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December 10, 2015

15-NWP-210

Mr. Richard Albright, Director
Office of Environmental Cleanup
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101

Re: Responses to National Remedy Review Board Recommendations to Proposed Cleanup Strategy for 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2 and 100-HR-3 Operable Units (100 D/H Area)

Dear Mr. Albright:

Enclosed are the Department of Ecology's (Ecology) draft responses to the National Remedy Review Board's recommendations to the proposed cleanup strategy for the 100-D/H Area at the Hanford Superfund Site. We worked with Rod Lobos in the U.S. Environmental Protection Agency (EPA) Hanford Project Office throughout our review process.

As you are aware, Ecology has been assigned the lead regulatory oversight responsibility for the operable units at 100 D/H Areas under the Hanford Federal Facility Agreement and Consent Order. However, the EPA retains regulatory authority for approving the selected remedies.

Please review these responses, make any edits you deem appropriate, and provide the final response to Amy Legare, Chair of the EPA National Remedy Review Board. We will email the Word file of the responses to you, for use in reviewing and editing.

Sincerely,

Jane A. Hedges
Program Manager
Nuclear Waste Program

nm/aa
Enclosure

cc: See page 2

cc electronic w/enc:
Dennis Faulk, EPA
Michael Cline, USDOE
Jim Hanson, USDOE
Jon Perry, MSA
Ken Niles, ODOE
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Responses to National Remedy Review Board Recommendations for 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2 and 100-HR-3 Operable Units on the Hanford Superfund Site

Site Characterization

Based on the package and presentation, the Board did not have sufficient information to fully evaluate certain aspects of the preferred approach, including:

1) The relative roles of maximum contaminant levels (MCLs) and State surface water quality standards in achieving the remedial action objectives (RAOs);

Response: *RAO-3 states "Prevent unacceptable risk from contaminants migrating and/or leaching through soil that will result in groundwater concentrations that exceed federal and state standards and risk based thresholds for protection of surface water and groundwater."*

Section 8.1 in the Package describes the specific applicable or relevant and appropriate requirement (ARARs) that could potentially apply to the remediation of the 100-D/H Operable Unit. One of the ARARs listed is the Nonzero Maximum contaminant level (MCL) goals and MCLs promulgated under the Safe Drinking Water Act of 1974 and/or the state of Washington.

Table 4 in the package lists the preliminary remediation goals (PRGs) for Proposed Groundwater and Surface Water Protection Cleanup levels, although the table does not list the specific source of the PRG. The specific source of each contaminate action level is contained in Table 6-31 in the Remedial Investigation/Feasibility Study for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units (DOE/RL-2010-95).

2) Lines of evidence to support a monitored natural attenuation (MNA) remedy for groundwater and soils;

Response: *The lines of evidence to support a MNA remedy for soil are proposed at sites with radioactive contamination. This was not clearly presented in the Remedy Review Board Package. The diffusion and dispersion of the nitrate, which is co-located with the Cr(VI) plume, results in attainment of the nitrate cleanup level within 13 years for Alternatives 2, 3, and 4 (summarized in Table 4 of the Proposed Plan). The MNA of nitrate and strontium-90 in the preferred remedy is appropriate for use with the pump-and-treat for Cr(VI).*

Both the nitrate and strontium-90 plumes are co-located within the Cr(VI), and migration is controlled through the groundwater extraction system. The Modeling of Design Alternatives for 100-HR-3 (ECF-100HR3-11-0114 [Appendix F of 100-D/H RI/FS report DOE/RL-2010-95]) contains more details.

As a result of ongoing groundwater remediation under interim action, nitrate concentrations have declined below the drinking water standard (DWS) in most wells. Only small areas continue to have concentrations above the DWS in the 100-D Area. Nitrate concentrations did not exceed the DWS in 100-H or the Horn during 2014. Strontium-90 has shown stable or declining concentrations, and is relatively immobile.

3) Scope and extent of potential risks to human health and the environment associated with the 100-H-36 structure, including potential contamination of sediments;

Response: *Agreed. The 100-H-36 structure was not characterized and the justification for the proposed remediation was not complete. As a result of the Remedy Review Board's comments, additional characterization of the 100-H-36 structure was completed to evaluate risk. The characterization data indicated this waste site does not present a risk to human health and the environment. Therefore, it will be listed in the proposed plan as no further action needed.*

4) MCLs and associated monitoring data for all potential contaminants of concern (COCs) in groundwater;

Response: *The MCLs are described in Section 8.1 of the Remedy Review Board Package. However, the example table of contents in the Remedy Review Board – Question and Answers for Superfund Site Managers guidance did not require monitoring data be included. A detailed discussion of the nature and extent of groundwater contamination is presented in Sections 4.4 and 4.5 of the 100-D/H RI/FS report (DOE/RL-2010-95). Sections 4.4.1.2 and 4.4.1.3 present results from the evaluation of potential COCs in the unconfined and confined aquifers, respectively.*

5) How sites were screened out (e.g., no future remedial action planned);

Response: *All waste sites were subject to a comprehensive set of evaluations that analyzed potential impacts on human health, ecological risks, and risks to groundwater as detailed in the 100-D/H RI/FS report (DOE/RL-2010-95).*

Analytical measurements following completion of interim remedial actions (removal, treatment, and disposal) at waste sites were combined with other information and measurements in these evaluations. Table 2 in the Remedy Review Board Package lists the number of waste sites that were evaluated and their status. Footnotes for this table lists the specific criteria that was used to determine the status of the waste sites.

6) Historic and current levels of strontium in the soils and groundwater;

Response: *The example table of contents in the Remedy Review Board – Question and Answers for Superfund Site Managers guidance did not require this data to be included. However, historic and current concentrations of strontium-90 in soil and groundwater resulted in the discharge of cooling water from the reactors.*

Removal, treatment, and disposal (RTD) of the cribs and ditches has removed strontium-90 from the vadose zone. There is one plume in the 100-H Area. Current COC concentration maps and trends for groundwater are updated and published annually. The Groundwater Annual Reports are available at:
http://www.hanford.gov/page.cfm/SoilGroundwaterAnnualReports

As identified in the 2014 annual report, strontium-90 in the 100-D Area is in a small area (detections in 2 wells above the DWS), at stable to declining concentration, and has remained relatively immobile based on downgradient monitoring (2014 data). There is only one area in 100-H with strontium-90 above the DWS, and concentrations remain fairly stable with some seasonal variation and a slight downward trend. Downgradient aquifer tube 47-D also exceeded the DWS with a concentration of 9.86 pCi/L. For 2014 compared to 2013, there was relatively little change in plume shape or concentrations at 100-H.

7) Lack of a comprehensible conceptual site model. The Board notes that this type of information is generally provided in the site information package. The Board recommends that the decision documents clearly address these items in a manner that will explain their role in the remedy selection process.

Response: *Comment noted. The Record of Decision (ROD) will include a summary of the Conceptual Site Model (CSM). Site characteristics, including physical features, waste site and groundwater contamination, transport mechanisms, and exposure pathways will be presented in the proposed plan.*

The package provided to the Board also lacked figures that depict the current groundwater flow and contaminant plumes.

Current groundwater flow figures will be provided in the ROD. A 2011 contaminant plume map will be included in the proposed plan, which is the basis for the RI/FS evaluations, shows all the contaminants of concern plumes. Current COC concentration maps and trends for groundwater are updated and published annually. The Groundwater Annual Reports are available at:
http://www.hanford.gov/page.cfm/SoilGroundwaterAnnualReports

Figures 4-4 and 4-5 in the 2014 annual report provide groundwater flow maps. Cr(VI) plume maps for 2014 are provided in Figures 4-9, 4-10, 4-17, and 4-18 (low and high river stage for the 100-D and 100-H Areas). Nitrate and strontium-90 groundwater plumes are provided in Figures 4-22 and 4-23 and Figures 4-26 and 27, respectively. The plume figures depict either the 100-D or 100-H area for clarity.

The Board recommends the development of capture zone maps to enhance the understanding of COC migration towards the Columbia River for inclusion in decision documents.

Response: *Comment noted. Capture zone maps are updated and published annually for the 100-HR-3 Operable Unit. Calendar year 100 Areas Pump-and-Treat Reports are provided at: http://www.hanford.gov/page.cfm/SoilGroundwaterAnnualReports. Capture zone maps will be included in the Record of Decision.*

Capture frequency maps and simulated capture frequency maps for 2014 are provided Figures 2-25a-3 and 2-26a-3 in the pump-and-treat annual report. These figures depict low and high river stage for the 100-D and 100-H areas, and demonstrate the current pump-and-treat system is effective in achieving river protection. The qualitative and quantitative effectiveness of the remedy in achieving a concentration of 10 µg/L Cr(VI) where groundwater discharges to the river is summarized in Figures 2-27a, b and 2-28a, b.

In addition, the Board recommends inclusion of a series of COC (chromium, strontium, and nitrate) concentration maps over time in the decision documents to afford a better understanding of concentration trends and the effect of the pump and treat system on COC behavior in the groundwater

Response: *COC concentration maps and trends will be included in the Record of Decision. COC concentration maps and trends are updated and published annually. The Groundwater Annual Reports are available at: http://www.hanford.gov/page.cfm/SoilGroundwaterAnnualReports.*

Figures depicting concentration trends for representative wells are included in Figures 4-11 through 4-16 of the 2014 report. The decreasing concentrations provide an indicator that groundwater pump-and-treat is successfully remediating Cr(VI). In addition, trends depicted for nitrate (Figure 4-25) and strontium-90 (Figure 4-28) indicate decreasing concentrations.

Waste Characterization

The Board notes that the proposed cleanup plan addresses a number of waste areas that have been investigated and cleaned up under previous interim actions. This plan is intended to be a final cleanup plan for the waste areas and outlines what additional actions are required. Table 2 provides a summary of each waste area's site status but did not include sufficient information in the package or site presentation to the Board to understand how each waste area status was determined. The table identifies sites that have no action, sites that are closed, sites that were rejected, etc., but it lacked sufficient information to explain what cleanup levels had been achieved (or not) for different media in order to provide the basis for the determination.

Response: *As noted above, Table 2 contains a summary of the waste sites with a total of 343 waste sites that were evaluated. Details of how each waste site was dispositioned could not be added to the Board Package. However, all waste sites identified within the 100-D/H Area were evaluated through the Baseline Risk Assessment using a range of methods for human health (direct contact), ecological risks, and groundwater protection.*

Details of the waste site evaluations are presented in Chapters 5, 6, and 7, and Appendices F, G, and L of the 100-D/H RI/FS report (DOE/RL-2010-95). A concise summary on the dispositioning of waste sites is presented in Section 8.2.1.1. The preliminary remediation goals that were used to evaluate interim action cleanup are included in Table 8-3.

Additionally, there was not enough information about the waste site contamination to determine whether there is principal threat waste in any of the areas. The Board recommends that this information be included in site decision documents.

Response: The proposed plan includes a discussion of principal threat waste and identifies that there is not any principal threat waste remaining in waste sites.

Future Land Use/Institutional Controls

The Board package provided by Region 10 presents conflicting future uses of the site. As stated, the Department of Energy (DOE) has reasonably anticipated future land use as conservation and preservation. EPA and Ecology believe that other uses, including residential use, are reasonably anticipated for the site. The Board recommends that future decision documents clearly identify the future land use and how the preferred alternative will be protective of that use. The Board further recommends referring to these documents when considering site future use: Office of Solid Waste and Emergency Response (OSWER) Directive No. 9355.7-04, May 1995, *Land Use in the CERCLA Remedy Selection Process* and EPA's November 2013 *Implementing Institutional Controls in Indian Country* handbook may provide useful guidance for this decision-making effort, as well as EPA's May 2011 policy on *Consultation and Coordination with Indian Tribes.*

Response: *In the 100 Areas of the Hanford Site, an assumption of "unrestricted use" was used to select a cleanup remedy and establish cleanup goals, such that future use of the land would not be precluded by contamination left from past Hanford Site operations.*

Unrestricted surface use is represented by a rural-residential scenario in which an individual in a rural-residential setting, living in the remediated areas, is conservatively assumed to consume crops raised in a backyard garden, meat and milk from locally raised livestock, and meat from game animals and fish.

The following exposure pathways are used to consider estimated dose from radionuclides in soil: inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure.

Unrestricted land-use cleanup levels for chemicals or non-radionuclides are based on Washington Administrative Code (WAC) 173-340-740(3). The exposure pathway for residual non-radiological contamination is from ingestion of contaminated soil.

The package presented to the Board indicated that institutional controls (ICs) will play an important role for the 100-D/H Area. The Board recommends that the proposed plan and other decision documents clearly explain in sufficient detail which specific ICs *would* be needed to ensure protectiveness of human health, upon what authority they would be based and how they *would* be enforced over the long-term (OSWER Directive No. 9355.0-89, December 2012, *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites).*

Response*: The Region agrees with this recommendation. Each type of institutional control is defined and discussed in greater detail in Chapter 8 of the RI/FS. The Proposed Plan includes a new table identifying institutional controls proposed for implementation at waste sites post remediation.*

Human Health Risk

The preferred alternative, as presented to the Board, includes "Void-Fill Grouting" for the 100-H-36 underground flume and the capping of pipeline ends at the 100-D-50:2 area. In the package provided to the Board, inadequate data or risk information was provided to support the basis for these proposed response actions that are reportedly needed to reduce leaching of contaminants and reduce direct contact human health risks, respectively. Therefore, the Board recommends that the decision documents provide the data and risk information to support these areas ' proposed remediation.

Response: *Additional characterization of the 100-H-36 waste site indicated this site does not present a threat to human health and the environment, and no further action is required. Void-fill grouting has been removed from this alternative.*

Capping the pipeline ends represents the most cost effective approach for the 100-D-50:2 pipeline. It effectively reduces potential exposure and protects a maternal colony of myotis bats, a state protected species. This waste site, which consists of two-24 inch pipes, is located within a subsurface pipe tunnel that is serves as habitat for the nesting colony of myotis bats. Therefore, RTD would result the destruction of this colony.

In the package provided to the Board, the chemical preliminary remediation goal (PRG) concentrations were developed using Ecology methodology, rather than EPA methodology for Superfund sites. During the presentation to the Board it was explained that the radiological PRG concentrations were developed using DOE's methodology (RESRAD), rather than EPA's methodology (PRG calculator). The Region confirmed that there was no analysis of the Ecology derived risk-based concentrations for chemicals to see if those concentrations fell within the NCP risk range (104 to 10·6) when using the regional screening level (RSL) calculator. The Board recommends that DOE redevelop risk-based PRGs using EPA's methodology, or at a minimum conduct a risk assessment using EPA tools for CERCLA risk assessment (i.e., the RSL and PRG calculators) to see whether the risk-based concentrations for cleanup levels will result in cleanup within the NCP risk range.

Response: *Human health risk from exposure to groundwater was evaluated through risk calculations and comparison to federal and state drinking water or cleanup standards. For assessing human health risks from radionuclides and chemicals in groundwater, the methodology identified in EPA's tap water scenario was used (residential drinking water source in EPA's "Regional Screening Levels for Chemical Contaminants at Superfund Sites"). The RI/FS document was completed before the last two versions of the PRG calculator (Sept / Nov 2014) were released. DOE, Ecology, and the Region will consider this in future documents.*

The Ecology derived risk-based concentrations have been compared to the NCP risk range using the RSL calculator. The Ecology derived concentrations fall into the NCP risk range or are more conservative than 10-6.

For assessing risk to chemicals in soil, the State Model Toxics Control Act (MTCA) Standard Method B (WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards") levels were used. MTCA provides chemical-specific standards that define acceptable risk levels based on reasonable maximum exposure scenarios. For direct contact, these MTCA-based Cleanup Levels (CULs) are based on a six-year exposure of a child through incidental soil ingestion, but does not include consumption of site-derived food. For the inhalation pathway, the MTCA (WAC 173-340) Standard Method B air CULs are based on exposure of adults and children from inhalation of vapors and dust in ambient air. The scenario assumes exposure to the top 4.6 m (15 ft) of soil.

The exposure pathways and duration in the MTCA unrestricted scenario used to evaluate risk and develop CULs for chemical soil contaminants are less conservative than the default residential scenario in EPA guidance. However, EPA guidance allows use of site-specific scenarios for assessing risk and setting CULs.

The MTCA unrestricted scenario is single pathway, the lower of the ingestion or inhalation. The EPA default residential scenario uses multiple pathways, which is the sum of ingestion, inhalation, and dermal pathways. The MTCA duration is six years for ingestion and is thirty years for inhalation. The EPA duration is thirty years for all pathways. The cancer risk limit for soil individual chemical CULs were set at the $1x10^{-6}$ limit in MTCA. Soil chemical CULs must also meet the multi-contaminant total cancer risk limit in MTCA of $1x10^{-5}$.

Although MTCA is less conservative on the risk scenarios, the acceptable MTCA risk limits are at the conservative end of the NCP cancer risk range, which is $1x10^{-4}$ to $1x10^{-6}$. MTCA uses the same hazard index of one limit as EPA for non-cancer toxic effects. DOE, Ecology, and the Region will consider this in future documents.

The Board package also indicated that cleanup levels for radionuclides were based on PRGs of either 10^{-4} or 15 millirem/year (mrem/yr), whichever is more stringent. During the presentation to the Board, the Region indicated that 15 mrem/yr had been used for earlier interim records of decision (RODs) but was now being used for radionuclides where it was more stringent. Since 1999, when the EPA guidance *Radiation Risk Assessment at CERCLA sites: Q & A* was published, it has been EPA's policy to use only dose-based cleanup levels when they are based on an applicable or relevant and appropriate requirement (ARAR). Otherwise, PRGs for radionuclides are generally derived using a 1×10^{-6} cancer risk as the point of departure with remedial action selection based on the NCP's nine remedy selection criteria to choose an alternative meeting the 10^{-4} to 10^{-6} cancer risk range. This policy was reaffirmed in the June 13, 2014, updated version of OSWER Directive No. 9285.6-20, *Radiation Risk Assessment at CERCLA Sites: Q & A.* The Board recommends that DOE develop new risk-based concentrations for those cleanup levels that were based on dose. The NCP nine criteria analysis indicates that concentrations lower than those that correspond to 1×10^{-4} can be achieved, then the lower risk of the selected concentrations should be expressed in terms of risk (e.g., 2×10^{-5}).

Response: *Interim cleanup levels were calculated in the late 1990s based on 15 mrem/year dose. The PRGs calculated in the 100-DH RI/FS document are based on 10^{-4} risk. The Tri-Party Agreement agencies made the decision to select the lower of the two since most of the remedial actions have already been implemented and it can be shown that DOE did not "chose" to update the risk calculation method to achieve lower cleanup levels. (Tri-Party Agreement agencies are Washington State Department of Ecology, United States Environmental Protection Agency, United States Department of Energy.)*

The most important issue is that the majority of the waste sites in the 100-DH area have already been remediated, so there will be no future remediation cost implications based on this choice. Both the interim action cleanup levels and proposed cleanup levels identified in the proposed plan are protective of HHE.

Remedial Action Objectives/Preliminary Remediation Goals

In the package presented to the Board, the PRGs for contaminated soils leaching to groundwater were not clear. In the presentation it was mentioned that the soil to groundwater PRGs would be used for most of the site. The Board recommends that the decision documents clearly present the PRGs for soil for the protection of groundwater and that the alternatives analysis consider the long-term effectiveness with regard to subsurface soil contamination that could extend to the groundwater at depth. The decision documents should more clearly present PRGs for each media and contaminant and the basis for these levels.

Response: *The PRGs for contaminants leaching from soil to groundwater are provided in Table 4 in the Remedy Review Board Package, that is, the proposed soil cleanup levels for protection of groundwater and surface water. The Proposed Plan and ROD will present the PRGS for soil for the protection of groundwater. The basis for these levels is provided in the 100-D/H RI/FS report, Section 8.1.4, and will also be provided in the ROD.*

Remedy Performance

In the package and presentation to the Board, the remedial alternatives considered for groundwater focused primarily on one [Cr(VI)] of the three (nitrate, strontium-90 and total chromium) COCs identified for groundwater. In the case of nitrate, the current interim groundwater actions for the 100-HR-3 plumes and for the identified "final" groundwater remedial alternatives do not treat nitrate, and do not plan to address the nitrate plume independent of actions that are meant to address Cr(VI). The Board notes that it appears likely that the nitrate plume could remain in the 100-D/H areas at the end of the remediation period of Cr(VI) and may not reach the cleanup levels (i.e., MCL for nitrate, which is 10 ppm) without active treatment. The Board recommends that the decision documents explain how the remedy, to the extent it is a final remedy, will achieve the groundwater RAOs if nitrate is not addressed through remediation.

Response: *The proposed plan summarizes the long-term permanence of the proposed remedy and states that MNA will bring the levels of the other two groundwater COCs achieve cleanup standards before Cr(IV).*

This is described in greater detail in The Modeling of Design Alternatives for 100-HR-3 (ECF-100HR3-11-0114 [Appendix F of DOE/RL-2010-95]), which identifies that diffusion and dispersion of the nitrate, which is co-located with the Cr(VI) plume, results in attainment of the nitrate cleanup level within 13 years for Alternatives 2, 3, and 4 (summarized in Table 4 of the Proposed Plan).

For each alternative, the time to achieve the nitrate cleanup level is less than the time to achieve Cr(VI) cleanup. As a result of ongoing groundwater remediation, nitrate concentrations have declined below the DWS in most wells. Only small areas continue to have concentrations above the DWS in the 100-D Area. Nitrate concentrations did not exceed the DWS in 100-H or the Horn during 2014.

The Board notes that there are other available treatment technologies for cleaning up Cr(VI) and nitrate in groundwater in addition to pump and treat (for example *in situ* chemical reduction using sodium dithionite and ferrous sulfate1). The Board recommends that DOE evaluate treatability and cost effectiveness for different treatment technologies, based on unit volume or mass of media (soil or groundwater) to be treated.

Response: *Both sodium dithionite and ferrous sulfate has been used at 100-D/H of the Hanford Site. In addition, bioremediation technologies have been demonstrated.*

The ISRM barrier is a sodium dithionite barrier installed in 2001 at the 100-D Area, and also tested at the 100-H Area. It continues to be monitored for effectiveness since it changes hexavalent chromium to trivalent chromium. However, the Tri-Party Agreement agencies shifted the remedy in 100-D to the pump-and-treat system due to the ineffectiveness of the barrier along a portion of the injection zone.

The high concentration hexavalent chromium still exceeds cleanup standards of 48 µg/L inland and 10 µg/L for surface water protection in the northern portion of the ISRM barrier, where breakthrough of the barrier occurs. This treatment was determined to be ineffective and not a cost effective alternative for overall treatment of the Cr(VI) at 100-D/H.

A zero-valent iron technology demonstration was conducted and found to be impracticable for the size of the hexavalent chromium plume that covers over 1.5 square miles (990 acres) in relation to the cost effectiveness compared to the ongoing pump-and-treat system. A similar conclusion was reached as it relates to the bioremediation technologies that were demonstrated.

The Board also recommends that DOE include justification, in the decision documents, as to why the preferred alternative is the best (considering the nine criteria, particularly cost effectiveness) for removing contaminants from groundwater

Response: *The evaluation of alternatives using the 9 CERCLA criteria is presented in the 100-D/H RI/FS report (Chapter 10) and summarized in the proposed plan. All of the alternatives (except No Action) pass threshold criteria.*

The Alternatives 2, 3, and 4 provide good long-term effectiveness and permanence for waste sites because contaminated soil and debris exceeding cleanup levels are removed or attenuate through radioactive decay. Alternatives 2 and 3 are rated slightly lower than 4 for waste sites. All three alternatives were rated as comparable for groundwater, providing very good long-term effectiveness and permanence.

For reduction of toxicity, mobility, or volume (TMV) through treatment, Alternative 2 and 3 were rated slightly higher, as RTD does not provide treatment except as required to meet waste disposal criteria, and Alternative 4 has the largest volume of waste site RTD. All three alternatives treat the same mass of groundwater contaminants.

For the short-term effectiveness evaluation, Alternative 4 achieves the waste site RAOs faster than Alternatives 2 or 3, but it is also anticipated to have higher adverse effects during construction and implementation based on the greater volume of material for RTD. The short-term adverse effects to workers are mitigated through health and safety programs, and risks to the community are low because of the remote location of the waste sites.

For groundwater, Alternative 3 provides a higher level of short-term effectiveness when compared to Alternatives 2 and 4. Alternative 3 has the shortest time estimated to achieve groundwater cleanup because of the increased pump-and-treat capacity relative to the other alternatives. Alternatives 2, 3, and 4 are all rated very good for waste site implementability. Alternatives 3 and 4 perform better than Alternative 2 under this criterion for groundwater remediation. Both rely exclusively on pump-and-treat, which is readily implemented and has been previously used at the Hanford Site.

The total present value costs are $333 million for Alternative 2, $374 million for Alternative 3, and $430 million for Alternative 4. Estimated costs for groundwater were $267 million (Alternative 2), $308 million (Alternative 3), and $355 million (Alternative 4).

Alternative 3 was recommended because it achieves protection of HHE through RTD of waste sites and pump-and-treat of groundwater, satisfies ARARs, and provides the best balance of tradeoffs under the modifying criteria. Alternative 3 is readily implementable, provides very good reduction in TMV through treatment, and was rated the highest for short-term effectiveness based on the time frames to achieve cleanup levels.

Furthermore, in the event a proposed treatment technology does not remove contaminants to a protective level in soil or groundwater, the Board recommends that DOE present in the decision documents other contingency treatment technologies to achieve remedial action objectives.

Response: *The proposed remedial technologies for soil, that is RTD, ICs, and pipeline capping, have all been proven reliable technologies at the Hanford Site. There is currently a successful pump-and-treat system operating for the 100-HR-3 Operable Unit using ion exchange technology to treat Cr(VI). Recent groundwater monitoring results have provided data that support the attenuation of the nitrate plume and radioactive decay of strontium-90 that will achieve cleanup within the estimated time frame for the alternatives.*

Multiple soil and groundwater remedial technologies and over 50 process options for treatment were screened in the 100-D/H RI/FS report (DOE/RL-2010-95, Tables 8-7 and 8-8). Information on each of the technologies retained for further evaluation is presented on Figures 8-7 through 8-23. The figures also include examples of relevant experience for each technology, including uses at the Hanford Site.

The preferred alternative as presented to the Board includes subsurface void filling at Area 100-H-36. The Board notes that controlled placement and effectiveness evaluation of subsurface grout injection is more difficult than above-ground surface grout spray applications. Long-term physical stability of both surface and subsurface grouts is very sensitive to multiple freeze/thaw cycles and wet/dry cycles. The Board also notes that grouts are typically alkaline in composition, so amphoteric (pH-sensitive) metals may become more mobile/soluble than at neutral soil conditions. The Board recommends that the details of the proposed grouting processes be carefully considered and that grout compatibility evaluation, via treatability studies, be considered.

Response: *Further characterization of the 100-H-36 waste site indicated the site does not represent a threat to HHE, and no further action is necessary.*

The Board notes that remedial actions for the waste sites have been underway at the 100-D/H areas since 1995, at the direction of earlier interim action RODs that addressed soil and groundwater. The primary objective of the 100-D/H 2012 remedial investigation/feasibility study (that served as the basis of the Board review package and the presentations to the Board) was to select a final remedy for these media. The Region stated that many of these actions have already been implemented, and most, if not all of the waste site remediation work will have been completed by the time a ROD is issued. The presentation to the Board also indicated that several cleanup levels selected in earlier interim action RODs have been superseded by new risk information, and that the cleanup levels that are likely to be selected for this final ROD will be lower, in several instances, than what had been selected in previous decision documents. It was not clear from the material presented to the Board whether the interim remedial actions for the waste sites that have already been implemented are going to satisfy the final ROD cleanup levels. The Board recommends that the decision documents include a discussion as to how the differences will be reconciled.

Response: *The ROD will include a discussion on how the differences will be reconciled. Data from all of the interim action waste site cleanups were compared to the proposed cleanup levels presented in the proposed plan to identify potential risk.*

Sites that did not pass the screening based on the new risk information were carried forward for evaluation in the FS. Section 8.2.1.1 of the 100-D/H RI/FS report (DOE/RL-2010-95) identified the 125 interim closed or no action waste sites with verification data that were quantitatively evaluated to the preliminary remediation goals and indicated no risk to HHE. This section also provides a description of the site specific evaluation of 21 waste sites that were identified that indicated no risk to HHE.

Waste sites remediated under the interim action ROD cleanup levels after 2012 will be compared to the cleanup levels identified in the final ROD to identify whether the cleanup is protective of HHE.

Applicable or Relevant and Appropriate Requirements

The Board did not have sufficient information to evaluate the role of the Washington Model Toxics Control Act (MTCA) for these areas and whether MTCA Method B is an ARAR for these areas.

However, it may be appropriate to use it as a "to-be-considered" guidance in developing soil cleanup levels. To the extent MTCA might be considered as an ARAR, the Board notes that the stringent cleanup levels identified by Ecology may not be achievable with current technology. The Board recommends that the Region, DOE, and Ecology work together in evaluating MTCA's appropriate role in designing a remedial action protective of human health and the environment.

In addition, the Board recommends that the proposed plan and decision documents explain how the cleanup adequately meets the National Historic Preservation Act (NHPA) consultation process, including, for example, the specific and concrete steps for how cleanup in the cultural areas will proceed in a manner that prevents disturbances (e.g., specific soil sampling designs to protect artifacts), including associated costs.

Response: *MTCA was evaluated through the ARAR process as described in OSWER 540-0-89-006, August 1989, Compliance with Other Laws Manual Parts I and II and other EPA and DOE guidance documents on developing ARARs.*

The Hanford Facility Agreement and Consent Order Action Plan, Section 7.5 requires that MTCA be evaluated in the ARAR process. For each proposed remedial action at the Hanford Site, ARARs are evaluated, proposed, and finally selected. As a risk-based method for calculating cleanup levels for chemical contaminants, MTCA has been determined to be pertinent to this remedial action and was evaluated along with other pertinent environmental regulations through the ARAR process.

The ARARs evaluation prepared for the RI/FS was conducted in accordance with the NCP, "Remedial Investigation/Feasibility Study and Selection of Remedy" (40 CFR 300.430[f][1][ii][B][2]). The chemical-specific ARARs and to be considereds (TBCs) that may affect remediation of 100-D/H Operable Unit are the substantive elements of the Washington Administrative Code regulations that implement the 2007 MTCA (WAC 173-340).

Within this branch of the Washington Administrative Code, there are detailed regulations for developing standards for remedial actions involving soil cleanup (2007 MTCA, "Unrestricted Land Use Soil Cleanup Standards" [WAC 173-340-740]) and groundwater cleanup standards (2007 MTCA, "Groundwater Cleanup Standards" [WAC 173-340-720]). These standards are in the form of risk-based concentrations, or established by modeling, that help establish soil and groundwater cleanup standards for nonradioactive contaminants. Section 8.1.2 of the 100-D/H RI/FS report presents details on the ARARs evaluation.

The National Historic Preservation Act is an ARAR for these actions. However, we do not agree that the proposed plan or decision documents are the appropriate documents to explain details of the National Historic Preservation Act consultation process. This effort is a part of an ongoing discussion between the Tri-Party Agreement agencies and tribal nations. The goal of these discussions is to produce a guiding document for preservation practices that will be used in remedial design/remedial action work plans to ensure culturally sensitive areas are preserved.

The Board notes that requirements were included in the ARARs table that were not addressed in the package and may not be applicable to the preferred alternative. The Board recommends that the decision documents contain an accurate portrayal of the ARARs and to the same degree of specificity discussed in EPA's January 6, 2012, Marshall Decision that references OSWER 540-0-89-006, August 1989, *Compliance with Other Laws Manual Parts I and II.*

Response: *The ARAR evaluation process follows OSWER 540-0-89-006, August 1989, Compliance with Other Laws Manual Parts I and II along with other EPA and DOE guidance documents. The ARARs contained in Hanford's decision document do reflect what is expected to be necessary to protect human health and the environment when the remedy is implemented. Due to the size, age, and unknowns at waste sites to be remediated at Hanford, there may be occasions where an expected requirement may not be needed.*

The package presents three alternative actions, other than "No Action," all of which include "Remove, Treat, Dispose" of the upper 15 feet of soil to prevent unacceptable risk (per the 2007 MTCA, Method B). The Board notes that MTCA provides other options that do not require meeting direct exposure cleanup levels throughout this 15-foot upper soil layer. Using one of these other options may be more consistent with federal guidance and could be more cost effective. The Board recommends that the Region suggest that DOE evaluate these other options as part of its alternatives analysis and compare them using the NCP's nine criteria. Reference OSWER Directive No. 9355.4-24, December 2002, *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.*

Response: *The depth of the remediation less than 15 feet was evaluated during the development of the feasibility study. The evaluation concluded that a depth of 15 feet for waste sites that are considered for the remove, treat, and dispose alternative was appropriate due to the types of contamination, future land use, proximity of the Columbia River, and other considerations.*

Monitored Natural Attenuation

As indicated in the package provided to the Board, MNA would be relied upon in the preferred alternative to address the strontium-90 plume. The Board recommends that the decision documents include an explanation of the MNA lines of evidence that support how radioactive decay will address the strontium plume, consistent with OSWER Directive No. 9200.4-17P, April 1999, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* Furthermore, consistent with the NCP, the decision documents should discuss the reasonable timeframe for restoring groundwater (i.e., the time required to reach protective levels through radioactive decay),and explain how MNA is an appropriate remedial action for Area D/H.

Response: *The areas of strontium-90 contamination within 100-D/H are within the footprint of the Cr(VI) plume and captured by the pump-and-treat system. Strontium-90 in the 100-D Area is in a small area (detections in 2 wells above the DWS), at stable to declining concentration, and has remained relatively immobile based on downgradient monitoring (2014 data). There is only one area in 100-H with strontium-90 above the DWS, and concentrations remain fairly stable with some seasonal variation and a slight downward trend. Downgradient aquifer tube 47-D also exceeded the DWS with a concentration of 9.86 pCi/L. For 2014 compared to 2013, there was relatively little change in plume shape or concentrations at 100-H.*

The proposed plan (Table 4) shows the remedial action time frame estimated to achieve cleanup levels for strontium-90 are 56 years for Alternatives 2 and 4 and 44 years for Alternative 3. Well within the timeframe for the hexavalent chromium to reach cleanup levels.

In addition, the presentation to the Board indicated that the strontium-90 groundwater plume is in close proximity to the Columbia River in Area 100-H. The Board recommends that a containment alternative for the contaminated groundwater be considered to prevent negative impacts to the river while the strontium-90 undergoes radioactive decay to below regulatory levels.

Response: *Based on 2014 groundwater data, concentrations in down gradient aquifer tube 47-D exceeded the DWS of 8 mg/L with a concentration of 9.86 pCi/L. These low level strontium-90 groundwater concentrations do not warrant a containment alternative. The remedial action time frame estimated to achieve cleanup levels for strontium-90 are 56 years for Alternatives 2 and 4 and 44 years for Alternative 3, while DOE still has control over the site. Containment is also provided by the pump-and-treat system.*

Stakeholders

During presentations to the Board by Ecology and the Yakama Nation, a number of issues related to tribal consultation and cultural values, as captured by the NHPA and the treaty rights asserted by Yakama Nation, were discussed. Resolution of some of these issues appears to involve federal trustee responsibilities and compliance with NHPA as an ARAR. The Board recommends that the Region, tribes, Ecology and DOE continue to work to ensure that the cultural areas (e.g., tribal cemetery land) are addressed in a manner consistent with legal requirements and EPA guidance and policy positions *(EPA Policy on Consultation and Coordination with Indian Tribes,* May 4, 2011). The Board also recommends that the proposed plan and other decision documents provide a clear description of the cleanup required in cultural areas. If protocols and procedures have not been agreed to by the time a proposed plan is published, the Board further recommends that the decision documents clearly articulate the expectations required to establish them. Finally, the Board recommends that the decision documents clearly state that cultural resource issues for each specific waste site be addressed prior to completion of the selected remedial action for the waste site.

Response*: The Region agrees with the Recommendation and is continuing to work with the Tribes and DOE on protocols and procedures regarding cleanup in culturally sensitive areas.*

The National Historic Preservation Act is an ARAR for these actions. However, we do not agree that the proposed plan or decision documents are the appropriate documents to explain details of the National Historic Preservation Act consultation process. This effort is a part of an ongoing discussion between the Tri-Party Agreement agencies and the tribes. The goal of these discussions is to produce a guiding document for preservation practices that will be used in remedial design/remedial action work plans to ensure culturally sensitive areas are preserved accordingly.

Effectiveness

The comparative analysis of alternatives provided by Ecology included a summary table rating each alternative. The Board recommends that the long-term effectiveness and permanence criterion and the reduction of toxicity, mobility, or volume by treatment criterion be re-evaluated for Alternative 4. The Board believes that the rankings for Alternative 4 are not supported by the information provided in the package. In addition, the Board recommends that the decision documents contain a text-only comparison of alternatives, e.g. Tables 6-8 in the package, as discussed in OSWER Directive No. 9200.1-23P, July 1999, *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents.*

Response: *Section 4.1 of the NRRB Package describes the effectiveness of each alternative. The proposed plan will include a text only comparison of the alternatives, which were modified slightly from those presented to the board based on discussion among the Tri-Party Agreement agencies. The evaluations for long-term effectiveness and TMV in the proposed plan are as follows:*

Long-Term Effectiveness and Permanence. *The long-term effectiveness and permanence criterion evaluates the risk remaining at the site after response objectives have been met. The evaluation considers (1) the magnitude of the residual risk, and (2) the adequacy and reliability of controls that may be required to manage treatment residuals or untreated waste.*

For the waste sites, Alternatives 2, 3, and 4 all provide very good long-term effectiveness and permanence under RTD because COC-contaminated soil and debris exceeding cleanup levels are removed and transported to the Environmental Restoration Disposal Facility (ERDF). One pipeline is capped under Alternatives 2 and 3. Three sites use MNA and ICs for remedial action under Alternatives 2 and 3.

All three of the alternatives provide good long-term effectiveness and permanence for waste sites because contaminated soil and debris exceeding cleanup levels are removed to ERDF, or naturally attenuated through radioactive decay. Alternatives 2 and 3 may be rated slightly lower, as the pipe capping at one waste site will need an IC to maintain protectiveness. The estimated time frames to achieve waste site cleanup are 25 years for Alternatives 2 and 3, and 5 years for Alternative 4.

The alternatives for groundwater treatment are comparable and provide very good long-term effectiveness and permanence. The alternatives use a combination of both active treatment and MNA that permanently reduces COC concentrations over different time frames. Table 4 presents the estimated remedial action time frames for groundwater cleanup. At the end of the remedial time frame, the COC concentrations under each of the alternatives will be reduced to levels that are protective of human health and the environment.

Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment. *RTD is not considered treatment because disposal of contaminated soils at the ERDF is generally without treatment except where required. As a result, RTD largely does not provide reduction of TMV through treatment. Alternatives 2, 3, and 4 are comparable in the reduction of TMV through treatment. RTD is the primary technology implemented for waste sites for all three alternatives. Alternatives 2 and 3 also use MNA through radioactive decay for TMV reduction at three waste sites. Alternative 4 provides the least reduction of TMV for waste sites because of the greatest RTD volume.*

All three alternatives treat the same mass of groundwater contaminants. Alternatives 3 and 4 use pump-and-treat and MNA, while Alternative 2 uses pump-and-treat, biological treatment, and MNA. All of the alternatives rated very good for this criterion.

Policy and Guidance

The Board notes that CERCLA Section 120(a)(2) states that "No department, agency, or instrumentality of the United States may adopt or utilize any such guidelines, rules, regulations, or criteria which are inconsistent with the guidelines, rules, regulations, and criteria established by the Administrator under the Act." Future decision documents should fully explain any such use of non-EPA documents (e.g., RESRAD), why it is appropriate and how it will ensure protectiveness of human health and the environment consistent with CERCLA and the NCP. The Federal Facility Agreement further requires use of our guidance.

Response: *Decision documents for the Hanford site will continue to meet all legal requirements, including identifying remedies that are protective of human health and the environment. Region 10 considers any applicable EPA guidance when developing supporting documents and decision documents. When appropriate, the Region may choose to use non-EPA guidance tools, such as RESRAD. The rationale for using these types of tools is provided in the supporting technical documents.*