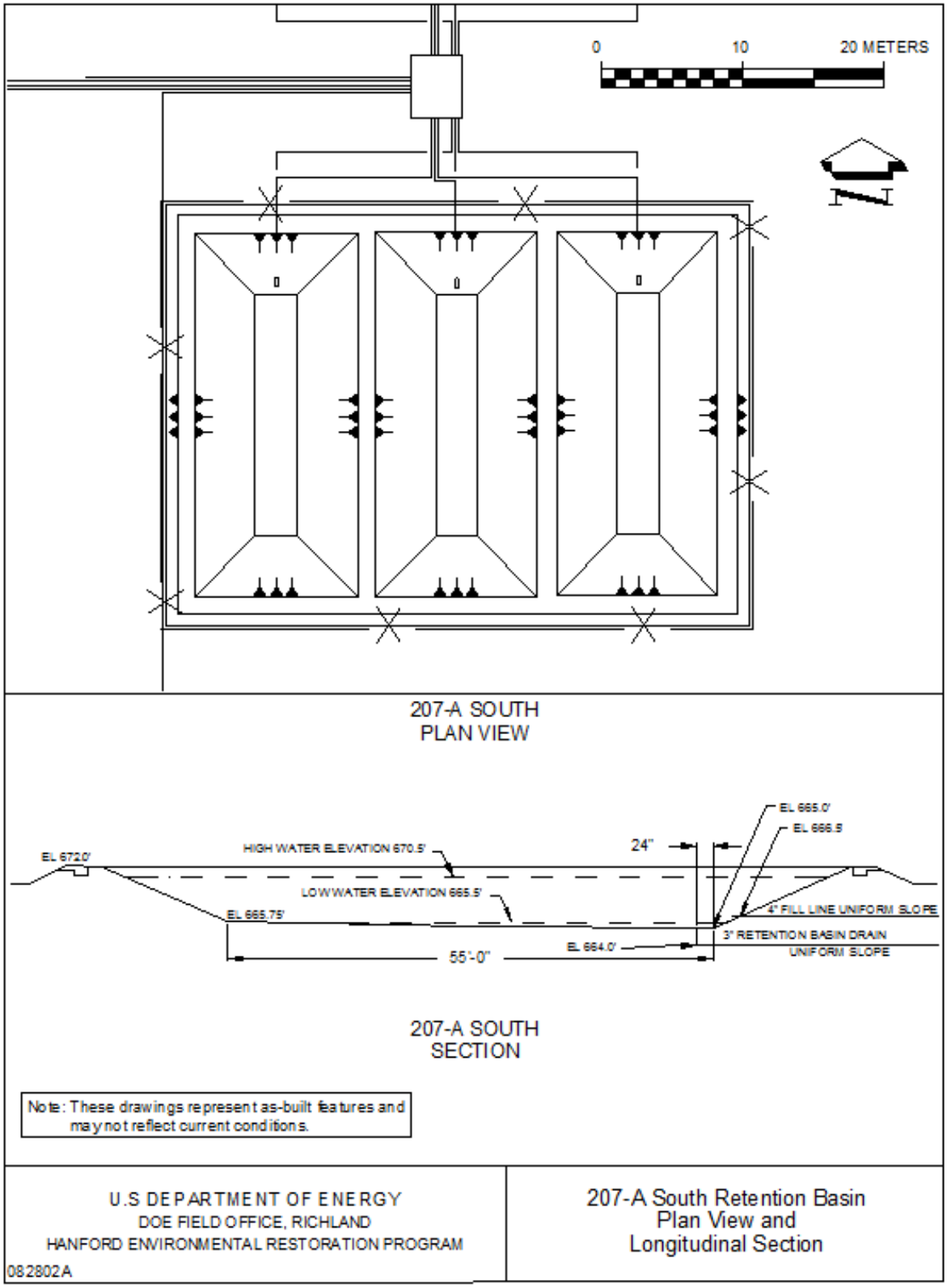

Figure 3. Simplified Diagram of the 207-A South Retention Basins

4.1.3. Waste Inventory and Characteristics

The 207-A SRB operated from 1977 to 1989. The total quantity of process condensate waste onsite at any one time was limited to the combined design capacity of the storage cells of approximately 794,937 L (210,000 gal). The total volume of process condensate the 207-A SRB received for temporary storage was 377,000,000 L (99,590,000 gal) of evaporator condensate (DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*).

The process condensate is an aqueous, mixed waste solution containing trace amounts of dissolved cations and anions, such as sodium, potassium, aluminum, hydroxides, nitrates, and nitrites with radionuclides (WHC-EP-0342, Addendum 15, *242-A Evaporator Process Condensate Stream-Specific Report*). The 242-A Evaporator process condensate is regulated as mixed waste (WAC 173-303-040, "Definitions") is derived from a waste containing spent halogenated and nonhalogenated solvents (WAC 173-303, dangerous waste codes F001, F002, F003, F004, and F005), and for the toxicity of ammonia (WT02, state-only toxic dangerous waste). The 207-A SRB constituents associated with these dangerous waste codes include ammonia, acetone, *m*-cresol, *o*-cresol, *p*-cresol, and methylene chloride.

4.1.4. Security Information

The 207-A SRB is located in the 200 East Area and, therefore, security information pertaining to the 200 Areas applies to this unit group. Both the Hanford Site and the 200 East Area are fenced. The 207-A SRB is located in a chained-off area. Changes to security are expected to occur during the course of 207-A SRB closure activities, and includes changing the chained-off area to a roped off area, additional signs (i.e., radiological area warning signs), entry restriction, and other items as needed. Radiological area warning signs and danger signs will be posted during demolition and excavation activities. Security measures will remain in place that limit entry to authorized personnel and that preclude unknowing access by unauthorized individuals until closure of the 207-A SRB.

4.2 GROUNDWATER MONITORING

This closure plan proposes clean closure of the 207-A SRB. If clean closure is not achieved, a groundwater monitoring plan will be submitted within 90 days after the determination that the 207-A SRB cannot be clean closed, as required by WAC 173-303-610(8)(a).

4.3 CLOSURE PERFORMANCE STANDARDS

The standards for closure of the 207-A SRB are in accordance with the requirements of the Tri-Party Agreement (TPA) Action Plan (Ecology et al. 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*). As required by WAC 173-303 and the TPA Action Plan (Ecology et al. 1989b), Section 6.3.1, clean closure must demonstrate that treatment, storage, or disposal (TSD) unit operations did not adversely affect soil. The closure performance standards of WAC 173-303-610(2)(a)(i) through (iii) require the owner or operator of a dangerous waste management facility to close the facility in a manner that will accomplish the following objectives:

(a)(i) Minimizes the need for further maintenance;

(a)(ii) Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere; and

(a)(iii) Returns the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity.

WAC 173-303-610(2)(b)(i) requires that for clean closure of soil the numeric cleanup levels calculated using unrestricted use exposure assumptions according to WAC 173-340, "Model Toxics Control Act—Cleanup," hereinafter called MTCA, cleanup regulations be achieved. For this closure, the numeric

cleanup levels for soil concentrations protective of human health, WAC 173-340-740, the associated requirements for soil concentration protective of groundwater, WAC 173-340-747, and for soil concentration protective of ecology, WAC 173-340-7490 will be considered. The cleanup levels selected are identified in Table 4 in the shaded column (Closure Performance Standards).

According to WAC 173-303-610(2)(b)(ii), all structures, equipment, bases, liners, etc., clean closure standards will be set by the Ecology on a case-by-case basis in accordance with the closure performance standards of WAC 173-303-610(2)(a)(ii) and in a manner that minimizes or eliminates post-closure escape of dangerous waste. Clean closure of the 207-A SRB structures and liner will be achieved by removal.

Clean closure will eliminate the need for future post-closure inspections, monitoring, and maintenance. After clean closure, appearance of the land will be consistent with future land-use determinations for adjacent portions of the 200 Areas as an industrial-exclusive portion of the Hanford Site. This land use is consistent with the formal determination made for this portion of the 200 Area as described in 64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)."

4.4 CLOSURE STRATEGY

The proposed clean closure determination for 207-A SRB is partially based on review of the operational history, operating records, waste management records, and a visual inspection of the 207-A SRB area. The 207-A SRB has not operated since 1989. Since that time routine surveillance inspections have been performed. Wind-blown debris, such as tumbleweeds, is removed on a periodic basis from the 207-A SRB storage cells. Rainfall and snowmelt accumulate in the storage cells and evaporate. After nearly 40 years since construction, small portions of the Hypalon® liner have been exposed and small areas of the elastomeric coating have degraded.

Based on these reviews, 207-A SRB is a candidate for clean closure under WAC 173-303, and verification sampling will be performed. Sampling and analysis activities were developed using the results of the records review and visual inspection (EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection* [EPA QA/G-5S] and Ecology Publication 94-111, *Guidance for Clean Closure of Dangerous Waste Units and Facilities*) and will be conducted via a sampling and analysis plan (SAP) (Section 4.6.1). The objective of the sampling described in this document is to determine if MTCA Method B unrestricted land use standards for soil will be met after 207-A SRB storage cell removal, and demonstration of meeting clean closure standards of the soil underneath the storage cells.

4.4.1. Previous Closure Activities

To preclude any further influent to the 207-A SRB, and in support of closure, the 207-A SRB was physically isolated from receipt of 242-A Evaporator process condensate effluent in 1989. Operations at the 242-A Evaporator were halted in 1989 to begin facility upgrades to allow waste to be transferred to the Liquid Effluent Retention Facility basins for storage and treatment at the 200 Areas Effluent Treatment Facility

The 207-A SRB was included as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* remedial investigation (RI) for 200-PW-2/4 Operable Unit (OU). Characterization activities consisting of borehole drilling, geophysical logging, field screening, and sampling and analysis of concrete cores and borehole soils were performed in 2003. In total, 27 soil samples and 9 concrete samples, plus required duplicate and blank samples were collected for analysis from the three 207-A SRB concrete storage cells. These activities were performed to identify the nature and extent of any chemical and radiological contamination in vadose zone soil underlying the 207-A SRB, in support of OU remedial

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decision making and dangerous waste management unit closure. The RI was conducted in accordance with the SAP contained in Appendix B of DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan Includes: 200-PW-2 and 200-PW-4 Operable Units*. Data collected from the 207-A SRB storage cells are presented in the RI report (DOE/RL-2004-25, *Remedial Investigation Report for the 200-PW-2 Uranium-Rich Process Waste Group and the 200-PW-4 General Process Condensate Group Operable Units*, Appendix B and Section 7.2.2.2). Work plan sampling and analysis requirements for the 207-A SRB characterization were determined through a data quality objectives process documented in CP-14176, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-4 Operable Unit*. A data review supports the decision to clean close the 207-A SRB by removal of the storage cells.

4.4.2. Clean Closure Strategy

The 207-A SRB will be clean closed by removing the storage cells and up to 1 m (3 ft) of soil beneath and adjacent to the cells, which will meet the requirements of WAC 173-303-610(2)(b)(ii). In accordance with WAC 173-303-610(2)(b)(i), the clean closure levels for soil will be the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA. These numeric cleanup levels will be developed using the MTCA Method B unrestricted land use standards current at the time of closure as of the effective date of the closure plan approval. Applicable cleanup levels consider carcinogens, noncarcinogens, groundwater protection, and ecological indicator values and are contained in Table 4. Ecological based cleanup levels will be calculated only in the event of a release, per WAC 173-340-7490(2).

Sampling and analysis will be performed to verify clean closure for the soil (Section 6, "Soil Verification Sampling and Analysis"). Both random and focused sampling strategies will be used. Focused sampling will entail choosing sampling locations based on where concrete joints are located, and where cracks in the elastomeric coating warrant sampling. Should sampling and analysis of the 207-A SRB indicate contamination at concentrations greater than the MTCA Method B unrestricted land use standards, additional soil removal will be performed underneath the storage cell floors to meet clean closure standards. If it is determined that clean closure cannot be achieved through additional soil removal, this closure plan will be modified to address landfill closure requirements in WAC 173-303-665, and a post-closure plan will be submitted, in accordance with Permit Condition V.5.B.5 and WAC 173-303-830.

For closure strategy purposes, the null hypothesis will be used to support the basis for clean closure. A null hypothesis is generally assumed true until evidence indicates otherwise. The null hypothesis, as defined in MTCA (WAC 173-340-200, "Definitions), is that the concentrations of contaminants of potential concern (COPCs) soil is assumed to be greater than unrestricted use cleanup levels, commonly called MTCA Method B cleanup levels. Therefore, the closure site is presumed to be contaminated (i.e., there has been a release from the unit). Rejection of the null hypothesis means sampling and analysis results of the closure site indicated the soil contains contamination levels below the MTCA Method B cleanup levels. Sampling and analysis will be used to determine whether the null hypothesis can be rejected, thereby confirming the underlying soil meets the closure performance standards.

4.5 CLOSURE ACTIVITIES

Clean closure of the 207-A SRB will include the following activities:

- 207-A SRB demolition and disposal (Section 4.5.1)
- Waste management (Section 4.5.2)
- Air emission controls (Section 4.5.3)
- Health and safety requirements (Section 4.5.4)

- Cultural and ecological resources (Section 4.5.5)
- Soil verification sampling and analysis (Section 4.6)

4.5.1. 207-A SRB Demolition and Disposal

Demolition of the 207-A SRB will include removal of the concrete storage cells, Hypalon® liner, and piping between the 207-A SRB and the pump pit. The majority of the demolition will require the use of heavy equipment (e.g., excavator with various attachments) to demolish the structure. Other standard industry or conventional demolition practices also may be used (e.g., hydraulic shears with steel shear jaws, concrete pulverizer jaws, or breaker jaws). Selection of demolition methods will be based on the structural elements to be demolished, remaining contamination, location, and integrity of the structure. Water may be used to control dust generated from demolition activities. The amount of water used will be minimized to prevent ponding and runoff. While unlikely, other controls such as portable ventilation filter units, HEPA-filtered vacuum cleaners, greenhouses, and/or fogging agents may be used. Additional storm water run-on and run-off controls may be implemented, as needed. The following demolition activities presume that the waste will be disposed in the Hanford Environmental Restoration Disposal Facility (ERDF), as discussed in Section 4.5.2. If for some reason the waste is not disposed of at ERDF, then waste will disposed of at a dangerous waste management unit authorized for disposal such as Trenches 31 and 34 in the 218-W-5 Burial Grounds.

4.5.1.1. Mobilization and Site Preparation

Demolition mobilization and site preparation include the activities necessary for field setup and closure action implementation. This includes obtaining field crew resources, equipment, materials, and performing field job site activities (e.g., site assessments and map development, providing worker support infrastructure, waste management areas, and other site preparation as required). Global positioning system (GPS) coordinates will be taken to ensure that after removal of the 207-A SRB storage cells, the grid for the verification sampling may be laid out (Section 4.6). Other prework tasks may include installing barriers and postings, site walk downs, completion of pre-demolition reviews, and equipment testing.

4.5.1.2. 207-A SRB Storage Cell Walls Demolition

The 207-A SRB storage cell walls will be rubblized. The demolition will occur most likely from north to south, removing concrete debris accordingly with no set pattern or amount removed. The rubblized debris from the walls and engineered fill material (per H-2-90783) from the 207-A SRB will be loaded into ERDF cans (roll-on/roll-off containers) for disposal at ERDF. A typical ERDF can is made of metal and is 20 feet long, 8 feet wide, and 5 feet tall. ERDF cans are typically covered with a tight fitting heavy duty tarp that is secured at multiple points for transport. While no liquid is expected to be in the storage cells prior to demolition, if present the liquid will be removed, characterized, containerized, and shipped for disposal to a permitted dangerous waste management unit.

4.5.1.3. Miscellaneous Piping and Soil

Piping runs that supported operations in the 207-A SRB storage cells will be removed between the 207-A SRB storage cell walls to the south wall of the pump pit. The pump pit is located approximately halfway between the 207-A SRB storage cells and the 207-A NRB storage cells. Piping running between the 207-A SRB storage cells and the pump pit will be removed at the south wall of the pump pit, and the holes left in the pump pit wall by the piping removal will be filled. Piping between the 242-A Evaporator to the pump pit and from the pump pit to the 216-A-37-1 Crib are not part of 207-A SRB and will not be removed as part of these closure activities.

The sides of the 207-A SRB excavation will be properly sloped to prevent cave-ins. The soil around the storage cells will be placed in ERDF containers and sent immediately to ERDF or staged at less than

90-day accumulation areas. If soil is stockpiled prior to loading, the soil will be sprayed with fixatives to eliminate wind blowing the soil. Any contaminated piping will have a fixative applied inside, as needed, prior to removal for disposal.

4.5.1.4. 207-A SRB Storage Cell Floors

The 207-A SRB storage cell floors are made of concrete and will be rubblized. Front-end loaders and excavators will load the rubble and remaining engineered fill material into ERDF cans. Based on drawing H-2-90783, the engineered fill consists of various materials: well graded sand, three inches of 2 inch minus pit run gravel, and organic-free dirt with cobbles no greater than 8 inches in diameter, compacted in up to one foot lifts. Based on the 207-A SRB footprint of 40 m (130 ft) long, 27.7 m (91 ft) wide, and 2.1 m (7 ft) deep, the final excavation footprint will be approximately 42.6 m (140 ft) long, 30.8 m (101 ft) wide, and 3 m (10 ft) deep. As discussed previously, additional soil removal may be performed underneath the 207-A SRB storage cell floors if deemed necessary to meet clean closure standards.

4.5.1.5. Decontamination

Decontamination of the 207-A SRB storage cells prior to demolition and removal is not planned based on previous operational history and concrete sampling results.

4.5.1.6. Completion Criteria

The demolition is considered complete after all waste debris has been removed to a nominal 1 m (3 ft) below the basin 207-A SRB floor, piping between the 207-A SRB storage cells and the pump pit disposed of at ERDF, the bottom of the excavation is sampled, and results documented. If sampling results identify contaminated soils, these soils will be excavated and additional sampling will be completed to confirm contaminated soils have been removed. If the sample results verify the soil meets the cleanup criteria, the 207-A SRB excavation footprint will be backfilled and returned to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity. Backfilling is anticipated to be completed in such a manner as to not unduly hinder future remediation in the immediate vicinity of the 207-A SRB, should remediation be necessary. Backfilling will be completed in such a manner as to mitigate potential construction safety hazards.

4.5.2. Waste Management

A variety of waste streams may be generated under this closure plan and will be in solid form. Some of the waste may be determined to be potentially dangerous or mixed waste. The generator and storage requirements of WAC 173-303-200, "Accumulating Dangerous Waste On-Site," will be followed.

Wastes generated through implementation of this closure plan will be disposed at ERDF or an approved RCRA TSD unit/dangerous waste management unit. ERDF is the preferred waste disposal facility. Waste is expected to meet the ERDF waste acceptance criteria (WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*) as is. Waste volume reduction practices, such as minimizing cross-contamination during the demolition and excavation, or segregation of clean materials from contaminated materials, will be implemented where feasible.

Waste management activities include waste characterization, designation, staging, packaging, handling, marking, labeling, segregation, storage, transportation, treatment, and disposal and are briefly described in the following subsections.

4.5.2.1. Projected Waste Streams

One or all of the following solid waste streams are anticipated to be generated during the closure and may fall into any combination of these categories: nondangerous/nonradioactive, radioactive, mixed, hazardous, dangerous, suspect radioactive, suspect dangerous, and suspect mixed:

- Concrete, liner, and associated debris

- Hypalon® liner
- Soils
- Miscellaneous waste (e.g., rubber, glass, paper, personal protective equipment, cloth, plastic, and metal)
- Equipment and construction materials

4.5.2.1.1. Hazardous/Dangerous Waste, Low-Level Waste, and Mixed Waste Management

These wastes will be packaged, stored, and transported to prevent dispersion and public exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable.

4.5.2.1.2. Solid Waste Management

Solid waste, such as personal protection equipment, step-off pad waste, will be managed per the action memorandum for the nonradiological and radiological contaminants present or suspected to be present (DOE-RL-2015-51). Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening will be used to segregate radioactive waste from nonradioactive waste. Waste is also screened to provide radiological information for shipping and disposal at ERDF. Container(s) will be properly marked and labeled Mixed waste may be staged at a USDOE designated less than 90 day waste container storage area. Miscellaneous solid waste will be dispositioned based on waste characterization information, consistent with disposal options in the action memorandum (DOE-RL-2015-51).

4.5.2.2. Waste Management and Characterization

Dangerous, low-level, and mixed wastes will be packaged, stored, and transported to prevent dispersion and personnel exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable. Miscellaneous solid waste will be managed as appropriate for the nonradiological and radiological contaminants present or suspected to be present. Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening will be used to segregate radioactive waste from nonradioactive waste. Container(s) will be properly marked and labeled. The containers will be segregated, as appropriate, and either shipped directly to ERDF or staged at a USDOE-designated 90-day waste container storage area. Non-bulk solid waste will be dispositioned based on waste characterization information.

Waste generated through implementation of this closure plan will be characterized in accordance with the waste acceptance criteria of the receiving facility. Characterization is performed using a variety of information that includes, but is not limited to, process knowledge, historical analytical data, sampling and analysis data, and radiological and chemical screening.

Waste characterization information for managing the demolition waste as dangerous/mixed waste is based on the historical information on 207-A SRB operations, the Part A, and previous characterization information.

4.5.2.3. Waste Handling, Storage, and Packaging

Marking, labeling, segregating, and staging of waste containers will be performed or directed by the waste specialist. If waste containers cannot be shipped directly to the disposal site, wastes may be stored at Hanford Facility dangerous waste management units that are permitted to operate as container storage areas until disposal. Dangerous/mixed waste may also be accumulated in accordance with the generator requirements of WAC 173-303-200.

4.5.2.3.1. Hazardous/Dangerous Waste, Low-Level Waste, and Mixed Waste Management

These wastes are anticipated to be packaged, stored, and transported in ERDF cans to prevent dispersion and public exposure. Waste specific storage and packaging requirements will comply with WAC 173-303 requirements, as applicable.

4.5.2.3.2. Miscellaneous Waste Management

Miscellaneous waste, such as personal protection equipment, step-off pad waste, will be managed as appropriate for the nonradiological and radiological contaminants present or suspected to be present. Miscellaneous solid waste that has contacted suspect dangerous or suspect mixed waste will be treated as such. Field screening may be used to segregate radioactive waste from nonradioactive waste. Waste is also screened to provide radiological information for shipping and disposal at ERDF. Container(s) will be properly marked and labeled. Mixed waste may be staged at a USDOE designated less than 90 day waste container storage area. Miscellaneous waste will be dispositioned based on waste characterization information.

4.5.2.3.3. Management of Bulk Waste

The preferred management of the 207-A SRB storage cell materials is in bulk form. Bulk waste will be placed in ERDF cans for eventual disposal at ERDF or other approved RCRA dangerous waste management units. ERDF cans will be temporarily staged in an area adjacent to the 207-A SRB or may be stored for up to 90 days in an approved less than 90 day storage area.

Bulk containers will be covered when waste is not being added or removed. Lightweight material (e.g., plastic and paper) will be bagged, if appropriate, prior to placement in ERDF. ERDF cans are closed with a tight cover after filling. ERDF cans will be closed prior to transportation of dangerous or mixed waste generated by closure.

To facilitate the loading of concrete debris and soil into ERDF cans, the concrete debris and soil may be placed on the ground, adjacent to the 207-A SRB excavation footprint, to gather enough material for filling the bulk containers. Once the management of bulk waste has been completed, samples will be taken from the surface soil where the concrete debris and soil were placed. Analytical results from these samples will be directly compared to cleanup levels. If an exceedance of the cleanup levels is identified, additional soil removal will be completed until cleanup levels are met.

Additionally, a fixative will be applied to the demolition site and any loose soil as needed, to help control dust as well as radiological and nonradiological contaminants.

4.5.2.3.4. Management of Waste Containers

Any non-bulk waste generated will be placed in a 55 gallon drum(s). Non-bulk containers or packages of waste requiring tracking (e.g., hazardous/dangerous and mixed) will be assigned a unique tracking number by a waste specialist.

Waste containers are inspected before use to ensure container integrity. The containers will be temporarily stored/staged in a suitable area adjacent to the 207-A SRB or may be staged for up to 90 days at an approved storage area. Containers awaiting analytical results will be marked and labeled, based on process knowledge and historical concrete and soil sampling data. Weekly inspections of the containers will be performed at the less than 90 day storage areas, if needed, to document the integrity, container marking/labeling, physical container placement, staging/accumulation area boundaries/identification/warning signs, and signs of any potential leakage. Non-bulk waste containers showing signs of deterioration will be identified during container inspection and overpacked or repackaged, as necessary.

Waste containers will remain closed, except during packaging and waste inspection activities, once they are staged.

4.5.2.3.5. Waste Profile

Prior to initiating closure activities, waste anticipated to be generated will meet the ERDF acceptance criteria. Though not expected, if waste profiling changes to the waste-tracking form needed to occur, the following activities would be completed:

- Field-screening measurements may be used to obtain data to adjust the waste-tracking form.
- The waste profile may be adjusted to include new waste codes (if necessary) based on new data determined by either in-process field-screening methods oranalytical laboratory analysis. Any designation for a new waste code would require revision and resubmittal of the Part A form to include the new waste code.

4.5.2.3.6. Final Waste Disposal

Dangerous, mixed, and radioactive waste generated through implementation of the closure plan will be dispositioned at ERDF. ERDF is the preferred disposal location for waste meeting ERDF waste acceptance criteria, as it is engineered to meet appropriate RCRA technological requirements for landfills as described in the ERDF record of decision (EPA, 1995, *Record of Decision, U.S. DOE Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*).

4.5.2.3.7. Waste Disposal Records

Original onsite waste tracking forms will be sent to ERDF with each container shipped. Original sample reports and a copy of the original onsite waste tracking form for each ERDF container will be retained and forwarded to the assigned waste specialist for inclusion in the project file following final waste disposition.

4.5.2.4. Waste Treatment

Typical treatment of waste from demolition activities (e.g., grouting, macroencapsulation, solidification, separation, size reduction, and/or repackaging) is not expected to be needed, based on available information. If treatment at the point of generation is deemed necessary to provide safe transport, meet waste disposal facility waste acceptance criteria, and/or address land disposal restriction requirements, such treatment may be conducted in accordance with ERDF requirements (DOE/RL-2015-51, Rev. 0). Residuals from treatment of waste originating from activities addressed in this closure plan can be disposed at ERDF, providing the treatment residuals meet ERDF waste acceptance criteria.

4.5.2.5. Waste Minimization and Recycling

Waste minimization practices will be followed to the extent technically and economically feasible during waste management. Introduction of clean materials into a contamination area, as well as contamination of clean materials, will be minimized to the extent practicable. Emphasis will be placed on source reduction to eliminate or minimize the volume of waste generated. Materials released offsite for disposal/recycle (e.g. residuals from analysis of samples) will conform to the receiving facility's acceptance criteria.

4.5.3. Air Emissions

There is no expectation that substantial emissions of criteria and toxic air pollutants will result from demolition activities. No bulk processing chemicals are known to be present at the 207-A SRB. Relatively small amounts of radiological contaminant fixing agents could be introduced into the 207-A SRB to support closure. These are commercially available products that are used throughout the Hanford Site on a daily basis.

Reasonable precautions will be taken to minimize visible dust emissions from active structural demolition with standard emission control techniques. Active excavations shall use water or crusting agents

(e.g., Soil-Sement®) as approved for dust control. Water usage for dust control will be minimized to protect against potential contaminant migration. Crusting agents or fixatives will be applied to any disturbed portion of the contamination area that will be inactive for more than 24 hours. Material to be disposed at ERDF will also comply with the moisture content and other applicable requirements of the ERDF waste acceptance criteria (WCH-191). Dust fixative is applied to the demolition and excavation site when potential concerns arise about health issues or the spread of contamination.

Airborne emissions associated with these closure activities will be minimized by the use of appropriate work controls. Airborne releases of contaminants during these closure activities will be controlled in accordance with USDOE radiation control and substantive air pollution control standards in order to maintain emissions of air pollutants at the Hanford Site to as low as reasonably achievable levels.

Minimal operations associated with greater than 100°C (212°F) deactivation methods (e.g., welding, laser cutting) will be expected. The applicability of WAC 173-400-110 ("General Regulations for Air Pollution Sources," "New Source Review (NSR) for Sources and Portable Sources") and WAC 173-460 ("Controls for New Sources of Toxic Air Pollutants") was evaluated. The proposed activity does not meet the definitions of establishment of a new source (under WAC 173-400-030, "Definitions", or modification (WAC 173-400-030[44]); therefore, the new source review requirements of WAC 173-400-100 are not applicable. WAC 173-460 is not an applicable chapter because these activities do not meet definitions of new toxic air pollutant source.

4.5.4. Health and Safety Requirements

Closure will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will perform any necessary closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment. Qualified personnel will be trained in applicable safety and environmental procedures and have appropriate training and experience in sampling activities. Field operations will be performed in accordance with applicable health and safety requirements. If an emergency would occur, the on-call Building Emergency Director will be notified, and the requirements associated with DOE/RL-94-02, *Hanford Emergency Management Plan*, will be implemented.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, USDOE orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. The Hanford Facility RCRA Permit, Attachment 5, describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the training matrix shown in Table 1, which provides training requirements for Hanford Facility personnel associated with 207-A SRB.

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Table 1. Training Matrix for the 207-A SRB DWMU

	Training Category[a]			
Permit Attachment 5 Training Category	General Hanford Facility Training	Contingency Plan Training	Emergency Coordinator Training	Operations Training
207-A SRB Closure Unit DWTP Implementing Plan	Orientation Program	Emergency Response (Contingency Plan)	Emergency Coordinator Training	General Waste Management and Closure Support
Job Title/Position				
NCO	X	X		X[a]
Operations Supervisor	X	X	X	X[b]
ECO	X			X[b]
Waste Service Provider	X			X[b]
Sampler	X			X[b]

a. Refer to the LLBG Trenches 31-34-94 DWTP for a complete description of coursework in each training category.

b. Training received is commensurate with the duties performed. Individuals in this category who do not perform these duties are not required to receive this training.

DWMU = dangerous waste management unit
DWTP = dangerous waste training plan
ECO = environmental compliance officer
LLBG = low-level burial ground
NCO = nuclear chemical operator

Project-specific safety training addressed explicitly to the project and the day's activity will include the following:

- Training will provide the knowledge and skills needed for sampling personnel to perform work safely and in accordance with quality assurance (QA) requirements.
- Samplers are required to be qualified in the type of sampling being performed in the field.

Pre-job briefings will be performed to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each employee in an electronic training record database. The Permittees training organization maintains the training records system.

4.5.5. State Environmental Policy Act and Cultural and Ecological Resources

Cultural and ecological resource reviews were performed in support of the closure plan activities to identify any potential impacts. The cultural and ecological resource reviews were conducted in accordance with USDOE requirements. Per memorandum dated June 25, 2015, no potential impacts are anticipated, as long as memorandum recommendations are followed. However, if changes are warranted during field work, an appropriate mitigation action plan will be developed and implemented.

A State Environmental Policy Act (SEPA) (RCW 43.21C, "State Environmental Policy") checklist was prepared. SEPA (RCW 43.21C) requires the environmental effects of a proposal be evaluated before decisions are made by Ecology. The purpose of this checklist is to provide information to help identify impacts for the action, in this case closure of the 207-A SRB, and to reduce or avoid impacts from this action. Ecology reviewed the submission and made a determination of non-significance (DNS).

4.6 SOIL VERIFICATION SAMPLING AND ANALYSIS

Sampling and analysis of the soil will be conducted to confirm that clean closure levels in the soil have been achieved. The SAP summarizes the sampling design used and associated assumptions based on the knowledge of the 207-A SRB. The sampling design includes input parameters used to determine the number and location of samples.

4.6.1. Closure Sampling and Analysis Plan

All sampling and analysis will be performed in accordance with the sampling and quality standards established in this closure SAP. The closure SAP details sampling and analysis procedures in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*; the American Society for Testing and Materials (ASTM) *Annual Book of ASTM Standards*; and applicable U.S. Environmental Protection Agency (EPA) guidance. Sampling and analysis activities will meet applicable requirements of SW-846, ASTM standards, EPA-approved methods, and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). This SAP was also developed using Ecology Publication 94-111, Section 7.0, "Sampling and Analysis for Clean Closure," and EPA/240/R-02/005 (EPA QA/G-5S).

4.6.1.1. Target Analytes

The Part A and effluent records for discharges to the 207-A SRB storage cells were reviewed. This information identified the federal and state waste codes of the liquid effluent discharged to the storage cells. The identified waste codes were the basis for the list of target analytes for analysis in this SAP. Table 2 details the waste codes listed for the storage cells and the target analyte associated with that waste code.

4.6.1.2. Verification Sampling Schedule

Verification closure sampling and analysis will be performed in accordance with the closure plan schedule in Section 8, "Schedule for Closure."

4.6.1.3. Sample Management

The Permittees are responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory.

4.6.2. Sampling Design

The objective of sampling the soil underneath the 207-A SRB storage cells is to obtain analytical data to confirm that the soil does not have contaminants that exceed the MTCA Method B clean closure performance standards.

This SAP used Ecology Publication 94-111, Section 7.0, "Sampling and Analysis for Clean Closure," to determine the type of sampling design that will be used to demonstrate clean closure. When designing the sampling plan, both focused and area-wide (grid) sampling methods were considered. Ecology Publication 94-111, Section 7.2.1, identifies area-wide sampling as appropriate when the spatial distribution of contamination at or from the closure unit is uncertain. Ecology Publication 94-111, Section 7.3, "Sampling to Determine or Confirm Clean Closure," identifies the area-wide sampling approach as generally appropriate for sampling to determine or confirm that clean closure levels are achieved. Focused sampling, as identified in Section 7.2.2 of Ecology Publication 94-111, is selective sampling of areas where contamination is expected or releases have been documented. Based on the records review and visual inspection performed for the storage cells, both the area-wide sampling approach and focused sampling of concrete seams at the wall and floor joints were determined appropriate for verification of clean closure. Sampling for carbon tetrachloride and chloroform will occur if the Hypalon® liner is observed to be degraded at the time of removal. These analyses will not be sampled for in soil if the Hypalon® liner is observed to be in good condition at the time of removal (see Section 4.6.2.7 for documentation requirement related to field observations).

Table 2. Target Analyte List

Target Analyte (Waste Code)	CAS Number*
m-Cresol (F004)	108-39-4
p-Cresol (F004)	106-44-5
o-Cresol (F004)	95-48-7
Acetone (F003) (U002)	67-64-1
Methylene Chloride (F001) (F002)	75-09-2
Carbon tetrachloride **	56-23-5
Chloroform **	67-66-3

*CAS = Chemical Abstracts Service

** If required

Area-Wide (Grid) Sampling. In grid sampling, samples are collected at regularly spaced intervals over space or time. An initial location or time is chosen at random, and the remaining sampling locations are defined so that locations are at regular intervals over an area (grid). Grid sampling is used to search for hot spots and to infer means, percentiles, or other parameters. It is useful for estimating spatial patterns or trends over time. This design provides a practical method for designating sample locations and ensures uniform coverage of a site, unit, or process.

Focused Sampling. Focused sampling involves selective sampling of areas where contamination is expected or releases have been documented. Focused sampling should be conducted in addition to grid sampling where there is evidence of leaks or spins or potential for a dangerous waste constituent to migrate. Focused sampling could involve linear sampling along a drainage way, boundary, or other linear dimension.

The quantity and location of the area-wide samples was determined using the Visual Sample Plan (VSP) software (PNNL, 2001). VSP, a tool used throughout Washington State and nationally, statistically determines the quantity of samples required to accept or reject the null hypothesis based on input parameters specific to the 207-A SRB.

Both parametric and nonparametric equations rely on assumptions about the data population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the distribution of data. Alternatively, if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation were used. For soils underneath the 207-A SRB storage cells, the data assumptions were largely based on information obtained from a grouping of similar

waste sites with the same type of constituents. To determine the parameters for this closure plan, the parameters from the 200-MG-1 waste sites in the SAP document DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, were evaluated, deemed appropriate, and used for the input parameters for soil in this closure plan. The VSP parameter inputs and the basis for those inputs are detailed in Table 2.

The decision rule for demonstrating compliance with the MTCA Method B clean closure level has three parts (referred to as the 3-part test per WAC 173-340-740(7)(e)):

- The upper one sided ninety-five percent confidence limit on the true mean soil concentration shall be less than the MTCA Method B soil cleanup level.
- No sample concentration can be more than twice the cleanup level.
- Less than 10 percent of the samples can exceed the cleanup level.

Using a nonparametric test and the input parameters identified in Table 3, VSP calculated a minimum of 20 samples are required to reject the null hypotheses with 95 percent confidence and ensure that soil would not be mistakenly determined as clean per the clean closure standards. For using the VSP software, the null hypothesis is to compare a site mean to a fixed threshold. Data will be evaluated to ensure that less than 10 percent of the individual values do not exceed the MTCA Method B clean closure performance standards and that no values are more than twice the cleanup level.

Sample locations were determined using the area-wide grid with a random start sampling method run in the VSP software. Statistical analyses of systematically collected data are valid if a random start to the grid is used. The 207-A SRB anticipated sampling area dimensions were entered into VSP to determine the locations of samples. The triangular grid sampling layout was determined to have an even distribution over the entire soil sampling area, providing the most representative data set. The choice of a triangular grid sampling layout required one additional sample location in order to complete the grid over the sample area, resulting in 20 samples. The 20 samples will be taken from the node locations indicated by the VSP results (Appendix A) and will be assigned sample location identifications and sample numbers using the Hanford Environmental Information System (HEIS). The southeast corner of the 207-A SRB excavation is considered the (0,0) point of the sampling location map in Appendix A.

The first node location was chosen at random by the VSP software, and the subsequent 19 sample locations were assigned by the VSP software using a triangular grid sampling layout. Supporting documentation and the sampling grid map automatically generated by the VSP software are provided in Appendix A.

For focused sampling at the concrete expansion joints in the 207-A SRB storage cell floors, professional judgment was used to determine the number of sample locations. VSP did not include the focus sampling locations because they are biased and would skew the randomness of the VSP locations. Three sample locations for each 207-A SRB storage cell floor were determined to be sufficient to support the overall sampling approach. GPS coordinates will be taken to determine the locations of these sample sites in the expansion joints. Once the storage cells are removed, these locations will be sampled in conjunction with the VSP result sample locations. Focused samples will also be collected at locations where there is evidence of potential leaks such as discoloration or staining. Evaluation of the results of focused sampling will be performed by direct comparison to the closure standard without applying any statistical tests. Additional cleanup (e.g. removal of soil) will be performed at the focused sample locations that exceed the cleanup standard.

4.6.2.1. Sampling Methods and Handling

For purposes of this SAP, soil surface is defined as the exposed layer once the 207-A SRB storage cells have been removed. The sample matrix will consist of soil collected in pre-cleaned sample containers taken at a depth of 0 to 15.24 cm (0 to 6 in.) below ground surface. Grab samples will be collected in the soil remaining after removal of the 207-A SRB. The sample matrix could consist of native soil,

engineered fill, or a combination of the two materials. Sampling of the subsurface (sampling up to 4.6 m [15 ft] below surface) was evaluated. However, based on the results of the records review and no identified dangerous waste releases, subsurface sampling is deemed unnecessary beyond the planned sampling of the exposed surface layer after removal of the storage cells and up to 1 m (3 ft) of soil beneath and adjacent to the cells.

Once the soil is sampled, the sampled media will be screened to remove material larger than approximately 2 mm (0.08 in.) in diameter. Removal of material larger than approximately 2 mm (0.08 in.) in diameter will allow for a larger surface area to volume ratio and be more likely to identify any potential contamination in the sample. Grab samples will be collected into containers at the chosen node sample locations. To ensure sample and data usability, sampling will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling.

Table 3. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Primary Objective of the Sampling Design	Compare a site mean or median to a fixed threshold	Reject the null hypothesis.
Type of Sampling Design	Nonparametric	Data are not assumed to be normally distributed.
Working Null Hypothesis	The mean value at the site exceeds the threshold (MTCA Method B closure performance standards).	The null hypothesis assumes that the site is contaminated, requiring the sampling and analysis to demonstrate through statistical analysis that the site is clean.
Area-Wide Grid Sampling Pattern	Triangular	A triangular pattern provided an even distribution of sample locations over the 207-A SRB storage cells.
Standard deviation (S)	0.45	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.45 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point; however, 0.45 has been selected to be more conservative. (Number of samples calculated increases with higher standard deviation values relative to a unit action level.)
Delta (Δ)	0.40	This is the width of the gray region. It is a user-defined value relative to a unit action level. The value of 0.40 is a value that balances unnecessary remediation cost with sampling cost.
Alpha (α)	5%	This is the acceptable error of deciding a dirty site is clean when the true mean is equal to the Action Level. It is a maximum error rate since dirty sites with a true mean above the Action Level will be easier to detect. A value of 5% was chosen as a practical balance between health risks and sampling cost.

Table 3. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Beta (β)	20%	This is the acceptable error of deciding a clean site is dirty when the true mean is at the lower bound of the gray region. A value of 20% was chosen during the data quality objectives process as a practical balance between unnecessary remediation cost and sampling cost.
MARSSIM sampling overage	20%	MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of *n*.

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.
MTCA = "Model Toxics Control Act—Cleanup" (WAC 173-340)

Sample container, preservation, and holding time requirements are specified in Table 4 for soil samples. These requirements are in accordance with the analytical method specified. The final container type and volumes will be identified on the Sampling Authorization Form (SAF) and the chain-of-custody form.

Table 4. Sample Preservation, Container, and Holding Time for Soil Samples.

Target Analyte	Method	Analysis/Analytes	Preservation Requirement	Holding Time	Bottle Type
Acetone Methylene chloride Carbon Tetrachloride* Chloroform*	EPA 8260	Volatile Organic Analytes	Cool ~4°C	14 days	Glass
m-cresol *p*-cresol *o*-cresol	EPA 8270	Semivolatile Organic Compound	Cool ~4°C	14/40 days	Amber Glass
Notes: For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition Final Update IV-B.* ** If required.*					

Level I EPA pre-cleaned sample containers will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits.

The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. A custody seal (e.g., evidence tape) will be affixed to each sample container and/or sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- SAF and form number
- HEIS number
- Sample collection date and time
- Sampler identification
- Analysis required
- Preservation method (if applicable)

Sample records must include the following information:

- Analysis required
- Sample location
- Matrix (e.g., water or soil)

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained.

All waste (including unexpected waste) generated by sampling activities will be managed in accordance with WAC 173-303 and applicable or relevant and appropriate requirements (ARARs) incorporated via the action memorandum, DOE/RL-2015-51.

4.6.2.2. Analytical Methods

All analyses and testing will be performed consistent with this closure plan, laboratory analytical procedures, and HASQARD (DOE/RL-96-68). The approved laboratory must achieve the lowest

practical quantitation limits (PQLs) consistent with the selected analytical method to confirm clean closure levels.

Analytical methods and performance requirements associated with the target analytes are outlined in Table 5.

Table 5. Soil Analytical Performance Requirements

CAS Number	Analyte	Analytical Method	Closure Performance Standard[a] (mg/kg)			Practical Quantitation Limit (mg/kg)	Accuracy Req't (Percent Recovery)[b]	Precision Req't (Relative Percent Difference)[b]
			Carcinogen	Non-carcinogen	Protection of Groundwater			
108-39-4	*m*-cresol	SW-846 Method 8270	N/A	4000	N/A	0.66	±30	±30
95-48-7	*o*-cresol	SW-846 Method 8270	N/A	4000	2.33	0.33	±30	±30
106-44-5	*p*-cresol	SW-846 Method 8270	N/A	8000	N/A	0.33	±30	±30
75-09-2	Methylene Chloride	SW-846 Method 8260	500	480	0.0215[c]	0.005	±30	±30
67-64-1	Acetone	SW-846 Method 8260	N/A	72,000	28.9	0.02	±30	±30
56-23-5	Carbon Tetrachloride*	SW-846 Method 8260	14.3	320	0.0416	0.005	±30	±30
67-66-3	Chloroform*	SW-846 Method 8260	32.3	800	0.0736[c]	0.005	±30	±30

Source: *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*

a. Closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to "Model Toxics Control Act—Cleanup" (MTCA) regulations (WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards;" WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection;" and WAC 173-340-7490, "Terrestrial Ecological Evaluation Procedures," through -7494, "Priority Contaminants of Ecological Concern"). These numeric cleanup levels will be calculated according to MTCA Method B (unrestricted use standards). Where both carcinogen and noncarcinogen performance standards are available, the lowest value will be used.

b. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples is also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

c. More stringent of standard MTCA Method B cleanup value for unrestricted land use between soil protective of groundwater with vadose at 25°C and soil protective of groundwater with vadose at 13°C.

CAS = Chemical Abstracts Service

N/A = not applicable

mg/kg = milligrams per kilogram

* = If required.

4.6.2.3. Quality Control

Quality control (QC) procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC will include the following samples:

- Collection of full trip blank
- Field transfer blank
- Equipment rinsate blank

- Field duplicate samples
- Field split samples

Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table 56.

Data verification, data validation, and data quality assessment will include both the primary samples and quality control samples.

Table 6. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Full Trip Blank	One per 20 samples per media sampled.	Contamination from containers or transportation
Equipment Rinsate Blank	As needed. If only disposable equipment is used, then an equipment blank is not required. Otherwise, one per 20 samples per media[a].	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Field Duplicate Sample	One per batch[h], 20 samples maximum of each media sampled (soil samples[b]).	Precision, including sampling and analytical variability
Field Split Sample	As needed. When needed, the minimum is one per analytical method, per media sampled, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements tables.	Precision, including sampling, analytical, and interlaboratory
Laboratory Quality Control[h]		
Method Blanks	1 per batch[h]	Laboratory contamination
Lab Duplicates	[c]	Laboratory reproducibility and precision
Matrix Spikes	[c]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	[c]	Laboratory reproducibility, accuracy, and precision
Surrogates	[c]	Recovery/yield
Tracers	[c]	Recovery/yield
Laboratory Control Samples	1 per batch[h]	Evaluate laboratory accuracy
Performance Evaluation Parameters[d]	Annual	Evaluate laboratory accuracy

Table 6. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Double-Blind Standards	Quarterly[e]	Evaluate laboratory accuracy
Audit/Assessment	Annually[f] or every 3 years[g]	Evaluate overall laboratory performance and operations

a. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

b. Soil grab samples are exempted from duplicate sampling.

c. As defined in the laboratory contract or quality assurance plan and/or analysis procedures.

d. Nationally recognized program, such as USDOE Mixed Analyte Performance Evaluation Program or Environmental Resource Associates.

e. Soil matrix double-blind standards are submitted by request of Analytical Services.

f. USDOE Quality Systems for Analytical Services requires annual audit of commercial laboratories.

g. DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), does not define a frequency for assessment of onsite laboratories. Three year evaluated supplier list requirement is typically applied.

h. Batching across projects is allowed for similar matrices.

USDOE = U.S. Department of Energy

4.6.2.4. Data Verification

Analytical results will be received from the laboratory, loaded into a database (i.e. HEIS), and verified. Verification includes, but is not limited to, the following items:

- Amount of data requested matches the amount of data received (number of samples for requested methods of analytes).
- Procedures and methods used.
- Documentation/deliverables are complete.
- Hard copy and electronic versions of the data are identical.
- Data seem reasonable, based on analytical methodologies and lab report.

4.6.2.5. Data Validation and Assessment

Data validation is performed by a third party of five percent of the results. The laboratory supplies contract laboratory program equivalent analytical data packages intended to support data validation by the third party. The laboratory submits data packages that are supported by QC test results and raw data.

Controls are in place to preserve the data sent to the validators and allow only additions to be made, not changes to the raw data.

The format and requirements for data validation activities are based upon the most current version of USEPA-540-R-08-01, *National Functional Guidelines for Superfund Organic Methods Data Review* (OSWER 9240.1-48), and USEPA-540-R-10-011, *National Functional Guidelines for Inorganic Superfund Data Review* (OSWER 9240.1-51). Five percent of the results will undergo Level C validation, as defined by the validation guidelines.

4.6.2.6. Verification of VSP Input Parameters

Analytical data from VSP sampling will be entered back into the VSP software as required. If all the analytical data for a particular analyte are nondetect, verification of VSP input parameters is not required for that analyte. The VSP software uses the analytical data to determine if the user input parameters were

estimated appropriately. Once analytical data are entered into the VSP software validation module, VSP will calculate the true standard deviation and determine whether the null hypothesis can be rejected. If the calculated standard deviation is smaller than the estimated user input standard deviation, no additional sampling will be required. If the calculated standard deviation is larger than the estimated standard deviation, additional sampling may be required. Verification of the null hypothesis through VSP will determine if the mean value of the site analytical data supports rejection of the null hypothesis (Section 6.2). These statistical methods are only applicable to grid samples. Documentation of the results of the VSP validation process will be provided as part of the closure report for meeting clean closure requirements.

4.6.2.7. Documents and Records

The Project Manager is responsible for ensuring that the SAP included in this closure plan is being followed by field personnel. Changes to the SAP in this closure plan which would affect the data needs, will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b) by USDOE to Ecology.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes. The logbooks used in these activities are record documents.

The project manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records or references to their storage locations. The following items will be included in the project file, as appropriate:

- Field logbooks or operational records
- Data forms (especially those that are not part of the field logbook)
- GPS data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports
- Documentation of the condition of the Hypalon® liner at the time of removal

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbook
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information
- Training records for employees, as they relate to analytical methods
- Laboratory state accreditation records

- Laboratory audit records

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records required by the TPA (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*) will be managed in accordance with the requirements therein.

4.6.2.8. Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed

Ecology will be notified of all changes requiring deviation from the SAP in the Closure Plan. If changes to the SAP are necessary due to unexpected events during closure that will affect sampling or analysis, the Permittees will notify Ecology to discuss the changes and how they will be addressed. Depending on the nature of the deviation, Ecology will make a decision to document the changes in the field notebooks covering the closure activities and in the closure certification package, or will require a permit modification. If a permit modification is required, a revision to this SAP will be submitted no later than 30 days after the unexpected event as a permit modification as required in WAC 173-303-610(3)(b)(iii) and WAC 173-303-830, "Dangerous Waste Regulations," "Permit Changes."

4.7 CLOSURE PLAN MODIFICATION

If contaminated soil is identified as a result of clean closure verification sampling activities (i.e., samples indicate contamination above clean closure standards), the nature and extent of contamination will be evaluated. The excavation will remain open until analytical results indicate that cleanup levels have been met. The primary option will be additional excavation to remove contaminated soil, as identified by analytical results. However, it may not be possible to remove or decontaminate all dangerous waste and dangerous waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with dangerous waste, and manage all as dangerous waste. In this case, a permit modification request will be submitted to Ecology to modify the closure plan. The permit modification request will address landfill requirements per WAC 173-303-665 and specific landfill requirements for a surface impoundment per WAC 173-303-650(6) should any contaminated soils be left in place.

4.8 SCHEDULE FOR CLOSURE

Table 7 describes the primary and secondary closure activities and the expected duration of activities. 207-A SRB removal, verification sampling, and analysis activities are anticipated to be completed within 180 days after Ecology's approval of the permit modification incorporating this closure plan, or after Ecology issues a Temporary Authorization (TA) to begin closure activities. Ecology can also issue an one-time 180-day extension to the TA should closure activities continue beyond the initial 180-day period, per WAC 173-303-830. During the course of these final closure activities, if an unexpected event should arise, a permit modification request to amend the closure plan will be submitted to Ecology for approval no more than 30 days after the unexpected event, in accordance with WAC 173-303-610(3)(b).

Table 7. Closure Activity Description

Primary Activity	Secondary Activity	Expected Duration
207-A SRB structure demolition and disposal • Demolish concrete structure and liner(s) • Rubblize concrete • Load rubble/debris/soil into ERDF Cans • Transport to ERDF • Dispose of into ERDF	Verify sampling and analysis of soil for clean closure levels • Prepare sample grid • Take samples • Analyze samples • Validate data • Analyze data	180 days
Same as above	Same as above	Up to an additional 180 days
Closure Activities Complete		
Prepare closure documentation and obtain Independent Qualified Registered Professional Engineer certification	Transmit closure certification to Ecology	60 days
ERDF = Environmental Restoration Disposal Facility		

4.9 CERTIFICATION OF CLOSURE

In accordance with WAC 173-303-610(6), USDOE will submit a certification of closure to Ecology. Both USDOE and the co-operator identified on the Part A will sign the certification of closure, and an Independent Qualified Registered Professional Engineer (IQRPE) will certify that the unit has been closed in accordance with the approved closure plan.

An IQRPE will be retained to provide certification of the closure, as required by WAC 173-303-610(6). The engineer will be responsible for observing field activities and reviewing documents associated with closure of 207-A SRB. At a minimum, field activities and documents reviewed would include the following:

- Review of the 207-A SRB storage cells visual inspection.
- Review of sampling procedures and results.
- Observe and/or review of sampling activities.
- Observe and/or review contaminated environmental debris removal (as applicable).
- Verify that locations of samples are as specified in the SAP.

The engineer will record his or her observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to develop the clean closure certification, which will then be provided to Ecology. Documentation supporting certification by the IQRPE will be placed in the Administrative Record.

Documentation supporting closure certification will be placed in the Administrative Record and will be provided to Ecology. At a minimum, the following documentation and information supporting closure certification will be included:

1. Field notes and photographs related to closure activities.
2. Description of minor deviations from approved closure plan and their justifications.

3. Documentation of removal and final disposition of all dangerous wastes and waste residues, including contaminated media, debris, and any treated residuals.
4. Documentation that decontamination procedures were followed and decontamination standards achieved.
5. All laboratory and/or field data, including sampling procedures and locations, QA/QC samples, chain-of-custody procedures, and required sample measurements.
6. Documentation that sample result data were input into the VSP validation module and report the results of the validation process.
7. Final summary report from the IQRPE, itemizing all data reviewed and including analytical results used to determine a final closure status.

4.10 POST-CLOSURE PLAN

The closure strategy is clean closure. If the 207-A SRB cannot be clean closed, a contingent plan, a post-closure plan and groundwater monitoring plan must be submitted to Ecology within 90 days of the determination that the unit cannot be clean closed.

4.11 AMENDMENT OF CLOSURE PLAN

As required by WAC 173-303-610(3)(b)(iii), the closure plan will be amended if changes to closure activities require modification of the approved closure plan. The revised closure plan will be submitted to Ecology within 30 days of the determination that the unit cannot be clean closed.

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APPENDIX A

SYSTEMATIC SAMPLING LOCATIONS FOR COMPARING A MEDIAN WITH A FIXED THRESHOLD (NONPARAMETRIC - MARSSIM)

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APPENDIX A
SYSTEMATIC SAMPLING LOCATIONS FOR COMPARING A MEDIAN WITH A FIXED THRESHOLD (NONPARAMETRIC - MARSSIM)

TABLE OF CONTENTS

A1 Summary 7
A1.1 Primary Sampling Objective 7
A1.2 Selected Sampling Approach 9
A1.3 Number Of Total Samples: Calculation Equation And Inputs 9
A1.4 Statistical Assumptions 10
A1.5 Sensitivity Analysis 11
A1.6 Recommended Data Analysis Activities 11
A2 References 12

FIGURES

Figure A-1. Sampling Grid 8
Figure A-2. MARSSIM Sign Test 11

TABLES

Table A-1. Summary of Sampling Design 7
Table A-2. X and Y Coordinates 8
Table A-3. Input Values 10
Table A-4. Sensitivity Analysis 12

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Terms

LBGR	lower bound of gray region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
VSP	Visual Sample Plan

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A1 SUMMARY

This report summarizes the sampling design used and associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil or groundwater) and how to analyze the samples (e.g., in situ or fixed laboratory) are addressed in other sections of the sampling plan.

Table A-1 summarizes the sampling design developed. Figure A-1 shows sampling locations in the field, and Table A-2 lists sampling location coordinates.

Table A-1. Summary of Sampling Design

Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Systematic with a random start location
Working (Null) Hypothesis	The median (mean) value at the site exceeds the threshold
Formula for Calculating Number of Sampling Locations	Sign test (MARSSIM version)
Calculated Total Number of Samples	20
Number of Samples on Map[a]	20
Number of Selected Sample Areas[b]	1
Specified Sampling Area[c]	1,313.6 m^2 (14,140.00 ft^2)
Size of Grid/Area of Grid Cell[d]	28.5722 m/707 m^2 (93.7 ft/7,610 ft^2)
Grid Pattern	Triangular

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

a. This number may differ from the calculated number because of grid edge effects, adding judgment samples, or selecting or unselecting sample areas.

b. The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.

c. The sampling area is the total surface area of the selected colored sample areas on the map of the site.

d. Size of grid/area of grid cell gives the linear and square dimensions of the grid used to systematically place samples.

e. Including measurement analyses and fixed overhead costs.

A1.1 Primary Sampling Objective

The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or null hypothesis) is that the median (mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median (mean) value is less than the threshold. Visual Sample Plan (VSP) calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

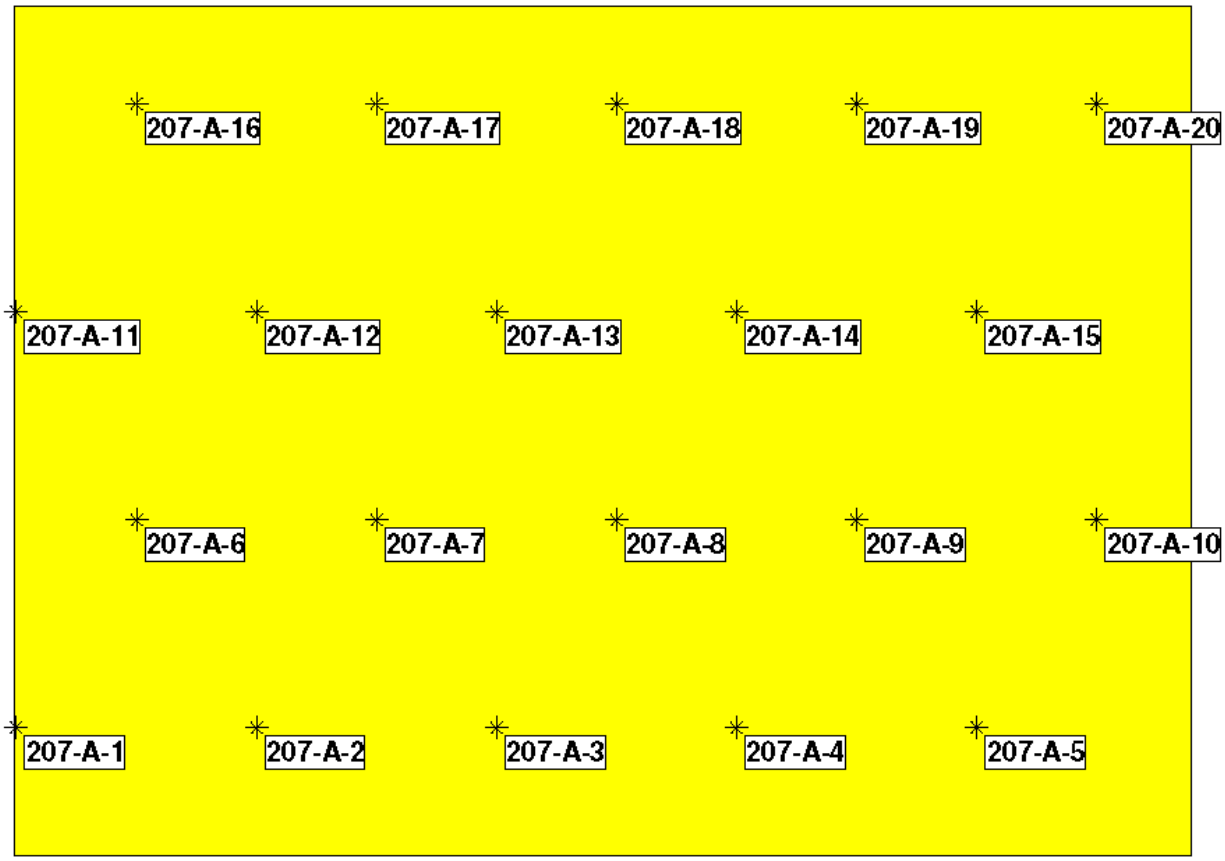


Figure A-1. Sampling Grid

Table A-2. X and Y Coordinates			
Area: 207-A South Retention Basin			
X Coordinate	**Y Coordinate**	**Label**	**Type**
0.2535	15.1433	207-A-1	Systematic
28.8257	15.1433	207-A-2	Systematic
57.3980	15.1433	207-A-3	Systematic
85.9702	15.1433	207-A-4	Systematic
114.5425	15.1433	207-A-5	Systematic
14.5396	39.8876	207-A-6	Systematic
43.1119	39.8876	207-A-7	Systematic
71.6841	39.8876	207-A-8	Systematic
100.2564	39.8876	207-A-9	Systematic
128.8286	39.8876	207-A-10	Systematic
0.2535	64.6318	207-A-11	Systematic
28.8257	64.6318	207-A-12	Systematic
57.3980	64.6318	207-A-13	Systematic
85.9702	64.6318	207-A-14	Systematic

Table A-2. X and Y Coordinates			
Area: 207-A South Retention Basin			
X Coordinate	Y Coordinate	Label	Type
114.5425	64.6318	207-A-15	Systematic
14.5396	89.3761	207-A-16	Systematic
43.1119	89.3761	207-A-17	Systematic
71.6841	89.3761	207-A-18	Systematic
100.2564	89.3761	207-A-19	Systematic
128.8286	89.3761	207-A-20	Systematic

A1.2 Selected Sampling Approach

A nonparametric systematic sampling approach with a random start was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and nonparametric equations rely on assumptions about the population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation were used.

Locating the sample points over a systematic grid with a random start ensures spatial coverage of the site. Statistical analyses of systematically collected data are valid if a random start to the grid is used. One disadvantage of systematically collected samples is that spatial variability or patterns may not be discovered if the grid spacing is large relative to the spatial patterns.

A1.3 Number Of Total Samples: Calculation Equation And Inputs

The equation used to calculate the number of samples is based on a sign test (PNNL-13450, *Visual Sample Plan (VSP) Models and Code Verification*). For this site, the null hypothesis is rejected in favor of the alternative one if the median (mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The following formula is used to calculate the number of samples:

$$n = \frac{(Z_{1-a} + Z_{1-\beta})}{4(SignP - 0.5)^2}$$

where:

$$SignP = \Phi(\frac{\Delta}{S_{total}})$$

Φ (z) = is the cumulative standard normal distribution on (-•,z) (see PNNL-13450 for details)

n = is the number of samples

S_{total} = is the estimated standard deviation of the measured values including analytical error

Δ = is the width of the gray region

α = is the acceptable probability of incorrectly concluding the site median (mean) is less than the threshold

β = is the acceptable probability of incorrectly concluding the site median (mean) exceeds the threshold

$Z_{1-\beta}$ = is the value of the standard normal distribution such that the proportion of the distribution less than Z_{1-a} is 1- α

$Z_{1-\beta}$ = is the value of the standard normal distribution such that the proportion of the distribution less than Z_{1-b} is 1- β

Note: MARSSIM suggests that the number of samples should be increased by at least 20 percent to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user supplied percent overage as discussed in EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, p. 5-33).

The input values that result in the calculated number of sampling locations are provided in Table A-3.

Table A-3. Input Values

Analyte	N[a]	Parameter					
		S	Δ	α	β	$Z_{1-\alpha}$ [b]	$Z_{1-\beta}$ [c]
Analyte 1	20	0.45	0.4	0.05	0.2	1.64485	0.841621

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

a. The final number of samples has been increased by the MARSSIM average of 20%.

b. This value is automatically calculated by VSP based upon the user defined value of a.

c. This value is automatically calculated by VSP based upon the user defined value of b.

VSP = Visual Sample Plan

Figure A-2 is a performance goal diagram, described in EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (QA/G-4). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median (mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

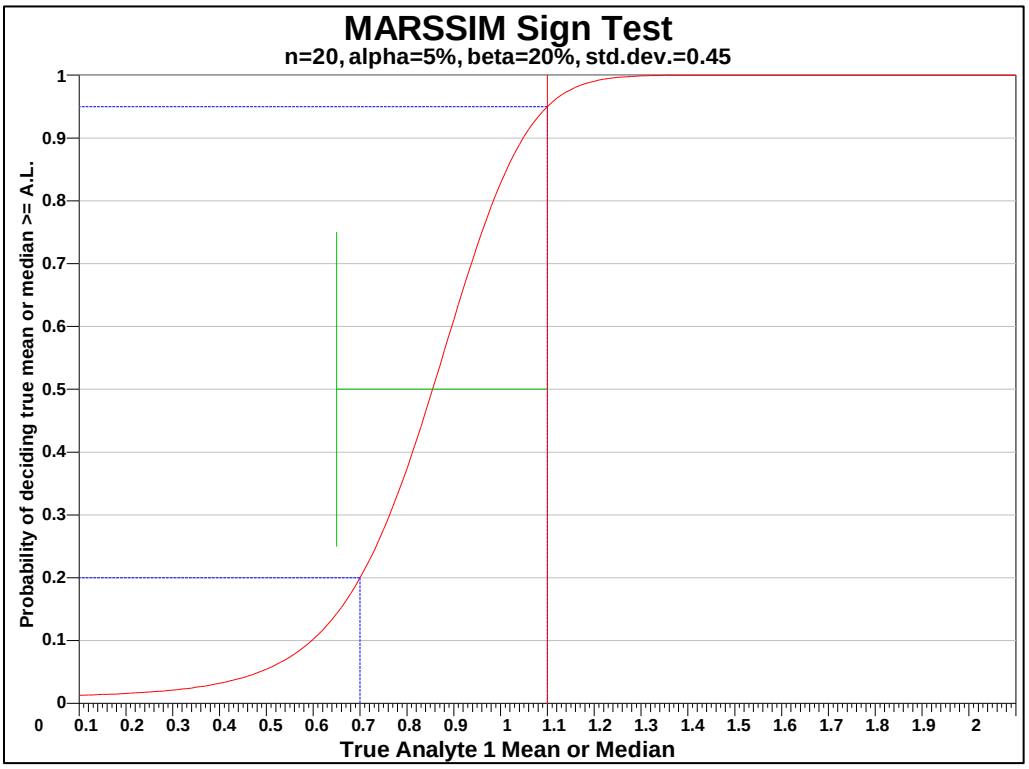
The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray shaded area is equal to D; the upper horizontal dashed blue line is positioned at 1-a on the vertical axis; the lower horizontal dashed blue line is positioned at b on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of D at b and the upper bound of D at 1-a. If any of the inputs change, the number of samples that result in the correct curve changes.

A1.4 Statistical Assumptions

The following assumptions are associated with the formulas for computing the number of samples:

- Computed sign test statistic is normally distributed.
- Variance estimate (S^2) is reasonable and representative of the population being sampled.
- Population values are not spatially or temporally correlated.
- Sampling locations will be selected probabilistically.

The first three assumptions will be assessed in a post-data collection analysis. The last assumption is valid because the gridded sample locations were selected based on a random start.



Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

Figure A-2. MARSSIM Sign Test

A1.5 Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, lower bound of gray region (percent of action level), beta (percent), probability of mistakenly concluding that m > action level and alpha (percent), probability of mistakenly concluding that m < action level. Table A-4 shows the results of this analysis.

A1.6 Recommended Data Analysis Activities

Post data collection activities generally follow those outlined in EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Table A-4. Sensitivity Analysis

Action Level (Threshold)=1		Number of Samples					
		a=5		a=10		a=15	
		S=0.9	S=0.45	S=0.9	S=0.45	S=0.9	S=0.45
LBGR=90	b=15	1,103	280	825	209	659	167
	b=20	948	240	692	176	542	138
	b=25	826	209	587	149	449	114
LBGR=80	b=15	280	75	209	56	167	45
	b=20	240	64	176	47	138	36
	b=25	209	56	149	40	114	30
LBGR=70	b=15	128	36	95	27	77	22
	b=20	110	32	81	23	63	18
	b=25	95	27	69	20	52	15

a = alpha (%), probability of mistakenly concluding that m <action level
b = beta (%), probability of mistakenly concluding that m >action level
LBGR = lower bound of gray region (% of action level)
S = standard deviation

Because the primary objective of sampling for this site is to compare the site median (mean) value with a threshold value, data will be assessed in this context. Assuming that the data are adequate, at least one statistical test will be performed to compare the data and threshold of interest. Results of exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them[1].

A2 REFERENCES

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Visual Sample Plan, Version 7.3, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://vsp.pnnl.gov/.

[1] This report was automatically produced by Visual Sample Plan (VSP) software version 7.2. This design was last modified 4/22/2015 9:36:49 AM. The report contents may have been modified or reformatted by end user of software.

WASTE ENCAPSULATION AND STORAGE FACILITY (WESF) HOT CELLS A THROUGH F

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to WESF **July 1, 2016**

Addendum	Last Modification Date	Modification Number
Unit-Specific Conditions	07/01/2016	8C.2016.5F
A: Part A Form	07/01/2016	8C.2016.5F
B: Reserved		
C: Reserved		
D: Reserved		
E: Reserved		
F: Reserved		
G: Reserved		
H: Closure Plan	07/01/2016	8C.2016.5F

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WASTE ENCAPSULATION AND STORAGE FACILITY HOT CELLS A THROUGH F PART V, CLOSURE UNIT GROUP 6 CONDITIONS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
07/01/2016	8C.2016.5F

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PART V, CLOSURE UNIT GROUP 6 CONDITIONS
WASTE ENCAPSULATION AND STORAGE FACILITY HOT CELLS A THROUGH F

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PART V, CLOSURE UNIT GROUP 6 CONDITIONS
WASTE ENCAPSULATION AND STORAGE FACILITY HOT CELLS A THROUGH F

UNIT DESCRIPTION

The Waste Encapsulation and Storage Facility (WESF) Hot Cell A through F is an inactive Dangerous Waste Management Unit. During operations, these hot cells protected workers and allowed them to safely handle radioactive materials. Large amounts of legacy contamination throughout Hot Cells A through F and the ventilation system require stabilization of the contamination, as well as upgrades to the ventilation system.

Hot Cells A through F Dangerous Waste Management Unit is proposed to be clean closed by removal. Once the stabilized hot cells have been removed, the remaining underlying soil will be sampled and must meet clean closure levels, as detailed in Addenda H, Closure Plan.

LIST OF ADDENDA SPECIFIC TO CLOSURE UNIT GROUP 6

Addenda A	Part A
Addenda H	Closure Plan

DEFINITIONS

Reserved

ACRONYMS

WESF	Waste Encapsulation and Storage Facility

V.6.A COMPLIANCE WITH PERMIT CONDITIONS

The Permittees shall comply with all requirements set forth in the Hanford Facility Resource Conservation and Recovery Act Permit (Permit) as specified in Permit Attachment 9, Permit Applicability Matrix, including all approved modifications. All addenda, subsections, figures, tables, and appendices included in the following unit-group Permit Conditions are enforceable in their entirety.

In the event that the Part V, Unit-Group Conditions for Closure Unit 6, WESF Hot Cells A through F conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-group conditions will prevail for Closure Unit 6, WESF Hot Cell A through F.

V.6.B CLOSURE

V.6.B.1 The Permittees will comply with all requirements set forth in the Addendum H, Closure Plan for the WESF Hot Cells A through F, and close the WESF Hot Cells A through F in accordance with the Addendum H, Closure Plan. [WAC 173-303-610(3)(a)]

V.6.B.2 Upon receipt of the final laboratory analytical report, the Permitttees will use the data analysis function to generate the Data Analysis Report from Visual Sample Plan, in order to demonstrate whether sampling assumptions in the Addendum H, Closure Plan, *Section H-A5.13, Sampling and Analysis Plan and Constituents to be Analyzed*, were met. The Permittees will provide the Data Analysis Report to Ecology within 30 days from receipt of the final laboratory analytical report. If sampling assumptions were not met, the Permittees must submit a permit modification request, in accordance with Permit Condition I.C.3, to amend the Closure Plan to include a revised sampling design. The permit modification request must be submitted within 60 days of submittal of the Visual Sample Plan Data Analysis Report to Ecology.

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WASTE ENCAPSULATION AND STORAGE FACILITY PART A ATTACHMENT A
SECTION XVII – PHOTOGRAPHS

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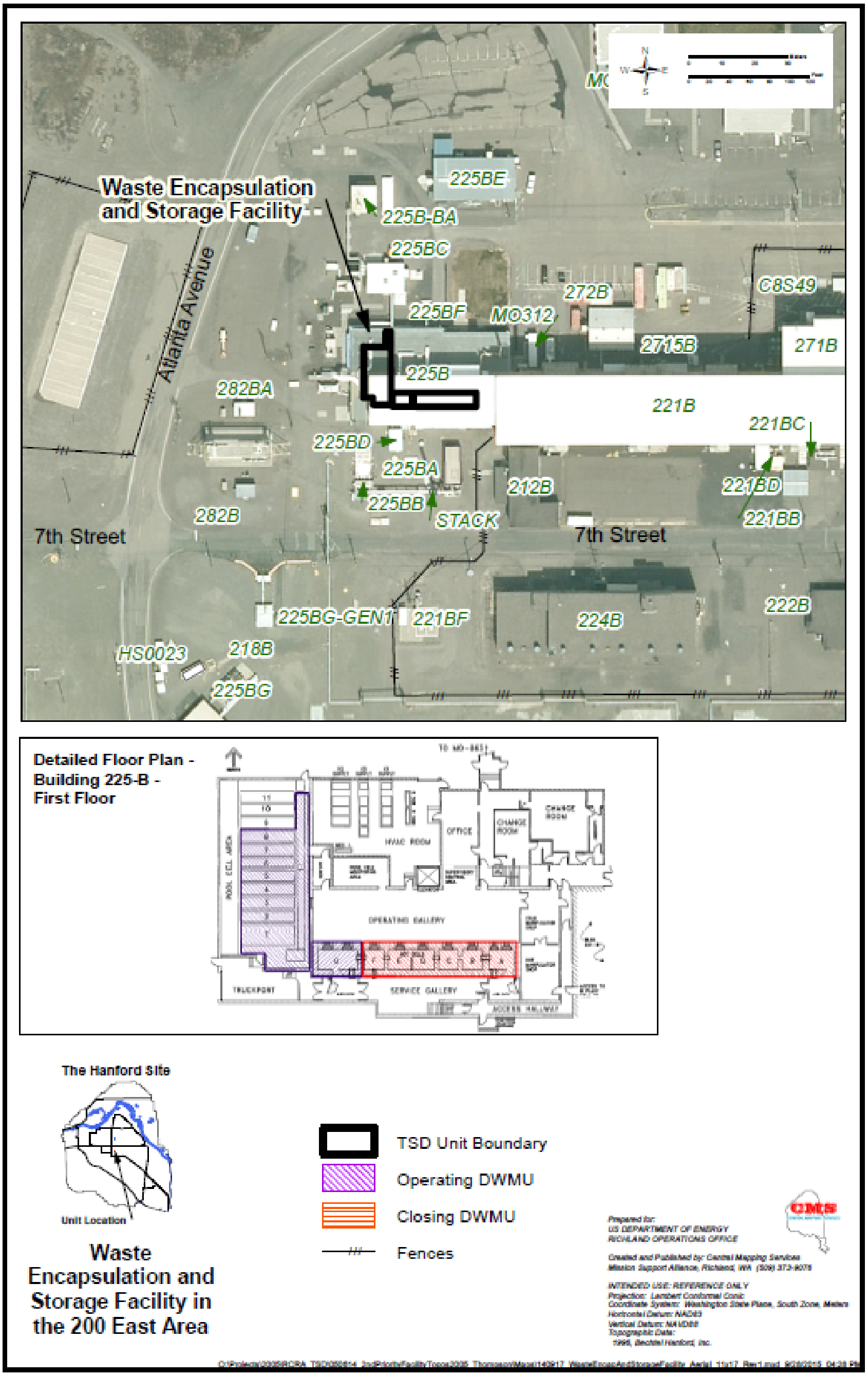
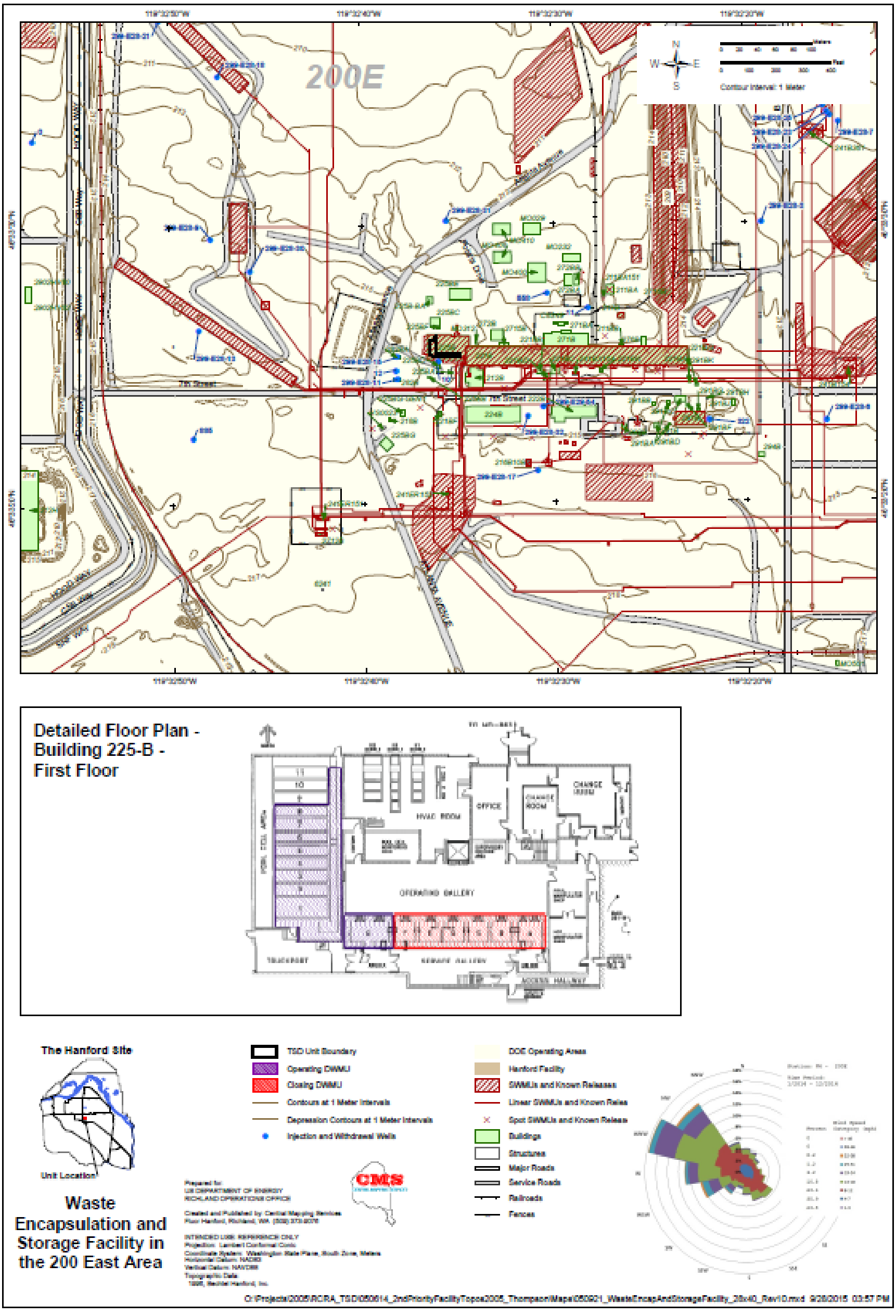


Note: Figure date is October 2015.

Figure A-1. WESF Aerial Photo Operating and Closing Units



Note: Figure date is October 2015.

Figure A-2. WESF Topographic Map Operating and Closing Units

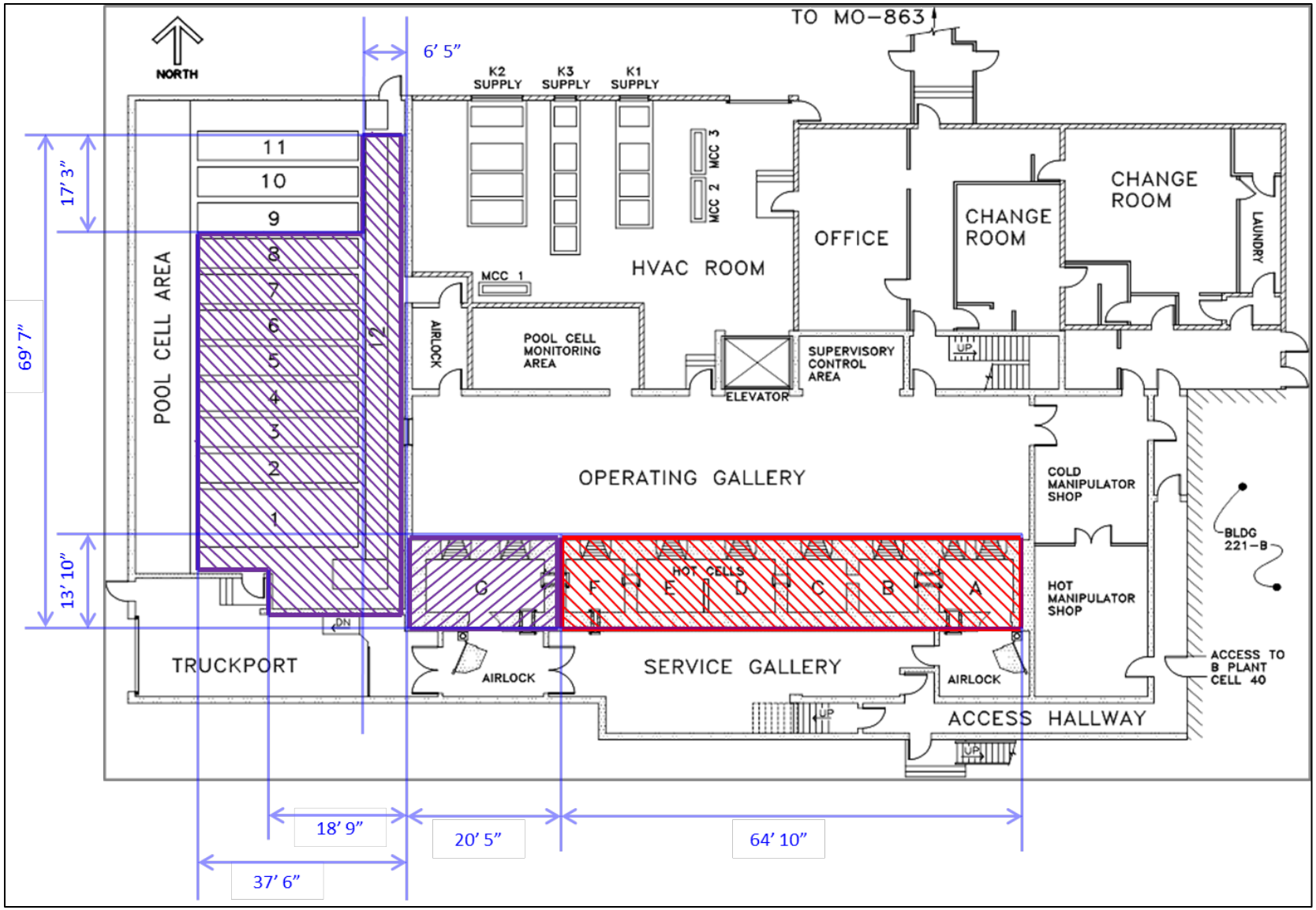


Figure A-3. Map of WESF Pool and Process Cells

Note: Photo was taken in 1997.

Figure A-4. 225-B Building

Note: These photos are undated and reflect the current appearance.

Figure A-5. F Cell

Note: Typical, undated photograph reflects the current appearance.

Figure A-6. C Cell and D Cell

Note: Length example; undated photo reflects the current appearance.

Figure A-7. 221 Hot Cells

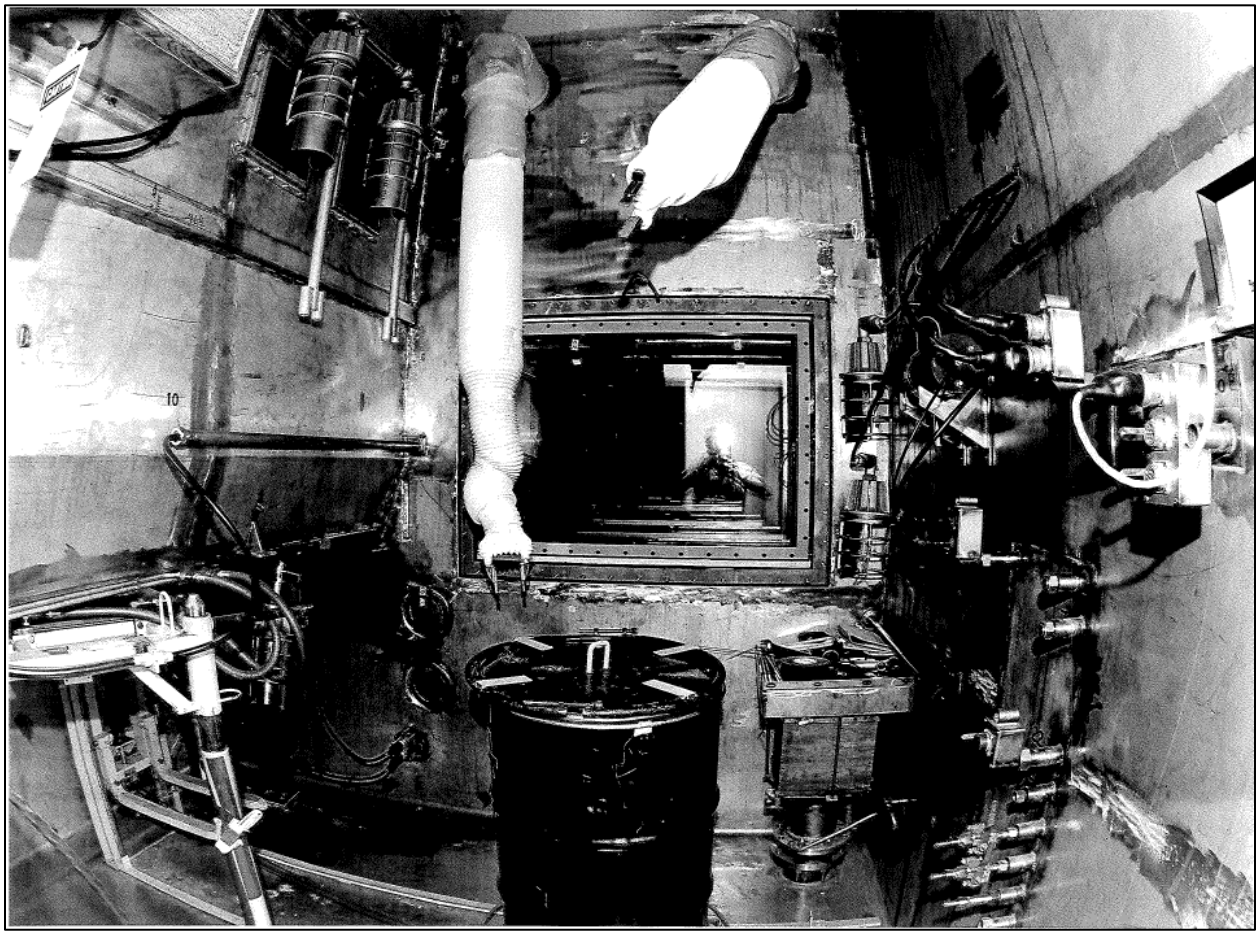
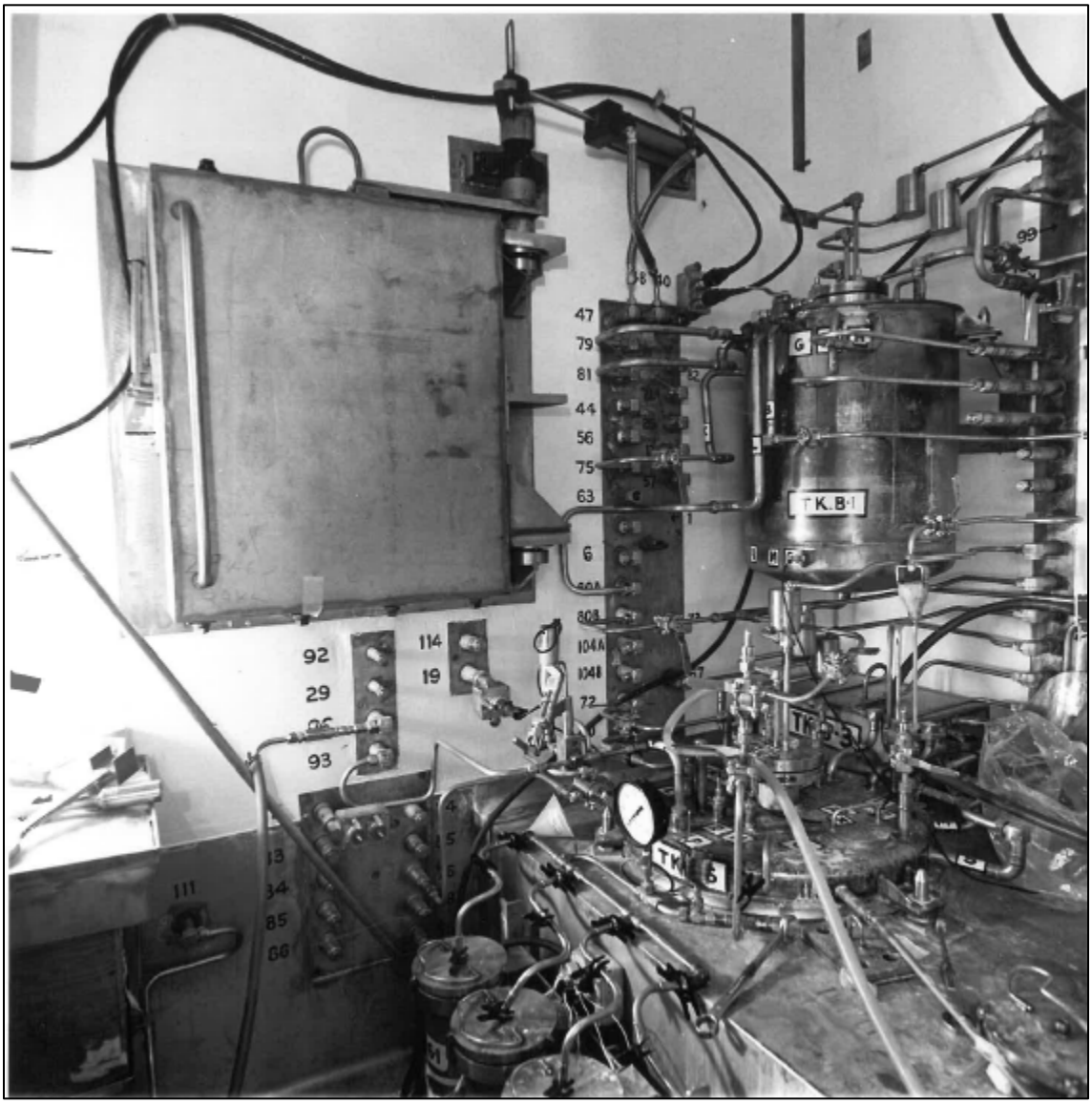
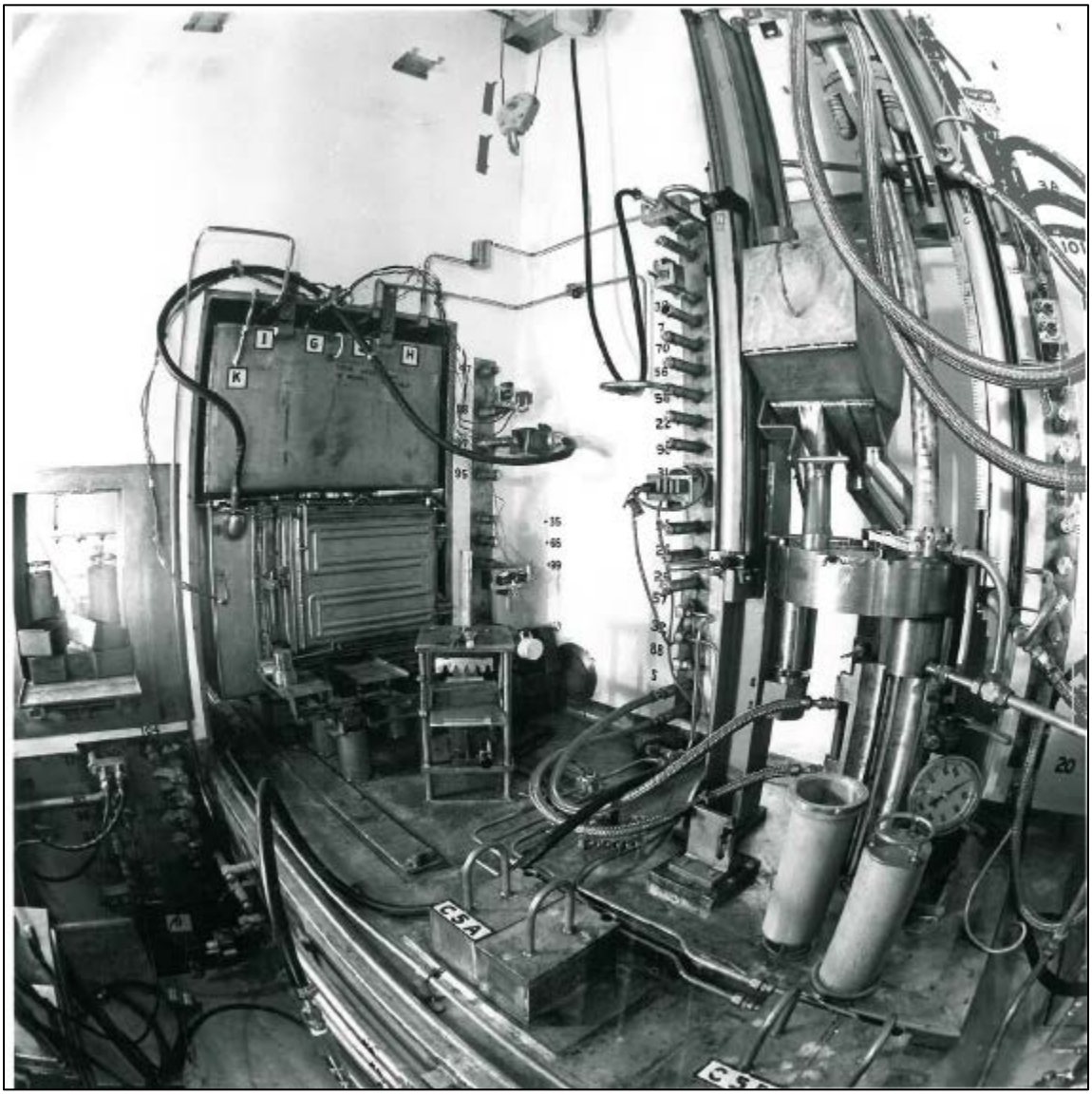


Figure A-8. Hot Cell A Looking North (2006)



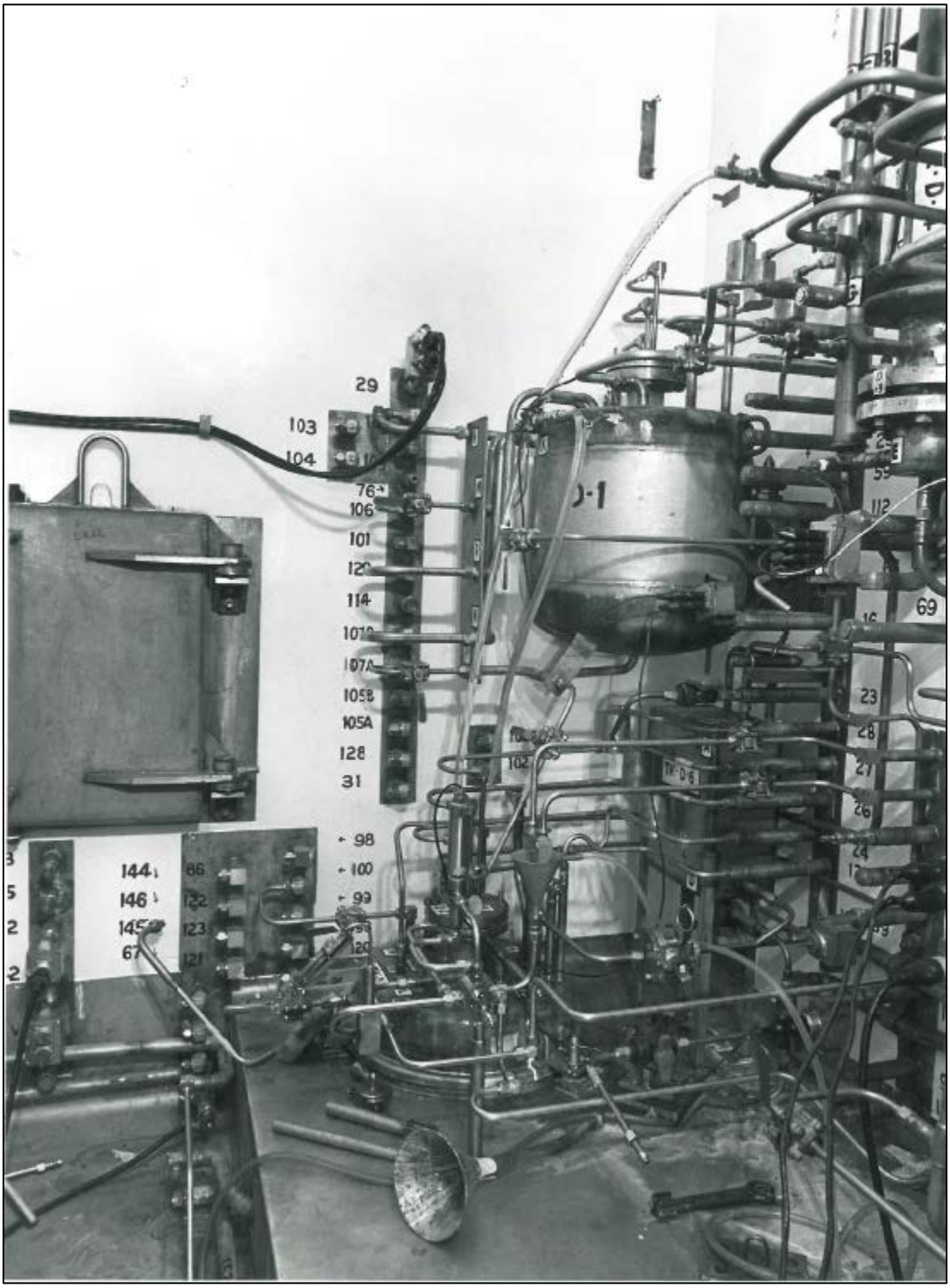
Note: Estimated date of photo is 1973 or 1974.

Figure A-9. Hot Cell B Looking Southeast



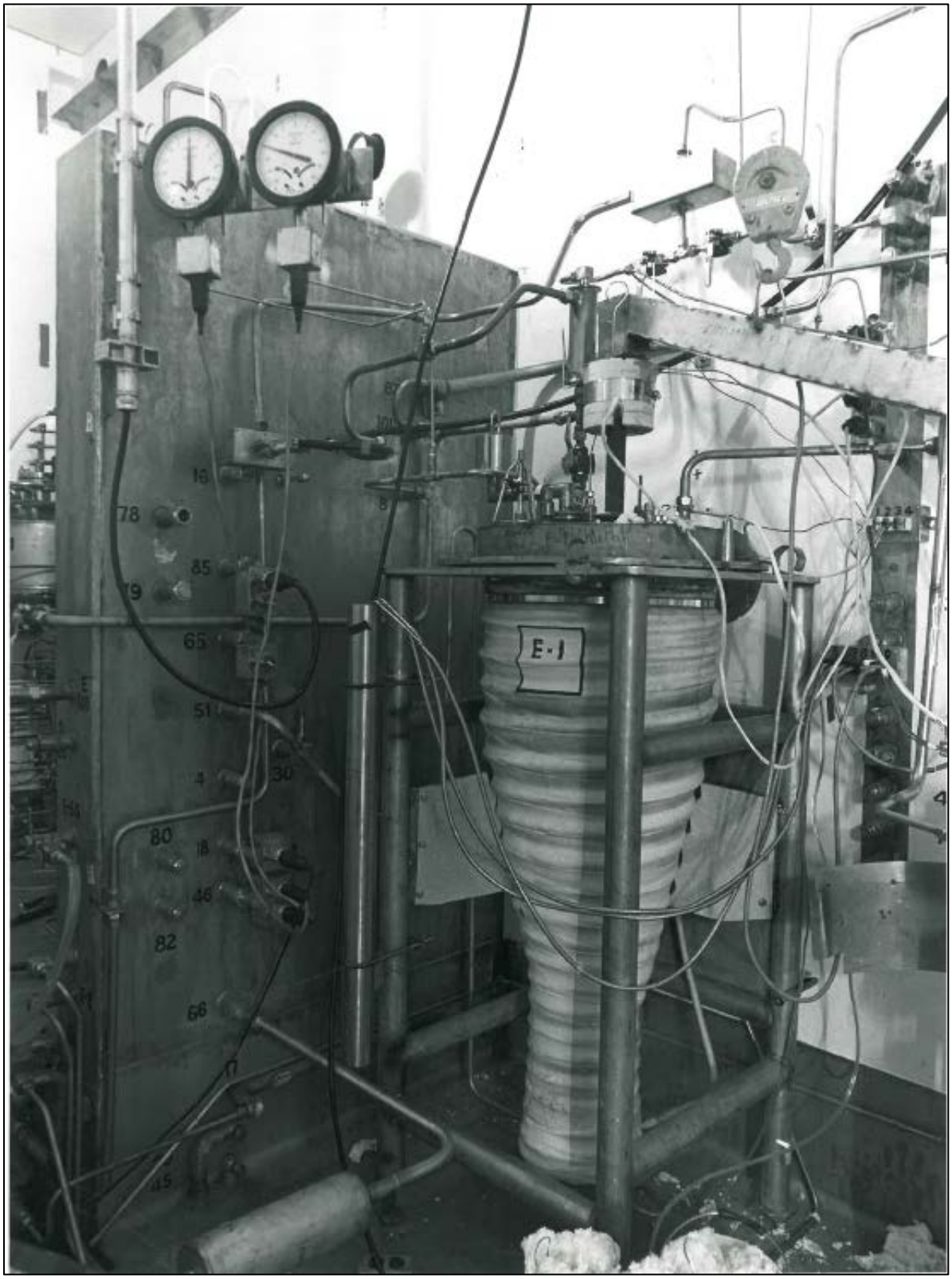
Note: Estimated date of photo is 1973 or 1974.

Figure A-10. Hot Cell C Facing East



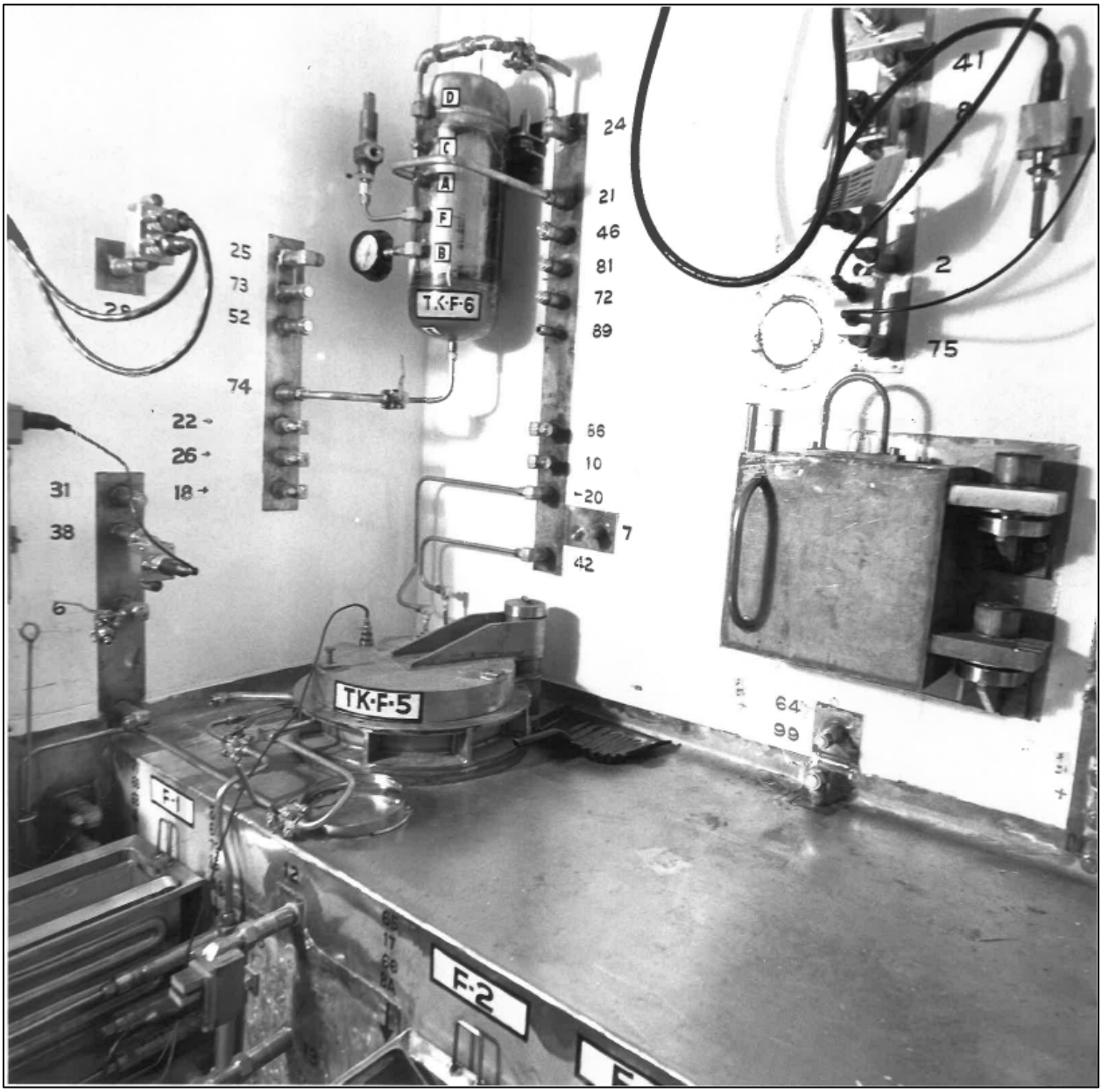
Note: Estimated date of photo is 1973 or 1974.

Figure A-11. Hot Cell D Looking Southeast



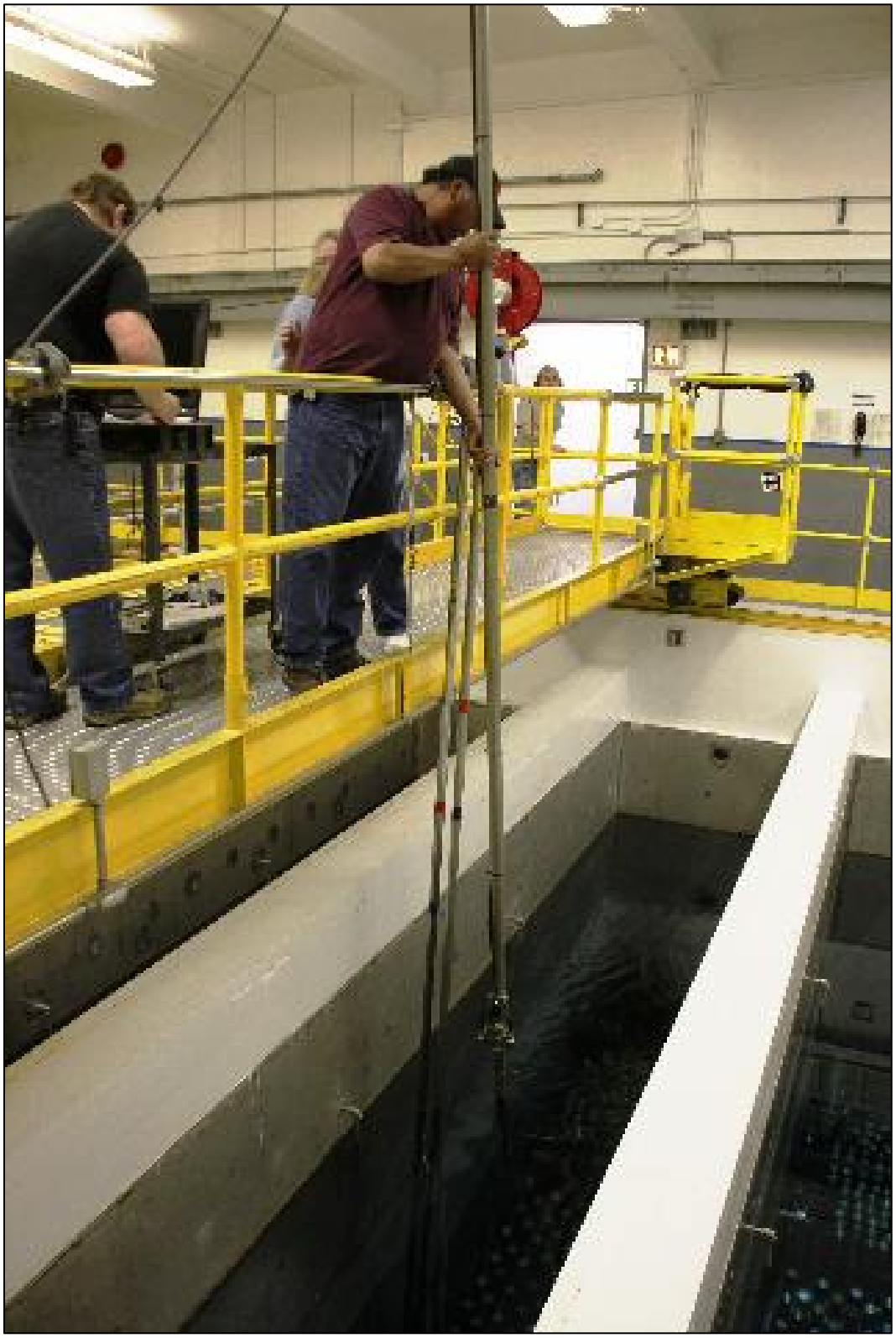
Note: Estimated date of photo is 1973 or 1974.

Figure A-12. Hot Cell E Looking Southeast into Hot Cell D



Note: Estimated date of photo is 1973 or 1974.

Figure A-13. Hot Cell F Facing Southeast

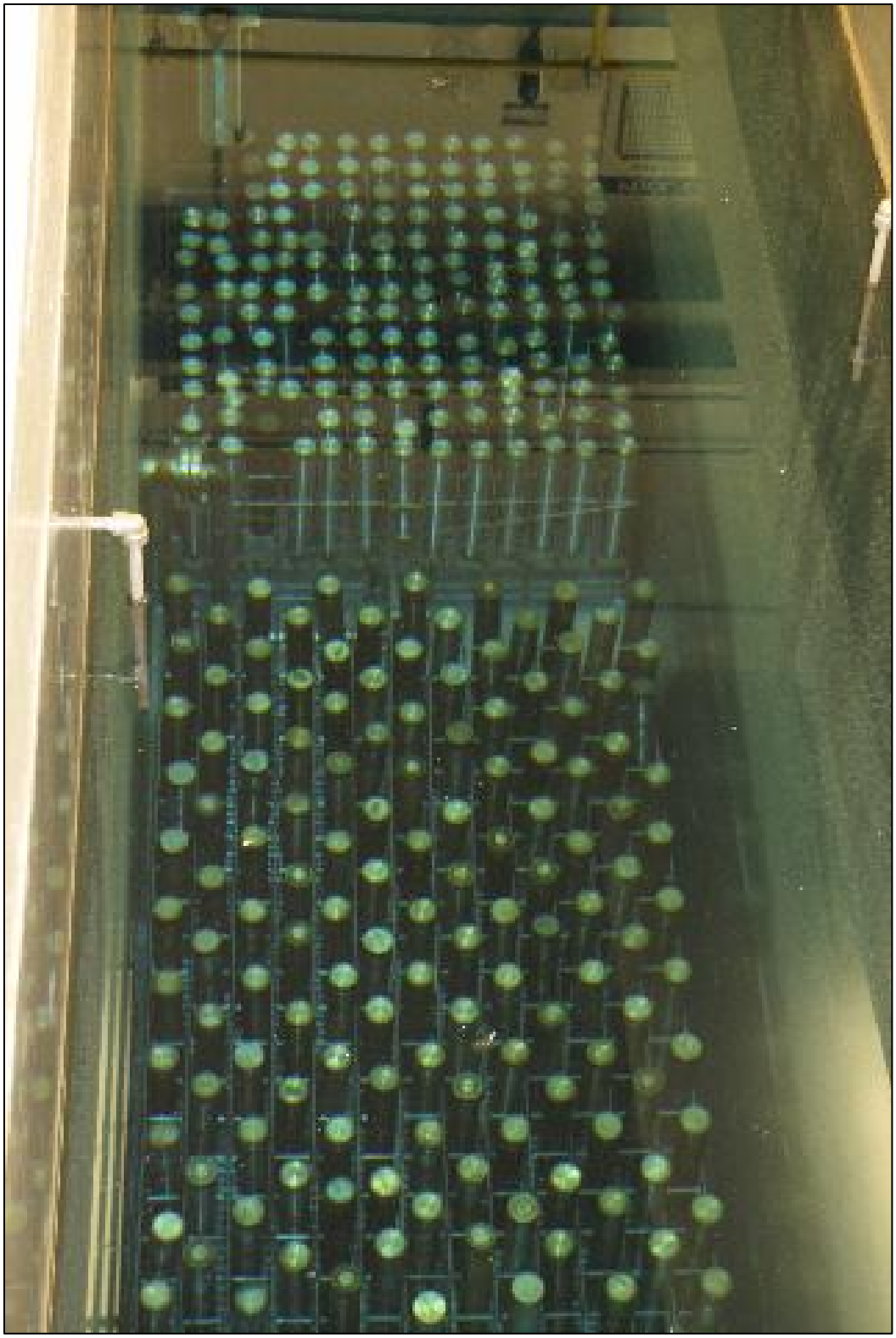


Note: Moving capsules in June 2012.

Figure A-14. Pool Cells

Note: Top view is from June 2012.

Figure A-15. Pool Cells



Note: Top view is from June 2012.

Figure A-16. Pool Cells

WASTE ENCAPSULATION AND STORAGE FACILITY (WESF)
HOT CELLS A THROUGH F
ADDENDUM H
DANGEROUS WASTE MANAGEMENT UNIT CLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
07/01/2016	8C.2016.5F

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ADDENDUM H
WASTE ENCAPSULATION AND STORAGE FACILITY HOT CELL A THROUGH F
DANGEROUS WASTE MANAGEMENT UNIT CLOSURE PLAN

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ADDENDUM H
WASTE ENCAPSULATION AND STORAGE FACILITY HOT CELL A THROUGH F DANGEROUS WASTE MANAGEMENT UNIT CLOSURE PLAN

TABLE OF CONTENTS

H1 Introduction 9
H2 Facility Contact Information 9
H3 Facility Description 9
H3.1 Facility History, Function, Location, and Layout 10
H3.2 Products and Production Processes 11
H3.3 Dangerous Waste Management and Units 11
H3.4 Unit Description 11
H3.4.1 Hot Cell A 15
H3.4.2 Hot Cell B 16
H3.4.3 Hot Cell C 18
H3.4.4 Hot Cell D and Hot Cell E 20
H3.4.5 Hot Cell F 22
H3.4.6 Hot Cell Viewing Windows 28
H3.4.7 Hot Cell Manipulators 28
H3.4.8 Hot Pipe Trench and K3 Duct Trench 28
H3.4.9 Tank-100 29
H3.4.10 WESF Ventilation System 29
H3.4.11 K3 Exhaust System 30
H3.4.12 Maximum Waste Inventory 32
H4 Closure Performance Standard 32
H4.1 Clean Closure Levels 32
H5 Closure Activities 38
H5.1 Health and Safety Requirements 39
H5.2 Records Review and Visual Inspections 41
H5.3 Site Preparation 42
H5.4 Unit Modification Prior to Stabilization 42
H5.5 Stabilization 42
H5.5.1 Grout Design 42
H5.5.2 Grout Delivery 43

H5.5.3 Grout Placement 44
H5.5.4 K3 Filter Pit and Filter Housings 45
H5.5.5 K3 Duct and Trench 45
H5.5.6 Hot Pipe Trench 46
H5.5.7 Hot Cell A Air Lock 46
H5.5.8 Hot Cells 46
H5.5.9 Hot Cell Viewing Window Protection 48
H5.5.10 Control of Contamination during Grouting 49
H5.6 Demolition of the Hot Cell A through Hot Cell F DWMU 49
H5.6.1 Location of Utilities 49
H5.6.2 Equipment Mobilization 49
H5.6.3 Demolition and Removal of Hot Cell A through Hot Cell F 49
H5.7 Removal of Wastes and Waste Residues 51
H5.8 Removal of Unit, Parts, Equipment, Piping, Containment Structure, and Other Ancillary Equipment 55
H5.9 Identifying and Managing Waste Generated During Closure 55
H5.9.1 Excess Grout 55
H5.9.2 Grout Rinsate 55
H5.9.3 Water Collected from Sawing and Cutting 55
H5.9.4 Hazardous Debris 56
H5.10 Identifying and Managing Contaminated Environmental Media 56
H5.11 Confirming Clean Closure 56
H5.11.1 Hot Cell A through Hot Cell F Closure Process 57
H5.12 Sampling and Analysis Plan and Constituents to be Analyzed 57
H5.12.1 Sampling and Analysis Plan 57
H5.12.2 Target Analytes 58
H5.12.3 Hot Cell A through Hot Cell F SAP Schedule 58
H5.12.4 Hot Cell A through Hot Cell F Project Management 58
H5.12.5 Sampling Design 60
H5.12.6 Sampling Methods and Handling 61
H5.12.7 Analytical Methods 64
H5.12.8 Quality Control 64
H5.12.9 Data Verification 65
H5.12.10 Data Validation 65
H5.12.11 Verification of VSP Input Parameters 65

H5.12.12 Documents and Records 65
H5.12.13 Sampling and Analysis Requirements to Address Removal of Contaminated Soil 69
H5.12.14 Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed 69
H5.13 Role of the Independent, Qualified, Registered Professional Engineer 69
H5.14 Certification of Clean Closure 69
H5.15 Conditions that Will Be Achieved When Closure is Complete 70
H6 Closure Schedule and Time Frame 70
H7 Cost of Closure 72
H8 References 74

FIGURES

Figure H1. Waste Encapsulation and Storage Facility Pool and Process Cells 12
Figure H2. WESF Second Floor Plan 13
Figure H3. WESF East/West Sectional View 14
Figure H4. WESF North/South Sectional View 14
Figure H5. Hot Cell A 16
Figure H6. Hot Cell B 18
Figure H7. Hot Cell C 20
Figure H8. Hot Cell D and Hot Cell E 22
Figure H9. Hot Cell F 23
Figure H10. Hot Pipe Trench and K3 Duct Trench 29
Figure H11. K1, K2, and K4 Ventilation 31
Figure H12. Current K3 Ventilation System 31
Figure H13 Core Drills and Grout Addition Locations in Canyon 45
Figure H14. K3 Filter Pit and Duct 45
Figure H15. Performance of Core Drills through Divider Wall 47
Figure H16. Monolith Cut Locations 51
Figure H17. Hot Cell A through Hot Cell F Sampling and Analysis Plan Project Organization 59
Figure H18. Waste Encapsulation and Stabilization Facility Hot Cell A through Hot Cell F Closure Plan Schedule 73

TABLES

Table H1. WESF Hot Cells A through F Contents 24
Table H2 WAC 173-303-680(2) through (4) Requirements 34
Table H3. Training Matrix for Hot Cell A through Hot Cell F DWMU 40
Table H4. WAC 173-303-320(2) Inspection Schedule for Hot Cell A through Hot Cell F 41
Table H5. Estimated Hot Cell Grout Volume 48

Table H6. Impurities in Cesium Feed Solution and Salt 53
Table H7. Impurities in Cesium Salts Wasted at Oak Ridge 54
Table H8. Impurities in Strontium Salt 54
Table H9. Target Analyte List 58
Table H10. Visual Sample Plan Parameter Inputs 62
Table H11. Preservation, Container, and Holding Time Requirements for Soil Samples 63
Table H12. Soil Analytical Performance Requirements 66
Table H13. Project Quality Control Sampling Summary 67
Table H14. Waste Encapsulation and Stabilization Facility Hot Cell A through Hot Cell F Closure Activities Schedule 71

TERMS

AMU	aqueous makeup
Cs-137	cesium-137
DOE	U.S. Department of Energy
DOE-RL	DOE Richland Operation Office
DQA	data quality assessment
DWMU	dangerous waste management unit
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FWS	Field Work Supervisor
HEIS	Hanford Environmental Information System
HEPA	high-efficiency particulate air
HHE	human health and the environment
IQRPE	Independent Qualified Registered Professional Engineer
LDR	land disposal restriction
LLW	low-level waste
MTCA	"Model Toxics Control Act—Cleanup" (WAC 173-340)
N/A	not applicable
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
SAP	sampling and analysis plan
Sr-90	strontium-90
TSD	treatment, storage, and/or disposal
VSP	Visual Sample Plan
WESF	Waste Encapsulation and Storage Facility

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H1 INTRODUCTION

This addendum details closure activities for the Waste Encapsulation and Storage Facility (WESF) Closure Unit Group 6 Hot Cell A through Hot Cell F dangerous waste management unit (DWMU).

H2 FACILITY CONTACT INFORMATION

WESF Operator and Property Owner:

Stacy L. Charboneau, Manager
U.S. Department of Energy, Richland Operations Office
P.O. Box 550
Richland, WA 99352
(509) 376-7395

WESF Co-Operator:

John Ciucci, President and Chief Executive Officer
CH2M HILL Plateau Remediation Company
P.O. Box 1600
Richland, WA 99352
(509) 376-0556

H3 FACILITY DESCRIPTION

WESF was constructed on the west end of B Plant between 1971 and 1973 to encapsulate and store radioactive cesium-137 (Cs-137) and strontium-90 (Sr-90) that had been separated from plutonium production waste stored in underground storage tanks on the Hanford Facility. Separation of cesium and strontium from tank waste occurred at B Plant.

WESF is a two-story, 1,858 m^2 (20,000 ft^2) building approximately 48 m long, 30 m wide, and 12 m high (160 ft long, 98 ft wide, and 40 ft high), constructed of steel reinforced concrete that is partitioned into seven hot cells, the hot cell service area, operating areas, building service areas, and the pool cell area.

The hot cells, hot cell service area, operating areas, and building service areas supported encapsulation operations. Encapsulation included conversion of Cs-137 to cesium chloride and Sr-90 to strontium fluoride, placement of cesium chloride and strontium fluoride into double walled stainless steel capsules, and seal welding of the capsules. Leak tests were performed to confirm adequacy of the welds.

WESF stores 1,936 capsules: 1,335 of cesium and 601 of strontium. The cesium capsules are double wall stainless steel containers with a length of approximately 53 cm (21 in.) and a diameter of approximately 8 cm (3 in.). Strontium capsules have the same general dimensions but consist of a Hastelloy® inner capsule and a stainless steel outer capsule. Of the cesium capsules, 23 are referred to as Type-W overpacks. Type-W overpacks were fabricated and overpacked at the 324 Building from 1997 to 1999. Of these overpacks, 16 contain degraded cesium capsules. The other seven contain containers of cesium chloride that were packaged during cleanout of the 324 Building. Type-W overpacks are made of stainless steel and have a length of 55.4 cm (21.8 in.) and a diameter of 8.26 cm (3.25 in.). If additional capsules need to be overpacked, a welding process would be developed and implemented in Hot Cell G.

The WESF pool cell area provides the necessary storage capability for cesium and strontium capsules. Underwater storage of the capsules provides both radioactive shielding and heat removal.

® Hastelloy is a registered trademark of Haynes International, Kokomo, Indiana.

H3.1 Facility History, Function, Location, and Layout

Construction of WESF started in 1971 and was complete by 1973. Encapsulation operations at WESF began shortly after completion of construction and were complete by January 1985. By March 1985, WESF completed transition into a standby/surveillance mode.

WESF has stored encapsulated Cs-137 and Sr-90 since encapsulation operations began in 1974. The capsules were initially managed as a commercial product and were used in a number of applications throughout the United States. The primary commercial application was sterilization of medical equipment.

In August 1987, the *Resource Conservation and Recovery Act of 1976* (RCRA) became effective on the Hanford Facility for active management of mixed radioactive and hazardous waste.

On July 14, 1997, the U.S. Department of Energy (DOE) decided to end commercial application of the capsules, and they were reclassified as a mixed waste.

WESF consists of seven hot cells, the hot cell service area, operating areas, building service areas, and the pool cell area. WESF has three DWMUs: two operating and one initiating closure (see Section H3.3 for details of the three DWMUs).

The seven hot cells are identified as Hot Cells A through G. The hot cells provided necessary radioactive shielding and equipment to allow workers to perform encapsulation tasks. Due to the highly radioactive nature of Cs-137 and Sr-90, all handling of Cs-137, Sr-90, and capsules must be performed remotely.

- Hot Cell A provided the capability to package waste generated inside the hot cells into drums and remove the packaged waste from the hot cells for disposal.
- Strontium processing occurred in Hot Cell B and Hot Cell C. Processing included the receipt of strontium solution from B Plant, conversion of the solution to strontium fluoride, drying of strontium fluoride and placement into an inner capsule, and seal welding and leak testing of the inner capsule.
- Cesium processing occurred in Hot Cell D and Hot Cell E. Processing included receipt of cesium solution from B Plant, conversion of the solution to cesium chloride, removal of water from the cesium chloride, melting of the cesium chloride and placement into an inner capsule, and seal welding and leak testing of the inner capsule.
- Hot Cell F provided the capability to decontaminate and store the inner capsules.
- Hot Cell G provided the capability to weld, inspect, and decontaminate the outer capsules.

The service gallery is located on the south side of the hot cells and contained support equipment for the hot cell processes, including utility and auxiliary process piping. The operating gallery is located on the north side of the hot cells. Remote work in the hot cells was performed from the operating gallery using manipulators. Figures H1 through H4 show the WESF layout.

When encapsulation operations were completed in 1985, WESF was transitioned into a standby and surveillance mode. In this mode of operation, only equipment and instruments required for continued safe storage of the capsules remained operational. This included the operation and maintenance of the pool cells and support systems for Hot Cells F and G. The confinement ventilation system remained operable to provide containment of legacy radioactive contamination and to support surveillance operations.

In 2001, water sources to Hot Cells A through F were isolated, and manipulators were removed from Hot Cell A through Hot Cell E. Manipulators in Hot Cell F and Hot Cell G remain active.

In 2014, the WESF Stabilization and Ventilation Project was initiated to stabilize legacy contamination in the hot cells and K3 exhaust ventilation duct and resolve inadequacies in the K3 exhaust system by replacing it with a new system. This project will be used to meet the DOE-Richland Operations Office (RL) commitment to the DOE Office of Environmental Management's Safety, Security, and Quality Programs (EM-40) to complete WESF ventilation upgrades by the end of fiscal year (FY) 2016 (13-NSD-0042, *Revised Schedule for Completion of Waste Encapsulation and Storage Facility (WESF) 2004-2 Ventilation Upgrades*) and is the first step towards placing the capsules into a dry storage configuration.

H3.2 Products and Production Processes

WESF does not generate products or have any production processes. WESF currently acts as a storage facility for stainless steel capsules containing radioactive cesium chloride and strontium fluoride salts. These capsules are stored in the Pool Cells DWMU and can be placed into the Hot Cell G DWMU for inspection or if a capsule is suspected of leaking. The Hot Cell A through Hot Cell F DWMU is not needed for capsule or mixed waste storage (see Section H3.3 for details of the three DWMUs).

H3.3 Dangerous Waste Management and Units

The three DWMUs at WESF are shown in Figure H1. One DWMU consists of the pool cells, and a second consists of Hot Cell G. The Pool Cells and the Hot Cell G DWMUs are operational and necessary for storage of the capsules. The third DWMU consists of Hot Cells A through F. This DWMU is not necessary for storage of capsules at WESF, and it will be undergoing closure.

This plan addresses closure of the Hot Cell A through Hot Cell F DWMU. Closure of the other two operating DWMUs will be addressed in closure plans for each operating DWMU.

The Hot Cell A air lock, hot pipe trench, and K3 duct trench are included in this closure plan but are not part of the Hot Cell A through Hot Cell F DWMU. Even though these areas are not part of the DWMU, they will be grouted along with the hot cells to preclude the spread of contamination from the hot cells.

H3.4 Unit Description

This section provides a detailed description of the WESF Hot Cell A through Hot Cell F DWMU. This is one of three DWMUs at WESF and the DWMU undergoing the closure actions described in this plan.

As discussed in Section H3.1, Hot Cells A through E are deactivated, and no activities are performed in these hot cells. Hot Cells F and G have remained operational to provide the capability to inspect and store the capsules and retain the capability for future removal of the capsules from WESF. The following activities are performed in Hot Cells F and G:

- Capsules may be moved into Hot Cell G to be inspected.
- Capsules suspected of leaking would be moved into Hot Cell G for initial inspection. Leaking capsules would be moved to Hot Cell F for storage out of the pool cell. The capsules could also be stored in Hot Cell G; however, personnel access to the hot cell would be prevented.
- In the future, capsules will be loaded into canisters/casks in Hot Cell G to allow removal of the capsules from WESF.

Following completion of the initial closure activities, as discussed in Section H5.5, Hot Cell F will be no longer be available for use to store capsules. Hot Cell G will remain operational as an operating DWMU. Shielded storage will be provided in Hot Cell G and could be used to store several leaking capsules. This will allow personnel access to the hot cell while capsules are being stored.

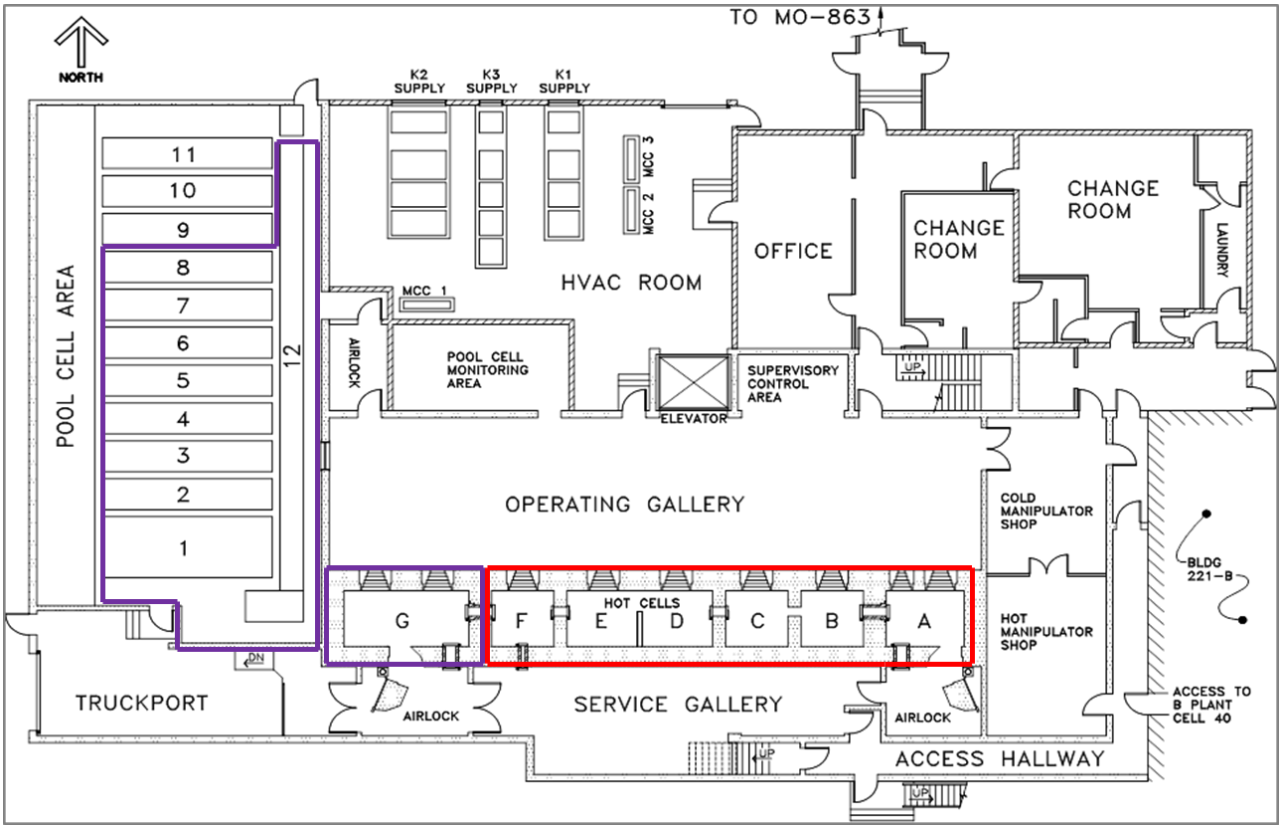

Figure H1. Waste Encapsulation and Storage Facility Pool and Process Cells

A plan view of the hot cells is shown in Figure H1. Removable high-density concrete cover blocks, located at the top of the hot cells (on the floor of the canyon), provide access to the hot cells, pool cell area, and truck port from the canyon. The north and south walls of all the hot cells and both the east and west walls of Hot Cell A and Hot Cell G are 89 cm (35 in.) thick, high-density 3,760 kg/m^3 (235 lb/ft^3), reinforced concrete. Hot Cell A has an 89 cm (35 in.) high-density concrete shielding door for personnel entry from the service gallery.

Process and/or service piping is embedded in the concrete walls of each hot cell. The pipes connect the hot cells to each other, as well as to the hot pipe trench, transmitter rooms, aqueous makeup (AMU) area, service gallery, and operating gallery. Process piping, including in-cell jumpers, was used to convey cesium and strontium solutions between tanks and other processing equipment. Service piping includes utility services such as air, water, and electricity that supported process equipment operation; service piping did not contain cesium or strontium.

All processing activities were completed before 1985, and the hot cells were placed into a standby/surveillance mode. Standby/surveillance actions for the hot cells included process equipment cleanout using a series of demineralized water flushes on all in-cell jumpers and tanks. Chemical flushes were then used to remove residual solids. After the chemical flushes, a final demineralized water flush was used. All jumpers were removed, with the tank nozzles remaining open, and the associated nozzle on the cell wall was capped.

Process feed lines from B Plant to WESF were flushed, as well as the drain lines from WESF to B Plant.

Hot cell piping and tanks were flushed using normal nuclear industry practices to remove any residual feed solutions, processing chemicals, and tank heels. Flushing was completed in 1985 before RCRA enactment.

No processing has occurred in the hot cells since they were placed in standby/surveillance mode. In 2000, high-efficiency particulate air (HEPA) filters within the hot cells were replaced, and the used filters remain in the hot cells. Items remaining in the hot cells are hazardous debris.

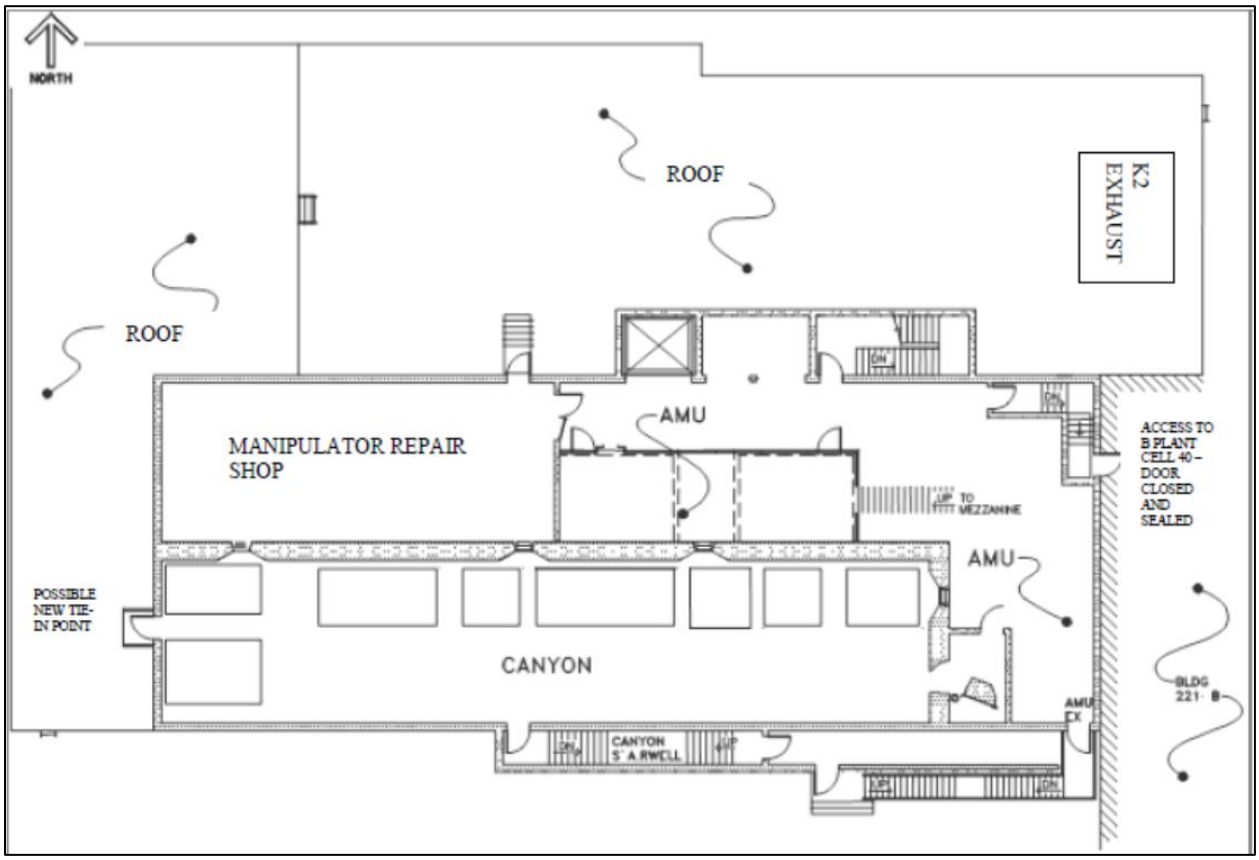

Figure H2. WESF Second Floor Plan

The following subsections provide detailed information on:

- Hot Cells A through F
- Hot cell viewing windows
- Hot cell manipulators
- Hot pipe trench and K3 duct trench
- Tank-100
- WESF ventilation system

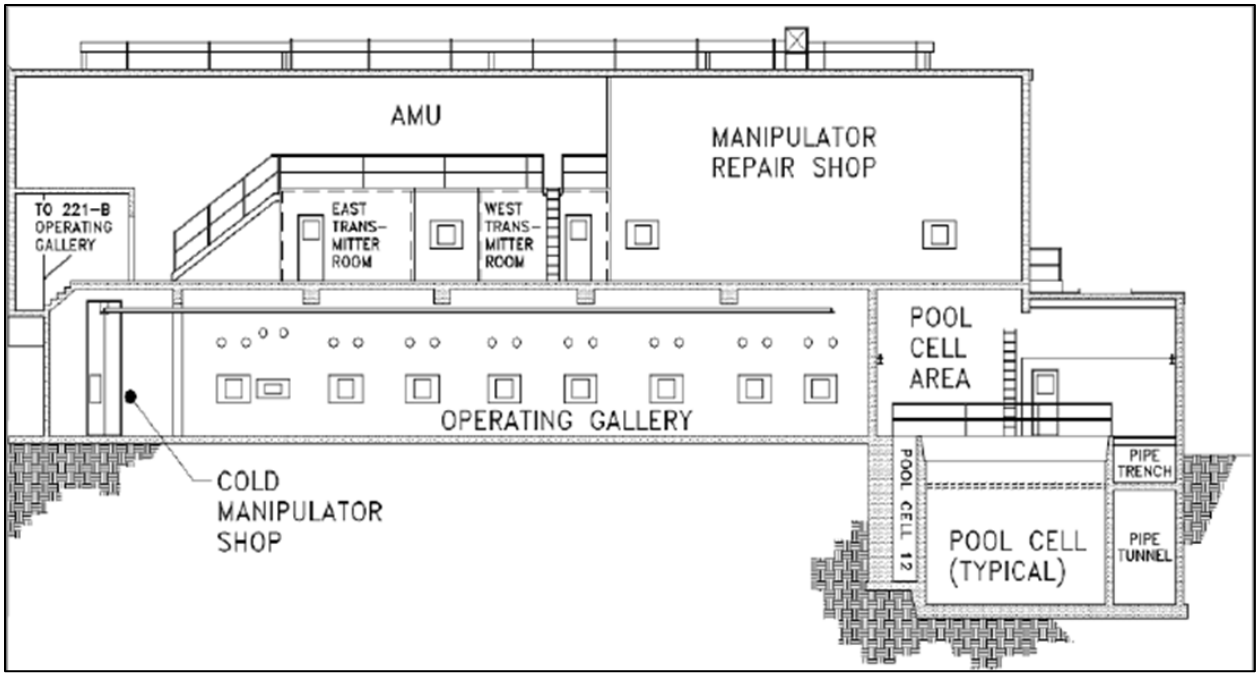

Figure H3. WESF East/West Sectional View

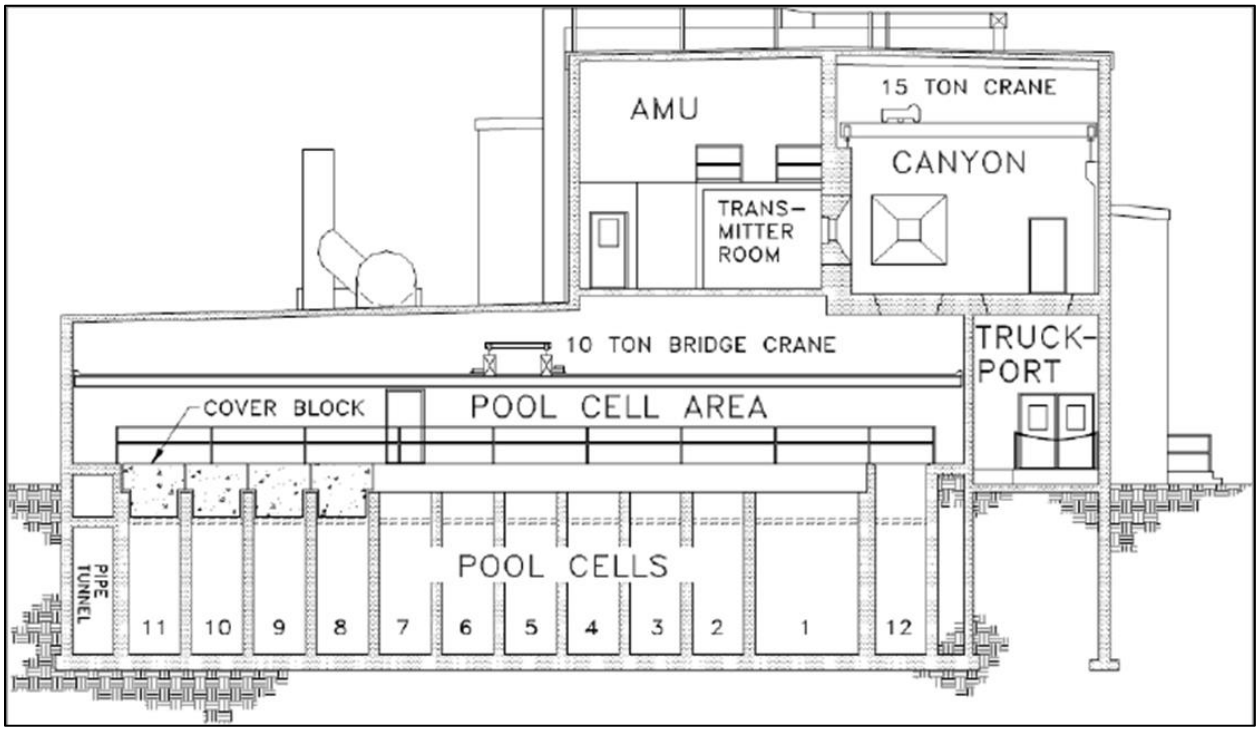

Figure H4. WESF North/South Sectional View

H3.4.1 Hot Cell A

Hot Cell A contains equipment that was required for handling high dose radioactive solid waste from the other hot cells and placing it in 208 L (55 gal) drums. The inside dimensions of Hot Cell A are 3 m (10 ft) long by 2.4 m (8 ft) wide by 4.1 m (13.5 ft) high. The floor and walls are lined with 14-gauge 304L stainless steel. Figure H5 is an illustration of Hot Cell A. It is an elevation looking south. Hot Cell B is located to the west.

The wall between Hot Cell A and the adjacent Hot Cell B contains a 1.2 m (4 ft) by 2.4 m (8 ft) by 1.2 m (4 ft) stainless steel hood for receiving contaminated solid waste. A pass-through with doors is located between the A Cell Hood and Hot Cell B. Pass-throughs were installed to allow solid waste and small equipment to pass between hot cells or other areas. A second pass-through with doors is located between the A Cell Hood and the service gallery (on the south wall of the A Cell Hood). A sump is located along the south wall of the hot cell. It is a small approximately 30 cm by 40 cm by 20 cm deep (12 in. by 16 in. by 8 in. deep) open-topped recess in the floor. A steam eductor (not located in the hot cell) was used to remove liquids that collected in the sump.

Hot Cell A does not contain any process piping. Radioactive contamination in Hot Cell A and the A Cell Hood is the result of the waste packaging process and consists of surface contamination. Contamination remaining within Hot Cell A and the Hot Cell A Hood is less than the contamination within the other hot cells because during WESF operations, Hot Cell A and the Hot Cell A Hood were periodically decontaminated to a level that would allow manned entry.

This hot cell is equipped with a shielded personnel entry door accessible from the Hot Cell A air lock located at the east end of the service gallery. Hot Cell A contains the following equipment:

- Handling equipment for 208 L (55 gal) drums (drum dolly lift runs north and south underneath the A Cell Hood to allow the drum to be positioned for loading and removal from the hot cell).
- Hot Cell A Hood.
- Service piping necessary to support encapsulation operations.
- Two HEPA filters installed in the hot cell exhaust ventilation ducting.
- Two used HEPA filters that were replaced in 2000 and remain on the hot cell floor.

Table H1 provides additional details for each listed item.

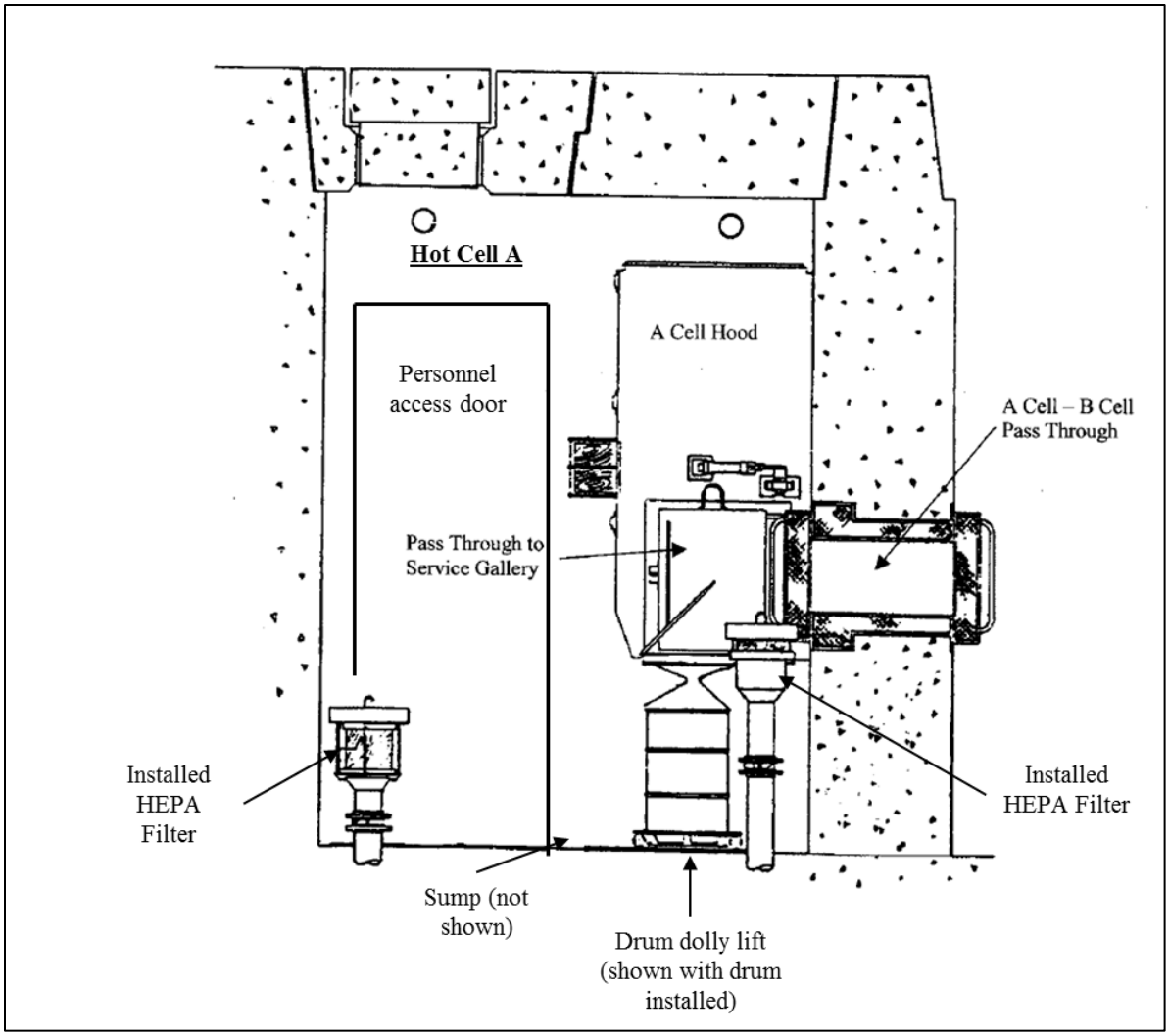

Figure H5. Hot Cell A

H3.4.2 Hot Cell B

Hot Cell B contains equipment that was used for strontium wet chemistry processing. This processing included the receipt of strontium nitrate from B Plant, conversion to strontium fluoride which was a precipitate, filtration to remove the precipitate, removal of the filtrate from the filter, placement of the filtrate into trays, and heating to remove water from the filtrate.

The inside dimensions of Hot Cell B are 2.4 m (8 ft) long by 2.4 m (8 ft) wide by 3.9 m (13 ft) high. The rear half of the Hot Cell B floor is elevated 56 cm (22 in.) and is 1.2 m (4 ft) wide. The wall between Hot Cells A and B is approximately 89 cm (35 in.) thick and is constructed from high-density reinforced structural concrete 3,760 kg/m^3 (235 lb/ft^3). The wall between Hot Cell B and Hot Cell C is approximately 51 cm (20 in.) thick and is constructed from reinforced structural concrete 2,400 kg/m^3 (150 lb/ft^3). The floor and lower portion of the walls are lined with 14-gauge 304L stainless steel. Figure H6 is an illustration of Hot Cell B. It is an isometric looking to the southwest. Hot Cell A is to the east, and Hot Cell C is to the west.

A pass-through with doors is located between the A Cell Hood and Hot Cell B (Figure H5). A pass-through without doors is located between Hot Cells B and C that was used to pass small equipment and solid waste between the hot cells.

A sump is located on the west wall of the hot cell next to the elevated portion of the hot cell. It is a small 30 cm by 40 cm by 20 cm deep (12 in. by 16 in. by 8 in. deep) open-topped recess in the floor. A steam eductor (not located in the hot cell) was used to remove liquids that collected in the sump.

Hot Cell B contains the following equipment:

- Feed metering tank (TK-B-1) located on the south wall.
- Supernate holding tank (TK-B-2) located in the elevated portion of the hot cell.
- Waste holding tank (TK-B-4) located in the wall between Hot Cell B and Hot Cell C.
- Precipitator tank (TK-B-5) located in the elevated portion of the hot cell.
- Strontium filters (F-B6-1 to F-B6-5) located on the floor on the east side of the hot cell.
- Strontium furnace (E-B-8) located in the wall between Hot Cell B and Hot Cell C.
- Process and service piping necessary to support encapsulation operations.
- Two HEPA filters installed in the hot cell exhaust ventilation ducting as well, as two used HEPA filters that were replaced in 2000 and allowed to remain on the hot cell floor.
- Four trays containing floor sweepings located inside the strontium furnace (E-B-8).

Table H1 provides additional details for each listed item.

When the WESF strontium encapsulation mission was completed in 1985, the following tasks were performed to clean out and empty the tanks in Hot Cell B (SD-WM-ER-022, *WESF Strontium Line Standby/Surveillance*):

- All process feed lines and drain lines from B Plant were flushed with demineralized water.
- All in-cell process pipes and tanks (including TK-B-1, TK-B-2, TK-B-4, and TK-B-5) were flushed with demineralized water.
- Sodium bicarbonate and caustic were used to flush TK-B-2, TK-B-4, and TK-B-5.
- Nitric acid was then added to TK-B-2, TK-B-4, and TK-B-5, and the resulting solution was reprocessed.
- All in-cell process pipes and tanks (including TK-B-1, TK-B-2, TK-B-4, and TK-B-5) were again flushed with demineralized water.
- Interiors of electrical conduits were wiped with a damp sponge.
- All in-cell jumpers on the tanks were removed and remained open to allow venting.

As a part of hot cell cleanup activities, loose material remaining on the Hot Cell B and Hot Cell C floors was swept up and placed into trays that were then stored inside the strontium furnace. The trays contain approximately 0.6 kg (1.3 lb) of material. This material in the trays includes strontium fluoride and processing debris, including metal shavings, failed manipulator components, as well as any other debris that was on the floor of the hot cell. Each tray is 26 cm (10.25 in.) by 8 cm (3.125 in.).

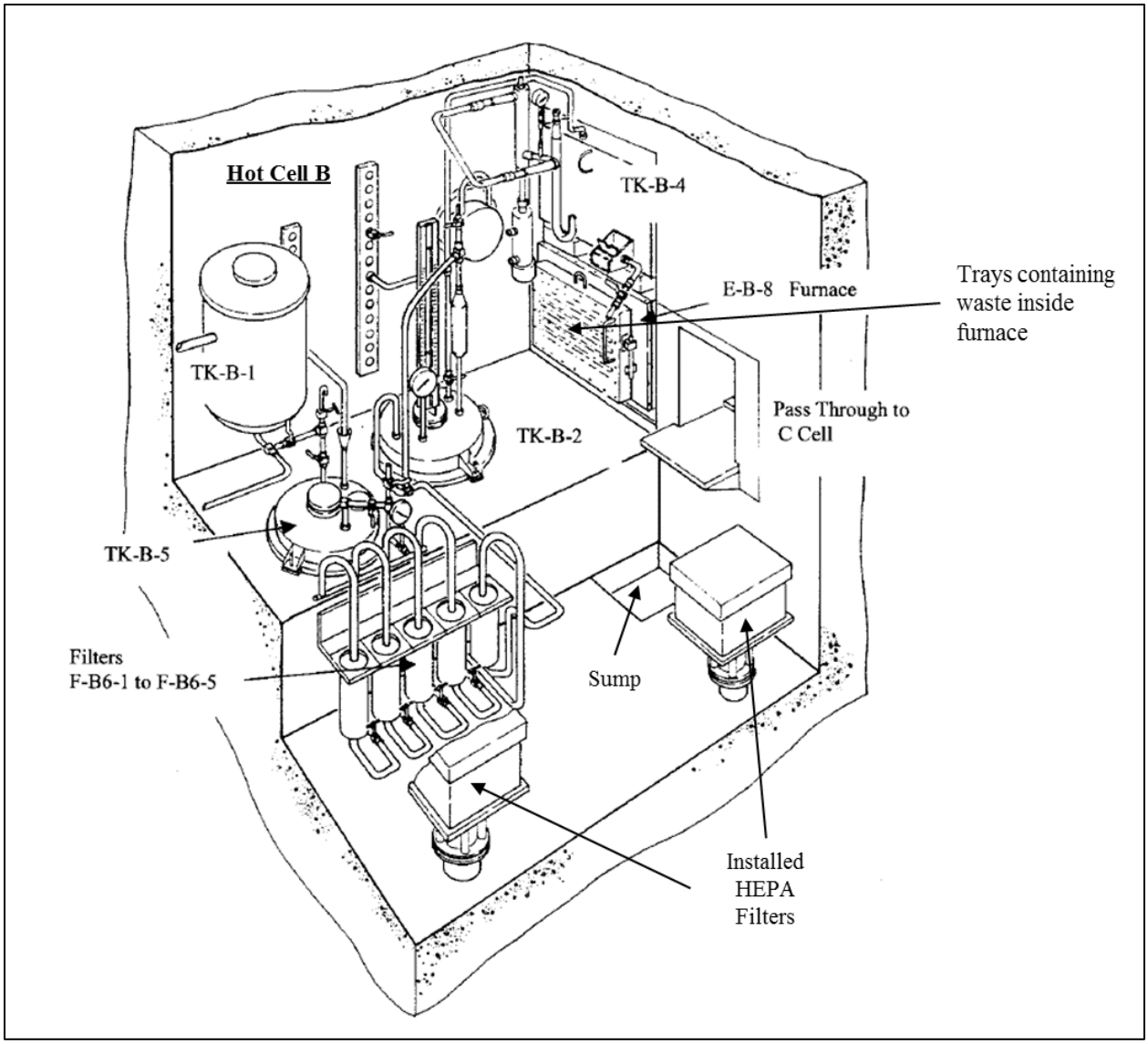

Figure H6. Hot Cell B

H3.4.3 Hot Cell C

Hot Cell C contains equipment that was used for the strontium fluoride encapsulation process. Processing consisted of removing the trays from the furnace, removing strontium fluoride from the trays, placing strontium fluoride in the inner capsule, compacting the material, welding the capsule end cap, and leak testing the inner capsule.

The inside dimensions of Hot Cell C are 2.4 m (8 ft) long by 2.4 m (8 ft) wide by 3.9 m (12.8 ft) high. The rear half of the Hot Cell C floor is elevated 22 in. and is 1.2 m (4 ft) wide. The walls between Hot Cells B and C and between Hot Cells C and D are approximately 51 cm (20 in.) thick and are constructed from reinforced structural concrete 2,400 kg/m^3 (150 lb/ft^3). The floor and lower portion of the walls are lined with 14-gauge 304L stainless steel. Figure H7 is an illustration of Hot Cell C. It is an isometric looking to the southeast. Hot Cell B is to the east, and Hot Cell D is to the west.

The rear half of the hot cell floor is elevated 56 cm (22 in.) to form a bench that contains two shielded storage locations and the compactor foundation. The wall between Hot Cells C and B contains the strontium waste tank (TK-B-4) and strontium furnace (E-B-8).

There are two pass-throughs: one is an open pass-through to Hot Cell B, and the second is a pass-through with doors to Hot Cell D. A sump is located on the east wall of the hot cell next to the elevated portion of the hot cell. It is a small 30 cm by 40 cm by 20 cm deep (12 in. by 16 in. by 8 in. deep) open-topped recess in the floor. A steam eductor (not located in the hot cell) was used to remove liquids that collected in the sump.

Hot Cell C contains the following equipment:

- Shielded storage locations (TK-C-5A and TK-C-5B).
- Strontium compactor (C-C-4).
- Process and service piping necessary to support encapsulation operations.
- Two HEPA filters installed in the hot cell exhaust ventilation ducting, as well as two used HEPA filters that were replaced in 2000 and allowed to remain on the hot cell floor.
- Two 61 cm (24 in.) long threaded capped pipes, containing 1.2 kg (2.6 lb) of floor sweepings, that are located in the southwest corner of the cell on wall brackets above the bench floor.

Table H1 provides additional details for each listed item.

When the WESF strontium encapsulation mission was completed in 1985, the following tasks were performed to clean out Hot Cell C (SD-WM-ER-022):

- All process feed lines and waste lines from B Plant were flushed with demineralized water.
- All in-cell process pipes were flushed with demineralized water.
- Interiors of electrical conduits were wiped with a damp sponge.
- All in-cell jumpers were removed and remained open to allow venting.

As a part of hot cell cleanup activities, loose material remaining on the Hot Cells B and C floors was swept up and placed inside capped pipes. Material in the pipes includes strontium fluoride, as well as any other debris that was on the floor of the hot cell.

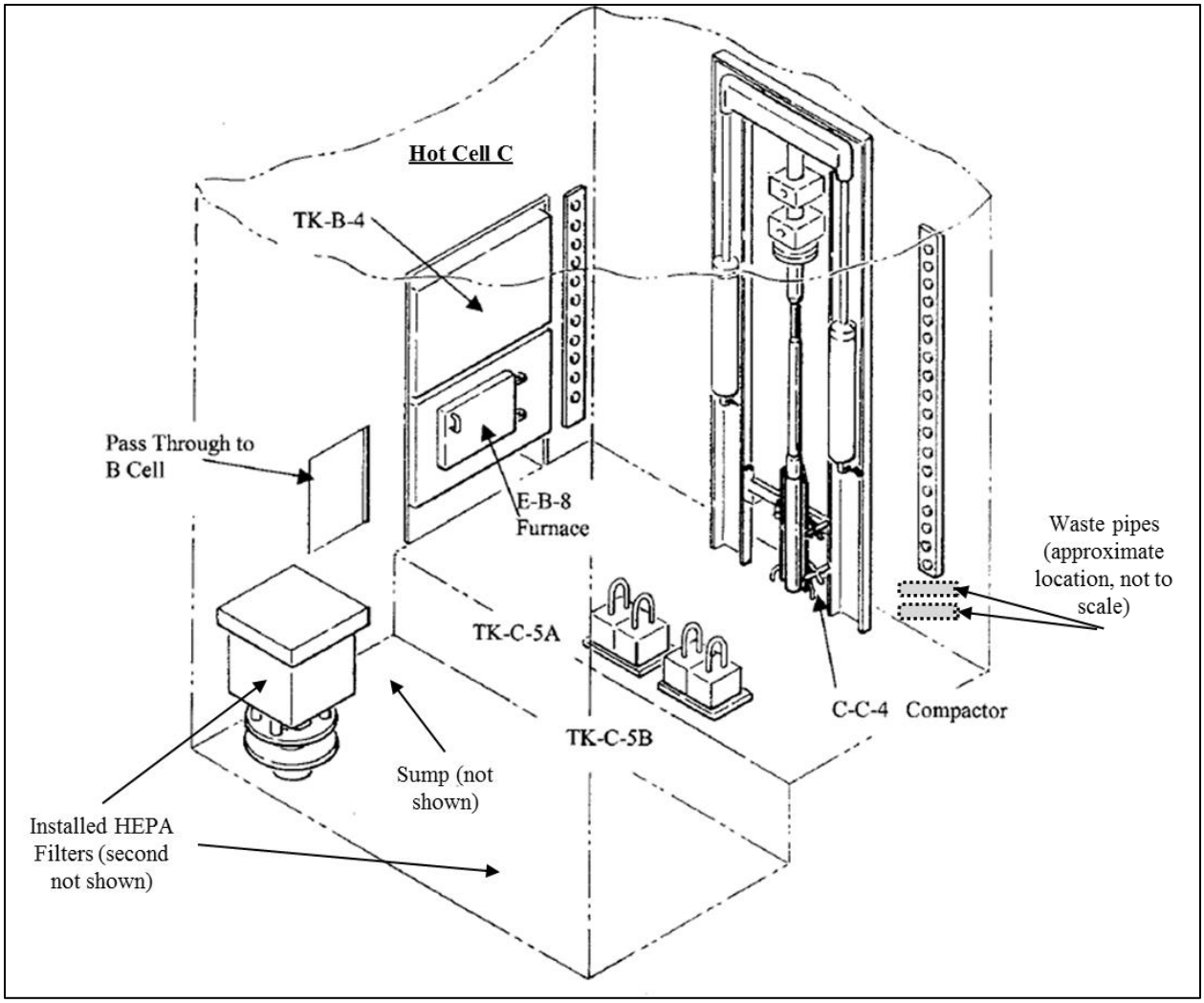

Figure H7. Hot Cell C

H3.4.4 Hot Cell D and Hot Cell E

Hot Cells D and E contain equipment that was used for conversion and encapsulation of cesium chloride. Processing in Hot Cell D consisted of receiving cesium carbonate feed from B Plant and converting it to cesium chloride. Processing performed in Hot Cell E consisted of heating the cesium chloride to remove the water and melt the cesium chloride, pouring the molten salt into the inner capsule, and preparing the capsule for welding. The inner capsule was welded in Hot Cell D, and leak testing was performed in Hot Cell E.

This double hot cell is approximately 5.5 m (18 ft) long by 2.4 m (8 ft) wide by 3.9 m (12.8 ft) high and is partitioned in the middle by a cell parapet wall that is 1.2 m (4 ft) wide by 2.4 m (8 ft) high and 20.3 cm (8 in.) thick. The rear half of the Hot Cell D portion of the floor is elevated approximately 25 cm (10 in.) and is 1.2 m (4 ft) wide. The walls between Hot Cells C and D and between Hot Cells E and F are approximately 51 cm (20 in.) thick and are constructed from reinforced structural concrete 2,400 kg/m^3 (150 lb/ft^3). The floor and lower portion of the walls are lined with 14-gauge Inconel® 600 alloy.

® Inconel is a registered trademark of Special Metals Corporation, New Hartford, New York.

Figure H8 is an illustration of this double hot cell. It is an isometric looking to the southeast. Hot Cell C is to the east, and Hot Cell F is to the west.

A recess in the elevated section of Hot Cell D is provided for placement of the cesium converter tank (TK-D-2). A pass-through with doors is located between Hot Cells C and D and between Hot Cells E and F for passage of small equipment and solid waste. A sump is located on the floor between Hot Cells D and E. It is a small 30 cm by 40 cm by 20 cm deep (12 in. by 16 in. by 8 in. deep) open-topped recess in the floor. A steam eductor (not located in the hot cell) was used to remove liquids that collected in the sump.

Hot Cell D contains the following equipment:

- Feed metering tank (TK-D-1)
- Converter tank (TK-D-2)
- Hydrochloric acid scrubbing equipment (TK-D-5, T-D-5, and T-D-7)
- Vacuum surge tank (TK-D-13)
- Condensers (E-D-4 and E-D-4A)
- Process and service piping necessary to support encapsulation operations
- Two HEPA filters installed in the hot cell exhaust ventilation ducting, as well as two used HEPA filters that were replaced in 2000 and allowed to remain on the hot cell floor

Hot Cell E contains the following equipment:

- Shielded storage location (TK-E-9)
- Helium leak check chamber (TK-E-12)
- Process and service piping necessary to support encapsulation operations
- Two HEPA filters installed in the hot cell exhaust ventilation ducting, as well as two used HEPA filters that were replaced in 2000 and allowed to remain on the hot cell floor

Table H1 provides additional details for each listed item.

When the cesium encapsulation mission was completed, the following tasks were performed (SD-WM-ER-014, *WESF Cesium Line Standby/Surveillance*):

- Demineralized water flush on all in-cell jumpers, tanks, and process piping (including TK-D-1, TK-D-2, TK-D-5, T-D-5, and T-D-7).
- Demineralized water flush on the process feed line between TK-D-1 and B Plant.
- Demineralized water flush on the drain line between TK-D-1 and B Plant.
- Flush of TK-D-2 with nitric acid and caustic solution to remove solids.
- Demineralized water flush on embedded service piping in Hot Cells D and E.
- Wiping of embedded electrical conduits with a damp sponge.
- Removal and opening of all in-cell jumpers on tanks to allow venting.

The shielded storage location (TK-E-9) and helium leak chamber (TK-E-12) contained complete capsules only. This equipment was not flushed as a part of standby/surveillance activities. SD-WM-ER-014 does not directly state how portions of the vessel ventilation system (condensers E-D-4 and E-D-4A and vacuum surge tank TK-D-13) were placed in standby. It is likely but not certain that they were also flushed with demineralized water with the rest of the in-cell jumpers and piping.

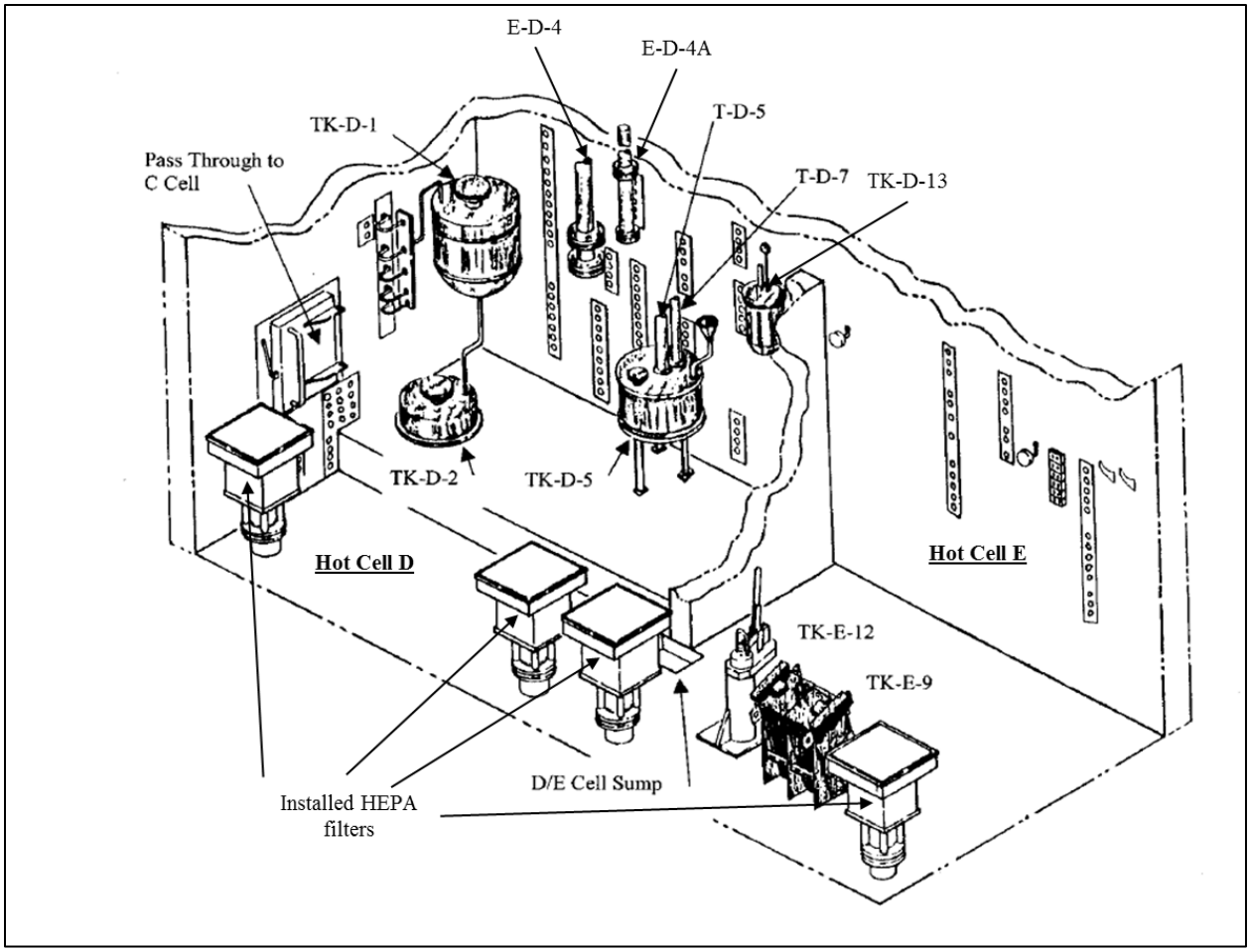

Figure H8. Hot Cell D and Hot Cell E

H3.4.5 Hot Cell F

Hot Cell F contains equipment that was used for storage and decontamination of the inner capsules.

The inside dimensions of Hot Cell F are 2.4 m (8 ft) long by 2.4 m (8 ft) wide by 3.9 m (12.8 ft) high. The rear portion of the hot cell floor is elevated 55.9 cm (22 in.) and is 0.6 m (2 ft) wide. The wall between Hot Cells F and G is approximately 89 cm (35 in.) thick and is constructed from high-density reinforced structural concrete 3,760 kg/m^3 (235 lb/ft^3). The floor and lower portion of the walls are lined with 14-gauge 304L stainless steel. Figure H9 is an illustration of the hot cell. It is an isometric looking southeast. Hot Cell E is to the east, and Hot Cell G is to the west.

A recess in the elevated portion of the hot cell floor is provided for placement of a shielded capsule storage location. A pass-through with doors is located between Hot Cells E and F and between Hot Cells F and G for passage of small equipment and solid waste. There is also a pass-through with doors between Hot Cell F and the service gallery on the south wall. Hot Cell F does not contain any process piping.

A sump is located on the floor on the east wall of the hot cell, next to the elevated area. It is a small 30 cm by 40 cm by 20 cm deep (12 in. by 16 in. by 8 in. deep) open-topped recess in the floor. A steam eductor (not located in the hot cell) was used to remove liquids that collected in the sump. After water sources to the hot cells were isolated in 2001, an air driven sump pump was installed in Hot Cell F for transfer of collected liquids to the radioactive low-level waste (LLW) tank (Tank-100). As part of the closure of Hot Cells A through F, this transfer line will be isolated.

Hot Cell F contains the following equipment:

- Capsule scrubber (TK-F-1)
- Electropolisher (TK-F-2)
- Capsule rinse location (TK-F-4)
- Storage location (TK-F-5)
- Air receiver tank (TK-F-6)
- Modular storage rack
- Service piping necessary to support encapsulation operations
- Two HEPA filters installed in the hot cell exhaust ventilation ducting as well as two used HEPA filters that were replaced in 2000 and allowed to remain on the hot cell floor
- Manipulators that will be removed during closure

Table H1 provides additional details for each listed item.

During processing, the cell was rinsed with water to minimize contamination spread to the capsules, prior to transfer to Hot Cell G. This practice kept the contamination levels in Hot Cell F low. Since the end of encapsulation operations, the hot cell has been swept and vacuumed, and miscellaneous parts/tools have been removed.

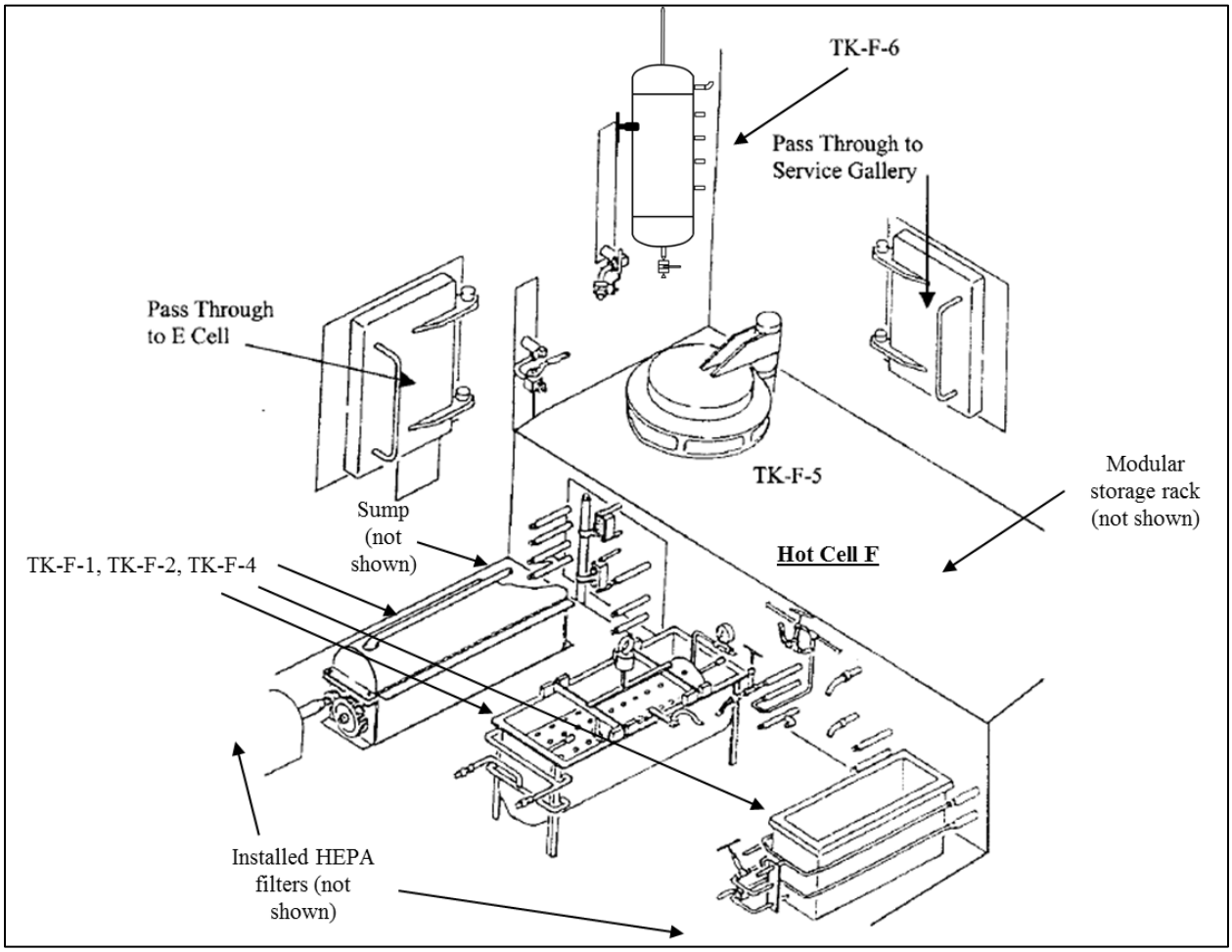

Figure H9. Hot Cell F

Table H1. WESF Hot Cells A through F Contents

Hot Cell	Hot Cell Contents	Content Description	Waste Description
A	Drum Dolly Lift	Equipment required for handling 208 L (55 gal) drums used to package the radioactive solid waste from the other hot cells.	Hazardous Debris
	Hood	1.2 m (4 ft) by 2.4 m (8 ft) by 1.2 m (4 ft) stainless steel hood.	
	HEPA Filters	Filters replaced in 2000; old filters remain on cell floor.	
	Service Piping Associated with Processing	Air and liquid service embedded lines from outside service areas and electrical lines.	
B	Four Trays of Strontium Floor Sweepings Inside the Furnace	Boats are open and contain strontium floor sweepings. Approximately 0.6 kg (1.2 lb) total waste.	Waste/Waste Residues
	Strontium Filter Assembly (F-B6-1 to F-B6-5)	Each filter housing is approximately 27.3 cm (10.8 in.) tall with 10.2 cm (4 in.) diameter; approximately 45% void. The filter housings were opened, and the sintered metal filters were removed. Both the filter housings and the filters were free of obvious material.	Hazardous Debris
	Process and Service Piping Associated with Processing	Process piping used to convey strontium solutions between tanks and processing equipment. Air and liquid service embedded lines from outside service areas and electrical lines. Embedded lines used as electrical conduits during processing were wiped internally with damp sponges to remove internal contamination.	
	HEPA Filters	Filters replaced in 2000; old filters remain on cell floor.	
	Feed Metering Vessel Tank (TK-B-1)	Cylindrical tank, vertical and unbaffled, 68.6 cm (27 in.) tall with 52.7 cm (20.8 in.) diameter. Tank has nozzles open to the cell atmosphere.	
	Supernatant Holding Tank (TK-B-2)	Cylindrical tank, vertical and unbaffled, with a dish shaped bottom with flanged heads; 91.4 cm (36 in.) tall with 61 cm (24 in.) diameter. Tank has nozzles open to the cell atmosphere.	

Table H1. WESF Hot Cells A through F Contents

Hot Cell	Hot Cell Contents	Content Description	Waste Description
	Waste Holding Tank (TK-B-4)	Rectangular tank, vertical and unbaffled. 50.8 cm (20 in.) wide, 76.2 cm (30 in.) long, and 52.1 cm (21 in.) tall. Tank has nozzles open to the cell atmosphere. Located in the wall between B and C cells.	
	Precipitator Tank (TK-B-5)	Cylindrical, vertical, unbaffled tank in the upper section and conical tank in the lower section. Upper section is 43.2 cm (17 in.) high with 61 cm (24 in.) diameter. Lower section is 48.3 cm (19 in.) high and tapers from a diameter of 61 cm (24 in.) to 15.2 cm (6 in.). Tank has nozzles open to the cell atmosphere.	
	Strontium Furnace (E-B-8)	Rectangular, approximately 52.7 cm (21 in.) wide, 76.2 cm (30 in.) long, and 52.1 cm (21 in.) tall. Located in wall between B and C cells.	
C	Process and Service Piping Associated with Processing	Process piping used to convey strontium solutions between tanks and processing equipment. Embedded lines, used as electrical conduits, raw water supply, compressed air, and argon supply.	Hazardous Debris
	HEPA Filters	Filters replaced in 2000; old filters remain on cell floor.	
	Strontium Compactor (C-C-4)	Used to compact strontium fluoride material in the capsule.	
	Shielded Storage Locations (TK-C-5A and TK-C-5B)	Identical shielded storage locations recessed in the C Cell floor. Annular configuration is approximately 45.7 cm (18 in.) long. These locations were used to store inner capsules and did not contain unencapsulated strontium.	
	Two Closed Waste Pipes	Two closed waste pipes with approximately 61 cm (24 in.) long with a pipe cap at each end with material swept from the floor of B Cell or C Cell after it was dried and reduced in volume in the furnace. These containers are stored in the southwest corner of the cell on wall brackets above the bench floor. Total approximate waste volume is 1.2 kg (2.6 lb).	Waste/Waste residues

Table H1. WESF Hot Cells A through F Contents

Hot Cell	Hot Cell Contents	Content Description	Waste Description
D/E	Process and Service Piping Associated with Processing	Process piping used to convey cesium solutions between tanks and processing equipment. Air and liquid service embedded lines from outside service areas and electrical lines.	Hazardous Debris
	Feed Metering Tank (TK-D-1)	Cylindrical tank 68.6 cm (27 in.) tall with 53.34 cm (21 in.) diameter. Tank has nozzles open to the cell atmosphere.	
	Converter Tank (TK-D-2)	Cylindrical tank 54.6 cm (21.5 in.) tall with 50.8 cm (20 in.) diameter. Tank has nozzles open to the cell atmosphere.	
	Hydrochloric Acid Scrubbing Equipment (TK-D-5, T-D-5, and T-D-7)	T-D-5 is 1.4 m (4.75 ft) tall, and T-D-7 is 1.9 m (6.3 ft) tall; both towers are 10.2 cm (4 in.) in diameter and contain 1.2 m (4 ft) of packing (pall rings). Tank has nozzles open to the cell atmosphere.	
	Vacuum Surge Tank (TK-D-13)	Cylindrical tank 16 in. tall with 8 in. diameter. The vacuum surge tank was part of the vessel ventilation system.	
	Condensers (E-D-4 and E-D-4A)	E-D-4 is a cylindrical tank approximately 140 cm (55 in.) tall with 20.3 cm (8 in.) diameter. E-D-4A is a cylindrical tank approximately 74 cm (29 in.) tall with 10.2 cm (4 in.) diameter. The condensers were part of the vessel ventilation system.	
	Shielded Storage Location (TK-E-9)	Rectangular storage location approximately 30.5 cm (12 in.) by 48.3 cm (19 in.) wide and 55.9 cm (22 in.) tall. This location was used to store inner cesium capsules and did not contain unencapsulated material.	
	Helium Leak Check Chamber (TK-E-12)	Outer shell with approximately 11.4 cm (4.5 in.) diameter and approximately 61 cm (24 in.) long. The helium leak chamber only contained completed inner capsules and did not contain unencapsulated material.	
	HEPA Filters	Filters replaced in 2000; old filters remain on cell floor.	
F	HEPA Filters	Filters replaced in 2000; old filters remain on cell floor.	Hazardous Debris
	Manipulators	Manipulators will be removed prior to addition of grout.	

Table H1. WESF Hot Cells A through F Contents

Hot Cell	Hot Cell Contents	Content Description	Waste Description
	Service Piping Associated with Processing	Air and liquid service embedded lines from outside service areas and electrical lines.	
	Capsule Scrubber (TK-F-1)	Open top rectangular tank approximately 78.7 cm (31 in.) long by 35.6 cm (14 in.) wide by 35.6 cm (14 in.) high. Contained complete capsules only.	
	Electropolisher (TK-F-2)	Open top rectangular tank approximately 78.7 cm (31 in.) long by 35.6 cm (14 in.) wide by 35.6 cm (14 in.) high. Contained complete capsules only	
	Capsule Rinse Location (TK-F-4)	Open top rectangular storage location approximately 78.7 cm (31 in.) long by 35.6 cm (14 in.) wide by 35.6 cm (14 in.) high. This equipment contained capsules only.	
	Storage Location (TK-F-5)	Cylindrical storage location approximately 72.4 cm (29 in.) deep with 41.9 cm (17 in.) diameter. This storage location was used for the storage of capsules only.	
	Air Receiver Tank (TK-F-6)	Cylindrical storage location approximately 64.8 cm (26 in.) tall with 20.3 cm (8 in.) diameter. This tank was part of the clean air supply system. It provided clean air at a constant pressure to hot cell equipment.	
	Modular Storage Rack	Rack consists of open tubes used for storage of capsules.	

H3.4.6 Hot Cell Viewing Windows

Lead glass windows are provided for shielding and direct viewing into the hot cells from the operating gallery. The viewing windows are composed of 25.4 cm (10 in.) of 3.3 g/cm^3 lead glass (hot cell side) and 39.6 cm (15.6 in.) of 6.2 g/cm^3 lead glass (operating gallery side).

Oil between the glass sections allows light to pass through the windows. The soft lead glass is protected by cerium stabilized, nonbrowning, tempered glass on the hot cell side and tempered glass on the operating gallery side. The oil will be removed from the Hot Cells A through F windows, before start of closure, using the work package process including waste planning. The oil between the glass sections is a white mineral oil (Chemical Abstracts Service number 8042-47-5) with no hazardous properties. Upon removal, the oil will be containerized and managed as a nondangerous maintenance waste.

Currently, the window in Hot Cell C is not clear enough to allow viewing into the hot cell. Viewing into Hot Cells A, B, D, and E is not possible because lighting inside the cells has failed.

H3.4.7 Hot Cell Manipulators

Hot Cell A has wall ports for four manipulators. Hot Cells B through F each have wall ports for two manipulators that can be installed or removed from the hot cells through 25.4 cm (10 in.) diameter ports in the wall.

Manipulators are removed from Hot Cells A through E, and plugs have been installed in the ports for contamination control.

Manipulators in Hot Cell F will be removed, and the ports will be plugged prior to the start of stabilization activities.

H3.4.8 Hot Pipe Trench and K3 Duct Trench

The hot pipe trench is a concrete channel, 1.5 m (5 ft) wide by 0.6 m (2 ft) deep, that contains the process feed piping that was used to transfer solutions from B Plant to WESF. The hot pipe trench also contains lines for transferring solutions from WESF back to B Plant.

The hot pipe trench is located beneath the floor of the hot cells and extends from Hot Cell G to the west wall of B Plant. At the west wall of B Plant, the hot pipe trench is reduced to a 35.6 cm (14 in.) stainless steel pipe encasement that terminates in Cell 39 at B Plant.

The walls of the hot pipe trench and encasement are constructed of high-density concrete and are lined with lead, where required, to provide shielding. B Plant has been isolated from WESF, and piping in the hot pipe trench is no longer used and is capped in B Plant.

When processing was completed at WESF before 1985, process transfer lines in the hot pipe trench were flushed with demineralized water. These lines have not been used for any processing since the WESF hot cells were placed in standby/surveillance mode. The transfer lines are expected to contain radiological contamination.

Process piping located in the hot pipe trench will not be filled with grout. The largest process feed pipe inside the hot pipe trench that will not be grouted is approximately 7.6 cm to 10.2 cm (3 to 4 in.) and will not cause structural integrity issues due to void space.

The K3 duct trench is approximately 0.6 m (2 ft) wide and 0.9 m (3 ft) deep. It runs underneath the hot cells and contains the K3 exhaust duct. Figure H10 shows the general configuration of the hot pipe trench, hot cells, and K3 duct trench. The elevated area is not present in all hot cells.

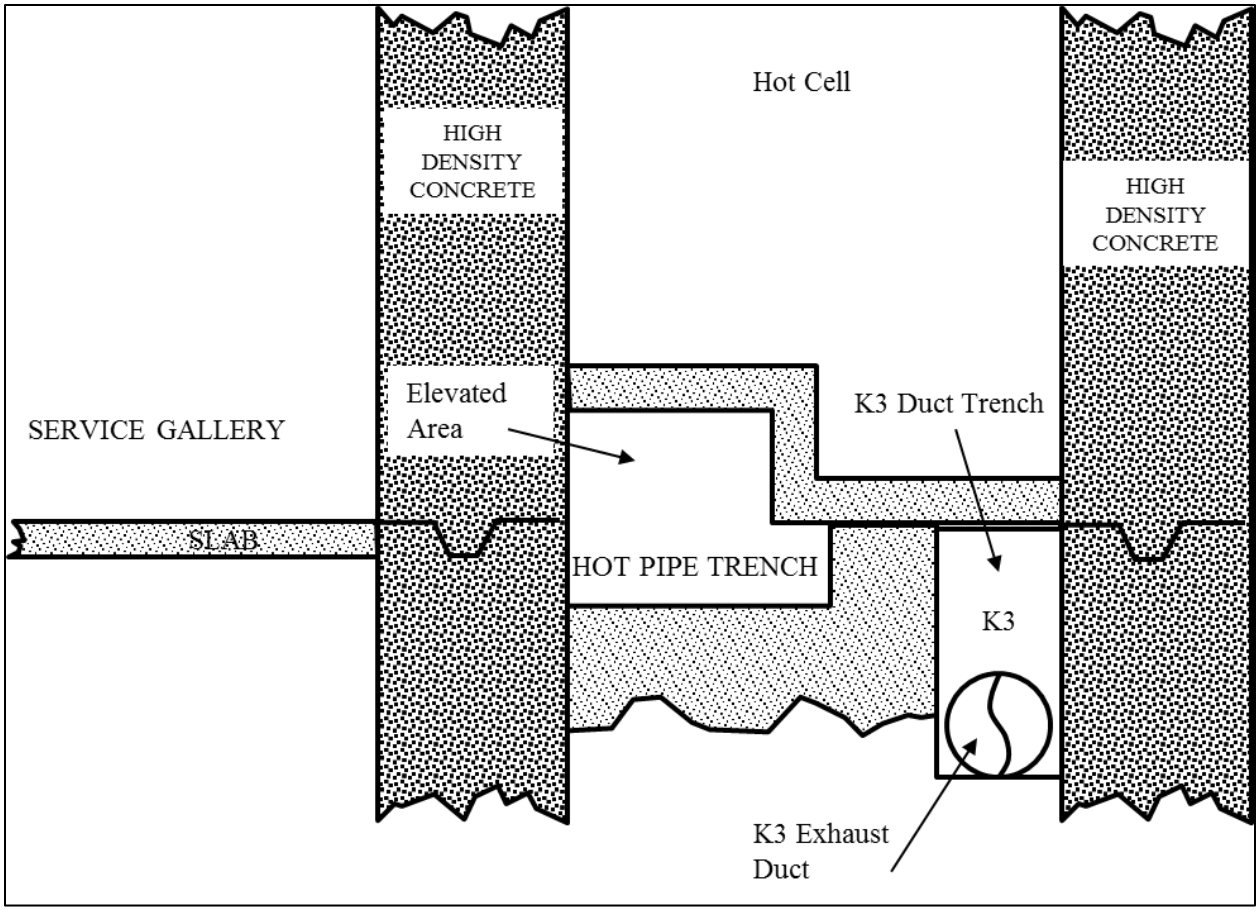

Figure H10. Hot Pipe Trench and K3 Duct Trench

H3.4.9 Tank-100

The WESF LLW collection tank (Tank-100) is an approximately 15,000 L (4,000 gal) stainless steel tank contained in a below-grade reinforced concrete vault with cover blocks. The tank is located on the outside of WESF, on the south side, and is not within a DWMU. The tank is under active ventilation from the K3 exhaust ventilation system and will be ventilated by the new system. Any liquid LLW generated in the hot cells would be transferred to Tank-100. As part of the closure activities, all hot cells (including Hot Cell G) will be isolated from this tank.

Tank-100 was replaced in 1998. Tank contents were sampled to support disposal of the removed tank and found to contain 1,1,1-trichloroethane. The original Tank-100 system, that was replaced in 1998, was clean closed in accordance with WAC 173-303-610, "Dangerous Waste Regulations," "Closure and Post-Closure," as documented by 98-EAP-588, "Closure Certification of the Waste Encapsulation and Storage Facility (WESF) Tank 100 (TK-100) System." 1,1,1-trichloroethane was not used at WESF after closure of Tank-100 in 1998, and no mixed waste management activities have occurred in the hot cells since the tank was replaced.

H3.4.10 WESF Ventilation System

The WESF ventilation system (Figures H11 and H12) is permitted for operation, under a Washington State Department of Health license and the Hanford Air Operating Permit, and is not part of the Hot Cell A through Hot Cell F DWMU. However, information is provided in this closure plan as part of the unit description to provide a complete understanding of the WESF facility.

The ventilation system at WESF is designed to produce pressure boundaries that prevent migration from areas contaminated with radioactive particulates to areas with less potential for contamination to the atmosphere. Contaminated areas are maintained at a negative pressure with respect to uncontaminated areas.

A second major function of the WESF ventilation system is the removal of hydrogen gas generated from the radiolysis of water resulting from the underwater storage of highly radioactive cesium and strontium capsules in the WESF pool cells. Hydrogen removal from the hot cells is not a significant concern, even if capsules are being stored in Hot Cells F or G, because all water sources have been removed from the hot cells.

Four separate supply systems (K1, K2, K3, and K4) and three separate exhaust systems service WESF. K1 and K3 systems are the only two that exhaust potentially contaminated air. The K2 exhaust system ventilates normally clean areas of WESF. K1 and K3 exhaust systems combine after the respective HEPA filters to exhaust air through a single monitored stack (296-B-10). Only portions of the K3 ventilation system that require grouting as part of the closure for the Hot Cell A through Hot Cell F DWMU will be discussed further in this closure plan.

H3.4.11 K3 Exhaust System

The K3 exhaust system ventilates the canyon and hot cells. These are the most contaminated areas of the building and are maintained at the most negative pressure. The K3 exhaust fan draws air from the canyon and hot cells and passes it through the K3 HEPA filters before it exits through the monitored 296-B-10 stack.

Each hot cell has two exhaust paths to a common duct, and each exhaust path has one stage of HEPA filtration. The final K3 HEPA filters consist of two parallel filter housings. Each filter housing unit is located in a separate K3 filter pit.

The underground K3 exhaust duct, filter housings, and filter pit will be filled with grout to stabilize the contamination contained with these areas. A new K3N ventilation system will be installed to replace the function of the K3 exhaust system. The K3N system will consist of a filter housing with two redundant exhaust fans. The filter housing will include two HEPA sections in series, with each HEPA section consisting of six individual HEPA filters. It will ventilate the canyon, Hot Cell G, and Tank-100. The fan will draw air from these spaces through the HEPA filter before it exits through the monitored 296-B-10 stack.

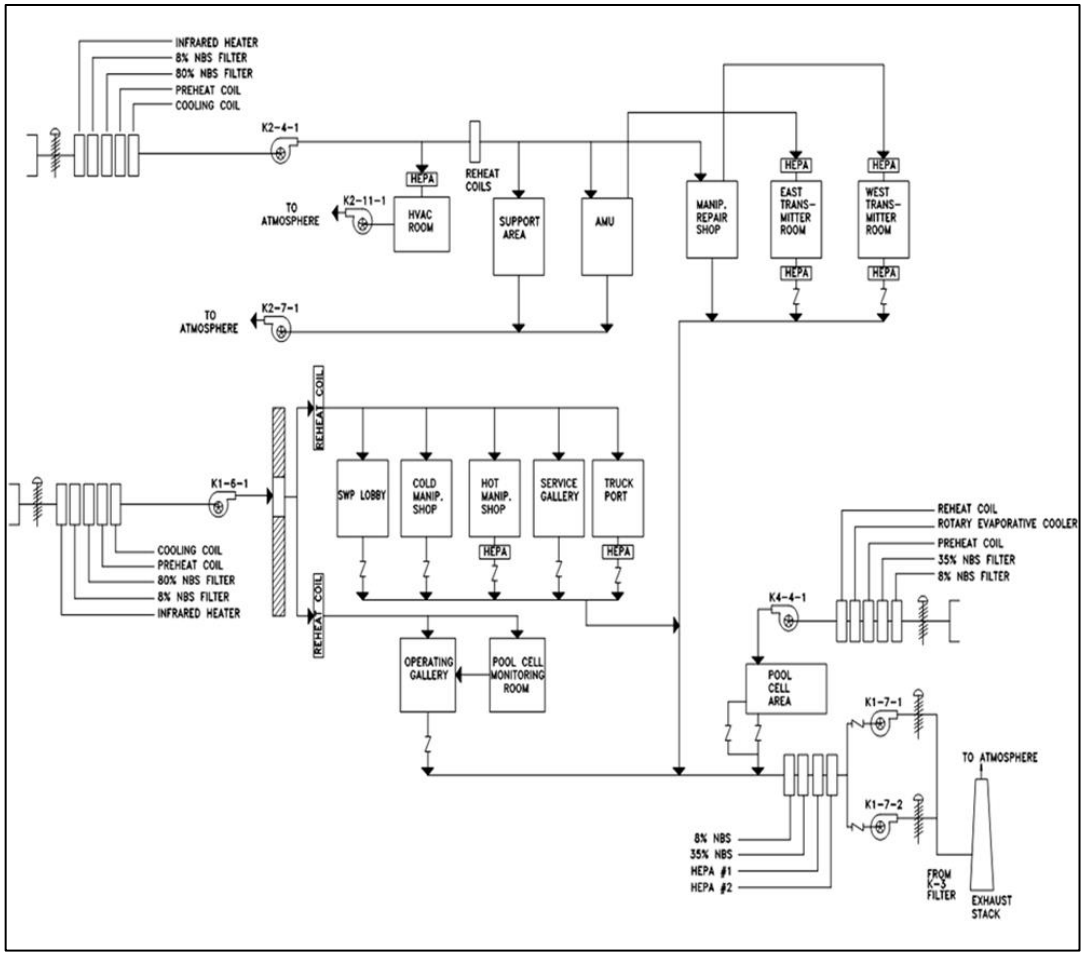

Figure H11. K1, K2, and K4 Ventilation

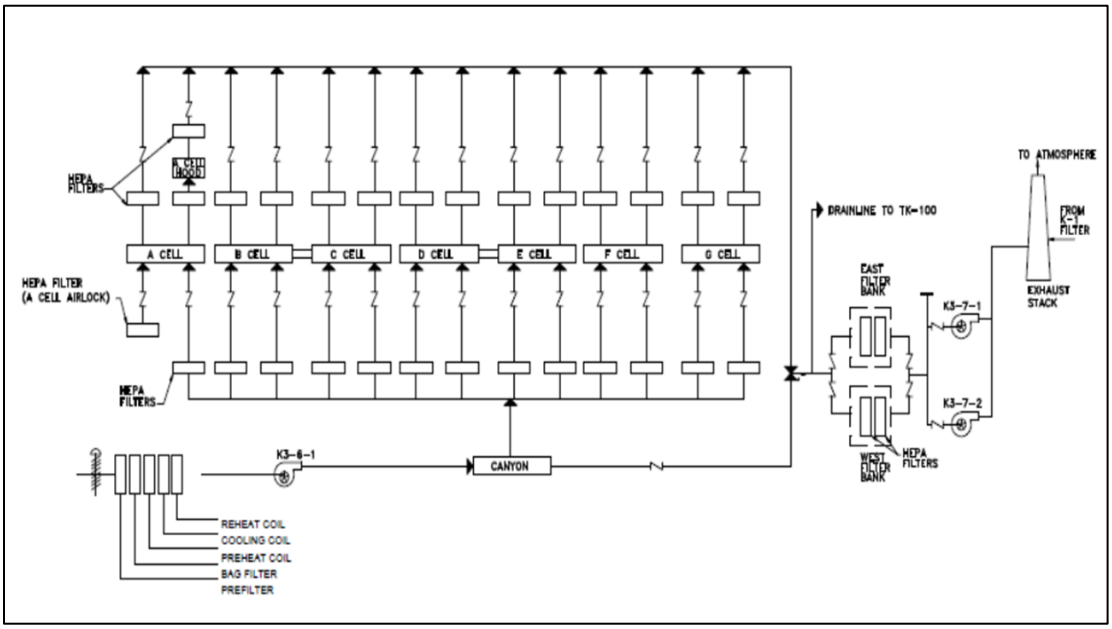

Figure H12. Current K3 Ventilation System

H3.4.12 Maximum Waste Inventory

WESF currently stores 1,936 capsules (the maximum number of capsules that are available to be stored). The waste volume inside each capsule is approximately 1 L (0.264 gal). Therefore, the maximum waste inventory of WESF is approximately 1,936 L (511 gal). Capsules are stored within the two operating DWMUs and will not be impacted by closure activities described in this plan.

Hot Cells A through F do not store any capsules and did not store any waste capsules after the effective date of RCRA at the Hanford Facility in August 1987.

The furnace, located in the wall between Hot Cells B and C, holds approximately 0.6 kg (1.3 lb) of waste in four trays inside the furnace. Hot Cell C holds approximately 1.2 kg (2.6 lb) of waste in two threaded, capped pipes.

The contents of Hot Cells A through F are detailed in Table H1.

H4 CLOSURE PERFORMANCE STANDARD

This closure plan covers initial closure actions for the Hot Cell A through Hot Cell F DWMU. Final clean closure of the Hot Cell A through Hot Cell F DWMU will be completed concurrent with closure activities for the remaining two operating WESF DWMUs. Closure performance standards for final closure of WESF will be based on WAC 173-303-610(2), which requires closure of the facility in a manner that accomplishes the following objectives:

- Minimize the need for further maintenance.
- Control, minimize, or eliminate, to the extent necessary, to protect human health and the environment (HHE), post-closure escape of dangerous waste, dangerous constituents, leachate, contaminated runoff, or dangerous waste decomposition products to the ground, surface water, groundwater, or atmosphere.
- Return the land to the appearance and use of surrounding land areas, to the degree possible, given the nature of the previous dangerous waste activity.

These performance standards are met through Sections H4.1 and H5.11.

Final clean closure of the remaining two DWMUs associated with the WESF Operating Unit Group will be addressed in WA7890008967, *Hanford Facility Dangerous Resource Conservation and Recovery Act Permit*, Revision 9, Part III, Operating Unit Group 14, Waste Encapsulation and Storage Facility.

H4.1 Clean Closure Levels

The Hot Cell A through Hot Cell F DWMU will be clean closed. Once the stabilized hot cells have been removed, the remaining underlying soil will be sampled and must meet clean closure levels. In accordance with WAC 173-303-610(2)(b)(i), clean closure levels for the soil are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to WAC 173-340, "Model Toxics Control Act—Cleanup," hereinafter called MTCA, regulations (WAC 173-340-700, "Overview of Cleanup Standards," through WAC 173-340-760, "Sediment Cleanup Standards," excluding WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties"). These numeric cleanup levels have been calculated according to the requirements of WAC 173-303-610(2)(b)(i) as of the effective date of the permit modification. These cleanup levels consider carcinogens, and noncarcinogens values.

The miscellaneous unit performance standards identified in WAC 173-303-680(2)(b)(i) through (4), as required by WAC 173-303-610(2)(b), are addressed in Table H2.

A null hypothesis is generally assumed to be true until evidence indicates otherwise. The null hypothesis, as defined in WAC 173-340-200, "Definitions," for Hot Cells A through F is that the underlying soil, once the hot cells have been removed, is assumed to be above unrestricted use cleanup levels, commonly called MTCA (WAC 173-340) Method B levels.

Therefore, the site is presumed to be contaminated. Rejection of the null hypothesis means that sampling and analysis results of the site indicated soil contamination below the MTCA Method B levels. Sampling and analysis in accordance with the sampling and analysis plan (SAP) (Section H5.12) will be used to determine whether the null hypothesis can be rejected, thereby confirming that soil meets the closure performance standards (MTCA Method B).

Since the DWMU is anticipated to be clean, should sampling and analysis determine that the null hypothesis can be accepted, indicating that the site is contaminated, such an event will be considered an unexpected event during closure, and the soil would then be identified as contaminated environmental media and managed in accordance with Section H5.10.

Table H2 WAC 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
(2) Environmental performance standards. A miscellaneous unit must be located, designed, constructed, operated, maintained, and closed in a manner that will ensure protection of human health and the environment. Permits for miscellaneous units are to contain such terms and provisions as necessary to protect human health and the environment, including, but not limited to, as appropriate, design and operating requirements, detection and monitoring requirements, and requirements for responses to releases of dangerous waste or dangerous constituents from the unit. Permit terms and provisions must include those requirements in WAC 173-303-630 through 173-303-670, 40 CFR. Subparts AA through CC, which are incorporated by reference at WAC 173-303-690 through 173-303-692, WAC 173-303-800 through 173-303-806, part 63 subpart EEE (which is incorporated by reference at WAC 173-400-075 (5)(a)), and 40 CFR, Part 146 that are appropriate for the miscellaneous units being permitted. Protection of human health and the environment includes, but is not limited to:	The Hot Cell A through Hot Cell F DWMU will be closed in a manner that will ensure protection of HHE through the activities identified in this closure plan, which was developed in accordance with and to meet the regulatory requirements of WAC 173-303-610.
(a) Prevention of any releases that may have adverse effects on human health or the environment due to migration of wastes constituents in the groundwater or subsurface environment, considering:	Grouting of Hot Cells A through F will prevent migration of dangerous waste constituents to the groundwater or subsurface environment below WESF.
(i) The volume and physical and chemical characteristics of the waste in the unit, including its potential for migration through soil, liners, or other containing structures;	
(ii) The hydrologic and geologic characteristics of the unit and the surrounding area;	
(iii) The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater;	
(iv) The quantity and direction of groundwater flow;	
(v) The proximity to and withdrawal rates of current and potential groundwater users;	
(vi) The patterns of land use in the region;	
(vii) The potential for deposition or migration of waste constituents into subsurface physical structures, and into the root zone of food-chain crops and other vegetation;	
(viii) The potential for health risks caused by human exposure to waste constituents; and	
(ix) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.	
(b) Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in surface water, or wetlands or on the soil surface considering:	Grouting of Hot Cells A through F will prevent migration of dangerous waste constituents to the soil surface under WESF. There are no surface waters or wetlands in the proximity of WESF.
(i) The volume and physical and chemical characteristics of the waste in the unit;	

Table H2 WAC 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
(ii) The effectiveness and reliability of containing, confining, and collecting systems and structures in preventing migration;	
(iii) The hydrologic characteristics of the unit and the surrounding area, including the topography of the land around the unit	
(iv) The patterns of precipitation in the region;	
(v) The quantity, quality, and direction of groundwater flow;	
(vi) The proximity of the unit to surface waters;	
(vii) The current and potential uses of nearby surface waters and any water quality standards established for those surface waters;	
(viii) The existing quality of surface waters and surface soils, including other sources of contamination and their cumulative impact on surface waters and surface soils;	
(ix) The patterns of land use in the region;	
(x) The potential for health risks caused by human exposure to waste constituents; and	
(xi) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.	
(c) Prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air, considering:	Grouting of Hot Cells A through F and the K3 ventilation system will prevent migration of dangerous waste constituents to the air outside of WESF. Contamination control methods, such as glove-bags and portable filtered ventilators, will be used during core drilling to prevent the spread of contamination. As the grout flows into placement locations, air will be displaced by the grout. Displaced air will contain water vapor and will be radioactively contaminated. Portable ventilation systems, which consist of a HEPA filter, heater, and fan, will be used to collect and filter the displaced air.
(i) The volume and physical and chemical characteristics of the waste in the unit, including its potential for the emission and dispersal of gases, aerosols and particulates;	
(ii) The effectiveness and reliability of systems and structures to reduce or prevent emissions of dangerous constituents to the air;	
(iii) The operating characteristics of the unit;	
(iv) The atmospheric, meteorologic, and topographic characteristics of the unit and the surrounding area;	
(v) The existing quality of the air, including other sources of contamination and their cumulative impact on the air;	
(vi) The potential for health risks caused by human exposure to waste constituents; and	

Table H2 WAC 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
(vii) The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.	Portable ventilation systems used to support grouting of the hot cells, hot pipe trench, K3 duct trench, and A Cell airlock will discharge inside the 225B Building, which is an abated air space. The portable ventilation systems used to support grouting of the K3 filter pit will discharge outside, and abatement and monitoring controls will be implemented. This activity will be licensed separately if the existing site license cannot be used.
(3) Monitoring, analysis, inspection, response, reporting, and corrective action. Monitoring, testing, analytical data, inspections, response, and reporting procedures and frequencies must ensure compliance with subsection (2) of this section, WAC 173-303-320, 173-303-340(1), 173-303-390, and 173-303-64620 as well as meet any additional requirements needed to protect human health and the environment as specified in the permit.	The stabilized hot cells will be maintained in a manner that prevents threats to HHE and monitored through routine radiation surveillances, using radiation as an indication of contamination outside the stabilized Hot Cell A through Hot Cell F DWMU.
WAC 173-303-320 Inspections	Inspections of the Hot Cell A through Hot Cell F DWMU are addressed in Section H5.2.
WAC 173-303-340(1)	WESF complies with annual reporting requirements through Hanford Facility Permit, Condition II.B.
WAC 173-303-390 Facility Reporting	
1. Unmanifested Waste Reports	N/A – WESF Hot Cell A through Hot Cell F DWMU will not be receiving additional waste shipments during closure.
2. Annual Reports	WESF complies with annual reporting requirements through Hanford Facility Permit, Condition I.E.22.
3. Additional Reports	
a. Releases of dangerous waste, fires, and explosions	Reports regarding releases of dangerous waste, fires, and explosions are addressed in DOE/RL-94-02, *Hanford Emergency Response Plan*.
b. Interim status groundwater monitoring data	N/A – WESF Hot Cells A through F are not a land disposal unit or surface impoundment, and groundwater monitoring is not required.
c. Facility closures specified in WAC 173-303-610(6)	Closure certification is addressed in Section H5.14 of this closure plan.

Table H2 WAC 173-303-680(2) through (4) Requirements

Requirement	Method of Compliance
d. As otherwise required by WAC 173-303-645 through 173-303-665, WAC 173-303-690 through 173-303-692, and WAC 173-303-400.	There have not been any releases from the Hot Cell A through Hot Cell F DWMU that are subject to the corrective action requirements. Air emission standards are met through the WESF K3 ventilation system.
4. Recordkeeping	WESF maintains a facility operating record in accordance with Hanford Facility Permit, Condition II.I.
WAC 173-303-64620 Corrective Action	There have not been any releases from the Hot Cell A through Hot Cell F DWMU that are subject to corrective action requirements.
(4) Post-closure care. A miscellaneous unit that is a disposal unit must be maintained in a manner that complied with subsection (2) of this section during the post-closure care period. In addition, if a treatment or storage unit has contaminated soils or groundwater that cannot be completely removed or decontaminated during closure, then that unit must also meet the requirements of subsection (2) of this section during post-closure care. The post-closure plan under WAC 173-303-610(8) must specify the procedures that will be used to satisfy this requirement.	The Hot Cell A through Hot Cell F DWMU will be clean closed. No post-closure care is required.

H5 CLOSURE ACTIVITIES

The Hot Cell A through Hot Cell F DWMU does not store capsules and will not be used in future waste management activities at WESF. As a result, Hot Cells A through F will undergo closure to minimize the need for further maintenance and eliminate the potential for the release of dangerous constituents from the DWMU.

As described in Section H3.4 of this closure plan, the hot cells were used to encapsulate Cs-137 and Sr-90 that had been separated from plutonium production waste in B Plant. As a result, the hot cells became contaminated with a significant amount of Cs-137 and Sr-90, along with smaller amounts of dangerous constituents.

The K3 exhaust ventilation system controls the release of contamination from the hot cells. This aging system relies on HEPA filters that have exceeded their operational life and need to be replaced. However, replacement of the filters is impractical due to the high levels of radionuclide contamination.

A project has been initiated to address K3 ventilation system issues. Implementation of this project will include initial closure activities for the Hot Cell A through Hot Cell F DWMU, along with installation of a new ventilation system. Although the ventilation system is not part of the DWMU, it is discussed in this closure plan so the reader can fully understand the approach for initial closure activities of the DWMU.

The integrated approach to complete initial closure activities of the DWMU includes the following tasks:

- Replace the K3 exhaust ventilation system with a new system (K3N). The K3N system will ventilate the Hot Cell A through Hot Cell F DWMU during initial closure activities. The K3N system will also provide ventilation for Hot Cell G, which is one of the two DWMUs that will remain operational at WESF.
- Stabilize legacy contamination in the K3 exhaust ventilation system and in Hot Cells A through F. Stabilization will be accomplished by filling contaminated areas with grout.

Completion of this project will also support eventual removal of cesium and strontium capsules, which are currently in the pool cells at WESF, and subsequent transfer of the capsules to a newly constructed treatment, storage, and/or disposal (TSD) unit.

Significant modifications to hot cells will be performed to enable replacement of the aging ventilation system, including the introduction of grout. Modifications have been analyzed to ensure that the safety functions of the structures are not negatively impacted. These structural evaluations are documented in CHPRC-02270, *Structural Evaluation for Grouting the 225-B Building Hot Cells*; CHPRC-02420, *W-130 Project Building 225B South Wall K3N Duct Penetration Analysis*; and CHPRC-02531, *W-130 Project Structural Evaluation of Vertical Core Drill Through Hot Cell Divider Walls*.

Initial closure activities for the Hot Cell A through Hot Cell F DWMU consists of the following main tasks:

- Site preparation
- Unit modification and evaluation prior to stabilization
- Stabilization of contamination within WESF

Following completion of the initial Hot Cell A through Hot Cell F DWMU closure activities described, an extended closure period will begin prior to completion of final Hot Cell A through Hot Cell F DWMU closure activities. Final closure activities for the Hot Cell A through Hot Cell F DWMU will be completed concurrent with closure activities for the remaining two operating WESF DWMUs. Final clean closure activities for the Hot Cell A through Hot Cell F DWMU consist of the following main tasks:

- Demolition and removal of the Hot Cell A through Hot Cell F DWMU
- Management and disposal of the hazardous debris
- Visual verification of underlying soil
- Sampling and analysis to confirm clean closure

H5.1 Health and Safety Requirements

Closure will be performed in a manner to ensure the safety of personnel and the surrounding environment. Qualified personnel will perform any necessary closure activities in compliance with established safety and environmental procedures. Personnel will be equipped with appropriate personal protective equipment (PPE). Qualified personnel will be trained in applicable safety and environmental procedures and have appropriate training and experience in sampling activities. Field operations will be performed in accordance with applicable health and safety requirements.

The Permittees have instituted training or qualification programs to meet training requirements imposed by regulations, DOE orders, and national standards such as those published by the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. The Hanford Facility RCRA Permit, Attachment 5, describes specific requirements for the Hanford Facility Personnel Training program. The Permittees will comply with the training matrix shown in Table H3, which provides training requirements for Hanford Facility personnel associated with closure activities for the Hot Cell A through Hot Cell F DWMU.

Project-specific safety training addressed explicitly to the project and day's activity will include training to provide the knowledge and skills needed for personnel to perform work safely and in accordance with quality assurance (QA) requirements.

Pre-job briefings will be performed to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Emergency contacts

Training records are maintained for each employee in an electronic database. The Permittees' training organization maintains the training records system. A record of training, as required by Table H3, will be kept in the operating record until the Washington State Department of Ecology (Ecology) approves certification of final closure of the three WESF DWMUs.

Table H3. Training Matrix for Hot Cell A through Hot Cell F DWMU

Training Category[a]							
Permit Attachment 5 Training Category	**General Hanford Facility Training**	**Contingency Plan Training**	**Emergency Coordinator Training**	**Operations Training**			
WESF DWTP Implementing Plan	**Orientation Program**	**Operations Program (Emergency Response – Contingency Plan Duties)**	**Emergency Coordinator**	**General Waste Management Duties**	**Awareness Program**	**Container Management**	**Miscellaneous Storage Unit Management**
Job Title/Position							
Nonfacility Personnel	X						
Maintenance Crafts	X				X[b]		
Radiological Control Technician	X				X[b]		
Nuclear Chemical Operator	X	X[b]		X[b]	X[b]	X[b]	X[b]
Shift Operations Manager	X	X[b]	X[b]				
Environmental Compliance Officer	X			X[b]			
Waste Service Provider	X			X[b]		X[b]	

DWMU = dangerous waste management unit
DWTP = dangerous waste training plan

[a] Refer to the WESF DWTP for a complete description of coursework in each training category.

[b] Training received is commensurate with the duties performed. Individuals in this category who do not perform these duties are not required to receive this training.

H5.2 Records Review and Visual Inspections

As a miscellaneous unit permitted closely to a container storage area, the clean closure determination for Hot Cell A through Hot Cell F is partially based on review of the operational history and operating records, as detailed in this closure plan, to verify that all items (both debris and waste) remaining in the hot cells during stabilization and closure are identified. Based on these reviews, Hot Cells A through F is a candidate for clean closure under RCRA, and confirmation sampling will be performed. Certain documents (SD-WM-ER-014; SD-WM-ER-022; and HNF-8556, *Estimate of WESF Hot Cell Inventory*) were reviewed to identify activities performed to place Hot Cells A through F into standby/surveillance mode and identify inventory within the hot cells. Information provided in those documents was utilized to develop this closure plan. In addition to reviewing these documents, visual verification of Hot Cell F contents was performed. Contents and conditions in Hot Cells A through E cannot be visually verified due to the unavailability of lighting within the cells.

During the extended closure period for the Hot Cell A through Hot Cell F DWMU, inspections will continue to maintain the facility in a manner that prevents threats to HHE. Once initial closure activities have been completed and the extended closure period begins, annual inspections of the DWMU will be performed in accordance with Table H4. Annual inspections are deemed sufficient because any structural degradation of the DWMU, that could potentially cause a release of dangerous waste constituents to the environment, would occur slowly and can be identified at this inspection frequency.

After Hot Cells A through F have been filled with grout, the DWMUs internal monitoring equipment will be encased within the grout and will be inactive. Annual inspections identified in Table H4 will be performed visually, and no additional monitoring equipment will be used.

Penetration covers are utilized during closure activities to minimize contamination migration. Once the grout has cured, the penetration covers no longer serve a purpose; therefore, inspection is not necessary.

The DWMU is located inside a building and is not accessible for unknowing or unauthorized entry by persons or livestock. The building is protected by locked doors with posted warning signs. Vehicular access to roads leading to the DWMU area are through the Hanford Facility 24-hour controlled access points. The access points are posted with restrictive signage.

Table H4. WAC 173-303-320(2) Inspection Schedule for Hot Cell A through Hot Cell F

Requirement Description	Inspection Frequency	Inspection
Posted Warning Signs	Annually	Verify that signs are posted and legible.
Hot Cell A through Hot Cell F Exterior Surfaces and Surrounding Area	Annually	Check for structural damage to the building. Check outside the building for liquid accumulations or signs of releases of hazardous waste. Verify viewing window plates are sealed.

Inspection documentation must include, at a minimum, the date and time of inspection, observations, corrective actions (if any), and name/signature of inspection personnel. Inspection documentation must be maintained in the WESF facility operating record for a minimum of five years after Ecology clean closure acceptance. Corrective actions taken as a result of inspections must be remedied on a schedule that prevents hazards to the public health and environment.

Once the Hot Cell A through Hot Cell F DWMU has been demolished and removed, visual verification of the underlying soil will be performed to identify any staining or discolored soil, the presence of wet areas, or other signs of potential contamination.

The presence of volatile emissions is unlikely; however, the potential for volatile emissions will be evaluated upon removal of the Hot Cell A through Hot Cell F DWMU. Areas of concern of the underlying soil would be considered a candidate for focused sampling under the SAP.

H5.3 Site Preparation

Site preparation will consist of installation and startup of the new K3N system. Stabilization activities will be performed with the K3N system operational.

H5.4 Unit Modification Prior to Stabilization

Areas to be grouted include Hot Cells A through F, the Hot Cell A air lock, the underground K3 exhaust ventilation system ducting, the hot pipe trench and K3 ventilation duct trench underneath the hot cells, and the K3 filters and filter pit. All of these areas will be isolated from the portions of WESF that will remain operational. Isolation will ensure that grout and contamination do not spread outside of the areas to be grouted and will include the following activities:

- Isolate equipment that connects to the K3 exhaust system ducting.
- Isolate utility lines that remain connected to the hot cells. These utilities include air and electrical services.
- Install covers over and/or seal hot cell penetrations, such as the viewing windows, manipulator ports, and pass-throughs between Hot Cell F to Hot Cell G and from Hot Cell F to the service gallery. Oil will be drained from the viewing windows before the covers are installed.

A prerequisite activity to grouting hot cells is to pour a concrete block over the lead shielding that is against the north service gallery wall. Lead shielding is in place to cover a hot spot that resulted from migration of cesium from Hot Cell D/E through holes in the Hot Cell D/E cell floor liner. The liner was repaired in 1980. The concrete block will ensure that no grout escapes when grouting Hot Cell D/E.

Grout will be added to contaminated spaces through existing piping or penetrations wherever possible. Where this is not possible, core drilling will be performed to provide penetrations into the spaces for the addition of grout. Penetrations will need to be made through the K3 filter pit walls, into the K3 filter housings, through the Hot Cell A airlock ceiling, through the top of the K3 duct trench (through the hot cell divider walls above), and through the top of the hot pipe trench (through the hot cell divider wall and hot manipulator shop above). Figure H13 shows the location of core drills and other grout addition penetrations in the canyon that affect Hot Cells A through F.

Contamination control methods, such as glove-bags and portable filtered ventilators, will be used during core drilling to prevent the spread of contamination. A wet core drill with a vacuum attachment, water collection ring, and wastewater collection system will be used to minimize dust generated during concrete core drilling.

An engineering evaluation has been performed to demonstrate that the addition of grout to the hot cells will not affect the structural integrity of the building (CHPRC-02270).

H5.5 Stabilization

The primary function of stabilization is physical isolation of contamination, so no exposure pathways remain where humans or the environment could be adversely impacted.

H5.5.1 Grout Design

For this application, grout will not perform a structural function for seismic/structural calculation purposes, but it will have sufficient compressive strength to support applicable loads upon completion of grouting activities.

During development of the WESF grout design, documentation related to the U Plant grouting project was reviewed to identify any lessons learned that might be applicable to the WESF activity. Documents reviewed included DOE/RL-2010-127, *90 percent Remedial Design Report for Grouting 221-U Plant Canyon*, and D&D-35827, *Project Experience Report, Canyon Disposition Initiative (221-U Facility)*.

The grout used at WESF will be a flowable, nonaggregate void filling grout formulated to meet the following performance criteria:

- Maximum allowable centerline temperature of 71ºC (160°F) during curing
- Minimum flow distance of 18 m (60 ft)
- Minimum allowable compressive strength of approximately 10,300,000 newton/m^2 (1,500 lb/in^2) at 28 days
- Capable of entering and filling openings/voids with a minimum dimension of approximately 1.3 cm (0.5 in.)

A grout testing plan will be developed as part of the QA testing program to ensure that the grout used complies with project specifications. Engineering and laboratory scale testing will be performed to confirm that the grout formulation meets the performance criteria prior to the addition of grout to any areas within WESF. Field inspection and testing will be performed during the grouting operation.

The grout design process included the performance of several evaluations to determine how well the grout will perform under conditions expected at WESF.

Radiolysis occurs when radioactive materials are in the presence of water. Hydrogen gas is generated as a result of radiolysis and, if allowed to accumulate, can present a flammability/explosive hazard. Evaluation has determined that the potential for an accumulation of hydrogen gas of sufficient concentration and under conditions necessary to support combustion is very small.

Over long time periods, concrete structures may degrade as a result of sufficient exposure to ionizing radiation. A very conservative calculation has been performed that shows that the time frame necessary for the recognized cumulative exposure threshold associated with concrete degradation is greater than 110 years. A more realistic, yet still conservative, calculation shows that the time frame necessary to reach a radiation exposure of concern is in excess of 590 years (CHPRC-02499, *W-130 Project Calculation: Estimate of Impacts to Grout as a Result of Radiation Exposure*). Based on review of the grouting design and hot cells, there is not a concern that there will be any degradation of grout or the hot cells concrete structure due to radiation exposure.

Grout can also be affected by exposure to high temperature. The grout design limits temperatures due to heat of hydration to 160°F, which will not negatively affect the grout or structural concrete. Potential impacts to the grout as a result of heat of hydration and decay heat have been evaluated, and there are no deleterious effects (CHPRC-02429, *W-130 Project Calculation: Estimate of Concrete Temperature in WESF Hot Cells From Decay Heat*).

H5.5.2 Grout Delivery

Grout will be prepared offsite and trucked to WESF. The grout will be tested to verify performance before construction begins. Grout samples will be collected and tested during construction.

A grout pump will be placed on the west side of the truck port entrance. Water will be provided from a fire hydrant or building hose connection.

Hose will be routed from the grout pump to locations to be grouted using the following general routing:

- From the grout pump to the K3 filter pit (outside the 225B Building)
- From the grout pump, through the truck port, to the Hot Cell G air lock, and into the service gallery

- From the grout pump, into the truck port, up through the floor opening into the canyon, and along the canyon floor to access the hot cells and the Hot Cell A air lock. Grout will be added to the hot cells through existing penetrations (ventilation inlet ports).

The piping and hose will remain in place for each route only as long as grout placement in the stabilized areas is required.

A temporary washout pit will be set up near the grout pump and truck delivery location to contain rinsate from the delivery trucks and grout pump.

A construction trailer(s) will be located near WESF to provide support for grouting activities. Electric power will be required for the trailer(s) and supplemental lighting. If used, portable generators will be in service for less than 365 days and will not be permitted as stationary sources. The engine used to power the generator set will meet the existing reciprocating internal combustion engine standards (40 CFR, Part 61, "National Emission Standards for Hazardous Air Pollutants") for that engine size.

H5.5.3 Grout Placement

Grouting will begin inside the exhaust duct, downstream of the K3 filter pit, and inside the two HEPA filter units, to stop any contamination from escaping through the exhaust system during subsequent grouting.

The following general sequence is used for stabilization grouting of the Hot Cell A through Hot Cell F DWMU:

- K3 filter pit (not part of TSD)
- K3 duct (not part of TSD)
- Hot Cell A air lock (not part of TSD)
- Hot pipe trench (not part of TSD)
- K3 duct trench (not part of TSD)
- Hot cells

The sequence provided is a general sequence only. The hot cells will be partially filled to provide shielding for the core drilling, which will allow access to the K3 duct trench, and complete the hot pipe trench grout addition. The Hot Cell A air lock does not need to be completely grouted before hot cell grouting starts. The exact sequence will be determined during the final work planning process and documented in the work package that is used to perform the work.

To minimize cracking of the grout, the lift depth will be limited to approximately 0.9 m (3 ft). This limitation will also allow placement of the next lift the following day.

Grout will be distributed from the grout pump set up outside the truck port to the vicinity of the grout fill location. Valves will be used at the fill connections to enable quick shutoff of grout once the volume is filled.

As grout flows into placement locations, air will be displaced by the grout. Displaced air will contain water vapor and will be radioactively contaminated. Portable ventilation systems, which consist of a HEPA filter, heater, and fan, will be used to collect and filter the displaced air. Portable ventilation systems used to support grouting of the hot cells, hot pipe trench, K3 duct trench, and A Cell airlock will discharge inside the 225B Building, which is an abated air space. Portable ventilation systems used to support grouting of the K3 filter pit will discharge outside, and abatement and monitoring controls will be implemented. This activity will be licensed separately if the existing site license cannot be used.

Expected grout volume will be used as an initial indicator to determine when grouting is complete. Design of the grout addition system will include provisions for visual confirmation that the spaces being grouted are filled as much as possible.

H5.5.4 K3 Filter Pit and Filter Housings

K3 filter housings (Figure H14) are located in an underground vault that consists of several chambers. All chambers of the underground vault and filter housings will be filled with grout. Estimated grout volume is 132 m^3 (173 yd^3).

Core drills will be made into each chamber of the filter pit and the filter housings to allow placement of grout. Contamination control methods, such as the use of glovebags and portable ventilators, will be used to prevent the spread of contamination during drilling and grouting.

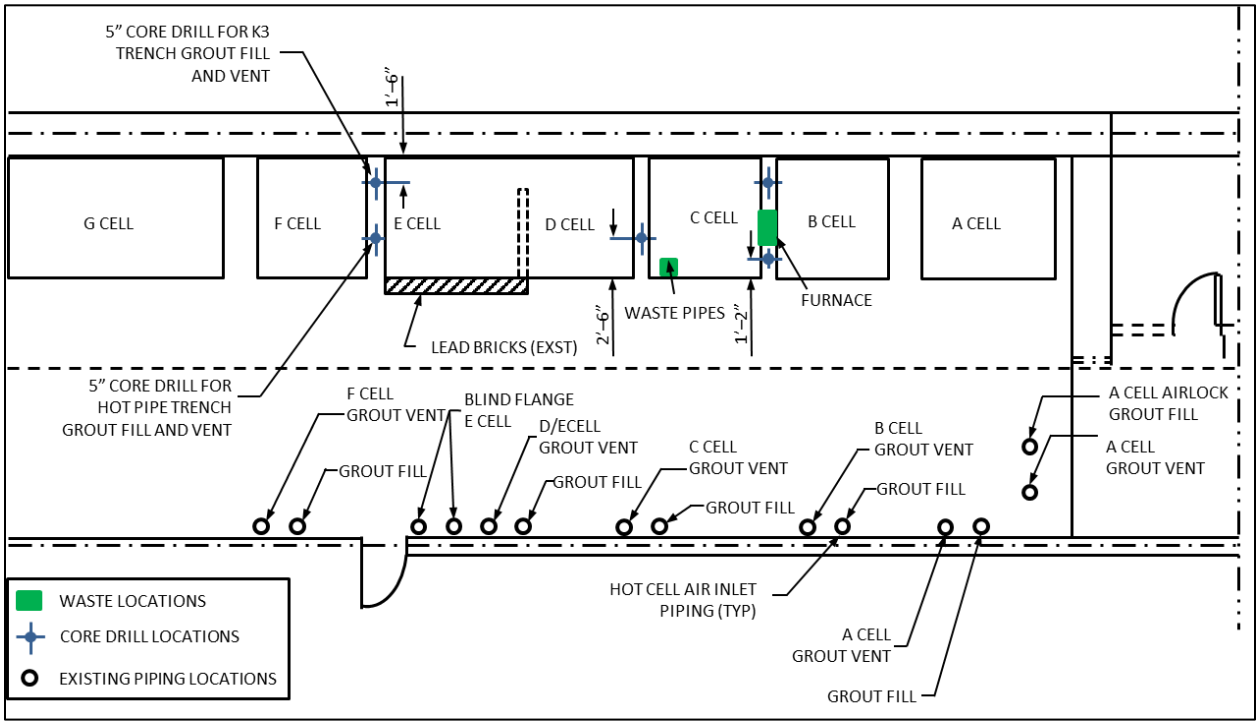

Figure H13 Core Drills and Grout Addition Locations in Canyon

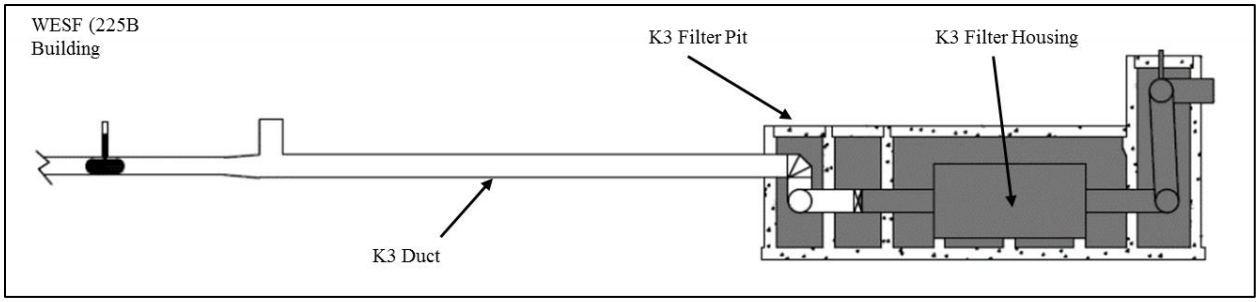

Figure H14. K3 Filter Pit and Duct

H5.5.5 K3 Duct and Trench

The K3 duct extends from the K3 filter pit to the 225B Building. It is located inside a trench and runs underneath the hot cells. Both the K3 duct and K3 duct trench will be filled with grout. The estimated grout volume is 11 m^3 (14 yd^3) for the duct and 13 m^3 (17 yd^3) for the K3 duct trench.

Grout will be added to the K3 duct through access points in the truck port and in Hot Cell G. Access to the K3 duct trench will be via core drills through the divider walls between Hot Cells B and C and between Hot Cells E and F. These divider walls are approximately 50 cm (20 in.) wide and approximately 4.9 m (16 ft) deep. Figure H15 shows how core drills through the divider walls will be performed. Grout will be added through these penetrations until the K3 duct trench is full.

H5.5.6 Hot Pipe Trench

The hot pipe trench runs underneath the hot cells next to the K3 duct trench. The entire hot pipe trench will be filled with grout. Access to the hot pipe trench will be via core drills through the floor of the hot manipulator shop and through the divider walls between Hot Cells B and C, between Hot Cells C and D, and between Hot Cells E and F (see Section H5.4 for core drill locations).

Grout will first be added to the hot pipe trench through a penetration made in the floor of the hot manipulator shop (not shown in Figure H13). Grout will then be added through the Hot Cell B and Hot Cell C divider wall penetrations, and finally through the Hot Cell E and Hot Cell F divider wall penetrations until the hot pipe trench is full. Penetration through the Hot Cell C and Hot Cell D divider wall will be used for venting. The core drill locations were chosen to avoid drilling through obstructions, such as the furnace between Hot Cells B and C.

Due to congested conditions in the hot pipe trench with piping and supports, grout pump discharge pressure will be the indication of complete filling since volume calculations will be inaccurate.

The estimated grout volume for the hot pipe trench is 28 m^3 (36 yd^3).

H5.5.7 Hot Cell A Air Lock

The Hot Cell A air lock will be grouted to stabilize contamination within the air lock and to prevent the Hot Cell A access door from opening when Hot Cell A is grouted. The air lock must receive at least one lift of grout before Hot Cell A stabilization can proceed.

Grout will be added to the Hot Cell A air lock through ceiling penetrations made by core drilling through the canyon floor (canyon is directly above the air lock). Estimated grout volume is 50 m^3 (66 yd^3).

H5.5.8 Hot Cells

Grout will be added to Hot Cells A through F to the underside of the cover blocks. The hot cells will be filled and actively vented during the grouting process using existing ventilation inlet ports.

Each hot cell has a viewing window on the operating gallery side that must be protected to ensure that there is no breach by liquid grout during the placement process. Protection of the windows is addressed in Section H5.5.9.

Numerous penetrations through the hot cell walls into the operating gallery and service gallery must be sealed to prevent leakage of contaminated grout. A combination of cover plates and mastic material will be employed for this purpose. Pass-throughs from Hot Cell F to Hot Cell G and Hot Cell F to the service gallery will be sealed from Hot Cell G and the service gallery sides to contain the grout.

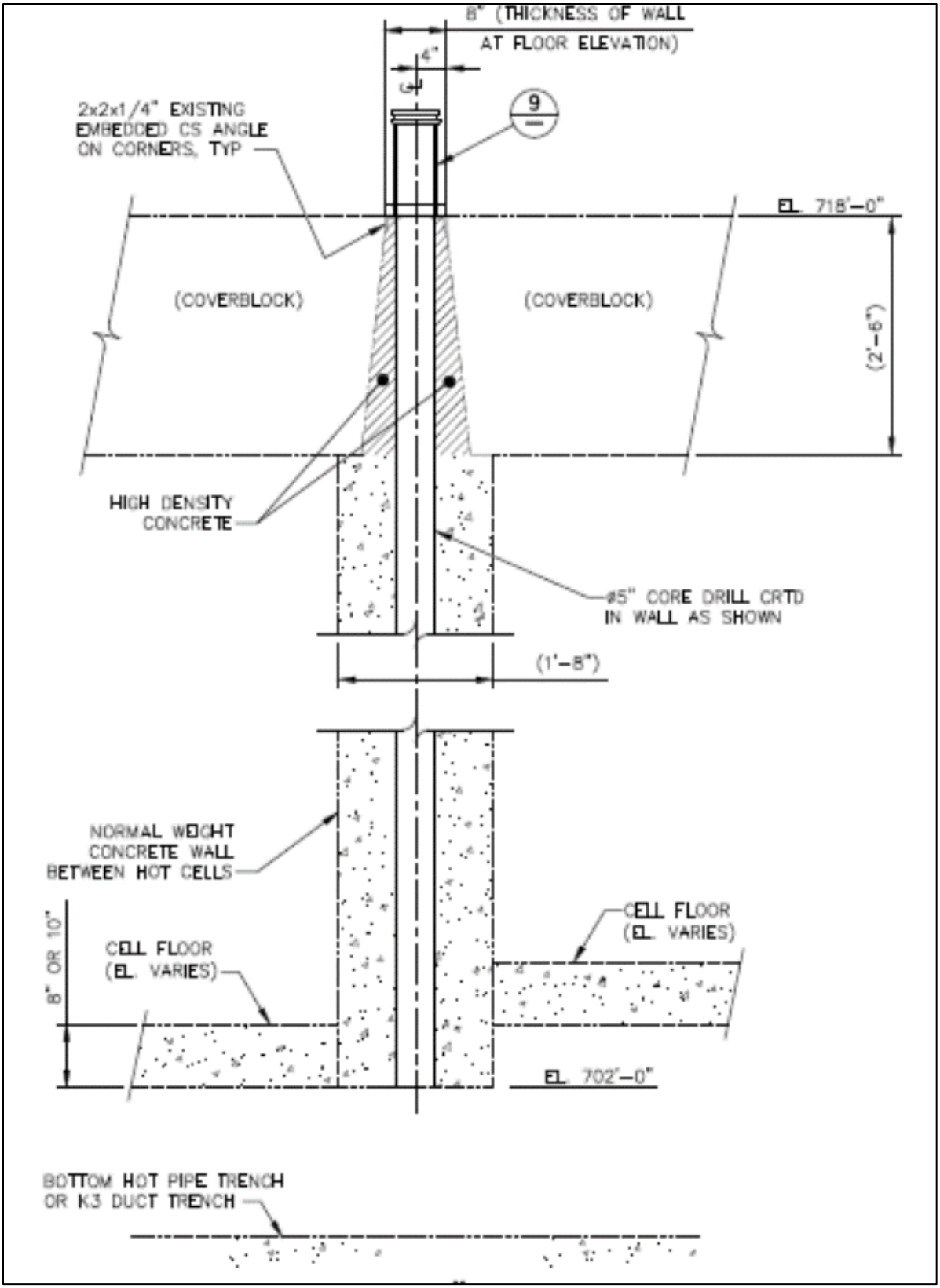

Figure H15. Performance of Core Drills through Divider Wall

Hot cell grouting will be performed in multiple lifts. Sequencing of hot cell stabilization will be finalized with the grouting contractor. Each cell could have a lift placed in turn, or one cell can be filled before moving on to the adjacent one. Because of the flowability of the grout and because no effort is made to seal the hot cells from each other, it is likely that all cells will fill together until the grout level is above the highest common penetration. Estimated grout volumes are listed in Table H5.

Table H5. Estimated Hot Cell Grout Volume

Hot Cell	Total Grout Volume (yd^3)
A	47
B	28
C	28
D and E	62
F	28

Hot cells contain the following tanks, piping, and other equipment:

- Process tanks within the hot cells are connected to the floors, walls, and/or connecting piping and are not expected to be buoyant. Tank drain and vent valves were left open during hot cell cleanout and the grout formula being used is thin, so grout is expected to enter and fill most of the tanks and other equipment left in the hot cells.
- HEPA filters in the ventilation exhaust and between Hot Cell A and the A Cell Hood are expected to fail, so grout will enter all of these spaces.
- Four trays of waste will remain in the furnace between Hot Cells B and C. The furnace has small penetrations, which will remain open during grouting and allow some grout to flow inside. However, macroencapsulation will be accomplished by grout surrounding and encapsulating the furnace. Although grout may not completely fill the furnace to encapsulate the trays directly, it will completely encapsulate the furnace containing the trays, so the statutory requirement of 42 USC 6924(m), "The Public Health and Welfare," "Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," will be met thorough substantial reduction of the migration potential of hazardous constituents from the waste.
- No effort will be made to seal pass-throughs between the hot cells, so grout should be forced into those spaces.
- Gaskets on the hot cell side of the window may or may not fail. If they fail, allowing grout to flow into the spaces around the window, between the window panes, then the seal installed on the operating gallery side of the window will contain the grout.
- Although not expected, items that are not attached to the floor or walls of the hot cells may become buoyant during grouting of the hot cells. These items included HEPA filters, open-top rectangular tanks in Hot Cell F, and miscellaneous loose items within the hot cells.

The approach to grout placement will be to add grout in lifts. The first lift of grout will flow around all fixed objects. This first lift will be allowed sufficient time to harden before placing the next lift. Any objects that float up with the grout will be bonded in the top surface, depending on displacement of the object. Tanks will have enough surface area in contact with the grout to develop a bond that will keep them in place when the next lift is placed. Hoses and HEPA filters will be bonded to the first lift because of their large surface area and light weight.

H5.5.9 Hot Cell Viewing Window Protection

Each hot cell has a viewing window consisting of multiple sections of glass (tempered and leaded) separated by inner sections of oil to provide operator shielding.

The total volume of oil between the panes of glass in each window is approximately 30 L (8 gal). The gap remaining after the oil is removed is approximately 0.64 cm (0.25 in.) between each pane. Removal of the oil is performed through the work package process, which includes the use of a waste planning process before work is performed. Once the oil is removed, it will be managed as identified in Section H3.4.6. Oil removal from the viewing window is performed using the following steps:

- Attach oil filling tubing to a plastic bottle.
- Open the oil inlet line to drain oil from the window into the preapproved container.

A steel plate will be attached to the outside of the shield wall in the operating gallery that covers the entire viewing window. It will extend far enough to use concrete anchors to hold it in place. A seal will be used between the plate and wall to ensure that contaminated grout will not breach the windows.

The grout lift heights inside each hot cell will be adjusted to ensure that the upper elevation of the grout lift occurs near the top of the window to reduce hydrostatic pressure on the window.

H5.5.10 Control of Contamination during Grouting

As the grout flows into placement locations, air, water vapor, and radiological contaminants may be released through the vent locations. Radiological contamination will be controlled by active ventilation with portable exhausters at specified locations. Active ventilation will allow air movement to be controlled throughout all phases of the project.

H5.6 Demolition of the Hot Cell A through Hot Cell F DWMU

Demolition of the Hot Cell A through Hot Cell F DWMU will take place concurrently with demolition of the remaining portions of WESF. The following primary activities are required to complete demolition of the Hot Cell A through Hot Cell F DWMU:

- Location of utilities
- Equipment mobilization
- Demolition and removal of Hot Cell A through Hot Cell F

H5.6.1 Location of Utilities

Prior to demolition, any in-use utilities will be located as well as the underground fire water line. The fire water line supplies water to the fire hydrant, which will be utilized as the water supply for dust suppression during demolition activities.

H5.6.2 Equipment Mobilization

Resources, equipment, and materials (e.g., support trailers, excavators, diamond saw cutters, front loaders, trailers, sand, water fog cannons, and boring machinery) necessary to perform demolition will be staged in designated laydown areas in proximity to WESF.

H5.6.3 Demolition and Removal of Hot Cell A through Hot Cell F

Demolition of the Hot Cell A through Hot Cell F DWMU will be accomplished utilizing cutting and sawing to create monoliths. Water may be used to control dust generated from demolition activities. The amount of water used will be minimized to prevent ponding and runoff. While unlikely, other controls such as portable ventilation filter units, HEPA filtered vacuum cleaners, greenhouses, and/or fogging agents may be used. Additional storm water run-on and run-off controls may be implemented, as needed.

If needed, crusting agents or fixatives will be applied to any disturbed portion of the contamination area, such as exposed soil from the removal of monoliths that will be inactive for more than 24 hours. Material to be disposed at the Environmental Restoration Disposal Facility (ERDF) will also comply with the moisture content and other applicable requirements of WCH-191, *Environmental Restoration Disposal*

Facility Waste Acceptance Criteria. Dust fixative is applied to appropriate portions of the demolition and excavation site at the end of each shift, and if wind arises, to prevent the spread of contamination.

Demolition activities described in the following subsections presume that the waste will be disposed of at ERDF, as discussed in Section H5.9.4.

H5.6.3.1 Cutting and Sawing

Demolition using cutting or diamond wire sawing will be used to create multiple monoliths. Grouting the hot cells stabilizes contamination on the surfaces of the hot cells, waste boats and pipes, and exterior of remaining equipment and debris. To avoid disturbance of the potential surface contamination on the hot cell surfaces, diamond wire sawing will be performed through the walls between the cells, with the exception of the wall between Hot Cells B and C, which contains the boats inside the furnace. Cuts will be made to include the exterior walls of the hot cells. A general depiction of the specific cut locations is identified in Figure H16. Final cut locations will be determined, through the use of engineering drawings and field walkdowns, before the start of demolition.

The exact locations of HEPA filters and other debris on the cell floors are not known. Monolith cuts are designed to take advantage of wall structural integrity for building the exoskeleton and to ensure that remaining tanks are cut, so they are no longer a closed vessel for disposal. Due to the location of TK-B-4 in the wall directly above the furnace, after the monolith containing TK-B-4 and the furnace has been removed, a horizontal cut will be made into the tank so it is no longer a closed vessel; however, the monolith will remain whole. The horizontal cut location is depicted in Figure H16. Care will be taken to avoid breaching the furnace below the tank. If a cut to create a monolith breaches HEPA filters or other debris, the exposed surfaces of debris along the cut line of the monolith will be sealed in accordance with 40 CFR Part 268.45, "Land Disposal Restrictions," "Treatment Standards for Hazardous Debris" (Table 1, "Alternative Treatment Standards for Hazardous Debris").

Sealing is performed by the application of an approved sealing material such as epoxy, silicone, or urethane compounds that must adhere tightly to the debris surface to avoid exposure of the surface to potential leaching media. Sealants must be resistant to degradation by the debris and its contaminants.

During cutting and sawing activities, water is used to cool blades and wires. This water is collected using a vacuum system and reused during the demolition. After cutting and sawing activities are complete, the water is containerized, solidified, and managed as a newly generated waste stream (Section H5.9). Due to the size of the monoliths and the softness of the grout, an exoskeleton may need to be fabricated to support the structure of the monolith. The exoskeleton is made from steel plates bolted to the outside surfaces of the monolith. Once the steel plates are bolted to the surfaces, steel beams are welded to the plates. Depending on the weight of the monolith, it may be necessary to bore under the monolith and install steel beams to support the structural integrity of the monolith from below. Once the exoskeleton is in place, the monolith may be removed with a crane and lifted to the transportation trailer. The other option for removal of the monolith is by using jacks to lift the monolith and then drive the trailer underneath the monolith. Monoliths will then be removed and managed as hazardous debris (Section H5.9.4).

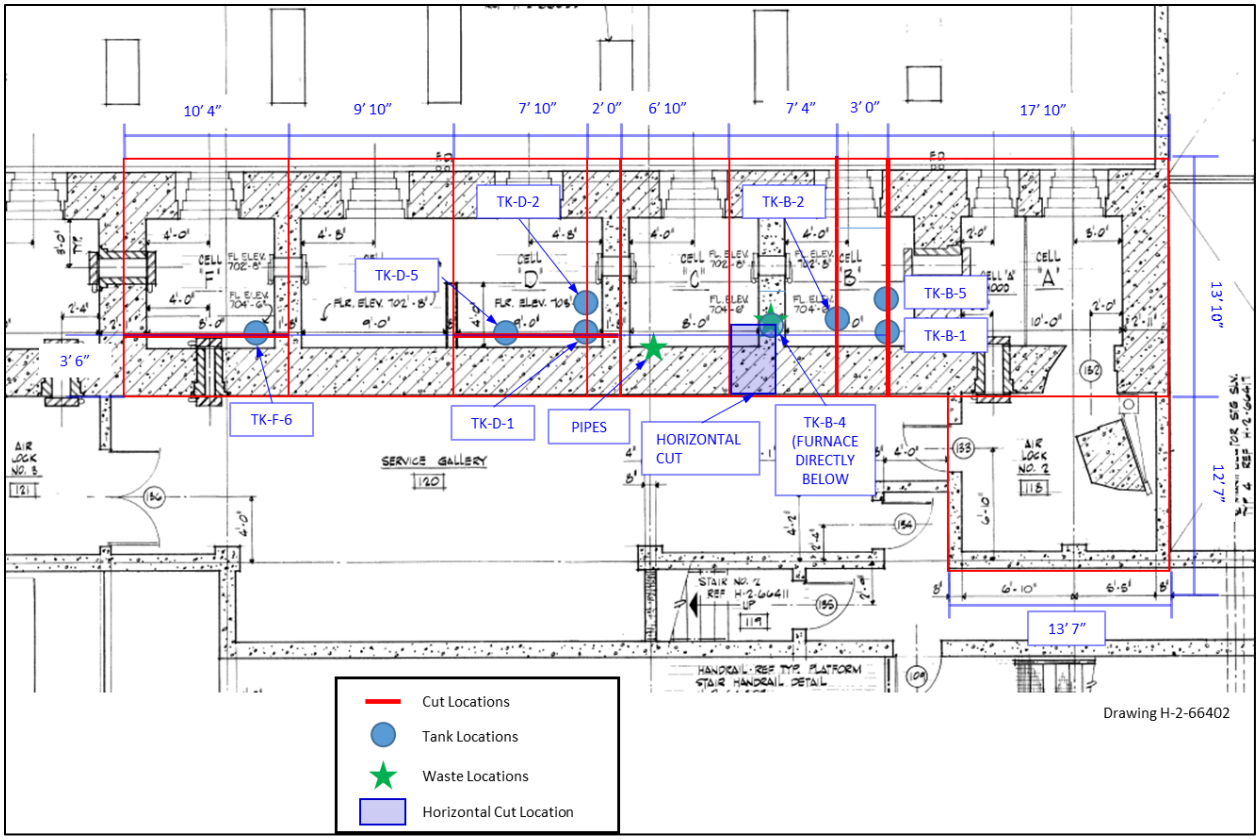

Figure H16. Monolith Cut Locations

H5.7 Removal of Wastes and Waste Residues

Hot Cells A through F contain materials and equipment used during packaging of the cesium and strontium capsules (see Section H3.4 for details of cell contents). In preparation for facility layup, a series of demineralized water flushes was performed in all of the in-cell jumpers and tanks. Chemical flushing was done in an effort to remove residual solids, and the tanks were again flushed with demineralized water.

The tank systems were flushed, removing all waste possible with normal means, with the intention of closing them and never reusing. During demolition of the Hot Cell A through Hot Cell F DWMU, locations of the monoliths have been placed to ensure that intact tanks, listed in Table H1, will be cut (and therefore no longer intact) and conservatively disposed of as hazardous debris. Cut locations for the tanks are shown in Figure H16.

Radiation hazards posed to personnel prevent the sampling and removal of cell contents; therefore, sampling will not be performed to quantify dangerous waste contamination. As a result, material and equipment remaining in the hot cells will be conservatively designated as hazardous debris.

Following facility layup, jumpers were removed from the tanks resulting in tank openings for grout filling.

The Hot Cell B furnace contains four trays with approximately 0.6 kg (1.3 lb) of strontium fluoride floor sweepings. Hot Cell C contains two threaded and capped pipes with approximately 1.2 kg (2.6 lb) of strontium fluoride floor sweepings. The pipes are located on the southwest corner of the cell on wall brackets above the bench floor.

DOE-RL has submitted a petition to Ecology for a site-specific variance from applicable land disposal restriction (LDR) treatment standards in accordance with 40 CFR 268.44(h)(2), "Variance from a

Treatment Standard," for specific waste items in Hot Cells B and C at WESF. These waste items hold 0.6 kg (1.3 lb) and 1.2 kg (2.6 lb) of floor sweepings from past cleanup activities in the cells. The floor sweepings contain strontium fluoride and processing debris, including metal shavings, and other miscellaneous waste material produced during operations of the hot cells. Ordinarily, the treatment standard for these forms of waste is a specific type of stabilization called microencapsulation. Microencapsulation is the stabilization of the waste material itself through the addition of Portland cement or lime/pozzolanic material, which reduces the leachability of contaminants from the waste. Microencapsulation treatment of the waste would then be followed by sampling and analysis of the stabilized waste to determine that LDR treatment standards have been accomplished.

However, treatment by microencapsulation would require intrusive activities, increasing exposure to workers, generation of a significant amount of additional waste requiring treatment, and potential risk of environmental exposure. Radiological and physical characteristics of the waste items prevent them from undergoing final analytical testing to verify that LDR treatment standards have been achieved. Treatment and verification of treatment by the usual methods of microencapsulation would cause potential exposure to workers, provide potential for environmental exposure, and fail to demonstrate LDR treatment.

A variance from the required LDR treatment standards is being requested to allow stabilization via in-cell macroencapsulation during grouting of the hot cells. Macroencapsulation is the application of a surface coating material such as polymeric organics (e.g., resins and plastics) or inert inorganic materials (e.g., Portland cement) that would encase the entire waste items rather than treat the interior waste such as in microencapsulation, substantially reducing surface exposure to potential leaching of contaminants. Portland cement would be used to encase the entire waste items within the cell. Macroencapsulated waste would be left intact at the WESF facility during an initial closure period. By treating the waste via macroencapsulation in WESF cells, leachability of contaminants is reduced, radiological exposure to workers is minimized, and transportation to another facility is not required. The requested petition (15-AMRP-0070, "Petition for Site-Specific Variance from Land Disposal Treatment Standards") outlines the justification and protectiveness of this treatment for waste items at the WESF hot cells.

During final facility removal, stabilized waste and waste residues associated with the Hot Cells A through Hot Cell F DWMU will be removed and managed as newly generated hazardous debris. Grouted Hot Cells A through F can be removed using standard demolition equipment, such as a diamond wire saw and excavators, cranes, and trailers in large monoliths, and transported for disposal in an approved disposal facility. Treatment standards for the newly generated hazardous debris will be the alternative debris standards for hazardous debris (40 CFR 268.45, Table 1) incorporated into WAC 173-303-140, "Land Disposal Restrictions," by reference. Additional detail on the newly generated waste is covered in Section H5.9.

Cesium and strontium salts have been analyzed to estimate impurities. The analysis performed identified possible dangerous waste designations of barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). These analytical data were used to characterize the salts and will be used to identify constituents of concern for the four trays and two pipes containing floor sweeping. Tables H6 through H8 provide analytical data for the cesium and strontium salts.

Impurities in the cesium salt are estimated as listed in PNL-5170, *A Review of Safety Issues that Pertain to the Use of WESF Cesium Chloride Capsules in an Irradiator*. Table H6 data were taken on cesium feed solution and salt analyzed for corrosion analysis. Concentrations are listed as weight percent solids. The silver concentration was not estimated but was added from process knowledge; therefore, it is not listed in the following tables.

Table H6. Impurities in Cesium Feed Solution and Salt

Element	Cesium Feed Solution (Wt%)	Salt Analysis (Wt%)
Aluminum (Al)	1.7	0.14
Boron (B)	--	0.14
Barium (Ba)	0.94	0.55
Calcium (Ca)	1.0	--
Cadmium (Cd)	--	0.02
Cobalt (Co)	--	0.1
Chromium (Cr)	0.27	1.4
Iron (Fe)	0.38	--
Potassium (K)	0.79	0.68
Magnesium (Mg)	0.25	0.68
Sodium (Na)	0.70	2.8
Nickel (Ni)	0.33	0.1
Lead (Pb)	1.4	0.14
Rubidium (Rb)	0.52	--
Silicon (Si)	7	0.21
Strontium (Sr)	0.18	0.02
Titanium (Ti)	--	0.02
Zinc (Zn)	--	0.03

Impurities in cesium salts wasted at the DOE Oak Ridge Site are listed in HNF-2928, *Certification That CsCl Powder and Pellet Materials Meet WESF Acceptance Criteria*. Concentrations are listed in Table H7 by weight percent.

Encapsulated cesium chloride salt contains dangerous waste chemical impurities from the fractionation process consisting of lead, barium, chromium, cadmium, and silver. Barium is generated continuously as a result of the cesium-137 decay chain.

Impurities in strontium salt are estimated in BNWL-1967, *The Containment of* $^{90}SrF_2$ *at 800°C to 1100°C Preliminary Results*. Table H8 data are estimates based on process flowsheet information; concentrations are listed in weight percent.

The encapsulated strontium fluoride salt contains dangerous waste chemical impurities from the fractionization process consisting of barium, lead, cadmium, chromium, and silver.

Table H7. Impurities in Cesium Salts Wasted at Oak Ridge

Element	Wt%
Aluminum (Al)	0.68
Boron (B)	5.17
Barium (Ba)	2.98
Calcium (Ca)	0.68
Copper (Cu)	0.02
Iron (Fe)	0.04
Potassium (K)	1.21
Magnesium (Mg)	0.04
Molybdenum (Mo)	0.009
Sodium (Na)	7.76
Nickel (Ni)	0.01
Silicon (Si)	2.59
Strontium (Sr)	0.01
Zinc (Zn)	0.03

Table H8. Impurities in Strontium Salt

Element	Probable Concentration (Wt%)
Aluminum (Al)	<0.5
Barium (Ba)	0.1-2.0
Calcium (Ca)	<0.1
Cadmium (Cd)	<0.2
Chromium (Cr)	<0.1
Copper (Cu)	<0.1
Iron (Fe)	<0.01
Hydrogen (H)	<0.1
Potassium (K)	0.05-0.5
Magnesium (Mg)	<0.1
Manganese (Mn)	<0.01
Nitrogen (N)	1-4
Sodium (Na)	<0.1
Nickel (Ni)	<0.05
Lead (Pb)	<0.2
R (as in Rare Earths)	<2.0
Silicon (Si)	<0.02

H5.8 Removal of Unit, Parts, Equipment, Piping, Containment Structure, and Other Ancillary Equipment

In general, equipment will not be removed from Hot Cells A through F. The hot cells contain tanks and equipment that were used during the encapsulation process (Table H1). Process and service piping is embedded in the concrete walls of each hot cell. Pipes connect the cells to each other, as well as to the hot pipe trench, transmitter rooms, AMU area, service gallery, operating gallery, manipulator repair shop, truck port, and Tank-100. Spare piping is provided between all areas and the hot cells. All tanks, equipment, and piping will remain in place.

Upon completion of the surveillance and maintenance mode in 1985, hot cell components not required for storing the capsules or managing the legacy contamination were shutdown. Shutdown involved equipment cleanout, equipment isolation or removal, jumper removal, nozzle blanking, cerium window refurbishment, and instrumentation deactivation.

Water sources to Hot Cells A through F have been isolated, and the manipulators have been removed from Hot Cell A through Hot Cell E. Manipulators will be removed from Hot Cell F prior to grouting. Remaining utility connections, including air piping and electrical connections, will be isolated from the hot cells prior to stabilization.

Section H5.4 provides further discussion of hot cell and K3 exhaust duct isolation activities that will be performed prior to stabilization.

H5.9 Identifying and Managing Waste Generated During Closure

Closure activities for WESF will result in the generation of three waste streams requiring management and disposal: excess grout generated during grouting activities, water collected from sawing and cutting, and hazardous debris resulting from demolition during final closure activities of the Hot Cell A through Hot Cell F DWMU.

H5.9.1 Excess Grout

Grout that does not meet specification requirements (Section H5.5.1), and grout remaining in a delivery truck when a particular grouting operation is completed, will most likely be generated during closure activities. This out-of-specification or excess grout (Section H5.5.1) is anticipated to be a nondangerous solid waste stream and will be managed and disposed at an approved disposal site as newly generated nondangerous waste.

H5.9.2 Grout Rinsate

A temporary washout pit will be set up near the grout pump and truck delivery location to contain rinsate from the delivery trucks and grout pump. The resulting grout rinsate wastewater stream is exempt per Ecology, 2012, *Categorical State Waste Discharge Permit Number ST0004511*, under exemption G12.F. The resulting rinsate wastewater is anticipated to be nondangerous.

H5.9.3 Water Collected from Sawing and Cutting

Water used to cool the blades and cutting wires will be collected using a vacuum system and reused throughout the cutting process. Once demolition activities are complete, the water will be containerized. The waste is anticipated to be nondangerous and is considered a newly generated solid waste stream. Until confirmation of the nondangerous waste designation, waste must be handled in accordance with all applicable requirements of WAC 173-303-170, “Requirements for Generators of Dangerous Waste,” through WAC 173-303-230, “Special Conditions.” The waste will be labeled, characterized in accordance with requirements in WAC 173-303-070, “Designation of Dangerous Waste,” anticipated to be designated as nondangerous waste, stored, and transported to an appropriate disposal facility.

H5.9.4 Hazardous Debris

Hazardous debris generated from demolition will be packaged onsite at WESF and transported to ERDF. Hazardous debris includes, but is not limited to, the following types of wastes resulting from demolition of Hot Cells A through F:

- Concrete and associated debris
- Miscellaneous waste (e.g., rubber, glass, paper, PPE, cloth, plastic, and metal)
- Equipment and construction materials

The preferred management of hazardous debris resulting from demolition of the hot cells is in bulk form. Bulk waste will include monoliths and other debris. Monoliths will be loaded onto trailers for transportation to ERDF. Other miscellaneous bulk debris will be placed into bulk containers, such as roll-off boxes, for ERDF disposal. These transport trailers and bulk containers will be stored/staged in a suitable area in proximity to the hot cell area or may be staged for up to 90 days in another suitable location. Waste must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230, labeled, characterized in accordance with WAC 173-303-070 requirements, stored, and transported to an appropriate disposal facility. Bulk containers will be covered when waste is not being added or removed. Lightweight material (e.g., plastic and paper) will be bagged, if appropriate, prior to placement in the bulk container, to eliminate the potential for materials blowing out of the bulk container or truck.

H5.10 Identifying and Managing Contaminated Environmental Media

If contaminated environmental media (soil) is identified as a result of clean closure verification sampling activities (i.e., samples indicate contamination above clean closure standards), the nature and extent of contamination will be evaluated. Soil surrounding the sampling node location, which indicated contamination above clean closure levels, will be removed horizontally to the next adjacent node locations where contamination was not identified and to a depth of approximately 3 ft. (0.6 m). Contaminated soil will be removed using equipment capable of removing the quantity of material required to complete removal and clean close the DWMU. Following removal of contaminated soil, additional confirmatory sampling efforts will be conducted in accordance with the approved closure plan SAP (Section H5.12.1), at the same node location(s) where contamination was identified, to demonstrate clean closure levels.

If contaminated soil removal is required from the DWMU, it will be managed as a newly generated waste stream in accordance with WAC 173-303-610(5). Contaminated soil generated during the closure period must be properly disposed. The contaminated soil must be handled in accordance with all applicable requirements of WAC 173-303-170 through WAC 173-303-230, containerized, labeled, characterized in accordance with WAC 173-303-070 requirements, designated as a dangerous or nondangerous waste, stored, and transported to an appropriate disposal facility. It will be treated (if necessary) to meet LDRs in 40 CFR 268, incorporated into WAC 173-303-140(2)(a) by reference, then ultimately disposed. While undergoing final activities to clean close the WESF Operating Unit Group, the Permittees will provide a more detailed evaluation of how contaminated environmental media will be managed in accordance with Ecology clean closure guidance.

H5.11 Confirming Clean Closure

Final clean closure activities for the Hot Cell A through Hot Cell F DWMU will be performed in conjunction with removal of the entire WESF facility. Final clean closure will be accomplished through demolition practices (Section H5.6), to remove Hot Cells A through F, along with the remainder of WESF. Demolition of the remaining two DWMUs within WESF is to be detailed in the closure plans for those two DWMUs.

Once the removal of WESF is complete, confirmation sampling of soil underlying the Hot Cell A through Hot Cell F DWMU will be conducted in accordance with the SAP, detailed in Section H5.12, to confirm that soil unrestricted use cleanup standards (MTCA [WAC 173-340] Method B) have been achieved. If sample results indicate contamination above clean closure levels, contaminated soil will be removed and managed in accordance with Section H5.10. Once analytical results confirm clean closure levels of the target analytes, clean closure certification will be prepared in accordance with Section H5.14.

H5.11.1 Hot Cell A through Hot Cell F Closure Process

Following completion of the initial closure activities described in this plan, the Hot Cell A through Hot Cell F DWMU will be in an extended closure period until final closure activities can take place (Section H6). Final closure activities for the Hot Cell A through Hot Cell F DWMU will be coordinated with final closure of the pool cell and Hot Cell G DWMUs. Final closure activities will occur after the cesium and strontium capsules have been removed from WESF.

When final closure activities for the Hot Cells A through Hot Cell F DWMU are ready to start, mobilization will begin to remove the grouted hot cells (Section H5.6.2). Disassembly of the hot cells is planned and will be performed with the following considerations:

- Hot cells will be cut into monoliths small enough to be safely transported using available means.
- Demolition of the hot cells is planned to avoid cutting through the Hot Cell B/Hot Cell C waste storage locations.
- Contamination control methods will be employed to avoid the spread of radiological contamination or mixed wastes to the environment.

A list of drawings showing the hot cell configuration will be maintained in the operating record to assist in identifying appropriate cut locations.

H5.12 Sampling and Analysis Plan and Constituents to be Analyzed

The SAP summarizes the sampling design used and associated assumptions based on the knowledge of the Hot Cell A through Hot Cell F DWMU. The sampling design includes input parameters that will be used to determine the number and location of samples once demolition of WESF is complete.

Sampling of the underlying soil for Hot Cells A through F will be conducted to confirm that soil unrestricted use cleanup standards (MTCA [WAC 173-340] Method B) have been achieved. If sample results indicate contamination above clean closure levels, the contaminated soil will be removed and managed in accordance with Section H5.10.

Due to the legacy radiological contamination within the hot cells, personnel entrance into the hot cells is not feasible. Therefore, sampling of the remaining equipment, classified as hazardous debris, and the four trays and two pipes, to demonstrate compliance with the concentration based treatment standard in 40 CFR 268.40, "Applicability of Treatment Standards," will not be performed under the closure activities outlined in this closure plan. The treatability variance (15-AMRP-0070) establishes the alternative performance based treatment standard of macroencapsulation, as identified in 40 CFR 268.45.

H5.12.1 Sampling and Analysis Plan

Sampling and analysis of the Hot Cell A through Hot Cell F DWMU underlying soil will be conducted to confirm that clean closure levels have been achieved. All sampling and analysis will be performed in accordance with the sampling and quality standards established in this closure SAP. The closure SAP details sampling and analysis procedures in accordance with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*; ASTM International (formerly American Society for Testing and Materials) *Annual Book of ASTM Standards*; and applicable U.S. Environmental Protection Agency (EPA) and Ecology guidance. Sampling and analysis activities will meet applicable requirements of SW-846, ASTM International standards, EPA approved methods, and

DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), at the time of closure. This SAP was also developed using Ecology Publication 94-111, *Guidance for Clean Closure of Dangerous Waste Units and Facilities*, Section 7.0, "Sampling and Analysis for Clean Closure," and EPA/240/R-02/005, *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S).

H5.12.2 Target Analytes

Analysis of cesium/strontium salts identified possible dangerous waste designations of barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Section H5.7 provides analytical data of cesium/strontium salts. Table H9 details the target analytes and associated waste codes.

Table H9. Target Analyte List

Target Analyte (Waste Code)	Chemical Abstracts Service Number
Barium (D005)	7440-39-3
Cadmium (D006)	7440-43-9
Chromium (Hexavalent) (D007)	18540-29-9
Lead (D008)	7439-92-1
Silver (D011)	7440-22-4

H5.12.3 Hot Cell A through Hot Cell F SAP Schedule

Confirmation closure sampling and analysis will be performed in accordance with the closure plan schedule in Section H6.

H5.12.4 Hot Cell A through Hot Cell F Project Management

The following subsections address project management and ensure that the project has defined goals, that the participants understand the goals and the approaches used, and that the planned outputs are appropriately documented. Project management roles and responsibilities discussed in this section apply to the major activities covered under the SAP.

The Permittee is responsible for planning, coordinating, sampling, preparing, packaging, and shipping samples to the laboratory. The project organization (regarding sampling and characterization) is described in the following subsections and shown graphically in Figure H17. The Project Manager maintains a list of individuals or organizations as points of contact for each functional element in Figure H17.

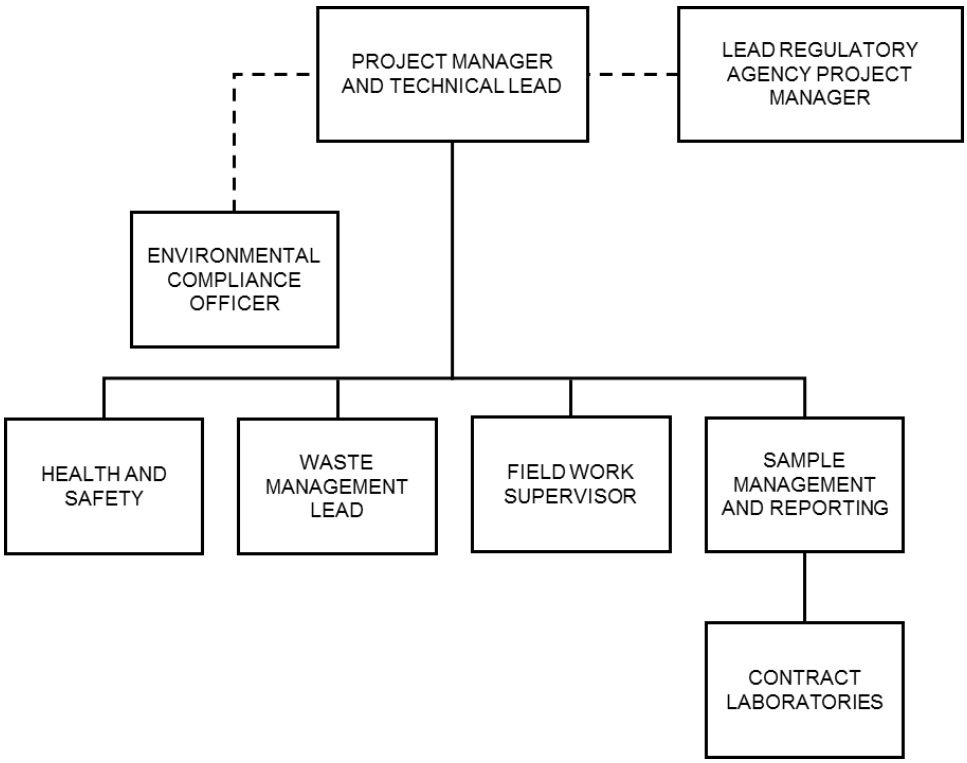

Figure H17. Hot Cell A through Hot Cell F Sampling and Analysis Plan Project Organization

The project has several key positions, including the following:

- **Lead Regulatory Agency Project Manager:** Ecology has assigned Project Managers responsible for closure oversight.
- **Project Manager:** The Project Manager provides oversight for activities and coordinates with DOE-RL, EPA, Ecology, and contract management. The Project Manager (or designee) for the Hot Cell A through Hot Cell F DWMU closure sampling is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The Project Manager is responsible for ensuring that project personnel are working to the current version of the SAP. The Project Manager works closely with QA, Health and Safety, and the Field Work Supervisor (FWS) to integrate these and other lead disciplines in planning and implementing the work scope. The Project Manager also coordinates with DOE-RL and the primary contractor management on all sampling activities. The Project Manager supports DOE-RL in coordinating sampling activities with the regulators.
- **Environmental Compliance and Quality Assurance:** The Environmental Compliance Officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts.
- **Health and Safety:** The Health and Safety organization is responsible for coordinating industrial safety and health support within the project, as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal primary contractor work requirements.
- **Sample Management and Reporting:** The Permittee's sampling organization coordinates field sampling as well as laboratory analytical work, ensuring that laboratories conform to Hanford Facility internal laboratory QA requirements (or their equivalent), as approved by

DOE-RL, EPA, and Ecology. The sampling organization receives the analytical data from the laboratories, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation. The sampling organization is responsible for informing the Project Manager of any issues reported by the analytical laboratory.

- **Contract Laboratories:** The contract laboratories analyze samples in accordance with established procedures and provide necessary sample reports and explanation of results in support of data validation.
- **Waste Management:** The Waste Management organization communicates policies and protocols and ensures project compliance for storage, transportation, disposal, and waste tracking.
- **Field Work Supervisor:** The FWS is responsible for planning and coordinating field sampling resources. The FWS ensures that samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified.

H5.12.5 Sampling Design

The primary purpose of sampling the underlying soil of the Hot Cell A through Hot Cell F DWMU is to determine if analytical data values exceed MTCA (WAC 173-340) Method B clean closure performance standards.

This SAP utilized Ecology Publication 94-111, Section 7.0, "*Sampling and Analysis for Clean Closure*," to determine the type of sampling design that will be utilized to demonstrate clean closure. When designing the sampling plan, both focused and area wide (grid) sampling methods were considered. Ecology Publication 94-111, Section 7.2.1, identifies area wide sampling as appropriate when the spatial distribution of contamination at or from the closure unit is uncertain. Ecology Publication 94-111, Section 7.3, "*Sampling to Determine or Confirm Clean Closure*," identifies the area wide sampling approach as generally appropriate to determine or confirm that clean closure levels are achieved. Focused sampling, as identified in Section 7.2.2 of Ecology Publication 94-111, is selective sampling of areas where contamination is expected or releases have been documented. Based on information provided in Section H5.4 for contamination in Hot Cells D and E, judgmental (focused) sampling of the soil will take place in the soil underlying those cells. Drawings in the operating record will be used to identify the location of underlying focused sampling. The remainder of the Hot Cell A through Hot Cell F DWMU underlying soil will include the area wide sampling approach. Both area wide and focused sampling are further defined in the following paragraphs.

Area-Wide (Grid) Sampling. Samples are collected at regularly spaced intervals over space or time. An initial location or time is chosen at random, and the remaining sampling locations are defined so that locations are at regular intervals over an area (grid). Grid sampling is used to search for hot spots and infer means, percentiles, or other parameters. It is useful for estimating spatial patterns or trends over time. This design provides a practical method for designating sample locations and ensures uniform coverage of a site, unit, or process.

Judgmental (Focused) Sampling. Selection of sampling units (i.e., the number and location and/or timing of collecting samples) is based on knowledge of the feature or condition under investigation and professional judgment. Focused sampling is distinguished from probability based sampling in that inferences are based on professional judgment, not statistical scientific theory. Therefore, conclusions about the target population are limited and depend entirely on the validity and accuracy of professional judgment. Probabilistic statements about parameters are not possible.

Once WESF has been removed, the remaining area will be measured, and the dimensions will be documented. Using measurements for the underlying soil area, the quantity and location of area wide samples will be determined utilizing the Visual Sample Plan (VSP) software. VSP is a tool, used throughout Washington State and nationally, that statistically determines the quantity of samples required

to accept or reject the null hypothesis. Parameters specific to the Hot Cell A through Hot Cell F DWMU will be used as input to VSP for purposes of developing the sampling plan for this closure plan.

Both parametric and nonparametric equations rely on assumptions about the data population. Typically, however, nonparametric equations require fewer assumptions and allow for more uncertainty about the distribution of data. Alternatively, if the parametric assumptions are valid, the required number of samples is usually less than if a nonparametric equation was used. For Hot Cells A through F, data assumptions are largely based on information obtained from a grouping of similar waste sites. Parameters from the 200-MG-1 waste sites were approved by Ecology in the SAP (DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*), evaluated, deemed appropriate, and utilized as input parameters for Hot Cells A through F. VSP parameter inputs, and the basis for those inputs, are detailed in Table H10.

The decision rule for demonstrating compliance with the MTCA (WAC 173-340) Method B clean closure level has three parts:

- The upper 95 percent confidence limit on the true data mean must be less than the MTCA B clean closure level.
- No sample concentration can be more than twice the cleanup level.
- Less than 10 percent of the samples can exceed the cleanup level.

For the purpose of utilizing VSP software, the null hypothesis will be that the site is considered contaminated until proven clean, and it will be tested by comparing a site mean to a fixed threshold. However, in addition to ensuring the site mean does not exceed the MTCA B clean closure performance standards, data will be evaluated to ensure that less than 10 percent of the individual values exceed MTCA (WAC 173-340) Method B clean closure performance standards and that no values are more than twice the cleanup level.

Area-wide sample locations will be determined using the area-wide grid with a random start sampling method run in VSP. Statistical analysis of systematically collected data are valid if a random start to the grid is used. The first node location will be chosen at random by VSP, and subsequent sample locations will be assigned by VSP using a grid sampling layout. The dimensions of the sample area (area under Hot Cell A through Hot Cell F DWMU once removed or if combined, under the three WESF DWMUs) will be entered into VSP to determine the locations of samples. The triangular grid sampling layout will provide an even distribution of sample locations over the Hot Cell A through Hot Cell F DWMU. The samples will be taken from the node locations indicated by VSP and will be assigned sample location identifications and sample numbers using HEIS.

H5.12.6 Sampling Methods and Handling

A grab sample matrix will consist of soil collected in EPA Level 1 precleaned sampling containers meeting the specifications in EPA 540/R-93/051, *Specifications and Guidance for Contaminant-Free Sample Containers*, taken at a depth of 0 to 15.24 cm (0 to 6 in.) below ground surface. For the purpose of this SAP, ground surface is defined as the exposed surface layer once the WESF structure has been removed. Subsurface sampling was evaluated however, there have been no documented releases of free liquid waste to the underlying soil so subsurface sampling was not deemed necessary.

Table H10. Visual Sample Plan Parameter Inputs

Parameter	Value	Basis
Primary Objective of the Sampling Design	Compare a site mean or median to a fixed threshold	Reject the null hypothesis.
Type of Sampling Design	Nonparametric	Data are not assumed to be normally distributed.
Working Null Hypothesis	The mean value at the site exceeds the threshold (MTCA B closure performance standards)	The null hypothesis assumes that the site is dirty requiring the sampling and analysis to demonstrate through statistical analysis that the site is clean.
Area Wide Grid Sampling Pattern	Triangular (assumed)	A triangular pattern will most likely provide an even distribution of sample locations over the Hot Cell A through Hot Cell F DWMU.
Standard Deviation (S)	0.45	This is the assumed standard deviation value relative to a unit action level for the sampling area. The value of 0.45 is conservative, based on consideration of past verification sampling. MARSSIM suggests 0.30 as a starting point; however, 0.45 has been selected to be more conservative. (Number of samples calculated increases with higher standard deviation values relative to a unit action level.)
Delta (Δ)	0.40	This is the width of the gray region. It is a user defined value relative to a unit action level. The value of 0.40 balances unnecessary remediation cost with sampling cost.
Alpha (α)	5%	This is the acceptable error of deciding a dirty site is clean when the true mean is equal to the action level. It is a maximum error rate since dirty sites with a true mean above the action level will be easier to detect. A value of 5% was chosen as a practical balance between health risks and sampling cost.
Beta (β)	20%	This is the acceptable error of deciding a clean site is dirty when the true mean is at the lower bound of the gray region. A value of 20% was chosen during the data quality objectives process as a practical balance between unnecessary remediation cost and sampling cost.
MARSSIM Sampling Overage	20%	MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of *n*.

Reference: EPA 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*.

Once the soil is sampled, the sampled media will be screened to remove material larger than approximately 2 mm (0.08 in.) in diameter. Removal of material larger than approximately 2 mm (0.08 in.) in diameter will allow for a larger surface area to volume ratio and be more likely to identify any potential contamination in the sample and will be in compliance with WAC 173-340-740(7)(a), "Unrestricted Land Use Soil Cleanup Standards." Grab samples will be collected into containers at the chosen node sample locations. To ensure sample and data usability, sampling will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. Soil sampling includes the following activities:

- Review of sampling request documentation
- Sample container and equipment preparation
- Field walkdown of sample area (includes marking sample locations)
- Sample collection and labeling
- Sample packaging, transporting, and shipping

Sample container, preservation, and holding time requirements are specified in Table H11 for soil samples. These requirements are in accordance with the analytical method specified. The final container type and volumes will be identified on the Sampling Authorization Form (SAF) and chain-of-custody form.

Table H11. Preservation, Container, and Holding Time Requirements for Soil Samples

Method	Analysis/Analytes	Preservation Requirement	Holding Time	Bottle Type	Minimum Sample Size
EPA 6010	Metals by ICP-OES	Cool ≤6°C	180 days	G/P	20 g
EPA 7196	Chromium (Hexavalent)	Cool ≤6°C	30 days prior to extraction; 24 hours after extraction	G/P	20 g

Note: For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V.*

EPA	=	U.S. Environmental Protection Agency	ICP	=	inductively coupled plasma
			OES	=	optical emission spectrometry
G	=	glass	P	=	plastic

To prevent potential contamination of the samples, decontaminated equipment will be used for each sampling activity.

EPA Level 1 precleaned sample containers will be used for samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits.

The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. A custody seal (e.g., evidence tape) will be affixed to each sample container and/or sample collection package in such a way as to indicate potential tampering.

Each sample container will be labeled with the following information on firmly affixed, water resistant labels:

- SAF and form number
- HEIS number
- Sample collection date and time

- Sampler identification
- Analysis required
- Preservation method (if applicable)

Sample records must include the following information:

- Analysis required
- Sample location
- Matrix (e.g., water or soil)

Sample custody will be maintained in accordance with existing Hanford Facility protocols to ensure maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained.

All waste (including unexpected waste) generated by sampling activities will be containerized, labeled, characterized, designated as a dangerous or non-dangerous waste, stored, and transported offsite where it will be treated (if necessary) to meet the LDRs in 40 CFR 268, incorporated into WAC 173-303-140(2)(a) by reference, then ultimately disposed of in an approved waste disposal facility in accordance with WAC 173-303-610(5).

H5.12.7 Analytical Methods

All analyses and testing will be performed consistent with this closure plan, laboratory analytical procedures, and HASQARD (DOE/RL-96-68). Accreditation of environmental laboratories ensures a lab is capable of providing accurate and defensible analytical data. The selected laboratory must be accredited by Ecology for the parameters and methods used. The approved laboratory must ensure that data satisfy all the project specific data acceptance criteria in this SAP. If a target analyte is detected at or above the clean closure level but less than the practical quantitation limit of the analytical method, Ecology will be notified and alternatives will be discussed to demonstrate clean closure levels.

Analytical methods and performance requirements associated with the target analytes are outlined in Table H12.

H5.12.8 Quality Control

Quality control (QC) procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability. Field QC sampling will include:

- Collection of full trip blank
- Field transfer blank
- Equipment rinsate blank
- Field duplicate
- Field split samples

Laboratory QC samples estimate the precision and bias of the analytical data. Field and laboratory QC samples are summarized in Table H13.

A data quality assessment (DQA) will be performed utilizing the guidance in EPA/600/R-96/084, *Guidance for Data Quality Assessment: Practical Methods for Data Analysis* (EPA QA/G-9), and implementing the specific requirements in Section H5.12.9 through Section H5.12.11.

Data verification, data validation, and DQA will include both primary samples and QC samples.

H5.12.9 Data Verification

Analytical results will be received from the laboratory, loaded into a database (e.g., HEIS), and verified. Verification includes, but is not limited to, the following activities:

- Amount of data requested matches the amount of data received (number of samples for requested methods of analytes).
- Procedures/methods are used.
- Documentation/deliverables are complete.
- Hard copy and electronic versions of the data are identical.
- Data seem reasonable based on analytical methodologies.

H5.12.10 Data Validation

Data validation is performed by a third party. The laboratory supplies contract laboratory program (CLP) equivalent analytical data packages intended to support data validation by the third party. The laboratory submits data packages that are supported by quality control test results and raw data.

Controls are in place to preserve the data sent to the validators and allow only additions to be made, not changes to the raw data.

The format and requirements for data validation activities are based upon the most current version of USEPA-540-R-08-01, *National Functional Guidelines for Superfund Organic Methods Data Review* (OSWER 9240.1-48), and, USEPA-540-R-10-011, *National Functional Guidelines for Inorganic Superfund Data Review* (OSWER 9240.1-51). As defined by the validation guidelines, 5 percent of the results will undergo Level C validation.

In accordance with Table H10, at least 80 percent of the sample results must be acceptable (data not rejected during the data validation process).

H5.12.11 Verification of VSP Input Parameters

Analytical data will be entered back into VSP software. If all the analytical data for a particular analyte is nondetect, verification of VSP input parameters will not be required for that analyte. VSP software uses the analytical data to determine if the user input parameters were estimated appropriately. Once analytical data are entered into VSP, the software will calculate the true standard deviation and if the null hypothesis can be rejected. If the calculated standard deviation is smaller than the estimated user input standard deviation, no additional sampling will be required. If the calculated standard deviation is larger than the estimated standard deviation, additional sampling may be required. Comparison of the maximum data value for each analyte to the clean closure standards will ensure all individual analytes are below the action levels. Verification of the null hypothesis through VSP will determine if the mean value of the site analytical data supports rejection of the null hypothesis (Section H4.1).

H5.12.12 Documents and Records

The Project Manager is responsible for ensuring that the current version of the SAP is being used and providing any updates to field personnel. The current version of the SAP is maintained by Ecology. Changes to the SAP affecting the data will be submitted as a permit modification in accordance with WAC 173-303-610(3)(b) by the permittees to Ecology.

Table H12. Soil Analytical Performance Requirements

Chemical Abstracts Service Number	Analyte[a]	Analytical Method	Closure Performance Standard (mg/kg)		Practical Quantitation Limit (mg/kg)	Accuracy Req't (% Recovery)[c]	Precision Req't (RPD)[c]
			Carcinogen	Noncarcinogen			
7440-39-3	Barium	SW-846 Method 6010	--	1.60E+04	2.00E+00	±30	≤30
7440-43-9	Cadmium	SW-846 Method 6010	--	8.00E+01	5.00E-01	±30	≤30
18540-29-9	Chromium (Hexavalent)	SW-846 Method 7196	--	2.40E+02	1.00E+00	±30	≤30
7439-92-1	Lead[b]	SW-846 Method 6010	--	2.50E+02	5.00E+00	±30	≤30
7440-22-4	Silver	SW-846 Method 6010	--	4.00E+02	1.00E+00	±30	≤30

a. Unless otherwise noted, closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA (WAC 173-340) Method B (unrestricted use standards). Where both carcinogen and noncarcinogen performance standards are available, the most conservative value will be used.

b. Closure performance standards are the numeric cleanup levels calculated using unrestricted use exposure assumptions according to MTCA (WAC 173-340) Method A (unrestricted use standards). MTCA Method A values were used when MTCA Method B values were not available.

c. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples is also performed. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

CAS	=	chemical abstract service	Req't	=	requirement
CFC	=	chlorinated fluorocarbon	WAC	=	Washington Administrative Code
MTCA	=	Model Toxics Control Act			

Table H13. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated
Field Quality Control		
Trip Blanks	One per 20 samples per media sampled One per cooler for VOCs	Contamination from containers or transportation
Equipment Rinsate Blanks	If only disposable equipment is used, then an equipment blank is not required Otherwise, one per 20 samples per analytical method per media sampled, or one per day[a]	Adequacy of sampling equipment decontamination and contamination from non-dedicated equipment
Field Duplicates	One per batch[g], 20 samples maximum of each media sampled (soil samples)	Precision, including sampling and analytical variability
Field Split Samples	When needed, the minimum is one per analytical method, per media sampled, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements tables[h]	Precision, including sampling, analytical, and interlaboratory
Laboratory Quality Control		
Method Blanks	1 per batch[g]	Laboratory contamination
Lab Duplicates	[b]	Laboratory reproducibility and precision
Matrix Spikes	[b]	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	[b]	Laboratory reproducibility, accuracy, and precision
Surrogates	[b]	Recovery/yield
Tracers	[b]	Recovery/yield
Laboratory Control Samples	1 per batch[g]	Evaluate laboratory accuracy
Performance Evaluation Programs[c]	Annual	Evaluate laboratory accuracy
Double-Blind Standards	Quarterly[d]	Evaluate laboratory accuracy
Audit/Assessment	Annually[e] or every 3 years[f]	Evaluate overall laboratory performance and operations

Table H13. Project Quality Control Sampling Summary

Quality Control Sample Type	Frequency	Characteristics Evaluated

a. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

b. As defined in the laboratory contract or quality assurance plan and/or analysis procedures.

c. Nationally recognized program, such as DOE Mixed Analyte Performance Evaluation Program or Environmental Resource Associates.

d. Soil matrix double-blind standards are submitted by request of Analytical Services.

e. DOE Quality Systems for Analytical Services requires annual audit of commercial laboratories.

f. DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD), does not define a frequency for assessment of onsite laboratories. Three year evaluated supplier list requirement is typically applied.

g. Batching across projects is allowing for similar matrices.

h. Field split samples are generally used for interlaboratory comparison as periodic checks in large sample sets or when a particular method or laboratory has been producing unexpected results. Field splits are not required for small, discrete sample sets undergoing routing analyses using methods for which splits have been submitted as part of larger sample sets.

DOE = U.S. Department of Energy

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

The Project Manager is responsible for ensuring that a project file is properly maintained. The project file will contain the records or references to their storage locations. The following items will be included in the project file:

- Field logbooks or operational records
- Data forms
- Global positioning system data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records. Records generated during closure will be maintained in the facility operating record for a minimum of 5 years after the clean closure certification has been accepted by Ecology.

H5.12.13 Sampling and Analysis Requirements to Address Removal of Contaminated Soil

In the event that sample results based on the MTCA (WAC 173-340) Method B three-part test (Section H5.12.5) indicate contamination above clean closure levels, the contaminated soil will be removed in accordance with Section H5.10. Following removal of contaminated soil, additional samples will be taken at the same grid location as identified by VSP. Additional focused sampling may be added in areas where contamination is identified (Section H5.12.5). Additional focused samples will be documented, as required in Section H5.12.12, and provided with the closure certification upon request by Ecology. These samples will be analyzed in accordance with the methods specified in Table H12, with accompanying QC samples as discussed in Section H5.12.8.

H5.12.14 Revisions to the Sampling and Analysis Plan and Constituents to Be Analyzed

If changes to the SAP are necessary due to unexpected events during closure that will affect sampling, a revision to this SAP will be submitted no later than 30 days after the unexpected event as a permit modification as required in WAC 173-303-610(3)(b)(iii) and WAC 173-303-830, "Permit Changes."

H5.13 Role of the Independent, Qualified, Registered Professional Engineer

An independent, qualified, registered professional engineer (IQRPE) will be retained to provide certification of the clean closure activities described in this closure plan, as required by WAC 173-303-610(6). The engineer will be responsible for reviewing completed field activities and documents associated with these initial closure activities. At a minimum, field activities and documents reviewed for certification of these closure plan activities would include the following:

- Review of the final design and grout testing plan
- Review of project documentation created during initial closure activities
- Review of documentation or inspection of the stabilized Hot Cells A through F
- Review of the grout testing report
- Observe and/or review demolition activities
- Observe and/or review hazardous waste disposal documentation
- Review sampling procedures and results
- Observe and/or review sampling activities
- Observe and/or review contaminated environmental media removal (as applicable)
- Verify that locations of samples are as specified in the SAP

The engineer will record observations and reviews in a written report that will be retained in the operating record. The resulting report will be used to support the clean closure certification of the Hot Cell A through Hot Cell F DWMU. Final clean closure certification will be conducted after closure activities are completed for the Hot Cell A through Hot Cell F DWMU and in coordination with closure certification of the Pool Cells and Hot Cell G DWMUs.

H5.14 Certification of Clean Closure

In accordance with WAC 173-303-610(6), within 60 days of completion of the final closure activities for the Hot Cell A through Hot Cell F DWMU, certification that closure activities have been completed in

accordance with the specifications in the approved closure plan will be submitted to Ecology by registered mail. The certification will be signed by the owner or operator and signed and stamped by an IQRPE.

Upon request by Ecology, the following information will be submitted to support closure certification:

- All field notes and photographs related to closure activities.
- Description of any minor deviations from the approved closure plan and justification for these deviations.
- Documentation of the final disposition of all dangerous wastes and dangerous waste residues (if applicable), including contaminated environmental media.
- Verification of hot cell isolation activities.
- Verification that grouting of Hot Cells A through F occurred as planned in the described in work documents.
- Verification of demolition.
- All laboratory and/or field data, including sampling procedures, sampling locations, QA/QC samples, and chain-of-custody procedures for all samples and measurements, including samples and measurements taken to determine or confirm clean closure.
- Summary report that identifies and describes the data reviewed by the IQRPE and tabulates the analytical results of samples taken to determine and confirm clean closure.
- Description of what the DWMU area looks like at completion of closure, including a description of the former unit after closure.
- Additional data, as required, by final clean closure of the Pool Cells and Hot Cell G DWMU closure plans.

The final clean closure activity for the Hot Cell A through Hot Cell F DWMU will be accomplished through removal of the DWMU, which will be addressed in the closure plan for the other two operating DWMUs. The Hot Cells A through Hot Cell F DWMU clean closure certification will be provided in conjunction with clean closure certification of the Pool Cells and Hot Cell G DWMU and the entire WESF OUG.

H5.15 Conditions that Will Be Achieved When Closure is Complete

Upon completion of the initial and final closure activities outlined within this closure plan, the Hot Cell A through Hot Cell F DWMU will be isolated and stabilized with grout, demolished, removed, and disposed of at ERDF.

Final clean closure conditions will be demonstrated in conjunction with the other two operating DWMU closures.

H6 CLOSURE SCHEDULE AND TIME FRAME

Final clean closure activities will take place in conjunction with final closure for the WESF Operating Unit Group. Stabilization via grout of Hot Cells A through F is a necessary step to prevent threats to HHE and support final closure of the WESF Operating Unit Group.

The Hanford Facility has an ongoing need to store cesium and strontium capsules safely and compliantly until a disposal alternative is available. While efforts are underway to implement an alternative method, it is anticipated to be a number of years before the capsules can be safely transferred from WESF to an alternative storage.

Continued storage of WESF capsules requires the Pool Cells and Hot Cell G DWMUs to remain operational until alternative storage capability is available.

Continued capsule storage will necessitate an extension to the 180 days to complete final clean closure activities for the Hot Cell A through Hot Cell F DWMU required in WAC 173-303-610(4)(b). This extension is being requested in accordance with WAC 173-303-610(4)(b)(i).

Hot Cells A through F contain a significant amount of legacy radioactive contamination. Stabilization of this contamination with grout will eliminate the potential for a release of this contamination while the cesium and strontium capsules are stored in the WESF pool cells. Additionally, stabilization of the legacy contamination will eliminate the potential for a release of dangerous waste constituents to the environment or to workers when the capsules are transferred out of WESF.

Approval of this closure plan will grant the Hanford Facility an extended closure period for performance of final clean closure activities, in accordance with WAC 173-303-610(4)(b), and a separate extension request will not be filed.

During this extended closure period, the Hanford Facility will comply with all applicable requirements of the permit. Additionally, the stabilized hot cells will be maintained in a manner that prevents threats to HHE and monitored through routine radiation surveillances, using radiation as an indication of contamination outside the stabilized Hot Cell A through Hot Cell F DWMU.

Closure activities and extended closure period expected durations are outlined in the closure activities schedule for the Hot Cell A through Hot Cell F (Table H14).

Table H14. Waste Encapsulation and Stabilization Facility Hot Cell A through Hot Cell F Closure Activities Schedule

Closure Activity Description		Expected Duration
Primary Activity	**Secondary Activity**	**Duration**
Preclosure Preparation Activities		
Prepare WESF • Isolating equipment that connects to the K3 exhaust system ducting • Isolating utility lines that remain connected to the hot cells. These utilities include air and electrical services	Isolate equipment that connects the K3 exhaust system ducting	N/A
	Isolate utility lines that remain connected to the hot cells, including air and electrical services	
	Install covers over/seal viewing windows, manipulator ports, and pass-throughs (drain window oil prior to cover installation)	
	Pour concrete block over Hot Cell D/E hot spot in service gallery	
Closure Activities		
Grout preparation	Core Drilling into DWMU	5 months
Perform grout stabilization	Grout K3 Filter Pit	6 months
	Grout K3 Duct and Trench	
	Grout Hot Pipe Trench	
	Grout Hot Cell A through Hot Cell F	
	Grout Hot Cell A Air Lock	

Table H14. Waste Encapsulation and Stabilization Facility Hot Cell A through Hot Cell F Closure Activities Schedule

Closure Activity Description		Expected Duration
Submit to Ecology a status report of the Hot Cell A through Hot Cell F stabilization project	N/A	1 month after stabilization complete
Extended Closure Activities		
Extended closure period to coincide with clean closure of the Pool Cells and Hot Cell G DWMU activities	Continued surveillances and inspections	To be determined
Demolition of the Hot Cell A through Hot Cell F DWMU	Equipment mobilization	10 days
	Demolition and removal of waste generated	6 months
Sampling and analysis of underlying soil (includes data verification and data validation)	N/A	4 months
Closure Activities Complete		
Submit final clean closure certification	N/A	60 days after final clean closure activities complete
N/A = not applicable		

H7 COST OF CLOSURE

A detailed written estimate outlining updated projections of anticipated closure costs for the Hanford Facility TSD units having final status is not required per Permit Condition II.H.

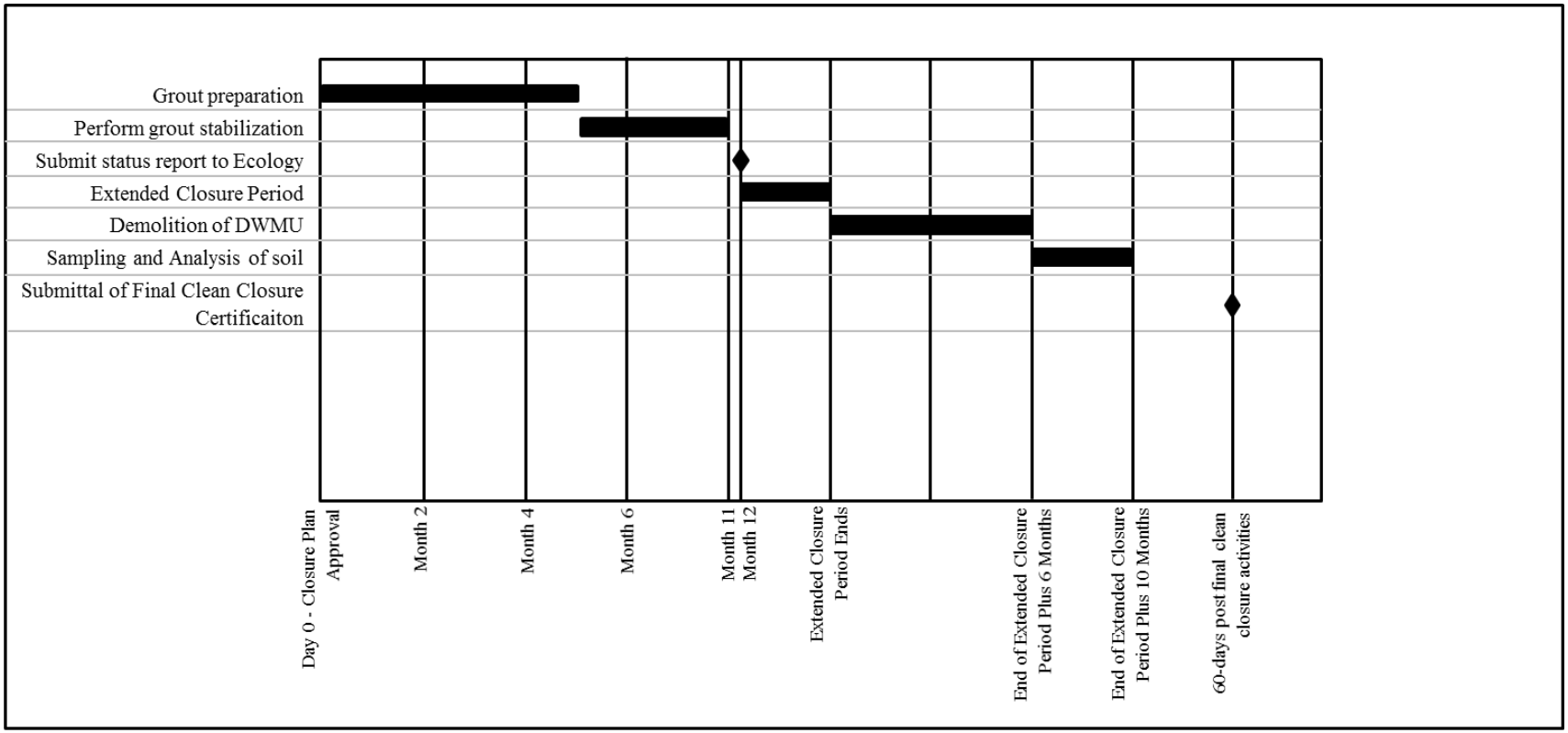

Figure H18. Waste Encapsulation and Stabilization Facility Hot Cell A through Hot Cell F Closure Plan Schedule

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183-H SOLAR EVAPORATION BASINS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 183-H Solar Evaporation Basins **August 13, 2013**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	08/13/2013	
1.0 Part A Form	10/1/2008	
2.0 Modified Postclosure Institutional Controls and Periodic Assessments	06/30/2002	
3.0 Groundwater Monitoring	08/13/2013	
4.0 Corrective Action Plan	06/30/2002	
5.0 Personnel Training During Post-Closure	06/30/2002	
6.0 Security	02/2004	
7.0 Closure Contact	02/2004	
8.0 Certification of Postclosure	06/30/2002	

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183-H SOLAR EVAPORATION BASINS
PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/13/2013	

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PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
183-H SOLAR EVAPORATION BASINS

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PART VI, POST-CLOSURE UNIT 2 UNIT-SPECIFIC CONDITIONS
183-H SOLAR EVAPORATION BASINS

The 183-H Solar Evaporation Basins comprise an inactive Treatment, Storage, and Disposal (TSD) unit that is undergoing postclosure activities. This TSD unit was operated as an evaporation treatment unit for dangerous wastes.

VI.2.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Post-Closure Unit 2, including Permit Conditions specified in VI.2.B. All sections, figures, and tables included in these portions are enforceable:

POST-CLSOURE UNIT 2

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Modified Post-Closure Institutional Controls and Periodic Assessments, dated June 30, 2002
Chapter 3.0	Groundwater Monitoring, dated August 13, 2013
Chapter 4.0	Corrective Action Plan, dated June 30, 2002
Chapter 5.0	Personnel Training, dated June 30, 2002
Chapter 6.0	Security, dated February 2004
Chapter 7.0	Closure Contact, dated February 2004
Chapter 8.0	Certification of Post-Closure, dated June 30, 2002

VI.2.B AMENDMENTS TO THE APPROVED POST-CLOSURE PLAN

VI.2.B.1 The Permittee will review the modified closure option in five (5) years (February 28, 2008). The purpose of the review will be to determine if this TSD unit can be clean closed.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 2.0
MODIFIED POSTCLOSURE INSTITUTIONAL CONTROLS AND PERIODIC ASSESSMENTS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 2.0
MODIFIED POSTCLOSURE INSTITUTIONAL CONTROLS AND PERIODIC ASSESSMENTS

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CHAPTER 2.0
MODIFIED POSTCLOSURE INSTITUTIONAL CONTROLS AND PERIODIC ASSESSMENTS

TABLE OF CONTENTS

2.0 MODIFIED POSTCLOSURE INSTITUTIONAL CONTROLS AND PERIODIC ASSESSMENTS 5
2.1 Institutional Controls 5
2.2 Periodic Assessments 5

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2.0 MODIFIED POSTCLOSURE INSTITUTIONAL CONTROLS AND PERIODIC ASSESSMENTS

2.1 Institutional Controls

No direct exposure contamination remains at 183-H. The extent of contamination remaining at the time of closure of this unit extended from deep vadose zone soils (4.6 m [15 ft] below the bottom of the basin structure) to and including saturated soils and groundwater. Therefore, no measures are required to limit or prohibit activities at the surface. For example, fences or barriers are not required for maintaining access restrictions.

Institutional controls are required to be maintained in order to ensure that groundwater is not used as a drinking water or irrigation source. Because RL will maintain control over this site for the foreseeable future and potentially until the groundwater is remediated, it is not anticipated that additional actions will be required to limit controls over groundwater usage. Should groundwater use restrictions be required after RL relinquishment of the area, appropriate deed restrictions will be made.

2.2 Periodic Assessments

Periodic assessments are required by Permit Condition II.K.3.b. The first periodic assessment will take place after a period of five years from the completion of closure (July 28, 2001). As allowed by WAC 173-340-410, a compliance monitoring plan for protection and confirmation monitoring during the five-year period may be combined with other plans. Protection and confirmation sampling of groundwater will be achieved through implementation of the dangerous waste final status groundwater monitoring plan. No soil remediation is anticipated to occur during the five-year period. Should subsequent assessment periods be required which include soil remediation activities, a compliance monitoring plan will be combined with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Operation and Maintenance Plan for the 100-HR-1 Operable Unit.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 3.0
GROUNDWATER MONITORING

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
08/13/2013	

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CHAPTER 3.0
GROUNDWATER MONITORING

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CHAPTER 3.0
GROUNDWATER MONITORING

TABLE OF CONTENTS

3.0 GROUNDWATER MONITORING DURING POSTCLOSURE 5
3.1 WAC 173-303-645(11)(d) Monitoring Requirements 5
3.1.1 WAC 173-303-645(3) Groundwater Protection Standard 6
3.1.2 WAC 173-303-645(8) General Groundwater Monitoring Requirements 7
3.2 RCRA Corrective Action Groundwater Monitoring Schedule 7
3.3 Groundwater Monitoring Under CERCLA 8
3.3.1 100-HR-3 Remedial Investigation Monitoring 8
3.3.2 100-HR-3 Interim Remedial Measure Monitoring 8
3.4 Inspection, Maintenance, and Replacement of Wells 9

FIGURES

Figure 3.1. Location Map for 100-H Area Monitoring Wells 10
Figure 3.2. Predicted Groundwater Flow During Interim Remedial Measure 11
Figure 3.3. Chromium Contamination in the 100-H Area 12

TABLES

Table 3.1. Sampling and Analysis Schedule for 183-H Solar Evaporation Basins RCRA Corrective Action & CERCLA Remedial Investigation Monitoring 13
Table 3.2. Analysis Suite Codes for 183-H RCRA Corrective Action & CERCLA Remedial Investigation Monitoring 15
Table 3.3. CERCLA Interim Remedial Measure Groundwater Well Network: 16

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3.0 GROUNDWATER MONITORING DURING POSTCLOSURE

Groundwater concentration limits have been exceeded for dangerous waste constituents in downgradient monitoring wells at 183-H Solar Evaporation Basins. Washington Administrative Code (WAC) 173-303-645(11) requires that a corrective action program be established in the Permit to (1) address the contamination, and (2) monitor the effectiveness of the action (Rasmussen 1996c). This post-closure plan, along with a revised groundwater monitoring plan (Hartman 1997), describes current and future actions to satisfy this requirement.

Corrective action to address groundwater contamination in the 100-H Area, including contamination that has resulted from 183-H Solar Evaporation Basins, has been initiated as part of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remediation activities. An Interim Remedial Measure (IRM) to remove hexavalent chromium will begin extracting groundwater from wells located in the vicinity of the former 183-H in July 1997 (DOE-RL 1996b). The IRM pumping system will change local hydraulic gradients and the direction of groundwater flow.

Not all of the dangerous waste constituents attributable to 183-H Solar Evaporation Basins are specifically targeted by the IRM treatment system. The primary treatment target is chromium. However, nitrate and two nondangerous waste constituents, technetium-99 and uranium, are also likely to be retained on the ion exchange columns, although hexavalent chromium will be preferentially retained. The IRM corrective action is the first phase of groundwater remediation in the 100-H Area, with subsequent phases to be determined by the feasibility study process under CERCLA. A final Record of Decision (ROD) will be established using information gained during the IRM for chromium.

Figure 3.1 shows the locations of existing groundwater monitoring wells in the 100-H Area. Figure 3.2 illustrates the changes to groundwater flow that are expected to occur during IRM pumping operations. In general, flow direction will change from an easterly to a more northerly direction beneath the former 183-H Solar Evaporation Basins. Changes in water quality, as observed in monitoring wells influenced by the pumping operation, are also expected to occur. Figure 3.3 provides a recent interpretation showing the distribution of chromium contamination in the 100-H Area.

Because of the corrective action pumping operations, the list of "point of compliance" wells per WAC 173-303-645 requirements will change from the definition presented in the 183-H compliance monitoring plan (Hartman and Chou 1995). Also, the change in flow direction may result in variable concentrations for the dangerous waste indicators in the wells previously identified as points of compliance. Therefore, a revised groundwater monitoring plan has been prepared (Hartman 1997) that reflects corrective action monitoring requirements.

The following sections outline the requirements for groundwater monitoring during corrective action and present a sampling and analysis schedule for meeting the requirements. The sampling and analysis schedule for RCRA corrective action requirements becomes a condition of the revised Permit. Other sampling and analysis activities within the 100-H Area are also described for general information purposes only.

3.1 WAC 173-303-645(11)(d) Monitoring Requirements

The WAC 173-303-645(11) Corrective Action Program requires the establishment and implementation of a groundwater monitoring program that is capable of demonstrating the effectiveness of the corrective action. This requirement states two general objectives:

- The program may be based on the requirements for a compliance monitoring program under WAC 173-303-645(10) and must be as effective as that program in determining compliance with the groundwater protection standard under WAC 173-303-645(3). A compliance monitoring program that met the objectives of the groundwater protection standard was established and adopted within the Permit (Hartman and Chou 1995).

- Monitoring during corrective actions must be capable of determining the success of the corrective action program. A revised groundwater monitoring plan has been prepared to reflect corrective action requirements (Hartman 1997). Also, as part of the IRM to address chromium contamination, a performance monitoring program has been designed and implemented to evaluate the effectiveness of the pump-and-treat system (DOE-RL 1997).

The following sections demonstrate how the corrective action monitoring requirements in WAC 173-303-645(11) will be met in the 183-H Corrective Action Groundwater Monitoring Plan and 183-H Post-Closure Plan.

3.1.1 WAC 173-303-645(3) Groundwater Protection Standard

Washington Administrative Code 173-303-645(3) introduces the principal requirements that must be met to comply with the Dangerous Waste Regulations for releases from regulated units. It refers to WAC 173-303-645(4) Dangerous Constituents, WAC 173-303-645(5) Concentration Limits, WAC 173-303-645(6) Point of Compliance, and WAC 173-303-645(7) Compliance Period. The Groundwater Protection Standard for the regulated unit has been established by Washington State Department of Ecology (Ecology) in the facility Permit.

3.1.1.1 WAC 173-303-645(4) Dangerous Constituents

Dangerous waste constituents were identified in the 183-H Compliance Monitoring Plan (Hartman and Chou 1995). They are hexavalent chromium, as represented by an analysis for total chromium using filtered samples, and nitrate.

Additional waste indicators used to define the contaminant plume attributable to 183-H are technetium-99 and uranium. Wastes from 183-H basins' leakage may have altered various other water quality parameters that are not regulated, but are useful for identifying and tracking contamination from 183-H Solar Evaporation Basins (e.g., specific conductance). Because fluoride was discovered to be elevated in the soil at the bottom of the excavation beneath the 183-H footprint (along with nitrate), fluoride will also be used as an indicator for 183-H contamination in groundwater.

All of the above constituents of interest will be monitored under the revised plan for corrective action groundwater monitoring (Hartman 1997).

3.1.1.2 WAC 173-303-645(5) Concentration Limits

Dangerous waste constituents from the regulated waste unit may not exceed concentration limits established by the Permit. Permit limits were defined previously in the 183-H Compliance Monitoring Plan (Hartman and Chou 1995). Concentration limits established for the 183-H groundwater plume were as follows:

Dangerous Waste Constituents	
Chromium (total; filtered sample)	122 µg/L--local background; upgradient sources
Nitrate	45,000 µg/L--EPA MCL for drinking water
Other 183-H Waste Indicators	
Technetium-99	900 pCi/L--EPA MCL for drinking water
Uranium (total; chemical analysis)	20 µg/L--EPA MCL--proposed

During the period of time that the IRM to address chromium is extracting groundwater, the corrective action monitoring described in the revised groundwater monitoring plan (Hartman 1997) will continue to evaluate new analytical results relative to these concentration limits. Additionally, fluoride results will be evaluated relative to previously established trends and to the U.S. Environmental Protection Agency (EPA) Maximum Containment Levels (MCL) for drinking water, which is 1,400 µg/L.

3.1.1.3 WAC 173-303-645(6) Point of Compliance

"The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated unit." Operation of the IRM groundwater extraction network will alter the pattern of groundwater flow. Therefore, the relative positions (i.e.,. upgradient, downgradient) for some of the monitoring wells used to establish the point of compliance listed in the 183-H Compliance Monitoring plan (Hartman and Chou 1995) will change (Section 3.2).

A new list of wells has been defined to act as points of compliance while the IRM is operating. The new list was developed at a workshop held on March 5, 1997 using the EPA Data Quality Objectives (DQO) process. The points of compliance identified at the workshop were subsequently approved by Ecology on April 22, 1997 via letter (Soper 1997b). The wells are identified in the revised groundwater monitoring plan for corrective action monitoring (Hartman 1997) (Section 3.2).

3.1.1.4 WAC 173-303-645(7) Compliance Period

The modified RCRA network and sampling schedule will be in effect during groundwater extraction operations that are conducted as part of the IRM for chromium. Based on the observed impact that the IRM has on groundwater flow patterns and water quality after operations begin, further modifications to the RCRA network may be appropriate during and following the IRM. This post-closure plan and the revised groundwater-monitoring plan for corrective action monitoring will be revised and incorporated into a permit modification, as necessary.

Following cessation of groundwater extraction operations under the IRM, RCRA monitoring under the final status monitoring plan (Hartman, 1997) will continue for a minimum of three consecutive years (WAC 173-303-645(7)(c) to demonstrate that the groundwater protection standards of WAC 173-303-645(3) have been met. This monitoring will complement monitoring conducted to (1) evaluate the performance of the IRM and (2) support selection of a final remediation alternative.

3.1.2 WAC 173-303-645(8) General Groundwater Monitoring Requirements

The requirements described in WAC 173-303-645(8) will be met as described in the *183-H Corrective Action Monitoring Plan* (Hartman, 1997). Newly collected data will be reported quarterly and an evaluation of monitoring data will be reported in the Annual Groundwater Project Report for the Hanford Site (e.g., Hartman and Dresel 1997).

3.2 RCRA Corrective Action Groundwater Monitoring Schedule

The *183-H Compliance Monitoring Plan* (Hartman and Chou 1995) has been revised (Hartman 1997) to accommodate changes in (1) the groundwater flow pattern and (2) concentrations of selected waste indicators, which are brought on by pump-and-treat remediation activities. The EPA Data Quality Objectives process (EPA 1994) was followed to help design the revised sampling and analysis schedule. Representatives from RL, Ecology, and EPA reached consensus on objectives, wells to be sampled, constituents for analysis, sampling frequency, and water level measurements (Furman 1997).

The resulting schedule for the 183-H Solar Evaporation Basins RCRA network is presented in Table 3.1. This table identifies the wells being sampled, the frequency of sampling, and an analysis suite code for the previous RCRA compliance monitoring schedule and for the revised corrective action monitoring schedule. Table 3.2 provides a complete description of the constituent analysis suites. Information on sampling schedules under CERCLA is included in the Tables, to provide a complete description of all groundwater-monitoring activities being conducted in the vicinity of the former 183-H Solar Evaporation Basins.

The RCRA sampling and analysis schedule includes a network of four wells sampled annually. The wells are 199-H4-8, 199-H4-12A, 199-H4-12C, and 199-H4-84 (Figure 3.1). (Well 199-H4-12C is also used as an extraction well for the pump-and-treat system.) Water samples will be analyzed for the constituents of concern previously identified for tracking contamination attributable to the 183-H Solar Evaporation Basins (nitrate, fluoride, chromium, uranium, and technetium-99). Additional analyses will be performed for alkalinity, other anions, and other metals, to aid in interpreting results. Field parameters (pH, temperature, specific conductance, and turbidity) will also be measured.

Minor modifications to the list of specific wells used and constituents analyzed may be appropriate to account for changing field conditions, IRM operational requirements, and changes identified during the data evaluation process. Recommendations for minor modifications will be presented for regulator approval outside of the permit modification process prior to implementation.

3.3 Groundwater Monitoring Under CERCLA

Groundwater underlying the former 183-H Solar Evaporation Basins is included in the 100-HR-3 Operable Unit. This groundwater operable unit contains the groundwater underlying the 100-D/DO Area, 100-H Area, and the 600 Area in between. Along the Columbia River, the boundary of the operable unit is generally accepted as the interface between groundwater discharging from the aquifer and river water. Samples of riverbank seepage and of pore water from riverbed sediment are used to monitor the interface.

3.3.1 100-HR-3 Remedial Investigation Monitoring

The remedial investigation was initially guided by a work plan (DOE-RL 1992) that directed a limited field investigation. A limited field investigation report, which includes a qualitative risk assessment, was prepared (DOE-RL 1994). A focused feasibility study was subsequently conducted that looked at various remediation alternatives to address chromium contamination, and to help decide whether interim remedial measures were warranted (DOE-RL 1995a). A proposed plan (DOE-RL 1995b) and Record of Decision (EPA 1996) were then prepared that described a pump-and-treat alternative to address chromium in the 100-HR-3 and 100-KR-4 Operable Units.

In addition to chromium, other groundwater constituents in the 100-H Area remain above EPA drinking water standards and/or Washington State cleanup levels (Peterson et al. 1996). Chemical constituents include aluminum, fluoride, iron, manganese, nitrate, and uranium. Radiological constituents include gross alpha, gross beta, strontium-90, and technetium-99. None of these constituents have been designated as contaminants of concern for interim remedial measures, by reason of human health or ecological risk.

Sampling under the remedial investigation is typically conducted annually, with some wells being monitored quarterly for selected constituents, and others being sampled once every two years. Biennial sampling is conducted where two wells monitor essentially the same conditions, but each well is sampled on alternate years. The schedule for remedial investigation monitoring well sampling for Fiscal Year (FY) 1997 and FY 1998 is included in Table 3.1.

3.3.2 100-HR-3 Interim Remedial Measure Monitoring

A decision was made in 1996 to proceed with accelerated remediation activities to remove hexavalent chromium (Cr+6) from groundwater underlying the 100-HR-3 Operable Unit (DOE-RL 1995b; EPA 1996). The activities involve pumping groundwater from wells located near the river and removing chromium using an ion exchange resin (DOE-RL 1996a). In the 100-H Area, two additional inland wells were added to the extraction network to intercept chromium migrating into the 100-H Area from sources located to the west. The treated effluent will be reinjected into the unconfined aquifer at an upgradient inland location. Operation of the pump-and-treat system is scheduled to start in July 1997. As stated in the ROD (EPA 1996), the remedial action objectives for the pump-and-treat system include the following three components:

- Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River (Note: The ROD identifies Cr+6 as the target contaminant).
- Protect human health by preventing exposure to contaminants in the groundwater.
- Provide information that will lead to the final remedy.

The relevant standard for meeting these objectives during the IRM is the State of Washington's Ambient Water Quality Standard (AWQS) for Protection of Freshwater Aquatic Life for hexavalent chromium, which is 11 µg/L for chronic exposure (WAC 173-201A-040). The highest priority contaminated areas to be addressed initially by the remedial action are adjacent to riverbed substrate that is known to provide suitable habitat for salmon spawning. Some of these areas have been defined by direct observation of riverbed substrate and sediment pore water analysis (Hope and Peterson 1996a and 1996b).

In addition to chromium, other contaminants of concern in the 100-H Area that were identified in the ROD (EPA 1996) are nitrate, strontium-90, technetium-99, and uranium. With the exception of strontium-90, the ion exchange treatment system is expected to reduce concentrations of all these contaminants. Tritium may also be present in the extracted water; however, tritium concentrations in 100-H Area wells have decreased to below drinking water standards (Peterson et al. 1996).

3.3.2.1 Data Quality Objectives for IRM Monitoring

Groundwater sampling and analysis activities associated with the IRM for chromium (DOE-RL 1997) serve two general purposes: (1) Performance monitoring to determine the effectiveness and efficiency of the extraction system, and (2) compliance monitoring to show how well the remediation is doing relative to target goals described in the ROD (EPA, 1996).

The objectives for performance monitoring are to collect water level and water quality data that are used to (1) optimize the performance of the groundwater extraction system; (2) document aquifer and chromium plume response to pumping and injection of treated effluent, and (3) obtain supplemental data to support selection of a final remediation alternative for the 100-HR-3 Operable Unit.

Objectives for compliance monitoring are described in the interim ROD (EPA, 1996), which states that monitoring will be conducted at near-river onshore locations that are above the river's high water line. Sampling will be conducted at multiple depth intervals at compliance locations. A dilution factor of 1:1 is allowed when demonstrating compliance with the WAC AWQS of 11 µg/L in riverbed sediment. That is, 22 µg/L at compliance locations is deemed equivalent to 11 µg/L at depths in riverbed substrate of up to 46 cm. Locations initially designated to serve as compliance monitoring points are wells 199-H4-4, 199-H4-5, 199-H4-49, 199-H4-63, and 199-H4-64.

3.3.2.2 IRM Monitoring Wells and Sampling Schedules

The groundwater monitoring wells used to support the interim remedial measures include extraction wells, injection wells, performance monitoring wells, and compliance monitoring wells. The wells are used to obtain water quality data and water level measurements. The schedules for sampling and analysis of these wells are described in Table 3.1 with the analysis listed in Table 3.2. The tables summarize the sampling and analysis schedules for the IRM network as it is planned for FY 1997 and FY 1998. These schedules are subject to change as the result of information gained during the IRM. The schedule for water level measurements is provided in Table 3.3.

3.4 Inspection, Maintenance, and Replacement of Wells

Each time a well is sampled by any of the Hanford Site groundwater monitoring programs, the wellhead, cap, protective posts, and concrete pad are inspected. If the samplers experience problems with dedicated sampling pumps, excessive turbidity in the sample, etc., these problems are noted and maintenance is scheduled.

Periodic maintenance and rehabilitation are generally performed on Hanford Site monitoring wells at five-year intervals.

This includes removing dedicated equipment, brushing the well bore, removing sediment accumulation, conducting a downhole video camera survey, responding to service difficulty reports, and reinstalling dedicated equipment. A comprehensive description of well maintenance, reconfiguration, and decommissioning is presented in Chapter 8 of the Hanford Site Annual Groundwater Monitoring Report for FY 1996 (Hartman and Dresel 1997).

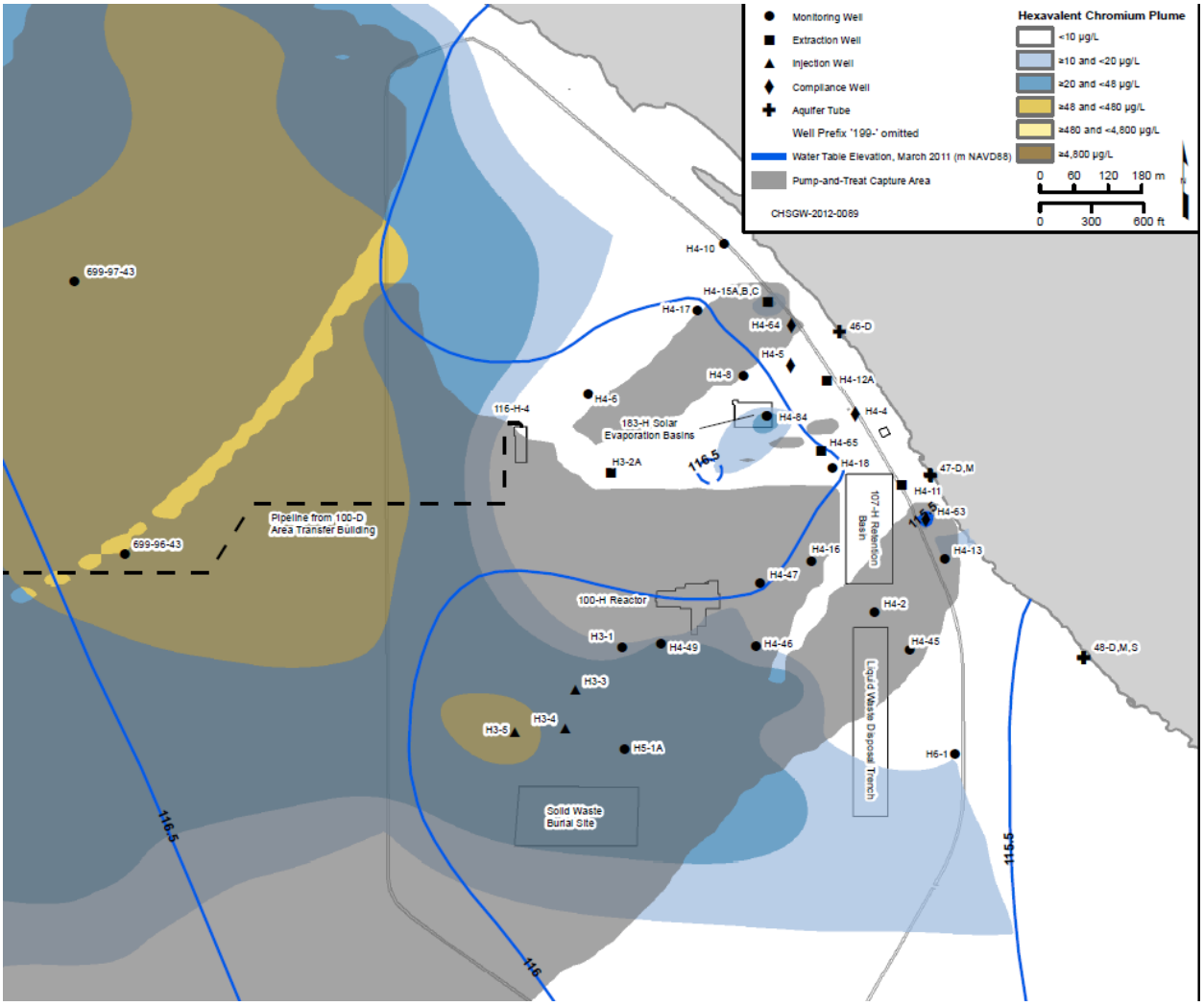

Figure 3.1. Location Map for 100-H Area Monitoring Wells

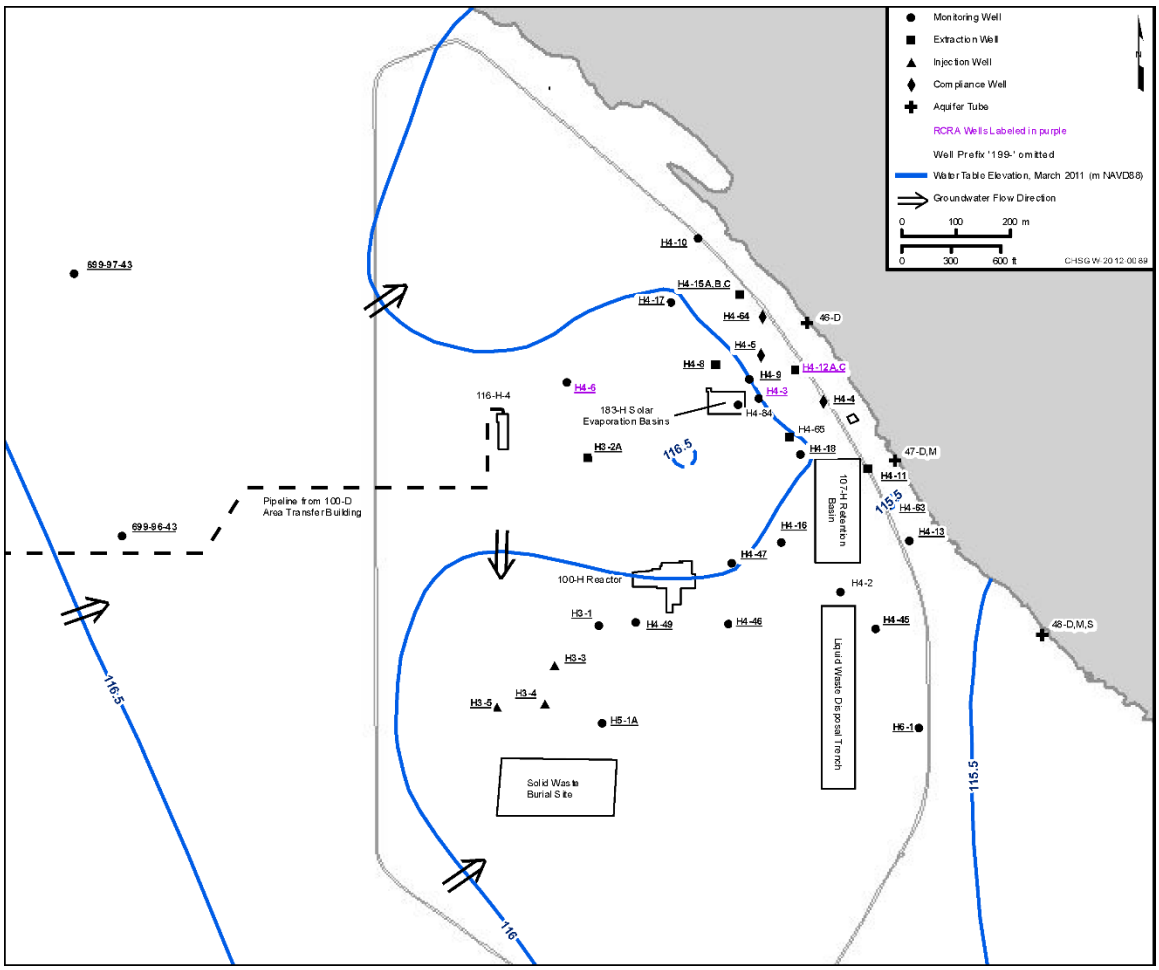

Figure 3.2. Predicted Groundwater Flow During Interim Remedial Measure

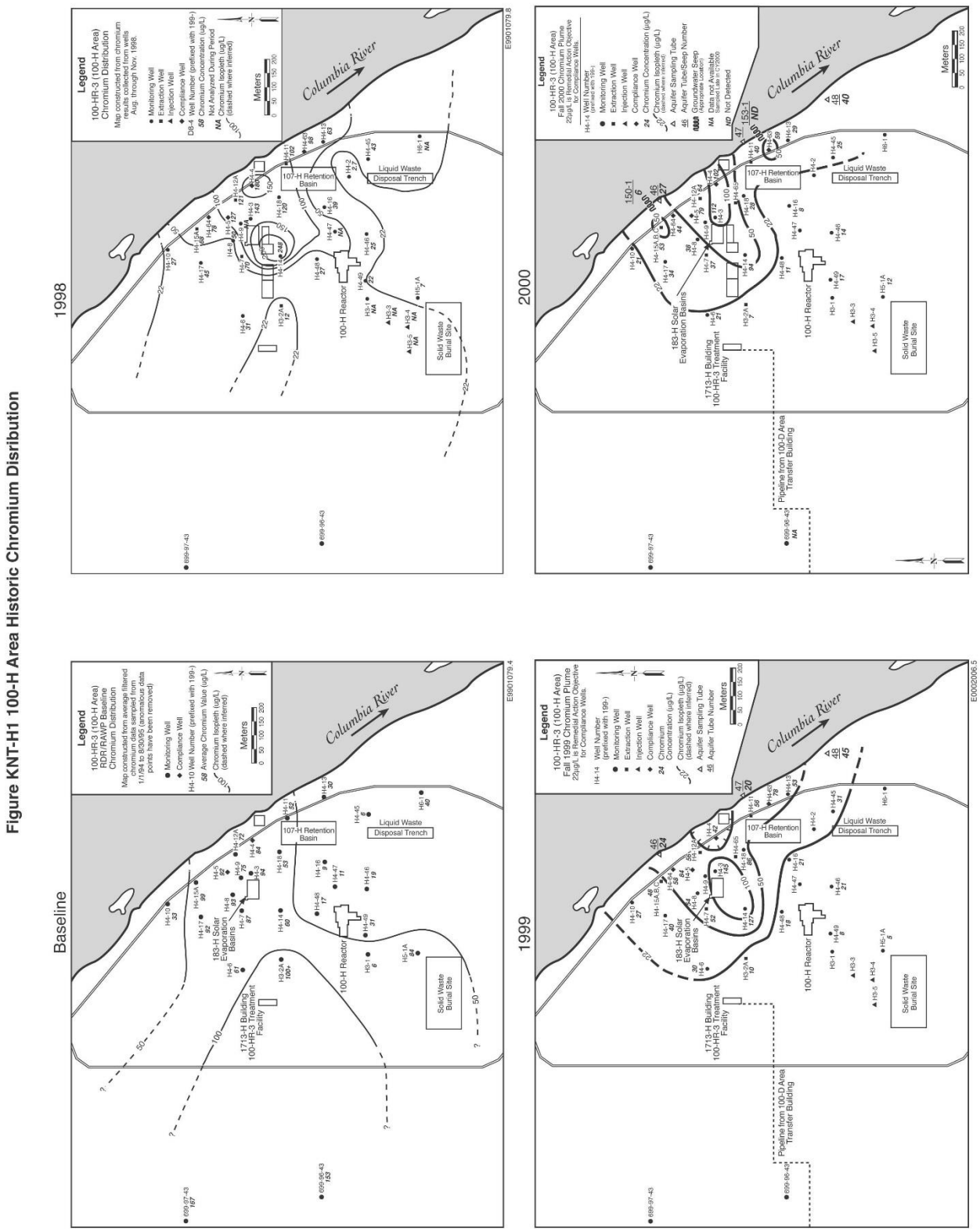

Figure 3.3. Chromium Contamination in the 100-H Area

E0101121

Table 3.1. Sampling and Analysis Schedule for 183-H Solar Evaporation Basins RCRA Corrective Action & CERCLA Remedial Investigation Monitoring

Well/Location Identifier	Facility Monitored/Purpose	RCRA:		CERCLA Remediation Activities:		
		183-H: Compliance (Pre-IRM[1])	183-H: Corrective Action [2]	RI/FS[3] Round 11: FY 97	Outlook[3] Round 12: FY 98	IRM Monitor Plan[4]
199-H3-1	Reactor building				BA(98)-2	
199-H3-2A	D-plume migration/ IRM extraction well	SA-1		A-2	A-2	SA-3 Q-Cr
199-H3-2C (deep conditions)	D-plume migration/ vertical distribution				BA(98)-2	
199-H4-3	183-H basins/IRM performance	SA-1	A-1	BA(97)-2		SA-Cr
199-H4-	183-H basins/IRM compliance	SA-1		A-2	A-2	M-Cr
199-H4-5	183-H basins/IRM compliance				BA(98)-2	M-Cr
199-H4-6	D-plume migration/ IRM performance	SA-1		BA(97)-2		SA-Cr
199-H4-8	183-H basins/IRM extraction		A-1			SA-3 Q-Cr
199-H4-8	183-H basins/IRM performance			BA(97)-2		SA-Cr
199-H4-9	183-H basins	SA-1			BA(98)-2	
199-H4-10	D-plume migration/ IRM performance			A-2	A-2	SA-Cr
199-H4-11	Retention basins/ IRM extraction					SA-3 Q-Cr
199-H4-12A	183-H basins/ IRM extraction	SA-1	A-1			SA-3 Q-Cr
199-H4-12B	183-H basins/ IRM performance					SA-Cr
199-H4-12C (deep conditions)	183-H basins/ IRM performance	SA-1	A-1	A-2	A-2	SA-Cr
199-H4-13	Retention basins/ IRM performance			A-2	A-2	SA-Cr
199-H4-14	190-H coolant prep/ IRM performance			BA(97)-2		SA-Cr
199-H4-15A	D-plume migration/ IRM extraction					SA-3 Q-Cr
199-H4-15B	D-plume migration/ IRM performance					SA-Cr
199-H4-15CS (deep conditions)	D-plume migration/ IRM performance					SA-Cr
199-H4-16	Reactor building/ IRM performance			BA(97)-2		SA-Cr

Well/Location Identifier	Facility Monitored/Purpose	RCRA:		CERCLA Remediation Activities:		
		183-H: Compliance (Pre-IRM[1])	183-H: Corrective Action [2]	RI/FS[3] Round 11: FY 97	Outlook[3] Round 12: FY 98	IRM Monitor Plan[4]
199-H4-17	D-plume migration/ IRM performance			BA(97)-2		SA-Cr
199-H4-18	183-H basins/ IRM performance	SA-1		A-2	A-2	SA-Cr
199-H4-45	Liquid waste disposal trench/ IRM performance			A-2	A-2	SA-Cr
199-H4-46	Reactor building/ IRM performance			BA(97)-2		SA-Cr
199-H4-47	Reactor building				BA(98)-2	
199-H4-48	Reactor building/ IRM performance				BA(98)-2	SA-Cr
199-H4-49	Reactor building/ IRM compliance				BA(98)-2	SA-Cr
199-H4-84	183-H basins/IRM compliance	SA-1		A-2	A-2	M-Cr
199-H5-1A	118-H-1 solid waste burial/IRM performance				BA(98)-2	SA-Cr
199-H6-1	Liquid waste disposal trench			A-2	A-2	
199-H4-63 (new well FY97)	IRM compliance					M-Cr
199-H4-64 (new well FY97)	IRM compliance					M-Cr
699-96-43	D-plume migration/ background			BA(97)-2		
699-97-43	D-plume migration/ background				BA(98)-2	

Sampling code abbreviations: 'BA' = biennial (next year), 'A' = annual, 'SA' = semiannual, 'Q' = quarterly, and 'M' = monthly. The '-1, -2, -3' suffixes define the analysis suite (Table 3.2). 'Q-Cr' indicates quarterly screening for chromium, Sr-90, etc. '(+Tc-99) ' indicates constituent added to basic suite listed in Table 3.2.

Footnotes (References):

1. *183-H Compliance* (183-H compliance groundwater monitoring plan - Hartman and Chou, 1995)
2. *183-H Corrective Action* (183-H corrective action groundwater monitoring plan - Hartman, 1997)
3. *RI/FS Round #11 and #12 Outlook* reflect Tri-Party Agreement Change Control Form #107, November 1996
4. *IRM Monitoring Plan* is for post-July 1997 (IRM Monitoring Plan [DOE-RL 1997])

Table 3.2. Analysis Suite Codes for 183-H RCRA Corrective Action & CERCLA Remedial Investigation Monitoring

Analysis/ Parameter	Constituent Code #1 (RCRA: FY97/98)[1]	Constituent Code #2 (RI Round 11&12--FY97/98)[2]	Constituent Code #3 (IRM--FY97/98)[3]
Metals by routine ICP (SW 846 6010B/C, SW 846 6020, or EPA/600/R-94/111, 200.8 - Target Analyte List Note: Filtered and unfiltered samples for all metal analyses, except ROM collects filtered samples only	Aluminum Iron Antimony Magnesium Barium Manganese Beryllium Nickel Cadmium Potassium Calcium Silver Chromium Sodium Cobalt Vanadium Copper Zinc	Aluminum Iron Antimony Magnesium Barium Manganese Beryllium Nickel Cadmium Potassium Calcium Silver Chromium Sodium Cobalt Vanadium Copper Zinc	
Metals: Other (Chromium, hexavalent: SW-846 7196A; ; Laboratory Specific Uranium Method)	Uranium		Chromium, hexavalent Uranium
Anions by IC (EPA/600/R-93/100, 300.0)	Chloride Fluoride Nitrate Sulfate	Chloride Fluoride Nitrate Sulfate	Nitrate
Radionuclide screening: (Laboratory Specific Methods)	Activity scan[4]	Gross alpha Gross beta Activity scan[4]	
Specific radionuclides: (Laboratory Specific Methods)	Technetium-99	Tritium	Strontium-89/90 Technetium-99 Tritium
Miscellaneous parameters: (Standard Methods 2320; EPA/600/4-79/020, 310.1 & 310.2)	Alkalinity		
Field parameters:	pH Specific conductance Temperature Turbidity	pH Specific conductance Temperature Turbidity	pH Specific conductance Temperature Turbidity

Footnotes (References):

1. Code #1 is based on 183-H compliance groundwater monitoring plan (Hartman and Chou, 1995); constituents in bold are dangerous waste constituents used for evaluations under WAC-173-303-645(10).
2. Code #2 is based on Tri-Party Agreement Change Control Form #107, November 1996
3. Code #3 is from IRM Monitoring Plan (DOE-RL 1997)
4. Selected wells only

Abbreviations: ICP = inductively coupled plasma; IC = ion chromatography

Table 3.3. CERCLA Interim Remedial Measure Groundwater Well Network:

Well Number	Intended Use	Operations Period-- July 1997 to end of IRM:			
		Hourly Water Levels[1]	Steel Tape Measure[2]	Hexavalent Chromium[3]	Co-contaminants[4]
199-H3-2A	Extraction well	Transducer	Monthly	Quarterly	Semiannual
199-H4-8	Extraction well	Transducer	Monthly	Quarterly	Semiannual
199-H4-11	Extraction well	Transducer	Monthly	Quarterly	Semiannual
199-H4-12A	Extraction well	Transducer	Monthly	Quarterly	Semiannual
199-H4-15A	Extraction well	Transducer	Monthly	Quarterly	Semiannual
199-H3-4	Injection well	Transducer	Monthly		
199-H3-5	Injection well	Transducer	Monthly		
199-H4-3	Performance monitoring		Quarterly	Semiannual	
199-H4-6	Performance monitoring		Quarterly	Semiannual	
199-H4-8	Performance monitoring	Transducer	Monthly	Semiannual	
199-H4-10	Performance monitoring	Transducer	Monthly	Semiannual	
199-H4-12B	Performance monitoring	Transducer	Monthly	Semiannual	
199-H4-12C	Performance monitoring		Quarterly	Semiannual	
199-H4-13	Performance monitoring		Quarterly	Semiannual	
199-H4-14	Performance monitoring		Quarterly	Semiannual	
199-H4-15B	Performance monitoring	Transducer	Monthly	Semiannual	
199-H4-15CS	Performance monitoring		Quarterly	Semiannual	
199-H4-16	Performance monitoring		Quarterly	Semiannual	
199-H4-17	Performance monitoring		Quarterly	Semiannual	
199-H4-18	Performance monitoring		Quarterly	Semiannual	
199-H4-45	Performance monitoring		Quarterly	Semiannual	
199-H4-46	Performance monitoring		Quarterly	Semiannual	
199-H4-48	Performance monitoring		Quarterly	Semiannual	
199-H4-49	Performance monitoring		Quarterly	Semiannual	
199-H5-1A	Performance monitoring		Quarterly	Semiannual	
199-H4-4	Compliance monitoring	Transducer	Monthly	Monthly	Annual
199-H4-5	Compliance monitoring	Transducer	Monthly	Monthly	Annual
199-H4-63	Compliance monitoring	Transducer	Monthly	Monthly	Annual
199-H4-64	Compliance monitoring	Transducer	Monthly	Monthly	Annual

Footnotes:
[1] Hourly measurements using pressure transducers and data loggers
[2] Routine steel tape measurements; monthly measurements to calibrate pressure transducers
[3] Hexavalent chromium using Hach methodology, ERC Mobile Laboratory
[4] Co-contaminants: Nitrate, strontium-90, technetium-99, tritium, and uranium
[3 & 4] Field measurements for pH, specific conductance, temperature, and turbidity during all sampling
Source: DOE-RL 1997

183-H SOLAR EVAPORATION BASINS
CHAPTER 4.0
CORRECTIVE ACTION PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 4.0
CORRECTIVE ACTION PLAN

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CHAPTER 4.0
CORRECTIVE ACTION PLAN

TABLE OF CONTENTS

4.0 CORRECTIVE ACTION PLAN 5
4.1 Soil Column Corrective Action 5
4.2 Groundwater Corrective Action 5
4.3 Remediation Expectations During the IRM 5

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4.0 CORRECTIVE ACTION PLAN

Corrective action with regard to residual contamination in the soil and groundwater associated with the 183-H Solar Evaporation Basins has already started. A significant amount of contaminated soil has been excavated from beneath the former concrete basins and has been moved to the Environmental Restoration and Disposal Facility (ERDF), in accordance with the 183-H Closure Plan contained in the Permit (Ecology 1994) and the action memorandum for disposal of 183-H concrete and soils (DOE-RL et al. 1996). Soil removal was completed at 183-H on May 7, 1997. Groundwater remediation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Record of Decisions (ROD) for the 100-HR-3 Operable Unit (EPA 1996) begins in July 1997 with the startup of a pumping well network and ion exchange treatment system that will remove chromium and some co-contaminants.

4.1 Soil Column Corrective Action

The majority of soil column contamination has been removed as described in Section 1.2. Nitrate and fluoride remain in the soil column above groundwater protection standards between the bottom of the excavation (6.1 m [20 ft] below grade) and the water table (approximately 4.6 m [15 ft] vertical area), under the former Basin 1. Clean backfill has been added to minimize infiltration of moisture. Institutional controls are in place to prevent human activities that might enhance soil moisture (e.g., irrigation). Final disposition of remaining nitrate and fluoride in the soil underlying the former 183-H facility will be addressed in a final feasibility study and ROD for the 100-HR-1 Operable Unit.

4.2 Groundwater Corrective Action

Groundwater contamination from 183-H waste is still present in groundwater near the former 183-H Basins. Corrective action to remove hexavalent chromium is being undertaken as an interim remedial measure for the entire 100-HR-3 Groundwater Operable Unit. The treatment methodology will remove hexavalent chromium from groundwater, and some nitrate, technetium-99, and uranium. Whether or not fluoride will be retained by the Dowex 21K resin has not yet been demonstrated, but the resin is expected to do so. Final disposition of groundwater contamination from all sources in the 100-H Area will be addressed in a final feasibility study and ROD for the 100-HR-3 Operable Unit, should the CERCLA Interim Remedial Measure (IRM) action not remediate all contamination.

4.3 Remediation Expectations During the IRM

The interim remedial measure for chromium is designed to remove hexavalent chromium from groundwater using an ion exchange resin. The resin is expected to also remove some nitrate, fluoride, technetium-99, and uranium (strontium-90 will not be removed), although hexavalent chromium will be removed preferentially. Determining how well the ion exchange resin will perform in removing these co-contaminants and 183-H waste indicators is an objective of the IRM performance monitoring program.

Selection of final remediation alternatives for the soil column associated with the 183-H Treatment, Storage, and Disposal (TSD) unit and the underlying groundwater will be done after completion of final feasibility studies for the 100-HR-1 and 100-HR-3 Operable Units. Information gained during the pump-and-treat remediation activities for chromium in groundwater will play a prominent role in guiding the final RODs for these operable units. Also, groundwater monitoring data obtained under the Resource Conservation and Recovery Act (RCRA) program (Hartman 1997), the CERCLA remedial investigation (Peterson and Raidl 1996), and the CERCLA interim remedial measure (DOE-RL 1997) will be used in a focused feasibility study to help identify the optimal final remediation alternative.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 5.0
PERSONNEL TRAINING DURING POST-CLOSURE

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 5.0
PERSONNEL TRAINING DURING POST-CLOSURE

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CHAPTER 5.0
PERSONNEL TRAINING DURING POST-CLOSURE

TABLE OF CONTENTS

5.0 PERSONNEL TRAINING DURING POST-CLOSURE 5

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5.0 PERSONNEL TRAINING DURING POST-CLOSURE

This section describes the training of the groundwater sampling and analysis task leader and sampling personnel required to complete post-closure care requirements as contained in this post-closure plan.

The training of the sampling and analysis task leader and sampling personnel will receive either classroom instruction or on-the-job training. Sampling and analysis personnel will be trained to perform these functions in accordance with the Hanford Analytical Services Quality Assurance Requirements Documents (DOE-RL 1996c). A person successfully completing the required training courses will be qualified as a groundwater sampler and/or task leader. All personnel will undergo training and at least an annual review for required course.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 6.0
SECURITY

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
02/2004	

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CHAPTER 6.0
SECURITY

This page intentionally left blank.

CHAPTER 6.0
SECURITY

TABLE OF CONTENTS

6.0 SECURITY 5
6.1 24-Hour Surveillance System 5
6.2 Barrier, Means to Control Entry, and Warning Signs 5

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6.0 SECURITY

6.1 24-Hour Surveillance System

The 100 Area will remain an area controlled by RL for the foreseeable future. These areas will be under 24-hour surveillance by Hanford Patrol protective force personnel.

6.2 Barrier, Means to Control Entry, and Warning Signs

No direct exposure hazards remain at 183-H Solar Evaporation Basins. However, roadways to the unit and site access will remain administratively restricted to use by authorized personnel only. Posted federal warning signs restrict access to the 100-H Area from the Columbia River.

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183-H SOLAR EVAPORATION BASINS
CHAPTER 7.0
CLOSURE CONTACT

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
02/2004	

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CHAPTER 7.0
CLOSURE CONTACT

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CHAPTER 7.0
CLOSURE CONTACT

TABLE OF CONTENTS

7.0 CLOSURE CONTACT 5

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7.0 CLOSURE CONTACT

The RL is the official contact for 183-H Solar Evaporation Basins during the postclosure period at the following address:

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U.S. Department of Energy
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Richland, Washington 99352
(509) 372-2400

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183-H SOLAR EVAPORATION BASINS
CHAPTER 8.0
CERTIFICATION OF POSTCLOSURE

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 8.0
CERTIFICATION OF POSTCLOSURE

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CHAPTER 8.0
CERTIFICATION OF POSTCLOSURE

TABLE OF CONTENTS

8.0 CERTIFICATION OF POSTCLOSURE 5

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8.0 CERTIFICATION OF POSTCLOSURE

No later than 60 days after completion of the postclosure care period, RL will submit to the Washington State Department of Ecology a certification of completion of postclosure care. RL and an independent registered professional engineer will sign this certification, stating that postclosure care for the unit was performed in accordance with the approved closure plan. The certification will be submitted by registered mail or an equivalent delivery service. Documentation supporting the independent registered professional engineer's certification will be supplied upon request of the regulatory authority.

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300 AREA PROCESS TRENCHES
CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to 300 Area Process Trenches **October 1, 2008**

Chapters	Last Modification Date	Modification Number
Unit-Specific Conditions	10/1/2008	
1.0 Part A Form	10/1/2008	
2.0 Introduction	06/30/2002	
3.0 Groundwater Monitoring Plan	06/30/2002	
4.0 Closure Contact	02/2004	
5.0 Certification of Postclosure	02/2004	
6.0 Reserved		
7.0 Reserved		
8.0 Postclosure Plan	06/30/2002	

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300 AREA PROCESS TRENCHES
PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
10/1/2008	

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PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
300 AREA PROCESS TRENCHES

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PART VI, POST-CLOSURE UNIT 1 UNIT-SPECIFIC CONDITIONS
300 AREA PROCESS TRENCHES

The 300 Area Process Trenches were operated to receive effluent discharges of dangerous mixed waste from fuel fabrication laboratories in the 300 Area. This chapter sets forth the modified closure requirements.

VI.1.A COMPLIANCE WITH APPROVED MODIFIED CLOSURE PLAN

The Permittees shall comply with all requirements set forth in Post-Closure Unit 1, including Permit Conditions specified in VI.1.B. The Permittees shall also comply with all the requirements in the 300-FF-1 and 300-FF-5 Record of Decision. All sections, figures, and tables included in these portions are enforceable:

POST-CLOSURE UNIT 1

Chapter 1.0	Part A Form, dated October 1, 2008
Chapter 2.0	Introduction, dated June 30, 2002
Chapter 3.0	300 Area Process Trenches Groundwater Monitoring Plan, RCRA Final Status Compliance Monitoring Plan (i.e., WHC-SD-EN-AP-185), dated June 30, 2002
Chapter 4.0	Closure Contact, dated February 2004
Chapter 5.0	Certification of Post-Closure, dated February 2004
Chapter 8.0	Post-Closure, dated June 30, 2002

VI.1.B AMENDMENTS TO THE APPROVED MODIFIED CLOSURE PLAN

VI.1.B.1 Pursuant to Permit Condition II.K.7, the 300 Area Process Trenches (APT) closure shall be a Modified Closure in coordination with the Record of Decision (ROD) for 300-FF-1 and 300-FF-5. Sections of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents (examples may include, but are not limited to, Remedial Design/Remedial Action CERCLA work plan, the Operation and Monitoring Work Plan, etc.), which satisfy requirements and Conditions of this Modified Closure Plan, will be reviewed and approved by the Washington State Department of Ecology.

VI.1.B.2 As stipulated through Chapter 3.0 the Resource Conservation and Recovery Act (RCRA) Final Status Compliance Monitoring Plan (i.e., WHC-SD-EN-AP-185) Appendix IX, sampling shall not be required unless post-closure monitoring results indicate a need to do so.

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300 AREA PROCESS TRENCHES
CHAPTER 2.0
INTRODUCTION

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 2.0
INTRODUCTION

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CHAPTER 2.0
INTRODUCTION

TABLE OF CONTENTS

2.0 300-FF-1 PROPOSED PLAN DISCUSSIONS AND EFFECTS ON THE 300-FF-1 PHASE III FEASIBILITY STUDY AND 300 AREA PROCESS TRENCHES MODIFIED CLOSURE/POSTCLOSURE PLAN 5

2.1 Introduction 5

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2.0 300-FF-1 PROPOSED PLAN DISCUSSIONS AND EFFECTS ON THE 300-FF-1 PHASE III FEASIBILITY STUDY AND 300 AREA PROCESS TRENCHES MODIFIED CLOSURE/POSTCLOSURE PLAN

2.1 Introduction

The purpose of this addendum is to document the discussions and present the data and evaluations that have been developed after submittal of the 300-FF-1 Phase III Feasibility Study (FS) to the regulatory agencies for review. A number of issues were raised by the regulatory agencies that have been addressed over the past several months. Discussions of issues between the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy (DOE) resulted in additional technical reviews of analytical data and site conditions that, in some cases, enhance or modify certain aspects within the 300-FF-1 Phase III FS and the 300 Area Process Trenches (300 APT) Modified Closure/Postclosure Plan. Rather than completely revise each document, this addendum is included which summarizes the discussions, data review, evaluations, and technical changes made. It supersedes related discussions in both documents and by inclusion in these documents is made part of the 300-FF-1, 300-FF-5, and 300 Area APT Administrative Records.

A listing of topics the addendum addresses is discussed in the next paragraph. The first item on that list is very important and warrants discussion in the introduction. A key conclusion resulting from using data collected prior to the Remedial Investigation (RI)/FS is that several chemical constituents are identified above regulatory standards for the 300 APT. The text in the 300 APT Modified Closure/Post Closure Plan currently indicates no chemical constituents are above *Model Toxics Control Act* (MTCA) Level C Industrial Soil Cleanup Values. This results in a substantial change to the conclusions made within the closure plan. Exceedance of this regulatory standard is a new regulatory driver to take cleanup action in the 300 APT in addition to the previously documented uranium risk driver. There were no changes to conclusions in the 300-FF-1 Phase III FS risk assessment using the older data. The magnitude of this change suggests that it is very important for reviewers to read this addendum as it supersedes some analyses in both the 300-FF-1 Phase III FS and the 300 APT Modified Closure/Postclosure Plan.

The key areas addressed in the addendum are (1) change in use of (SW-846) data collected prior to *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) characterization activities, (2) evaluation and use of additional cobalt-60 data from the South Process Pond, (3) development of a uranium cleanup standard, (4) evaluation of a cost-efficient technique to meet MTCA C Industrial Soil Cleanup Values, (5) review of volume and cost estimates, (6) revision of remedial alternatives, and (7) establishing proposed preferred remedial alternatives.

Another topic that merits a brief discussion here is the combining of the 300-FF-1 and 300-FF-5 Operable Units Proposed Plans. During review of the separate 300-FF-1 and 300-FF-5 Proposed Plans, the regulators determined that the documents should be combined to create a more integrated approach. Therefore, the proposed plan has been written to combine information from both operable units. Once the Public Comment Period is completed, the remedial alternatives for both operable units and the 300 APT will be presented in the Record of Decision. In addition, 300 APT-specific permit conditions will be administratively incorporated into the site-wide permit.

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300 AREA PROCESS TRENCHES
CHAPTER 4.0
CLOSURE CONTACT

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
02/2004	

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CHAPTER 4.0
CLOSURE CONTACT

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CHAPTER 4.0
CLOSURE CONTACT

TABLE OF CONTENTS

4.0 CLOSURE CONTACT 5

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4.0 CLOSURE CONTACT

The RL is the official contact for 300 Area Process Trenches during the postclosure period at the following address:

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(509) 372-2400

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300 AREA PROCESS TRENCHES
CHAPTER 5.0
CERTIFICATION OF POSTCLOSURE

CONTROL LOG

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Modification History Table

Modification Date	Modification Number
02/2004	

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CHAPTER 5.0
CERTIFICATION OF POSTCLOSURE

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CHAPTER 5.0
CERTIFICATION OF POSTCLOSURE

TABLE OF CONTENTS

5.0 CERTIFICATION OF POSTCLOSURE 5

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300 AREA PROCESS TRENCHES
CHAPTER 8.0
POSTCLOSURE PLAN

CHANGE CONTROL LOG

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Modification History Table

Modification Date	Modification Number
06/30/2002	

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CHAPTER 8.0
POSTCLOSURE PLAN

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CHAPTER 8.0
POSTCLOSURE PLAN

TABLE OF CONTENTS

8.0 POSTCLOSURE PLAN 5
8.1 Inspection Plan 5
8.1.1 Security Control Devices 5
8.1.2 Well Condition 5
8.2 Maintenance Plan 5
8.2.1 Repair of Security Control Devices 5
8.2.2 Well Replacement 5
8.3 Personnel Training 5
8.3.1 Outline of the Training Program 6
8.3.2 Job Description 6
8.3.3 Training Content, Frequency, and Techniques 6
8.3.4 Training for Emergency Response 6
8.3.5 Implementation of Training Program 7

TABLE

Table 8.1. Inspection Schedule for the 300 Area Process Trenches 7

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8.0 POSTCLOSURE PLAN

8.1 Inspection Plan

This section describes compliance monitoring activities, security equipment, and inspections for well conditions during a period of modified closure compliance monitoring. Table 8.1 lists the inspection items and the inspection frequency for the postclosure care period. These inspections may be implemented in checklist form. Such a checklist could specify entering checklist performance and results in the appropriate inspection logbook.

8.1.1 Security Control Devices

Each of the groundwater monitoring wells has a locked cap to prevent unauthorized access and is surrounded by four steel guard posts for visibility to prevent damage from vehicles. The overall well condition, locks, guard posts, and pumps will be inspected during each sampling event. Problems and/or damage will be noted on well inspection forms for tracking of repairs.

8.1.2 Well Condition

Inspection of groundwater monitoring wells will be conducted pursuant to Permit Condition II.F and carried out under internal procedure BHI-EE-01 (BHI 1995) or equivalent guidance. This procedure calls for a surface inspection of a well at each sampling event. The procedure also calls for a subsurface inspection of the well at a minimum of every 3 to 5 years. This routine subsurface inspection may consist of pulling and inspecting the pump, brushing the inner walls of the casing and screen, and conducting a down-hole television survey.

8.2 Maintenance Plan

This section provides a plan for maintenance of the unit during the compliance monitoring period required for modified closure. Elements of this maintenance plan include repair of security devices, and well replacement. The maintenance plan is based on observations made and recorded in the well inspection form during site inspections. Except where immediate action is required, maintenance action will be initiated within 90 days of inspection and discovery.

8.2.1 Repair of Security Control Devices

The responsible maintenance organization will be notified of any problems to the well locks or guard posts and/or problems noted in the well inspection form during inspections and/or well monitoring activities. Well repairs will be made as soon as possible after notification of damage. Repairs to the four steel guard posts at each monitoring well will be made before the following inspection period and tracked on well inspection forms to completion.

8.2.2 Well Replacement

Maintenance of groundwater monitoring wells will be carried out under internal procedure BHI-EE-01 (BHI 1995) or equivalent guidance. This procedure covers correction of problems found during routine inspection or that manifest themselves at other times. If field maintenance procedures are inadequate to solve problems identified during site inspection, management will decide whether to repair or replace the well.

Where monitoring well damage requires modification of the groundwater monitoring program, the monitoring plan will be amended in accordance with WAC 173-303-610(8)(d).

8.3 Personnel Training

This section describes the training of personnel required to maintain the 300 APT in a safe and secure manner during postclosure care as required by 40 CFR 265.16, WAC 173-303-330, and Permit Condition II.C of the Hanford Facility Dangerous Waste Permit.

8.3.1 Outline of the Training Program

This section outlines the introductory and continuing training programs necessary to conduct the postclosure activities at the 300 APT in a safe manner. This section also includes a brief description of how training will be designed to meet job tasks as required in 40 CFR 265.16(a).

Surveillance Personnel: The following outline provides information on classroom and on-the-job training that surveillance personnel will complete before conducting independent site surveillance at the 300 APT:

- Security inspections.
- Location, integrity, and inspection of groundwater wells.

8.3.2 Job Description

This section provides the job description(s) for postclosure activities at 300 APT as required by 40 CFR 265.16(d)(1) and WAC 173-303-330(2)(a).

Site Surveillance: Personnel with training in the following areas will conduct the inspections:

- Control devices
- Damage

8.3.3 Training Content, Frequency, and Techniques

The training of personnel requires the following job-specific training areas, as appropriate.

- **Emergency Preparedness Training**: This training will include a review of emergency procedures that consists of listening to standard emergency signals, and reporting procedures.
- **The Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Scope, Organization, and Quality Assurance Plan**: This training will include the documentation requirements included in the chain of custody to the laboratory, how to correct mistakes made on field data sheets, and any applicable manifests or shipping orders required for shipping samples to the laboratory.
- **Groundwater Field Sampling Procedures**: This training will include pump description and operation of the three types of pumps (used by the field personnel), operational procedures for the generators and the pumps used to gather groundwater samples, and special requirements for collecting and packaging samples containing volatile organic materials that require acid preservatives or special filtering. Training also will be given in the areas of field data record preparation and chain of custody to the laboratory.
- **Site Security Inspections**: Personnel will be instructed on how to inspect for obvious signs of a security breach. Signs may include downed barricades.
- **Location, Integrity, and Inspection of Groundwater Wells**: Personnel will be shown the locations of the groundwater wells and instructed on how to inspect the cap and casing of each well to ensure that it is locked.

8.3.4 Training for Emergency Response

This section will demonstrate that personnel conducting postclosure activities at the 300 APT have been fully trained to respond effectively to emergencies and are familiar with emergency procedures and equipment. In addition, hazardous waste site operation training will be provided in accordance with 29 CFR 1910.120.

- **Response to Fires**: The 300 APT will have no existing structures and may be covered with a soil cover. As such, there is no need for fire equipment. However, if personnel are at the unit when a brushfire breaks out, they will notify the Hanford Fire Department.

- **Response to Groundwater Contamination**: Based on the current groundwater monitoring program, groundwater contamination beneath the 300 APT does not constitute an emergency situation, nor will it become so as a result of closure. Therefore, emergency response training in this regard is not warranted at this time.

8.3.5 Implementation of Training Program

Surveillance personnel will undergo the required training programs outlined in Section 8.5.1 as they pertain to monitoring requirements. Surveillance personnel will not be allowed to perform inspections at the 300 APT until the required training programs have been completed.

Table 8.1. Inspection Schedule for the 300 Area Process Trenches

Inspection item	Inspection frequency
Security control devices: well caps, and locks	Quarterly
Well condition	Semiannually
Subsurface well condition	3 to 5 years

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