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Confederated Tribes and Bands
of the Yakama Nation ERWM

Established by the
Treaty of June 9, 1855

October 28, 2013

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Richland, WA 99354

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Subject: Review of the Proposed Plan and Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units (DOE/RL-2012-15, Draft A) and Propose Plan (DOE/RL-2012-68, Draft A).

Dear Ms. Hedges and Nguyen:

The U.S. Environmental Protection Agency (EPA) anticipates issuing the Record of Decision (ROD) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for the 100-NR-1 and 100-NR-2 Operable Units early next year. The Confederated Tribes and Bands of the Yakama Nation appreciate the opportunity to review and provide comments on these documents.

The Confederated Tribes and Bands of the Yakama Nation is a federally recognized sovereign pursuant of the Treaty of June 9, 1855 made with the United States of America (12 Stat. 951). The U.S. Department of Energy Hanford site was developed on land ceded by the Yakama Nation under the 1855 Treaty with the United States. The Yakama Nation retains reserved rights to this land under the Treaty.

The Hanford Reach is one of the most cultural resource-rich areas in the western Columbia Plateau. Pre-Hanford uses of the area included agriculture and use by Native American tribes. Archaeological evidence demonstrates the importance of this area to Native American tribes, whose presence can be traced for more than 10,000 years. The near-shore area of the rivers (Columbia, Snake, and Yakima) contained many village sites, fishing and fish processing sites, hunting areas, plant-gathering areas, and religious sites. Upland areas were used for hunting, plant gathering, religious practices, and overland transportation.

Chinook salmon, sockeye salmon, coho salmon, and steelhead trout use the river as a migration route to and from upstream spawning areas and are of economic importance. The Treaties of 1855 provide for the peoples of three Nations to "live along" and fish the River Corridor.

The Yakama Nation's vision for the cleanup and closure of the Hanford Site includes meeting the following objectives:

100-NR-1 & 100-NR-2

1. Compliance with Yakama Nation Treaty Rights, including full access to cultural (and natural) resources by the Yakama Nation and its members within its ceded land and aboriginal territory, including on the Hanford Site.
2. Official recognition that Native Americans living near the Hanford site are the most vulnerable people to environmental contaminants, as underscored by EPA's Columbia River Fish Contaminant Survey.
3. Protection of the health of Yakama Nation tribal members and the environment so that the Hanford Site and all its resources (including the Columbia River, its islands, other surface waters, geologic resources, groundwater, air, and biological resources such as plants, fish, and wildlife) are safe for all exposure scenarios and tribal uses.

The Yakama Nation supports cleanup actions that are complete, permanent, and are based on proven technology. We do not support remedial actions that leave large quantities of long-lived radionuclides or dangerous waste in place and rely on long-term stewardship or institutional controls to address future potential exposure scenarios. Long-term stewardship and institutional controls will not be effective for wastes that remain dangerous for hundreds or thousands of years. Assuming that contaminants remain in place implies that a Long-Term Stewardship Program Plan must be implemented which will remain effective longer than any human institution has ever existed.

The Yakama Nation further supports the following key principles for all remedial actions that are completed on the Hanford Site:

1. Cleanup decisions that follow the CERCLA RI/FS process and requirements through the finalization and approval of CERCLA documents (including risk assessments and supporting secondary documents) prior to development of Proposed Plans and final RODs.
2. Cleanup decisions based on adequate site-specific characterization, including for the vadose zone and groundwater.
3. Cleanup actions that comply with all applicable or relevant and appropriate federal and state regulatory requirements.
4. Cleanup actions that are compatible with clean closure criteria.

As mentioned above, the Yakama Nation does not support remedial actions that leave significant quantities of contamination in place at the Hanford Site, nor do we support remedial actions which would preclude clean closure.

We look forward to discussing our vision of cleanup and our concerns regarding the current cleanup plans for Hanford with you further.

Sincerely,

Russell Jim

Russell Jim
Yakama Nation ERWM Program Manager

cc:
Matt McCormick, Manager, US Department of Energy
Ken Niles, Oregon Department of Energy
Stuart Harris, CTUIR

Gab Bohnee, Nez Perce
Marlene George, YN ERWM
Administrative Record

Attachments:
Note these comments do not reflect a detailed description of all our concerns.

Attachment #1:

Yakama Nation ERWM Comments on the

100-N Area Proposed Plan & Remedial Investigation / Feasibility Study:

1. **Protection of Yakama Nation treaty rights, including full access to cultural resources on the Hanford Site by the Yakama Nation:** Ensuring Treaty compliance is a critical intergovernmental concern. By and through this document, USDOE supports the participation of Yakama Nation in activities related to remediation and restoration of resources affected by Hanford and implements its trust responsibility and enforceable obligations to the Yakama Nation. From the YN ERWM's perspective, efforts to include the tribal program in the development of the RI/FS/PP were weak.

    a. The Treaty, which reserves specific rights and resources for the Yakama Nation, should be acknowledged as an ARAR or a "must comply" standard for cleanup decisions. This includes the right to practice full subsistence activities in Yakama Nation usual and accustomed use areas. All future Interim and Final Record(s) of Decision(s) should be in harmony with treaty rights of the Yakama Nation under the Treaty of 1855 including upland treaty rights.

    b. All statements (see page 266, section 3.8.3) included in the Proposed Plan and RI/FS documents that convey the USDOE's "beliefs" or "positions" regarding the extent of tribal treaty rights, including statements that it is the USDOE's position that Hanford is not "open and unclaimed land," should be removed from the documents.

    c. All potential impacts to treaty-reserved rights and resources should be thoroughly evaluated and considered in a revised RI/FS and Proposed Plan and supporting documents. The preferred alternative should be consistent with the USDOE's American Indian Policy, with the federal trust responsibility, and with the terms of the Treaty of 1855.

    d. The YN ERWM Program believes Preferred Alternative is not protective; does not meet ARARs; is inconsistent with anticipated (*and feasible*) future land and groundwater use; and does not represent the maximum extent possible a permanent solution in a cost effective manner.

2. **Land Use:** Language in the Proposed Plan and selected Preferred Alternatives indicates that DOE is not considering cleanup to unrestricted use and is striving toward a less stringent cleanup based on the Comprehensive Land-Use Plan (i.e. use of Method A-Industrial Standards vs. Method B-Unrestricted Standards). While cleanup decisions may ultimately be defined by management boundaries, the risk assessment should be based upon actual human behaviors.

    a. Contrary to statements in the Propose Plan describing the CLUP (page 31), (i.e., "In consideration of these land-use decisions and associated Tribal and public input, DOE and Ecology propose a cleanup strategy supporting residential

exposures), use of a TI Wavier for Sr-90 does not support residential use cleanup levels for the groundwater. Furthermore, the final CLUP did not include any suggestions, or address any concerns provided by the Yakama Nation.[1]

b. All potential impacts to treaty-reserved rights and resources should be thoroughly evaluated and considered in a revised RI/FS and Proposed Plan and supporting documents, including use of the Yakama Nation Risk Scenario as the basis for setting cleanup levels.

c. The preferred alternative should be consistent with the USDOE's American Indian Policy, with the federal trust responsibility, and with the terms of the Treaty of 1855.

d. The CLUP was a Federal undertaking that determined what type of activities could occur within the Hanford landscape, yet traditional cultural properties (TCP) were never addressed. Areas designated for industrial use, research and development, and conservation mining could have significant impacts on the landscape, and adversely affect a TCP should one be present.

3. **Cultural Resources & Institutional Controls**: There is the assumption of, and over-reliance on, the use of Institutional Controls to ensure protectiveness rather the primary objective which is protectiveness of the environment and human health through selection of remedies that employ treatment technologies that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants.

The philosophy underlying the cleanup of Hanford should be guided explicitly by the goal of allowing Native Peoples to safely live the lifestyle to which they are entitled. This way of thinking will be particularly important when considering how to incorporate non-quantitative elements into the Preferred Alternative such as the spiritual or cultural value of a site.

The Yakama Nation has previously expressed deep concern in leaving in place large quantities of hazardous radiological and chemical wastes on the site with the long-term use of institutional controls as protective measures. DOE has acknowledged Sr-90 is present throughout the vadose zone in the 100 Area, and it will continue to impact groundwater quality until the residual contamination is removed through radioactive decay. Within the timeframes that are realistically applicable to this scenario (estimated to be approximately 300 years) institutional controls will almost inevitably fail and allow some exposure to human health and the environment.

The YN expects a discussion of the culturally sensitive areas with reference to both historic and prehistoric Native American use within the Proposed Plan.

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[1] Yakama Nation letter to John Wagoner, Manager, Department of Energy, Richland Operations Office, June 30, 1998.

Implied agreement with implementation of a ROD change rather than an MOA or outlining actions within the ROD is misleading to the public. The YN requests consultation with DOE on this issue.

Use of institutional controls must be addressed in light of, and with appropriate deference to, Yakama Nation treaty rights which guarantee use of the land for specific purposes which are considered inseparable from the Yakama way of life.

a. Regarding the use of institutional controls at DOE waste sites, the National Research Council pointed out: "While there is typically a tacit recognition that engineered barriers and waste stabilization approaches have limited periods of effectiveness, these technologies are frequently employed with inadequate understanding of, or attention to, the factors that are critical to their success. These include the need for well-conceived plans for performance monitoring that identify and correct potential failures and plans for maintenance and repair, including possible total system replacement." (NRC, 2000). This level of planning, both technical and financial does not appear to have been included in the analysis of alternatives.

b. Currently, there are several projects and major decisions that will be made that affect the entire Hanford Site, yet still a comprehensive Traditional Cultural Property (TCP) study has not been performed. Site wide undertakings and decisions such as clean up levels, restoration, vegetation management, land use plans, the use of barriers and institutional controls need to take into consideration their effects on TCPs. It is the obligation of DOE under the National Historic Preservation Act (NHPA), Section 110, to inventory and evaluate properties to determine eligibility under the agency's jurisdiction.

c. Cultural resources have not been adequately addressed in either of the 100-N documents (RI/FS and PP). Please refer to the EPA document, *CERCLA Compliance with Other Laws Manual: Part II*[2] (hereafter referred to EPA Guidance), where it details out how to be in compliance with the NHPA during the CERCLA process in Section 4. Section 4.1.3 clearly states efforts should be made to identify cultural resources. Generally DOE carries out these efforts during the Section 106 process for each project, however between 2003 and 2011, 115 projects were carried out under the "no potential to cause effect" classification in the 100-N Area. This means these projects were completed without proper Tribal consultation, and did not have a full Section 106 cultural review.

d. As outlined in the EPA Guidance document Section 4, once cultural properties are identified it needs to be determined if they are eligible and if the proposed actions will have an adverse effect on the eligible properties. In the 100-N Area there is a known TCP, which it is mentioned in the document. Further the EPA Guidance states any **adverse effects to eligible properties must be mitigated, "this mitigation plan should be included in**

[2] EPA, CERCLA Compliance with Other laws Manual: Part II. Clean Act and Other Environmental Statues and State Requirements, EPA/540/G-89/009, OSWER Directive 9234. 1-02, August 1989.

an MOA signed by the consulting parties (page 4-10)". EPA Guidance 4.1.4.2 states "The remedial design process should provide for scheduling and funding of the development and implementation of a detailed cultural resources mitigation plan".

e. The EPA Guidance 4.1.5 (page 4-11) details proper documentation, "Compliance with the NHPA requirements should be documented in the RI/FS report, describing, as appropriate, the determination of whether cultural resources are or are not present; the results of the Cultural resource survey (CRS) process and recommendations on the eligibility of the identified cultural resources for the national Register; the impact, if any, on such resources; and the associated mitigation measures to minimize potential "no adverse" or "adverse" effects. When cultural resources are present, the ROD should identify the NHPA as an ARAR. For each alternative, the ROD should identify whether the alternative will comply with substantive NHPA requirements. **For the selected remedy, the ROD should also include a brief statement describing what compliance with NHPA entails, e.g. "that there will be no impact on cultural resources or what mitigation measures will be required."**

f. The 40 CFR 300.435(b)(2) states; "During the course of the RD/RA, the lead agency shall be responsible for ensuring that all federal and state requirements that are identified in the ROD as applicable or relevant and appropriate requirements for the action are met."

g. It is evident the RI/FS and Proposed Plan documents do not meet EPA guidelines. DOE has not performed the necessary tasks to determine effects to cultural resources, **in consultation with the YN to determine effective avoidance, minimization, and/or mitigation measures.** The **final ROD must reflect compliance with NHPA**, which will be impossible with current data.

h. YN ERWM request EPA and DOE to complete the necessary task of **"describing what compliance with NHPA will entail" and completing the necessary MOA to mitigate for adverse effects to the Mooli Mooli TCP, in consultation with YN.**

i. Although the report speaks of ethnographic studies by PNNL, there has been no attempt to identify new cultural properties or traditional cultural properties in many years, as mandated under Section 110 of the national Historic Preservation Act. The Hanford Cultural Resource Management Plan outlined a process for identifying one TCP per year; however this has not been done. DOE has not been meeting their Section 110 obligation of identifying cultural properties on the Hanford site. There are known TCP that have not been evaluated that include:

    i. White Bluffs
    ii. Coyote Rapids
    iii. Columbia River
    iv. Wahluke Slope
    v. Other potentially unknown TCPs in the Hanford area.

Cultural properties are only being addressed through the Section 106 process,

on a project by project basis, which is entirely ineffective. This piecemeal method does not allow for a comprehensive landscape study and does not allow for proper consultation with YN. None of the Alternatives were evaluated against the nine balancing criteria based on effects on a TCP. The YN ERWM Program request this be done.

j. It is unclear as to what is in place to ensure compliance with the Antiquities Act of 1906. Under the Antiquities Act of 1906, the Hanford Reach National Monument (HRNM) was created by Proclamation 7319 in 2000. The Proclamation lists the resources that are to be protected including: riparian, aquatic and upland shrub stepped habitats, native plant and animal species as well as archaeological, historic and sacred sites throughout the monument. While the majority of the HRNM is managed by USFWS, the river corridor lands underlying the Hanford reactors and operational areas are managed by DOE. These lands contain high levels of contamination and significant cultural resources.

k. It is recognized in the Proclamation that DOE has the responsibility to clean up hazardous substances and the restoration of natural resources. The Proclamation further states, "As Department of Energy and US Fish and Wildlife Service determine that lands within the monument managed by the Department of Energy become suitable for management by the US Fish and Wildlife Service, the US Fish and Wildlife Service will assume management by agreement with the Department of Energy." Clearly it was the intent of the President that the HRNM land would be cleaned, restored and then managed by the USFWS.

The entire HRNM would then be managed according to the mission of the USFWS guided by the HRNM Comprehensive Conservation Plan (CCP), which states a primary purpose of, "Protect and restore biological, cultural, geological and paleontological resources." Areas in the River Corridor 100 Areas are some of the most contaminated, and it remains the obligation of DOE to clean and restore these areas within the HRNM and areas that could affect the HRNM in consultation with the Department of Interior. Anything other than complete cleanup and restoration of the HRNM would be in direct conflict with the Antiquities Act, Proclamation 7319, and the HRNM CCP.

l. Full compliance with government-to-government requirements are not fulfilled by the vague statements found in the Proposed Plan (page 13, Table 10-10, RI/FS): "*During preparation of this Proposed Plan, DOE and Ecology invited the Tribes to formal consultation on this proposed cleanup action. In addition to these formal activities, DOE and Ecology have worked with Tribal staff during the RI/FS process*" or "Effects *to other cultural values will be minimized through implementation of Hanford Cultural Resources Management Plan* (DOE/RL-98-10), *Revised Mitigation Action Plan for the Environmental Restoration Disposal Facility* (DOE/RL-2005-27), *and consultation with area tribes, as needed. This will help ensure appropriate mitigation to avoid or minimize any adverse effects to natural and cultural resources and address any other relevant concerns.*"

- The Proposed Plan and decision documents do not adequately explain how cleanup meets the National Historic Preservation Act 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).

m. The Preferred Alternative for groundwater with ICs for extended time periods is inconsistent with the CLUP (It is stated that cleanup actions will support reasonably anticipated future land uses consistent with the Hanford Reach National Monument and "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (the "CLUP') (HCP EIS) (64 FR 61615). CLUP is designated for 50 years operational and 100 years for institutional controls. Beyond that time period, the site could be used for any and all types of land use; including irrigation. It is known that there will be continued releases above cleanup levels for over 100 years.

n. Yakama Nation ERWM remains concerned that any remedy reviews (i.e. 5 year ROD reviews) will not include appropriate sampling actions or technological systems review to confirm performance of these IC.

4. **Evaluation of Alternatives: Key Concerns/Comments:**

a. DOE should develop cleanup plans that are protective of human health and the environment, and allow **safe unrestricted** Tribal uses.

b. Discussion of the "Shoreline site" is misleading to the public. Correctly stated "The "Shoreline Site" is not listed in WIDS; it was defined in *Corrective Measures Study for 100-NR-1 and 100-NR-2 Operable Units* (DOE/RL-95-111) as a single, unique waste site containing the 100-N-Springs (riverbank seeps) along the eastern shore of the Columbia River, as well as associated contaminated soil from strontium-90 contaminated groundwater discharge from the 1301-N and 1325-N cribs and diesel fuel-contaminated soil from waste site 100-N-65 (*Corrective Measures Study for 100-NR-1 and 100-NR-2 Operable Units* [DOE/RL-95-111]) none the less it must be remediated.

None of the alternatives presented propose a remedy for the "Shoreline site". Long-term use of ICs (~ 225 years) is unwarranted based on the statement "Because of its proximity to the existing apatite PRB, intrusive remedial actions (i.e., RTD) of the shoreline site (including the trench) would compromise the integrity and effectiveness of the apatite barrier" (page 8-57, RI/FS). Apparently nearly 5 Curies of the 100-N Area strontium-90 inventory remains in this riparian zone without a proposed remedy.

c. The Proposed Plan for cleanup of the 100-N Area and the associated RI/FS Report does not support an adequate cleanup of the area groundwater or soils. While identified waste sites were heavily contaminated, the fact remains that significant quantities of strontium (and other contaminants of concerns, including hexavalent chromium, cadmium, cobalt, manganese, nitrates) will remain unaddressed under the current Preferred Alternative. In order to achieve long-term protection of the Columbia River, contaminants will need to be removed from the vadose & riparian zones in the 100-N Area.

- The riprap cover consisting of large boulders that was placed over the N-Springs seeps in 1984 to minimize the accessibility of the seeps to both human and faunal

contact cannot ensure restricted access for the required time period of approximately 230 years.

- Strontium-90 inventory discussions are not consistent. There appear to be discrepancies between total curies discussed in chapter four (page 4-263) and chapter eight (page 8-56). These discrepancies should be examined and resolved in both the Proposed Plan and RIFS documents.
- Page O-19 states Srtontium-90 will continue to desorb from saturated sediments & the PRZ at levels which exceed cleanup PRGs.

d. Exposure pathways to contaminated media have been documented to be complete. Both the Proposed Plan and the RI/FS assert that there are "no complete exposure pathways for risk to human populations" based on the formally designated land use and existing institutional controls. However, this statement is contradicted by DOE's own description of the 100-N Area "Groundwater carrying mobile radioactive contaminants enters the Columbia River via a series of riverbank seeps, referred to as the N-Springs, which are also considered a contaminant source in the 100-N Area (*Westinghouse Hanford Company Environmental Surveillance Annual Report – 100 Areas* [WHC-EP-0161] RI/FS, PG 4500).

Natural seeps are observed along the shoreline, in the riparian zone, associated with the early summer drop of the Columbia River water levels. These seasonal seeps represent secondary contaminant sources to the riparian zone." The seeps are monitored by the DOE's Public Safety and Resource Protection Program. None of the Alternatives address remediation of this complete pathway.

e. Assumptions and Inputs: Appendix K, Section 4.1, of the RI/FS indicates cost calculations included the assumption of ICs. EPA guidance (OSWER Directive 9283.1-33) states "While ICs related to groundwater or surface use may be used as part of a response action, the NCP preamble indicates that ICs generally are not to be included when evaluating whether a CERCLA remedial action is appropriate in the first place."

Without ICs, none of the proposed remedial alternatives are appropriate, and therefore should be considered deficient and removed from the Proposed Plan in favor of alternatives that permanently and verifiably remove contamination from the 100-N Area.

f. Statements in Appendix K, section 4.1 (RI/FS) also indicate additional IC maybe included through closure reclassifications. All potential costs estimates must be identified within the remedy selected for each waste site. It is assumed that ICs will be maintained for 5 years beyond the time that the cleanup goals are initially achieved. Clarification should be added regarding to how IC will be incorporated into the RCRA TSD permits.

g. The Yakama Nation ERWM Program supports use of technologies that reduce or eliminate contamination from source terms on the Hanford Site. The apatite permeable reaction barrier does not meet these criteria. It may contain it, but for how long? At some point it will saturate.

h. Statements are made implying that the decision to deploy apatite sequestration techniques at additional locations will be made through a process without public involvement. This approach is inappropriate -- to prospectively decide future remedy selection or imply the approval of use of a "plug-in approach" without public

comment -- within the context of the Proposed Plan. DOE should revise the Proposed Plan to remove this text from the document.

Should DOE be considering application of the "plug-in approach" to waste site remediation, the YN ERWM program request DOE to develop a separate document and subject it to the public review process. Application of apatite to locally elevated areas of Sr-90 outside the PRB would require an Amendment to the ROD and public review opportunities. See page 42, line 33 of the PP.

i. It is unclear how consideration of the adequacy and reliability of controls were evaluated for Long-term Effectiveness and Permanence of the alternatives. Was there an assessment of the reliability of management controls for providing continued protection from residuals? Did the evaluation include the assessment of the potential need to replace technical components of the alternatives, such as a cap, a slurry wall, or treatment systems (e.g., Sr-90 barrier, groundwater wells/treatment systems, and additional application of apatite to the vadose zone and groundwater outside of the PRB) and the potential exposure pathway and risks posed should the remedial action need replacement? How long before the barrier saturates with Sr-90. The barrier is like a filter and all filters plug eventually. What action will DOE take when this occurs? Where will future Sr-90 contaminated be disposed of at – when all Hanford waste sites are closed?

   The DOE should revise the Proposed Plan to address these deficiencies and include detailed cost information for each alternative.

   - Installation of an additional 1000 foot apatite barrier through jet injection of 305 borings to a depth of 20 feet is an inefficient use of funds. Remove, treat, and dispose (RTD) would permanently remove the majority of Sr-90 contamination in this portion of the PRZ that provides a continuing source of contamination to groundwater.
   - See our previously identified and relevant concerns regarding use of the Apatite Barrier.[3]

j. The Proposed Plan's Preferred Alternative 3 does not include all the required information: The Preferred Alternative does <u>not</u> include the required description of contingency measures that will be implemented should the remedial alternative monitoring show that the alternative is meeting remedial action objectives and performance criteria.

   Conditions that would trigger the contingency should also be specified (e.g., continued plume migration or contaminant levels are well above levels predicted for a specified time) (EPA 540-R-98-031). The Proposed Plan and Preferred Alternative should incorporate remedial actions that will meet these thresholds and state explicitly the contingency measures and additional actions that will be taken should CERCLA monitoring demonstrate the Preferred Alternative has not worked as planned. YN ERWM requests DOE update the Proposed Plan to provide details for public review including cost of implementation of contingency measures.

   - Use of natural attenuation as a component of a groundwater remedy requires contingencies for additional or more active remedial actions to be incorporated

[3] Yakama Nation letter to Shirley Olinger, Manager, Department of Energy, Office of River Protection, David Brockman, Manager, Richland Operations Office, Dennis Faulk, Manager, USEPA, Richland, Jane Hedges Program Manager, WA Department of Ecology, July 20, 2010.

that are triggered by specific contaminant concentration levels in the site groundwater monitoring network (or other criteria as appropriate).[4] These contingencies were not developed or included in the RI/FS or the Proposed Plan.

l. DOE needs to evaluate soil flushing as an alternative. Clarify reason for not considering it.

m. The Feasibility Study did not consider focused RTD of Sr-90 to reduce the source term mass at the most highly contaminated liquid disposal sites to an appropriate level (such as MTCA Method-B Unrestricted Use Standards). Such an approach is the only method that definitively and permanently removes contamination from the vadose zone and periodically rewetted zone. The analysis provided by the DOE instead provided only a cursory evaluation of RTD over the entire 100-N Area which was deemed to be infeasible. Such intentionally deficient analysis does not constitute an appropriate evaluation of RTD technology, and is deficient for the purposes of the Proposed Plan and RIFS.

RTD remediation would reduce the quantity of strontium that is released to groundwater at from focused source areas and significantly improve the effectiveness of the apatite PRB located at the Columbia River's edge. Even partial removal of contamination sources can greatly reduce the long-term reliance on both active and passive groundwater remediation. This more aggressive strategy to remove upland Sr-90 contamination sources would also result in significantly shorter use (and cost) of ICs and a shorter groundwater restoration timeframe.

Detailed analysis of focused RTD would likely result in an overall rating that is higher than the Preferred Alternative in all of the Threshold & Balancing Criteria analysis factors. The YN ERWM program believes it would be under the cost of Alternative #5 with the public assurance that a significant portion of the source of Sr-90 contamination has been removed.

Focused RTD could be implemented in conjunction with local apatite PRBs to reduce or eliminate the mobilization of strontium-90 contamination during the RTD process. Such an approach would prove dramatically more effective than that which has been proposed in the Preferred Alternative.

At the very minimum YN ERWM Program recommends this approach as the Preferred Alternative.

n. Design elements for Alternatives selection should be described in sufficient detail in the Proposed Plan so that the public can evaluate and comment on the proposal (EPA 540-R-98-031). The Proposed Plan provides the foundation for the ROD to defer the final technology selection to the remedial design phase.

- (See Proposed Plan Table 4) Note: Although the remedial alternatives developed for evaluation do not have specific provisions for sustainable elements, those values can be incorporated during the remedial design phase.

o. None Alternatives were evaluated against the nine balancing criteria with recognition of what happens with transition to Long-term Stewardship prior to completion of remediation under the Record of Decision (e.g., was a cost benefit analysis of remedy costs including long-term stewardship costs done?) The environmental consequences of doing this action or not doing it have not been evaluated. It is unclear how any of

[4] EPA; Directive 9234.2-25

the Alternatives can ensure compliance with the balancing criteria with transition into Long-term Stewardship. These analyses should be done as this action will clearly need to be reflected and integrated into the final ROD.

p. Alternatives 2 thru 5 incorporate use of a Technical Impracticability Wavier (TI) for the Drinking Water Standard (DWS) ARAR. The TI waiver should not be granted for the 100-N Area upland Strontium -90 groundwater plume for several reasons that include:

- CERCLA TI Waivers based on "engineering perspective" implies that a TI determination should primarily focus on the technical capability of achieving the cleanup level, with cost playing a subordinate role. The NCP Preamble states that TI determinations should be based on: "...engineering feasibility and reliability, with cost generally not a major factor unless compliance would be inordinately costly."[5] RCRA Subpart S (Corrective Action) has similar guidance.[6] However, in both instances *the role of cost (or scale) of the action is subordinate to the goal of remedy protectiveness* (EPA Guidance; Directive 9234.2-25). Cost is indicated as the primary consideration and should not be.
- IT description does not include an evaluation of impacts on the performance of each *Balancing Criteria* (e.g., will there be less reduction in toxicity, mobility or volume through treatment because of the wavier?).
- A demonstration that ground-water restoration is technically impracticable generally should be accompanied by a demonstration that contamination sources have been, or will be, identified and removed to the extent practicable.[7]
- EPA Guidance (Directive 9234.2-25)(Final RODs) states where site characterization is very thorough and there is a moderate to high degree of certainty that cleanup levels can be achieved, a final decision document should be developed that adopts those levels.
- Use of an apatite barrier has been proven effective in attainment of cleanup levels. Guidance indicates a TI wavier is not warranted in the case of the 100-N Area Sr-90 upland groundwater plume.
- The requested TI Wavier fails to demonstrate that no other remedial technology could reliably or feasibly attain the cleanup levels at the site within a reasonable timeframe. Removal actions are appropriate where contamination poses an actual or potential threat to drinking water supplies or threatens sensitive ecosystems. Removals of source material (hot spots) and containment of migrating zones of high levels of contamination in groundwater all fall under this category. [8]
- TI Wavier based on the infeasibility of an upgradient apatite permeable reactive barrier for Sr-90 does not satisfy the requirement to have an adequately designed groundwater restoration remediation system design and implementation. Failure to achieve desired cleanup standards resulting from inadequate system design or

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[5] See NCP Preamble, 55 FR 8748, March 8 1990

[6] See Proposed Subpart S; 55 FR 30830, July 27, 1990 & TI discussion in Section 264.525(d)(2) and 264.531 of the Proposed Subpart S rule.

[7] EPA; Directive 9234.2-25

[8] EPA; Directive 9234.2-25

operation is not considered by EPA to be a sufficient justification for a determination of TI of ground water cleanup.[9]

q. Current apatite barrier design should be optimized and/or enhanced to ensure operating capacity can handle any additional flux of strontium-90 from the upland plume.

r. Use of a TI wavier denies the basic premise of (WAC 173-303-645) application of alternative requirements for groundwater monitoring which requires the integration of monitoring networks and a single point of compliance (throughout the entire groundwater operable unit). Groundwater cleanup is based on the highest beneficial use. Ecology, through the Model Toxics Control Act (MTCA) has determined that use of groundwater as a source of drinking water is the beneficial use requiring the highest quality of groundwater. The effectiveness of the RCRA corrective action groundwater monitoring program should be based on achievement of MTCA Method B groundwater cleanup levels throughout the entire groundwater operable unit for all constituents. To be able to provide a defensible and technically sound determination, the RCRA TSDs dangerous waste constituents should include all constituents listed for the SWMUs and other areas of concern, and the well monitoring network enlarged.

- Clarify how any reduction in the number of ground water monitoring wells (as indicated in Appendix K, Attachment #1 for all alternatives) will ensure use of protectiveness of human health and the environment and compliance with WAC 173-303-610, 645, and 650.

5. **General Comments on the Analysis of the Alternatives:**

a. Alternative design details (i.e., specific provisions for sustainable elements) are to be identified in the RDR/RAWP to be prepared after the ROD is issued. EPA guidance (EPA 540-R-98-031) states this information should be included in both the Preferred Alternative Section of the Proposed Plan and the Selected Remedy Section of the ROD, not in the workplan.

b. Summary of Comparative Analysis of Alternatives (Proposed Plan Table 4): YN ERWM program believe the weight applied to ranking of the effectiveness of the alternatives to be incorrect. There is obvious discrepancy in the rating of Alternatives 4 and 5 as having less *Long-term effectiveness and permanence* and less *Reduction of toxicity, mobility, or volume through treatment* or *Short-term effectiveness and time to achieve RAOs* in comparison with Alternative 3. While cost for waste sites is less under Alternatives 3, Alternatives 4 and 5 take less time, remove a greater portion of the source waste, and have better reduction of mobility of a specific area than Alternative 3. Both Alternatives 4 and 5 take less time to achieve PRGs for nitrate and strontium in the GW than Alternative 3.

- The evaluation of the long-term effectiveness and permanence afforded by alternatives assesses the effectiveness an alternative will have in eliminating exposure pathways or reducing levels of exposure identified in the baseline risk assessment. Both Alternatives 4 and 5 should rank higher than Alternative 3 as both have additional design elements to remove and/or capture contaminants in the groundwater pathways.

[9] EPA; Directive 9234.2-25

- The statement that effects of injecting apatite and organic substrate treatment in the same area may have unintended consequences is not supported by Hanford site treatability study data. Injection of apatite and bioventing have the virtually the same potential. Alternative 3 should rank equal with Alternative 2 in this comparative analysis criteria.
- Clarification is needed in the Proposed Plan support statement that co-treatment of nitrates and emplacement of an apatite barrier in the upland areas is so technically challenging to warrant given ranking for implementability criteria. Statement that there are potential concerns with placement within the Mooli Mooli cultural resource area does not preclude the need for additional needed remediation. (See our comments regarding Cultural Resources.)

c. The Preferred Alternative eliminated in-situ biological treatment for nitrates citing possible clogging of and reduction in the effectiveness of the apatite barrier. Ex-situ treatment for nitrates (bioreactors) was similarly dismissed. However, its effectiveness (>99%) is documented in a Hanford study.

- Proposed in situ bioremediation has been described as potentially biofouling the apatite PRB injection wells and the saturated zone. Cost estimates and further consideration should be given to inclusion of ex-situ nitrate treatment in the preferred alternative.
- Allowing up to 508 pounds of nitrates to enter the Columbia River is not acceptable. Data cited in the PP/RI/FS for mass of nitrate entering the river from offsite sources is outdated and irrelevant. DOE has the responsibility to remediate the contamination in the groundwater and the river that is the result of its operations on the Hanford site.
- Caution is appropriate if young children might be exposed, such as in the Nonresident Tribal scenario, because they are particularly at risk for methemoglobinemia, the critical effect for nitrate exposure (IRIS 2009). Nitrates should be remediated.

d. The Propose Alternative states biosparging will reduce TPH-D concentrations throughout the plume to less than the groundwater cleanup level in three (3) years. With the uncertainties expressed regarding the efficiency of the bioventing system (WCH-370, 2009, *Bioremediation Well Borehole Soil Sampling and Data Analysis Summary Report for the 100-N Area Bioremediation Project (UPR-100-N-17)*, Rev. 0, Washington Closure Hanford, Richland, Washington.), this statement seems optimistic. What contingencies are planned should the selected groundwater remediation remedy not meet RAOs as described?

- Clarify if short-term effectiveness evaluations for all alternatives were based on only the time to build/implement the remedy or if it includes the time to achieve all remedial action PRGs.

6. **Comments Regarding 100-N Groundwater Remedial Alternatives:**

a. The PRB has not been proven to be effective in the conditions present in the Hanford 100-N area: All the action alternatives identified in the Proposed Plan rely on the construction of a PRB to intercept and immobilize strontium-90 contaminated groundwater prior to reaching the Columbia River. Previous tests of this remedial process technology in the 100-N area have failed to demonstrate the technology is

effective and reliable at performing these two actions (USDOE, 2010; Williams et al., 2008).

The recent publication by Pacific Northwest National Labs *Apatite Treatability Test: High-Concentration Calcium-Citrate-Phosphate Solution Injection for In-Situ Strontium-90 Immobilization: Final Report* (2010) gives cause for additional concern that this technology is inadequate since even in locations where monitoring showed the greatest reductions in strontium-90, Federal drinking water standards for beta-emitting radionuclides were not met.

A partially functioning or dysfunctional PRB provides little to no protection against the ongoing release of strontium-90 contaminated hyporheic water and groundwater. This technology therefore fails to reduce the volume, toxicity, or mobility of the contaminant it is designed to remediate. The remedial alternative is deficient, and feasible alternatives be considered instead.

The YN ERWM Program request DOE revise the Proposed Plan action alternatives to incorporate proven treatment technologies, or technology that is supported by a full CERCLA Feasibility Study as the best alternatives to reduce volume, toxicity, and mobility of the strontium-90 contaminated groundwater.

b. Permeable Reaction Barrier construction is unreliable: Construction of the PRB relies on observing specific criteria in wells proximate to the injection sites to demonstrate surrounding soils have been fully treated with adequate reactive solution to create a continuous reactive barrier. Previous injection attempts have failed to meet the required criteria at "a significant number of well locations" (Vermeul et al., 2010).

   Subsequent PRB construction details have not resolved the problems associated with ensuring proper placement of reactive agents in the soil column. Utilizing construction methods that are known to have not previously met performance criteria without modification constitutes a deficient approach to remediating strontium-90 contamination in the 100-N Area.

   The YN ERWM Program request DOE perform, document, and publish additional feasibility testing for construction of a PRB or alternate remedy that demonstrates construction specifications can be met to ensure adequate performance. If these criteria cannot be consistently achieved and documented in field tests, the PRB should not be considered in the Proposed Plan.

c. Construction of the permeable reaction barrier results in unacceptable impacts to the Columbia River: Construction of existing portions of the PRB resulted in significant, measurable, and distinct increases in metals and radionuclide concentrations measured in groundwater adjacent to injection wells (Williams et al., 2008, Vermeul et al., 2009). No remediation measures have been proposed to address the potentially large release of strontium-90 into the Columbia River that will occur during construction of the new PRB sections or supplemental injections described in all of the action alternatives of the proposed plan for strontium in groundwater.

   Simulated impacts to the Columbia River based on the USDOE groundwater fate and transport modeling show strontium-90 breaking through the PRB. The predicted impact includes a cumulative total activity of approximately 0.077 curies entering the river. The RI/FS describes this activity as "a small percentage" of the total mass of radiostrontium in the upland aquifer. Such logic is unacceptable when viewed in the appropriate context for the 100-N area, which includes groundwater contamination by strontium-90 at concentrations as high as 8,000 picocuries per liter. At this

concentration, consumption of only 2 liters of contaminated water result in a committed dose of 20 millirems, approximately five times the annual allowable dose (4 mrem) under current Federal regulations (40 CFR 141.66). Selected remedial actions must provide consistently dependable performance for the duration of the period in which remediation is necessary.

The YN ERWM Program requests DOE revise the proposed action alternatives to address the mobilization of strontium-90 and other metals that has been observed following the injection of calcium-phosphate-citrate solutions. Any contamination that is mobilized as part of the proposed remedial actions should be contained, containerized, and disposed of according to the applicable legal requirements. Revise the Proposed Plan and RI/FS to incorporate design criteria for the PRB or alternate remedy which include long term maintenance and monitoring which maintain a minimum factor of safety of 2 or greater for PRB groundwater remediation performance over the next 300 years.

d. General Groundwater Comments (e thru o): It is unclear how remediation of the Strontium-90 contamination will achieve RAOs for all groundwater COCs. Clarification requested within PP and RI/FS documents.

e. It is unclear how remediation measures for TPH-d in the vadose zone and groundwater (bioventing and biosparging) will also remediate any total chromium or cobalt, present. Both of these actions are designed to create a redox zone which may allow release of metals.

   However, elevated metal levels may indicate a relationship between the geologic environment and other waste sources and not active biodegrading of total petroleum hydrocarbons (TPHs). Regardless of cause, there is no system in place (or suggested) to capture these contaminants. The YN ERWM Program requests more clarification (see RI/FS page 8-53) and consideration of remedy design changes to ensure capture of flushes of contamination to the groundwater and river at levels exceeding cleanup standards.

f. By their inter-connectedness, to ensure continuity of the Hanford site groundwater remediation efforts, treatment of hexavalent chromium should also be included in the 100-NR-2 ROD GW remediation plan. Discussion is need to demonstrate (using travel times, etc) that the contamination reportedly originating from the 100-K-1 OU is prevented from exceeding the DWS, MCLs, AWQS downstream and/or reaching the river. Otherwise, the ROD must include a remedy for all these constituents.

g. The YN ERWM Program requests DOE provide a reference document to support the statement that hexavalent chromium detected in the 100-N area groundwater is being addressed through the 100-K interim actions.

   The 100-N area chromium needs to be addressed. The Work Plan[10] reported chromium sampling at 100-N as "inconsistent and discontinuous in frequency and location" and chromium was not a "typical analyte" in much of past 100-N well sampling. Chromium occurs widely across 100-N and at concentrations above action levels in at least one well (199-N-80).

[10] Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan Addendum 5: 100-NR-1 and 100-NR-2 Operable Units (DOE/RL-2008-46-ADD5) and Sample Analysis Plan for the 100-NR-2 Operable Units RI/FS (DOE/RL-2009-42).

- Well 199-N-80 should be in the RCRA TSD groundwater monitoring network for the 1301-N unit as it is closely associated and down-gradient.
- YN ERWM Program requests the following well to be included in the 1301-N groundwater monitoring network: N-1/-2/-2/-14/-16/-18/-19/-21/-26/-27/-28/-29/-34/-50/-56/-57/-64/-74/-80/-96A/-106A/-173.
- Minimum Standards for Construction and Maintenance of Wells" (WAC 173-160 & -162), should be the ARAR regulations for the location, design, construction, and abandonment all 100-N Area wells.
- Ecology letter (April 16, 2009) to Mark French stated "Chromium concentrations in groundwater at wells located near and immediately downgradient to the 116-N-1 (1301-N) surface impoundment (e.g. 199-N-80, 199-N-56, and 199-N-3) have exceeded and continue to exceed the 48ug/L groundwater cleanup level (WAC 173-303-720(4))."
- Ecology has consistently requested use of hexavalent chromium K_d=0 mL/g, based on field observations of chromium mobility and results of site-specific leaching and batch sorption tests. The Proposed Soil cleanup levels for Hexavalent Chromium to ensure protection of groundwater should be set at 0.2 mg/kg.

  This value is found using a K_d value of 0 mL/g and more accurately depicts movement of this contaminant through soils. Fate and transport simulations presented in DOE/RL-2010-98 should be recalculated using 0.0 K_d value. The YN ERWM Program requests the use of 0.0 K_d value and that concentrations in the groundwater and along the shoreline and the subsequent timeline should be re-evaluated for decline in concentration.

h. Groundwater is not generally considered a primary source, yet the YN ERWM Program is concerned that any remedy reviews will not include appropriate sampling actions or technological systems review to confirm performance or to consider missing source area contaminants (i.e. the 100-N reactor/fuel basin plume).
   - Clarify how and demonstrate (using travel times, etc) that contamination from these COCs will be prevented downstream and/or from reaching the river in exceedence of the DWS, MCLs, AWQS

i. The YN ERWM Program request EPA use of the new RfD value (0.0006) for Uranium by EPA's Office of Drinking Water as the basis of the Maximum Contaminant Level for drinking water is noted in the Tri-Party approved comment resolution document attached to DOE letter (13-AMRP-0041) to EPA and Ecology, 11/21/2012.

j. The YNERWM Program disagrees with the application of several footnotes identified in Table A-1 & A-2:
   - Table A-1, footnote (j) indicates the hexavalent chromium PRG is based on IROD cleanup levels (DOE/RL-96-17). The YN ERWM Program request DOE change the PRG to 0.19.
   - Footnote 'e' (see footnote-Table A-1) states "In instances where verification sampling exceeds irrigated PRGs but achieves non-irrigated PRGs, the Tri-Party Agencies may elect to apply ICs to ensure protectiveness rather than continue excavation". The purpose of verification sampling is to determine if cleanup levels have been met or if further excavation is required. The PRGs listed are the

proposed cleanup levels to be met are they not? This is an over-reliance on the use of ICs rather than appropriate RTD or other remediation.

- Footnote 'g' (see footnote-Table A-1) states "The SSL or PRG value for groundwater or surface water protection is considered nonrepresentative because there is no breakthrough of the analyte simulated within 1,000 years for the majority of the soil columns (breakthrough is defined as concentrations above 1E-04 µg/L, or 1E-04 pCi/L)." Point of departure is defined by EPA as $1X10^{-6}$. MTCA risk is $1X10^{-6}$. The YN ERWM Program request DOE to calculate PRGs for all analytes noted with footnote (g).
- Footnote 'f' (see footnote-Table A-1) states "Should site-specific data during remediation indicate that the PRG is not representative of site conditions, additional protectiveness evaluations may occur." The YN ERWM Program request details of these evaluations are included within the Proposed Plan and available for public review.

k. The Preferred Alternative (or Proposed Plan) does not include the required description of the contingency measures that will be implemented should the monitoring show that natural attenuation is unable to achieve the cleanup goals. Conditions that would trigger the contingency should also be specified (e.g., continued plume migration or contaminant levels are well above levels predicted for a specified time) (EPA 540-R-98-031). Update and provide details in the Proposed Plan for public review including cost of implantation of contingency measures.

   The Proposed Plan should include a detailed description of quality assurance measures that will be implemented as part of the preferred alternative's use of an apatite PRB for strontium-90 sequestration. The description should include a program of subsurface testing to ensure placement of reagents, as well as identify performance standards which the alternative must achieve before the reagents are applied in the field.

l. The YN ERWM Program believes there are some noted incorrect applications of regulations which need correction and re-evaluation of risks to the groundwater (e.g. Text in the Proposed Plan states "For sites in the Columbia River...protect aquatic life in the Columbia River by achieving ...state water quality standards at groundwater discharge points to the river." It is noted that aquatic water quality criteria are only directly applicable where groundwater discharges to surface water." WAC 173-340-720(4)(b)(ii) (2007) indicates that WAC 173-340 Method B for potable groundwater applies for the protection of surface water beneficial uses, and references WAC 173-340-730; in this way, water quality standards are incorporated in WAC 173-340-720. WAC 173-340-730(3)(b)(i) also gives the relationship of water quality standards and WAC 173-340.) We believe the aquatic water quality criteria do apply to the ground water because the property abuts the surface water and should be applied at 100-N.

m. Monitor wells are assumed to have a design life of 30 years yet monitoring will continue for hundreds of years. Clarification is needed to ensure that cost estimates include replacement of wells over time.

7. **Comments Regarding Human Health Risks:**

a. Accumulated scientific evidence demonstrates that Native Americans are, as a statistical cohort, subject to the highest risk of disease and cancer from exposure to environmental contaminants. The Columbia River Basin Fish Contaminant Survey is a technical report that assesses the amount of chemical pollution in certain species of fish, and the potential health risks from eating fish those fish. The study is based on fish samples collected between 1996 and 1998 from tribal fishing waters in Washington, Oregon and Idaho. EPA funded the study which was coordinated by the four member tribes of the Columbia River Intertribal Fish Commission (CRITFC).

   - Official recognition that Native Americans living near the Hanford site are the most vulnerable people to environmental contaminants, as underscored by EPA's Columbia River Fish Contaminant Survey. Adults in CRITFC's member tribes who eat fish frequently (48 meals per month) over a period of 70 years may have cancer risks that are up to 50 times higher than those in the general public who consume fish about once a month.

b. Tribal risk information from the Remedial Investigation/Feasibility Study basically indicates ranges of over ten times the allowed risk for cancer and fifty times the noncancer health effects (Appendix G Table G-59) throughout the 100-N groundwater plume areas. Tribal risk from groundwater use in a Sweat Lodge indicates ranges of unprecedented risk (ranging from over a hundred times the allowed risk for both nonradionuclide and radionuclide cancer causing analytes to over 13,000 times the noncancer health effects (HI) for some exposure routes (Appendix G Table G-60). However, this information was not used to develop cleanup levels or make cleanup decisions.

   - Hexavalent Chromium, Strontoium-90, tritium, and arsenic are some of the major contributors to risk for the Native American scenarios.

   - These cancer risks are greater than the maximum allowable EPA risk threshold of 1×10^{-4} (1 in 10,000 people) The Hazard Index (HI) is greater than the EPA target HI of 1.0.

c. There remains unacceptable risk to the YN tribal members from both chemical and radiological contaminants. Much of the risk assessments are based on the RCBRA and other supporting documents. In the Introduction (page xxvii), PRGs are described as "PRGs are more specific than RAOs and establish acceptable exposure levels for specific contaminants and exposure pathways that are intended to be protective of HHE.." However, since PRGs were not developed for any tribal scenarios they do not represent levels that are protective of tribal health.

d. The methodology used to assess risks for the RI/FS uses PRGs developed in the RCBRA (DOE/RL-2007-21).

   - The YN has outstanding issues with the use of River Corridor Baseline Risk Assessment and its 'sub-documents'[i.e. Tier 1 document for wildlife or the Tier 2 document for plants and invertebrates] as a major supporting document in cleanup decisions for the River Corridor Areas. These documents are not finalized or approved nor have our comments and concerns been addressed. [11]

   - RCBRA (River Corridor Baseline Risk Assessment Volume II, Part 1: Human Health Risk Assessment August 2011): Volume II, Part 1: Human Health Risk

[11] See our February 28, 2011 letter to the Tri-Party Agencies (DOE-Matt McCormick, EPA-Dennis Faulk, and Ecology- Jane Hedges

Assessment August 2011pg 7-34: For the Nonresident Tribal scenarios, the total cancer risk estimates exceed 10^{-4} and HIs exceed 1.0 for all ROD areas.

e. Conservation/mining land use is as a part of the basis for the preliminary remediation goals (PRGs). YN ERWM program disagrees with this land use designation to develop PRGs. Yakama Nation Treaty rights guarantee (among other rights) use of groundwater for sweat lodge activities. Groundwater is to be restored to its most beneficial use, which is drinking water standards (i.e. Method B, unrestricted land-use values). All PRGs should be calculated based on unrestricted land-use (at the very minimum.) YN ERWM has submitted previous comments on the development of the PRGs. We join with Ecology in questioning the development of the PRGs. See footnote #2.

f. Calculation of radionuclide PRGs based on use of a risk ELCRs of a 1 in 10,000 risk or radionuclide dose (15 mrem/year) is in opposition the EPA guidance which states the point of departure for risk is 1 in a million. The allowable target risk range is $1X10^{-4}$ to $1X10^{-6}$ but DOE continues to drive cleanup with the lowest level rather than initially striving to meet the highest standard of 1 in a million (1X10-6). $1X10^{-6}$ is consistent with MTCA (WA States regulations) and it should be DOE's cleanup goal.[12] As MTCA explicitly defines radionuclides as hazardous substances, the combined limit for radionuclides and chemicals should correspond to a lifetime cancer risk of $1 X 10^{-5}$ or less at the minimum.

- Clarify the need for an additional evaluation of HH ELCR and hazards were performed when MTCA Method B would suffice.
- Exposure Point Concentrations (EPCs) were used to calculate the ELCRS and noncancer hazards. Frequently these EPCs resulted in deletion of COPCs when used to compare COCs against the applicable standard or risk-based concentration. What was the process used to validate the results from which the EPCs were derived? Please refer to our prior discussions of EPCs in response letter to Hanford Risk Assessments, etc.
- Years to attain mature plant revegatation is more correctly identified as a range of 80 to 100 years. Recalculate infiltration rates using this more appropriate range of years. Adjust Alternatives to incorporate these values to reflect a more accurate timeline in achieving remediation goals.
- Many PRGs have been inappropriately developed and uncertainties remain as these documents still require revision. Our concerns remain regarding the methodology used to calculate the EPCs. EPA's ProUCL methods were identified yet in some instances a 95UCL was not calculated (a maximum value used instead). Use of the max ignores most of the information in the data set.
- When the number of measurements is small (e.g., n<5) or the detection frequency is low (<5%), ProUCL ultimately recommends collection of more samples to

[12] The 15 millirem per year (mrem/yr) dose limit used by DOE in the past is not protective enough; this dose equates to a lifetime cancer risk of 3×10^{-4}, which is three times the maximum allowable value under CERCLA. Note: If the EPA's own risk coefficients for radiation are used, it equates to a fatal cancer risk of more than 5×10^{-4} and a cancer incidence risk of 1×10^{-3}, which is well outside the CERCLA target range of 10^{-4} to 10^{-6}.)

compute defensible statistics.[13] Collection of additional samples was not done. Some unremediated waste sites may have exceedances of PRGs, which would provide the basis for remedial action or further evaluation. EPA review of YN comments on these issues in our earlier correspondence on the RCBRA, etc would provide further clarification.

g. A review of CVP documents (most dating 2001-2008) for a number of waste sites raised concerns. Several indicate the use of outdated standards or as of yet agreed to (by the Tri-Parties) values (i.e. the 100 Area Analogous Sites RESRAD Calculations (BHI 2005a) to calculate non-radiological COCs, [e.g. copper, lead, selenium, TPH; Aroclor-1254]. Many state use of MTCA 1996 values or soil RAGs based on "100 time groundwater cleanup rules and 100 times dilution attenuation factor times surface water quality criteria. Provide a more detailed explanation of the review of all CVPs including the comparison process and whether additional characterization and/or sampling was performed for those CVPs where filtered sampling results, etc where utilized. Adjust the need for addition site-specific remediation as warranted.

   - The YN ERWM Program does not support "backsliding" on any of the more stringent IROD cleanup values.

h. Text (and Table A-1) within the document identifying 20 mg/kg for arsenic as an unrestricted land use clean up value is misleading. It implies Washington State Department of Ecology concurrence with use of this value on the Hanford site as background. The 20mg/kg cleanup level is the WAC 173-340 (1996) Method A value.

   - The YN ERWM Program believes it is incorrect to apply Method A on the complex Hanford site as it is used for sites which contain a small number of hazardous substances.

   - Its application has resulted in residual levels for arsenic which do not reflect the Unrestricted Land Use Soil Cleanup Standards WAC 173-340-740(3)]) 2007 Method B value (0.67 mg/kg) and the MTCA ("Deriving Soil Concentrations for Groundwater Protection" [WAC 173-340-747(3)(a)]), groundwater protection value (0.00737 mg/kg) cleanup values (which would default to site background levels of 6.5mg/kg). The proposed 20 mg/kg value for arsenic exceeds the 1×10^{-6} individual cancer risk based on the MTCA.

   - In simple terms, the risk analysis showed that casual users of the River Corridor as it is have low enough risk to be safe. However, all of the residential user scenarios have unacceptably high risk. Some of the risk was associated with uranium,

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[13] quotes from EPA sources, supporting use of the 95% UCL:1) Dec 2002 OSWER 9285.6-10 (http://www.hanford.gov/dqo/training/ucl.pdf) "It is important to note that defaulting to the maximum observed concentration may not be protective when sample sizes are small, because the observed maximum may be smaller than the population mean..... The use of the maximum as the default EPC is reasonable only when data samples have been collected at random from the exposure unit and sample size is large" (p. 20). 2) ProUCL Ver. 3.0 (Singh et al, 2004) (http://www.epa.gov/nerlesd1/tsc/images/proucl3apr04.pdf)

"It is recommended that the maximum observed value NOT be used as an estimate of EPC....It should be noted that for highly skewed data sets, the sample mean indeed can even exceed the upper percentiles (e.g., 90%, 95%), and consequently, a 95% UCL of the mean can exceed the maximum. This is especially true when dealing with log normally distributed data sets of small sizes" (page 55).

mercury, chromium, cadmium, and radiological contaminates. But a major part of the high risk levels found in the residential scenarios is from consumption of arsenic contaminated plants, animals and water. A large proportion of Nonresident Tribal cancer risk and HI is related to arsenic soil concentrations that are approximately equivalent to levels in areas unaffected by Hanford Site activities. When cancer risk estimates are calculated without the contribution of arsenic, the total cancer risk estimates still exceed 10^{-4} for all six ROD areas.

- While much of the arsenic is assumed to be from pre-Hanford agricultural practices, there was a portion that could be attributed to Hanford operations. That amount of the Hanford process arsenic load should be determined, and the cleanup of that arsenic should be a part of the Hanford cleanup plan.

i. The Proposed Soil cleanup levels for Hexavalent Chromium to ensure protection of groundwater should be set at 0.2 mg/kg. This value is found using a Kd value of 0 mL/g and more accurately depicts movement of this contaminant through soils. Fate and transport simulations presented in DOE/RL-2010-98 should be recalculated using 0.0 Kd value. Concentrations in the groundwater and along the shoreline and the subsequent timeline for decline in concentration re-evaluated.

j. The YN ERWM Program disagrees with the statement "As a result, risks are overstated because the UCL and the EPC do not take credit for the existing clean backfill that covers the remediated waste site." Risk from remaining contamination is what is supposed to be evaluated; delete text.

k. YN ERWM has reviewed in detail the comments of the Washington State Department of Ecology submitted on the 100-N Area RI/FS documents and join in their comments (with the exception of phyto-remediation), as supplemented by this submission. We particularly highlight and join the comments regarding human health and ecological risk and groundwater modeling.[14]

8. **General Comments on Principal Threat Wastes & Current and Future Exposure Scenarios:**

   a. It is unclear in the discussion of the Alternatives why there is no treatment included for long-lived the identified TRU radionuclides of plutonium and americium and cesium-137. Clarify in this section and also in the Alternatives discussions.

   b. Principal Threat Waste Approach: Delete text referencing $1X10^{-3}$. This is very misleading to the public. EPA guidance states point of departure is $1X10^{-6}$.

   c. Scope and Role:

      A holistic approach would ensure that protective decisions are made for the site in its entirety. We disagree with exclusion of contaminants emanating from offsite. The Preferred Alternative does not include an evaluation of contribution from other sources (i.e. the N Reactor plume) nor does it include upgradient contaminant sources from the 100-K area.

[14] Ecology letter 13-NWP-107 to Jonathan Dowell, DOE-Richland Operations Office dated October 2, 2013 regarding the *Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units,* DOE/RL-2012-15, Draft A.

- YN ERWM Program recommends the 100-N Area ROD includes a detailed schedule for completion of the reactor removal, and the event that removal does not occur, a contingency to address the remaining soil contamination.
    i. DOE/RL-2005-93; Following removal action, drill one borehole (complete as a groundwater monitoring well under work scope) in the boundary of the 118-N Reactor Fuel Storage Basin. Future documentation will cover this work scope. This work is a remaining data gap for 100-N Area final ROD.
    ii. Clarify how the railroad tracks between 100-N & 100-K were remediated.

9. **General Comments on the Remedial Action Objectives:**
    a. The purpose of Remedial Action Objectives (RAOs) is to explain and address site risks and to include an action (and specifics/details) to be taken achieve the objective. RAOs are the measurement tools for evaluating the success of the ROD remedy during the CERCLA 5 year review process. Without a specific action, the metrics for measurement are filled with subjectivity and uncertainty.
        - Four of the five (5) RAOs do not have a definitive task or standard to be met. An Example of a specific action to include using RAO#3: Prevent COCs migrating and/or leaching through the soil that will result in groundwater concentrations exceeding federal and state standards and risk-based thresholds for protection of surface water and groundwater *by treatment of the contaminated soils or RTD.*
            i. Clarify all RAOs with specific action(s) to be performed and/or standard(s) to be met.
    b. Calculation of radionuclide PRGs based on use of a risk ELCRs of a 1 in 10,000 risk or radionuclide dose (15 mrem/year) is in opposition the EPA guidance which states the point of departure for risk is 1 in a million. The allowable risk range is $1X10^{-4}$ to $1X10^{-6}$ but DOE continues to drive cleanup with the lowest level rather than initially striving to meet the highest standard of 1 in a million(1X10-6). $1X10^{-6}$ is consistent with MTCA (WA States regulations) and it should be DOE's beginning remediation point and ultimate cleanup goal.
    c. Cleanup levels (i.e., PRGs) should reflect the current MTCA Method B standards and in cases where they are less stringent than before, there should be no back-sliding from previous cleanup commitments in the Proposed Plan or RI/FS.
        - YN ERWM Program requests the following edits to Table A-1of the Proposed Plan and in RI/FS: Note Table needs to define concentration units. Delete the column titled "No Irrigation", cleanup should be to unrestricted (including irrigation) use:
            1. Arsenic = 6.5mg/kg (direct contact)
            2. Barium=1,600mg/kg (soil protective of groundwater)
            3. Hexavalent Chromium=0.19 mg/kg (soil protective of groundwater)
            4. Nitrogen in Nitrate=40 mg/kg (soil protective of groundwater)
            5. Mercury=2mg/kg (soil protective of groundwater)
            6. Pu-239/240=23.5*
            7. Thorium-228=2.2*

8. Thorium-232=2.2*
9. Tritium=241*

* Note: Proposed PRG "backslides" from current IROD for RCRA TSD.

- YN ERWM Program requests the following edits to Table A-1 Proposed Groundwater and Surface Water Protection Cleanup Levels (PRGs) values(mg/kg): Note Delete the column titled "No Irrigation", cleanup should be to unrestricted (including irrigation) use:
  i. Strontium-90=0.35 pCi/L[15]

- Include the following RCRA TSD COCs/PCOCs*:
  i. Carbon tetrachloride
  ii. Hydrazine
  iii. Iron
  iv. Magnesium
  v. Phosphate
  vi. Tetrachloroethene
- Include the following radionuclide:
  i. Ruthenium-106

*DOE/RL-2000-16

d. The YN disagrees with footnote 'e' (see footnote-Table A-1) which states "In instances where verification sampling exceeds irrigated PRGs but achieves non-irrigated PRGs, the Tri-Party Agencies may elect to apply ICs to ensure protectiveness rather than continue excavation". The purpose of verification sampling is to determine if cleanup levels have been met or if further excavation is required. The PRGs listed are the proposed cleanup levels to be met are they not? This is an over-reliance on the use of ICs rather than appropriate RTD or other remediation.

e. More clarification is needed on how cleanup levels will be adjusted to account for waste site-specific residual contaminations and for sites with multiple residual contaminants. The same is needed for evaluation of groundwater exceedances.

f. Clarification and inclusion of information is need in the Proposed Plan and analysis of the appropriate alternatives in several areas:

- Table 4 (PP-Summary of Comparative Analysis of Alternatives) cost explanation columns do not reconcile with *explanation boxes* adjacent to each Alternative. Clarification is requested.
- Cost analysis for required well-conceived plans for performance monitoring that identify and correct potential failures and plans for maintenance and repair, including possible total system replacement is missing (NRC, 2000). This level

[15] Nez Perce Tribe' July 15, 2010 letter to Matt McCormick regarding DOE/RL-2009-54, Rev O; Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision

of planning, both technical and financial (i.e., costs, does not appear to have been included in the Proposed Plan or the analysis of alternatives).

- The Preferred Alternative (or Proposed Plan) does not include the required description of the contingency measures that will be implemented should the monitoring show that natural attenuation is unable to achieve the cleanup goals. Conditions that would trigger the contingency should also be specified (e.g., continued plume migration or contaminant levels are well above levels predicted for a specified time) (EPA 540-R-98-031). Update and provide details in the Proposed Plan for public review including cost of implantation of contingency measures.
- Are remediation costs for waste sites whose remediation was expected to begin under the Interim ROD for the 100-NR-1/NR-2 fixed and will not increase? What would be an estimate of increase in costs should these identified sites not have remediation under the Interim ROD?
- Removal or disposition of pipelines is not included in the RDT discussion. If they are, more clarification is needed.
- Design elements for Alternatives selection should be described in sufficient detail in the Proposed Plan so that the public can evaluate and comment on the proposal (EPA 540-R-98-031). The Proposed Plan provides the foundation for the ROD to defer the final technology selection to the remedial design phase. Implied design changes (e.g., through the RD/RA work Plan) or design studies for implementation of the remedy need more discussion within the Proposed Plan. Any associated costs should be included in the Proposed Plan.
- It is unclear if any of the Alternatives were evaluated against the nine balancing criteria based on what happens with transition to Long-term Stewardship prior to completion of remediation under the Record of Decision (e.g., Was a cost benefit analysis of remedy costs including long-term stewardship costs done?) The environmental consequences of doing this action or not doing it have not been evaluated. It is unclear how any of the Alternatives can ensure compliance with the balancing criteria with transition into Long-term Stewardship. These analyses should be done as this action will clearly need to be reflected and integrated into the final ROD.

10. **General Comment on Removal, Treatment, and Disposal at Waste Sites:**

a. Clarify in this section's discussion that RCRA TSD pipelines are to be RTD as this is a comment element to all Alternatives. Clarify if there are pipelines at deeper depths which will not be removed and how they are/were dispositioned.

- The raw water 102" headers (pipes) from the 182-N Building to the 109-N Building need to be removed. These lines are 102" in diameter. In the future, if these pipes remain, they will degrade and collapse creating a long and deep trench; a hazard for the future.

- The radioactive drain lines from the 109-N Building and 105-N Building handled primary water that included fission products. These lines need to be removed. The radioactive drain line near on the east side of the 105-N Building had a

major leak in the 1980s. The soils around the radioactive drain line along the 105-N building must be sampled.

b. Discussion regarding mitigation of culturally sensitive sites is inadequate. See previous comments.

11. **General Comments on Temporary Surface Barriers and Pipeline Void Filling:**

a. Design of surface barriers and discussion of pipeline void fillings should be included in the ROD per EPA guidance and the RCRA permit not within the RDR/RAWP. Include this statement in the Proposed Plan for clarification.

b. Clarify if there are pipelines at deeper depths which will not be removed. Include this information in the Proposed Plan.

12. **General Comments on NEPA**:

a. The relationship of NEPA and NEPA values to related information is not clearly presented. While Table 10-10 identifies the NEPA Values evaluated in relationship to the Alternatives presented, more clarity and discussion in need to clarify that some of the required assessments supporting NEPA values that are not yet made until after the RI/FS is approved.

b. The statement, "NEPA values were incorporated into the assessment conducted as part of the FS" gives the impression that NEPA values were done in the FS, and that is the end of NEPA values. Many of NEPA values are incorporated and enforce implementation of applicable laws and regulations into later phases of the CERCLA documentation process, including the ROD and RD/RAWP. Correct text and provide reference in RI/FS where these applicable laws and regulations are to be discussed and how they will be applied.

13. **General Comments on Future Interim ROD changes:**

a. Future Interim ROD changes**:** Incorrect statement made: "There will be a period of time between when the final action ROD is approved and the required RD/RAWP is prepared and issued. During this period, DOE-RL plans to continue remedial activities, such as waste site RTD. In order for these actions to be consistent with the final action remedy selection, the current interim action RD/RAWPs will be modified using the TPA (Ecology et al., 1989a) change notice process to include the final cleanup levels specified in the final action ROD when it is issued."

- The CERCLA process for changes in cleanup values in a ROD requires, at a minimum, an Explanation of Significant Difference (ESD) and maybe a ROD amendment. The TPA cannot circumvent the required CERCLA process. We expect review opportunities.

14. **Corrective Action:**

a. Text throughout the Section (an elsewhere in document) poorly communicates closure requirements for RCRA TSD units and the proper integration of corrective action for past practice units. Corrective action (WAC-173-303-64620) is for past practice units and not for Treatment, Storage, and Disposal units (TSDs). TSDs use WAC 173-303-610 for closure not corrective action (-64620).

b. Rewrite text to more clearly state 1) closure plans for TSDs are necessary for integration. This authority comes from the Site-wide permit not the RI/FS, and 2) the intent of the Tri Parties' CERCLA remediation at the Hanford Site is to fulfill the ~~corrective action requirements at the Site for past practice units remediated under~~ CERCLA authority. Include citation referencing Sitewide Permit II.Y.1 corrective regulatory citations in text discussions.

Attachment #2:

Washington State Department of Ecology Nuclear Waste Program, Cleanup Section/ER Project Comments on the Draft Remedial Investigation/Feasibility Study for the 100-NR-1 and 100-NR-2 Operable Units (DOE/RL-2012-15, Draft A:

Item 1 General	**Comment:** The conceptual model for TPH-D in groundwater is inaccurate and groundwater modeling has used unacceptable mixing assumptions to determine compliance at the groundwater/river interface. By using two modeling domains, the modeling appears to use mixing of river water inland to show results at the river interface that are lower than what near shore wells currently show. Several comments address details related to this overall concern, including: 2, 190, 195, 206, 272, 301, & 341. **Basis/Justification:** Conceptual site model and modeling results do not match current groundwater concentration values at the river and within the plume area inland. TPH-D restoration timeframe at the river interface is listed as zero years (see Fig. 5-19, 5-36, and Table 10-8), even though 2012 Groundwater data shows concentrations exceeding 500µg/L at near shore wells. Regulations do not allow a mixing zone to demonstrate compliance with surface water cleanup levels. [WAC 173-340-720(8)(d)(i)(C)]	Rework conceptual site model. Rerun groundwater modeling for TPH or consider inland modeling domain output to be concentrations for compliance purposes. Maximum, rather than average, concentrations should be used as model input to provide for bounding conditions of the amplitude of the plumes as well as the horizontal footprint.

Item 2 General	**Comment:** Groundwater modeling for all COCs has used unacceptable mixing assumptions to determine compliance at the groundwater/river interface. By using two modeling domains, the modeling appears to use mixing of river water inland to show results at the river interface that are lower than what near shore wells currently show. Comment #1 is related. **Basis/Justification:** Regulations do not allow a mixing zone to demonstrate compliance with surface water cleanup levels. [WAC 173-340-720(8)(d)(i)(C)]	Rework conceptual site model. Rerun groundwater modeling for Sr-90 and nitrate. Alternatively, consider inland modeling domain output to be concentrations for compliance purposes. Maximum, rather than average, concentrations should be used as model input to provide for bounding conditions of the amplitude of the plumes as well as the horizontal footprint.
Item 3	**Comment:** No Sr-90 PRG value is given for the protection of groundwater from soil leaching. A concentration value is given for Sr-90 for the groundwater protection RAG from DOE/RL-96-17. This concentration value (28 pCi/g) should be adopted as the value used in Table 8-3 and the proposed plan that addresses ongoing strontium-90 going from the vadose zone into the groundwater. Comment 170 is related. **Basis/Justification:** Ongoing vadose zone contamination of Sr-90 is widespread and will continue to leach into the groundwater until it is depleted. No values are given that addresses this ongoing occurrence for groundwater protectiveness from soil leaching.	Provide throughout the document the groundwater protectiveness as provided in Table 8-3 for DOE/RL-96-17 for groundwater protection in the text and on figures and tables, as appropriate, for the reader to understand.

Item 4 General	**Comment:** The remedial alternatives descriptions call the nitrate remedy for Alternatives #2 & #3 groundwater monitoring rather than monitored natural attenuation (MNA). The differences between groundwater monitoring and MNA should be described. If the remedy is MNA, attenuation mechanism should be thoroughly described. There is no case made for reduction of nitrate being a strong attenuation mechanism. If diffusion/dispersion is the only mechanism it should be thoroughly described. Comments 88, 296, & 312 are related. **Basis/Justification:** The National Remedy Review board made the recommendation that future "decision documents should identify mechanisms of natural attenuation for all contaminants for which MNA is being selected. These mechanisms, which may be different under different conditions, should be identified for the range of hydrologic and geochemical settings encountered..." This level of detail on attenuation mechanisms should be included in the RI/FS. Amy R. Legare, "National Remedy Review Board Recommendations for the 100-K, 200-UP-1, and 300 Areas of the Hanford Superfund Site", memo, June 26, 2012.	Explain intention of nitrate remedy for Alternatives #2 & #3, pointing out similarities/differences between groundwater monitoring and MNA. Add text describing attenuation mechanisms for nitrate.

Item 5	**Comment:** Phytotechnology involving both phytoextraction (to the contaminants absorbed in the soil, etc.) and rhizofiltration (to the dissolved portion of Sr-90 from the groundwater) using Coyote Willows should be a retained technology for Sr-90. **Basis/Justification:** Phytotechnology is a viable technology that can be applied very effectively. Justification for not retaining in Section 8.5.3.1 is not based on actual field data/observation and some of the statements are exaggerated (e.g. intensive to manage) without proper studies/background. Study shows that the food chain transfer and the Sr-90 in the leaf and the roots are at a level significantly low enough to not cause any harm to the human health and the environment and these sources can be managed easily (U.S. Department of Energy. *100-N Area Strontium-90 Treatability Demonstration Project: Phytoextraction Along the 100-N Columbia River Riparian Zone – Field Treatability Study*. By R.J. Fellows et al. (January 2010)). Phytotechnology will address both the aquifer and the dissolved portion of the Sr-90 in the riparian zone. Modeling shows that one could achieve MCL at the river within 50 years or possibly much less using phytotechnology. Section 5.3 of the *Hanford Site Groundwater* Strategy (DOE/RL-2002-59) lists as a key strategy element to "place a high priority on actions that protect the Columbia River and near-shore environment from degradation caused by the inflow of contaminated groundwater." Phytoextraction may significantly decrease the time to achieve standards for groundwater entering the Columbia River. To adequately perform a cost/benefit analysis for phytoremediation, the potential remedial timeframe should be thoroughly described. This also addresses the stated TPA goal (M-	Phytotechnology (both phytoextraction and rhizofiltration) should be retained and evaluated to treat Sr-90. Perform a full analysis of potential implementation. Include the following in the analysis: 1. Determine area requiring cover (length along the river and planting strip width). 2. Determine availability for biological consumption, and associated risk. 3. Discuss basis for management strategy or describe testing required to determine strategy, including whether plants require annual maintenance, what exclusionary fencing would be required to minimize damage by mammals, determining if harvested biomass would require handling as hazardous/radioactive waste, etc. 4. Calculate effective time period required. 5. Perform a detailed cost/benefit analysis. All retained technologies should have associated bulleted lists, tables, figures, and text updated.

Item 6	**Comment:** The RI/FS Document failed to analyze a number of alternatives that could be applied to meet remedial action objectives cost effectively. The following detailed analyses needs to be incorporated for proper evaluation and decision making: • Alternative analysis using phytotechnology involving both phytoextraction and rhizofiltration using Coyote Willows. • Alternative analysis using both phytoremediation in the riparian zone using for a length of about 400 feet and apatite barrier with the following two options i. Expanded apatite barrier thickness in both sides ii. Expanded apatite barrier only towards the river with alternate delivery systems (e.g. horizontal drilling, inclined borehole, etc.) iii. Hot spot treatment of Sr. 90 in the inland portion of the plume **Basis/Justification:** Phytotechnology is viable technology that can be applied very effectively (see Comment 5). New development shows that horizontal/inclined drilling can be used to inject necessary fluids, etc. to expand the barrier in both directions.	Expand alternatives analysis to include phytotechnology and alternate apatite treatments as described in comment.

Item 7 General	**General Comment** on the modeling, fate and transport: The following issues need to be addressed and be incorporated in ANY alternative evaluation to remediate the groundwater: • Carry out necessary modeling and /or sensitivity analysis to have a clear understanding using following scenarios: i) Scenarios using low, average and high Kds of Sr-90 ii) Scenarios with low average and high saturated conductivities (Ks) iii) Uncertainty analysis and the significance of uncertainty associated with the parameter and model uncertainties iv) Predictive analysis with expanded barrier concept outlined in Comment #6 **Basis/Justification:** Studies show significant variation of the Kd and Ks and other associated important input parameter will impact the results of the modeling significantly which will affect costs of various remedial alternatives.	Carry out modeling and/or sensitivity analysis as outlined.

Item 8 General	**Comment:** The testing requirements for natural attenuation should apply to Bioventing and Biosparging also. **Basis/Justification:** Section 11.4.2 and 11.4.3 of Ecology guidance (Pete Kmet, *Guidance for Remediation of Petroleum Contaminated Sites*, Ecology Publication 10-09-057, October 2011) also lists these characteristics and more for remedy selection. *Bioremediation Well Borehole Soil Sampling and Data Analysis Summary Report for the 100-N Area Bioremediation Project* (UPR-100-N-17), September 2009, WCH-370 Rev0.	Add text describing methodology, field testing and analytical testing requirements for monitoring the attenuation mechanism for Biosparging and Bioventing.
Item 9 General	**Comment:** There are numerous discrepancies in the number of waste sites that were used as a basis in this RI/FS. • P 2-3 bulleted list of 10-WSRFs • P 4-7 L37 states 32 waste sites were remediated and interim closed out. Why not list all of these on Page 2-3? • P 5-1 Highlighted section states 38 waste sites remediated • P 5-2 L 15 calls out 32 waste sites • P 6-18 Table 6-8 actually lists 34 waste sites by name, but the number as totaled shows 33. • P 7-5 L 15 states there are 24 waste sites	Provide a clear and concise number of waste sites in a Table and use the number consistently.

Item 10 General	**Comment:** The text throughout the document is contradictory in respects to the 120-N-1, 120-N-2, and 100-N-58. Bullets below point out specific locations: • Section 1.3.2.4, Page 1-20, Lines 28-29 state that the 120-N-1 and 120-N-2 are unlined ponds that were replaced by 100-N-58. • Section 1.3.2.4, Page 1-24, Line 4 states that "In 1986 two ponds were replaced by a lined pond (120-N-2)". • Section 1.3.2.6, Page 1-27, Line 45 relays 120-N-2 as being the double lined pond. • Section 4.3.5, Page 4-75, Lines 5-7 speak about 120-N1 and 100-N-58 being unlined ponds.	Provide review of the 3 waste sites and correct text accordingly.
Item 11 P: xxi S: ES Fig. ES-3	**Comment:** Figure ES-3. "100-NR-2 OU Commingled Strontium-90 and Nitrate Groundwater Plumes, 2011" has a hatched line that extends along the shoreline then crosses onto the site. This marking is not shown on the legend.	Please provide a legend item explaining this hatched line.
Item 12 P: 1-14 S: Table 1-2	**Comment:** The abbreviations for MW and LWDF are not defined as others are in the bottom of the table.	Provide abbreviations with definitions.
Item 13 P: 1-16 Fig. 1-8	**Comment:** In the text 116-N-1, 116-N-3, 116-N-2, 1314-N Liquid Waste Storage/Disposal Facility are used, but they are not identified on this map. Please provide these facilities. If two numerical numbers exists, then include both or provide a table that cross-references these facilities with one another. **Basis/Justification:** Reader has no information where these facilities are that are discussed in the text compared to the figure provided.	Provide where these facilities are in comparison to Figure 1-8 and the text discussions on pages 1-17 through 1-20. Please use both facility and waste site numbers throughout chapter 1 to limit confusion.

Item 14 P: 1-17 S: 1.3.2.3 L: 24-30:	**Comment:** Based on the information presented, the 100-N-63 waste site, 116-N-2, 1314-N Loadout Facility, 116-N-1 and 116-N-3 should all be recognized as having "mixed waste" that went through these facilities. As written, it reads that certain facilities had radioactive waste and others had mixed waste. **Basis/Justification:** Clarity that mixed waste, both radioactive and chemical waste, was stored or treated at these facilities.	Add "mixed waste" where radioactive effluent or where "effluent" is discussed.
Item 15 P: 1-19 S: 1.3.2.3 L: 32-38	**Comment:** Please provide the reduction in Cs-137 going to 116-N-3 from the recirculating cooling water treatment system. **Basis/Justification:** Completeness and more information for processing	See comment.
Item 16 P: 1-20 & 1-21 S: 1.3.2.4 L: 40-24	**Comment:** For 166-N Tank Farm, provide a discussion that Figure 1-10 represents petroleum concentrations in the unconfined aquifer. No discussion is provided that extremely high concentrations of total petroleum hydrocarbons – diesel exist in groundwater. **Basis/Justification:** Even at a summary level, discussion of the contamination to groundwater from past releases is needed to understand the magnitude associated at 100-N facilities.	Include in this location a discussion of petroleum in groundwater and reference Figure 1-10.
Item 17 P: 1-21 S: 1.3.2.4 L: 11	**Comment:** Text states that "other smaller petroleum releases...and each has been identified and tracked as a waste site." The "each has been identified and tracked" is misleading. **Basis/Justification**: Since petroleum discovery is an on-going process during remediation I would assert that not all of it has been identified.	Combine this sentence with the one following to read: "Other petroleum releases have occurred at 100-N that were associated with leaks in pipelines and operational errors..."
Item 18 P: 1-23 S: 1.3.2.4 Fig. 1-10	**Comment:** Figure 1-10 is out of place.	Please move Figure 1-10 to page 1-53 where it is called out.

Item 19 P: 1-24 S: 1.3.2.4 L: 7-9	**Comment:** Explain what is meant by "exceeded NPDES discharge limits". It is unclear whether this term relates to concentration limits or flow limits.	Clarify what NPDES discharge limits were being exceeded.
Item 20 P: 1-25 S: 1.3.2.5 L: 10	**Comment:** Radioactive spacers are introduced without a proper description.	Please provide description of the spacers.
Item 21 S: 1.3.2.6	**Comment:** Please provide the status of these four RCRA facilities. Please address whether they are a closure unit, operating unit or post-closure unit. From the discussion, 1324-NA (120-N-1) and 1324-N (120-N-2) are post-closure units. **Basis/Justification:** (WA7890008967, 2010, Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste, as amended, Washington State Department of Ecology, Richland, Washington. Available at: http://pdw.hanford.gov/arpir.)	Please state that all 4 units are in the closing section of the sitewide permit.
Item 22 P: 1-26 S: 1.3.2.6 L: 16	**Comment:** The reference to 100-N-58 seems irrelevant to the topic. Although collocated with the future RCRA TSD, 100-N-58 was not part of the TSD unit.	Delete reference to 100-N-58. Or provide a segue from the RCRA TSDs to the CERCLA closeout of the 100-N-58.
Item 23 P: 1-27 S: 1.3.2.6 L: 22-25	**Comment:** Text states in error that 116-N-1 (1301-N) waste site met interim action RAGs. The next line describes the ESD which was required to interim close 116-N-1 specifically because it did <u>not</u> meet interim RAGs.	Modify text to state that interim action RAGs were not met at 116-N-1.
Item 24 P: 1-27 S: 1.3.2.6 L: 30	**Comment:** The text erroneously lists 116-N-2 instead of 116-N-3. Please edit the sentence as shown.	"...protection. Waste sites 116-N-1 and ~~116-N-2~~ <u>116-N-3</u> were both classified as "interim closed out" ..."

Item 25 P: 1-28 S:1.3.3 L: 22 & 38	**Comment:** Text on Line 22 calls the 100-N-1 a settling pond while Line 38 calls it a settling basin.	Choose one title and use consistently.
Item 26 P: 1-29 & 30 S: 1.3.4.1 L: 39-41	**Comment:** Modify the text on "Limited Field Investigations" to clearly describe that there were two separate LFIs performed on 100-NR-1 waste sites. Provide the names, numbers and any other identification information for the seven high priority waste sites. Clarify that the LWDFs were investigated under a separate LFI than the other 100-NR-1 waste sites. **Basis/Justification:** Nowhere is the actual 7 waste sites provided in this section.	Modify text in the "Limited Field Investigations" section to clearly describe the 2 separate soil LFIs.
Item 27 P: 1-30 S: 1.3.4.1 L: 38	**Comment:** The whole paragraph speaks to the Sr-90 Kd and groundwater in a section designed for the vadose zone.	Recommend moving the paragraph under 1.3.4.2 "Groundwater Investigations".
Item 28 S: 1.3.4.2	**Comment:** More discussion is required for this section. Information is not provided to make the discussion meaningful. No real findings are provided. **Basis/Justification:** More information is needed so the reader can understand the purpose of the investigation.	Provide more information in this section on all groundwater investigations or a pointer to the section where more discussion is provided.
Item 29 P: 1-31 S: 1.3.4.2 L: 4-9	**Comment:** Both DOE O 5400.1 and 5400.5 have been replaced. The new DOE Orders are: DOE O 450.1A for 5400.1 that was approved in 2008 and 458.1 Chg. 2 for 5400.5 that was approved on 6/6/2011. **Basis/Justification**: Wrong DOE Order is cited. These orders are archived and are no longer current.	Modify this section to include the correct DOE O numbers and correct the reference section accordingly.

Item 30 P: 1-32 S: 1.3.4.2 L: 9-15	**Comment:** Provide for comparison where the water table elevation for the unconfined aquifer along the river shoreline is in relation to the 113 m. In addition, amsl (above mean sea level) is needed after the 113 m. **Basis/Justification:** The groundwater elevation is needed along the river shoreline for context to the aquifer along the river shoreline. Anytime an elevation is provided above mean sea level (amsl) is required after the measurement.	See comment and basis/justification.
Item 31 P: 1-34 S: 1.3.4.4 L: 2	**Comment:** text talks about "nonoperational" areas without describing what a nonoperational area consists of.	Provide definition.
Item 32 P: 1-35 S: 1.3.4.4 L: 4-8	**Comment:** Provide a listing of the 23 new waste sites for completeness and show them on Figure 1-13. **Basis/Justification:** Clarity of discussion.	See comment.
Item 33 P: 1-38 S: 1.3.5.1 L: 5-11	**Comment:** It is unclear which facilities are being discussed. The 1324-N and 1324-NA facilities are not listed in Figure 1-7 (assumedly because they are listed on a separate table by their waste site numbers 120-N-2 and 120-N-1). **Basis/Justification:** Facilities are missing from the table that summarizes facility status.	Clarify that facilities listed in text and Figure 1-7 are those that have been included in the Action Memorandum for 100 N Area Ancillary Facilities (1998).

Item 34 P: 1-38/9 S: 1.3.5.1 L: 11-4	**Comment:** Text is confusing; it states that waste sites beneath the reactor will be remediated through the NEPA process, but then goes on to state that any contaminated soil beneath the reactor will be remediated in accordance with the CERCLA ROD. Executive Summary p. vi also has language related to this subject. In addition, Table 1-8 footnote c states that the 100-N-66 will be addressed through the NEPA process. **Basis/Justification:** Clarity is required.	Clarify if the N reactor and 100-N-66 (and any other contamination found beneath the ISS structure) will be dealt with under a future NEPA decision, under the proposed ROD, or elsewhere. Cite TPA milestone M-93-00 as requiring final completion of final disposition of all 100 Area Surplus Production Reactors.
Item 35 P: 1-44 S: 1.3.5.2 Table 1-9	**Comment:** Table 1-9 lists UPR-100-N-42 as a no action site. This is incorrect. **Basis/Justification:** The draft Waste Site Reclassification Form (WSRF) has not been approved. The draft WSRF proposed "interim closure" and not "no action". A recent agreement (7-16-2013) with DOE places the UPR-100-N-42 as needing further characterization and possible remedial action.	Change the status of UPR-100-N-42 to "Accepted", which is the status as of 8/15/2013.
Item 36 P: 1-44 S: 1.3.5.2 L: 1	**Comment:** Please change the call-out from Table 1-10 to Table 1-9. **Basis/Justification:** Table 1-9 seems more appropriate here.	Change text to "In addition to the waste sites listed in Table ~~1-10~~ 1-9, the 100-N Interim Action ROD..."
Item 37 P: 1-45 Table 1-10	**Comment:** Table 1-10 does not belong to the section it is currently placed in.	Please move Table 1-10 to an appropriate location like page 1-53.

Item 38 P: 1-49 S: 1.3.5.3 L: 9-10	**Comment:** Remove the sentence "Figure 1-21 illustrates the pump and treat impact on groundwater strontium-90 concentrations at the riverbank." No impact is indicated at all. This figure (1-21) is simply the pump and treat well system. It does not even represent the capture zone as stated in the caption for the figure. No extraction wells exist at the river to capture strontium-90 contamination. **Basis/Justification:** Figure does not support the sentence.	Remove sentence, update figure, or both.
Item 39 P: 1-52 S: 1.3.5. L: 3	**Comment:** The TPH wells are noted here without any context to apatite injection.	Either explain how the apatite and TPH intertwine or remove the "and downstream from the TPH wells."
Item 40 P: 1-57 S: 1.3.7.3 L: 9-11	**Comment:** In the third Five-Year CERCLA Review in 2011, issue 1 and Action 1.1 refer to the permeable reactive barrier at 100-N. Add this discussion here in the document. **Basis/Justification:** Issue 1 addresses 100-N apatite permeable reactive barrier.	Include discussion of 2012 Five-Year Review Issue 1 and Action 1.1.
Item 41 P: 2-16 S: 2.1.4.1 Fig. 2-2	**Comment:** Only 7 of the 8 yellow borehole icons can easily be seen, while the others are hard to see. It appears as though 2 overlap.	Recommend using another color such as red for the icon for easier viewing.
Item 42 P: 2-24 S: 2.1.7.1 Fig. 2-4	**Comment:** The legend of Figure 2-4 denotes "polygons" that the text does not explain or describe.	Please provide a description in the text for what a "polygon" is or remove.
Item 43 P: 2-25 S: 2.1.7.1 L: 11 & 14	**Comment:** Text refers to Table 2-6 in error for both surface water and sediment samples. Table 2-6 does not present analytes. **Basis/Justification:** The correct reference should be Table 2-5.	Correct table to read Table 2-5.

Item 44 P: 3-1 S: 3.1 L: 35-41	**Comment:** An elevation difference of 82 ft amsl is not considered a "relatively flat plain", especially with the words previously describing this plain as "broad, slightly undulating plain". Please either describe it as undulating and simply state that the reactor and all ancillary facilities are located on this broad plain. **Basis/Justification:** Elevation change of 82 ft amsl is not "flat".	Change the last sentence to state, "The reactor and all ancillary facilities are located on this broad, slightly undulating ~~relatively flat~~ plain."
Item 45 P: 3-3 S: 3.1 L: 24-25	**Comment:** Provide the elevation level values for this "abandoned channel" in comparison to the current river channel for the reader to understand this difference rather than "much higher". **Basis/Justification:** This abandoned river channel is important to the conceptual site model and the groundwater flow and transport modeling.	See comment.
Item 46 P: 3-3 S: 3.1 L: 26-29	**Comment:** Provide the difference in the meaning of "infrastructure drainage" and "infrastructure features". Provide whether these are man-made or natural. Discuss how the "landscape supports occasional small wetland-like features" **Basis/Justification:** It is unclear what is meant by certain terms and these terms appear synonymous at times.	See comment.
Item 47 P: 3-32 Table 3-4	**Comment:** Provide additional information on the various acronyms used in Table 3-4. Provide what "KGS" means. **Basis/Justification:** Acronym not defined.	Define KGS. Include the footnote from Table 3-10 on the Kansas Geological Survey model.

Item 48 P: 3-33 S: 3.4.2.1 L: 2-5	**Comment:** Discuss why Slug test calculations have been based on the Kansas Geological Survey ("Slug tests in partially penetrating wells" [Hyder et al., 1994]) method. **Basis/Justification:** Blanket statement with no supporting discussion provides no information to why this method is better than another method.	Provide why the slug test calculations used Kansas Geological Survey method.
Item 49 P: 3-35 Fig. 3-21	**Comment:** Wells 199-N-91A, 199-N-97A, 199-N-95A and 199-N-93A do not have a well screen indicated on the cross-section. Please provide the well screen as is done with the other wells. **Basis/Justification:** For well 199-N-91A, no well screen makes it difficult to know in what formation the well is screened and where the water table is in association with it.	Provide the well screen for all wells.
Item 50 P: 3-35 Fig. 3-21	**Comment:** The water level is for 2010. Please change and make consistent with other cross-sections for 2012. Comments 50, 51, 52, and 53 are related. **Basis/Justification:** Water levels should be consistent for all maps to compare. Since most of the cross-sections have 2012 measurements and that data is available, use 2012 water level elevations.	Provide the water level elevations for this cross-section for the year 2012 for consistency.
Item 51 P: 3-38 Fig. 3-24	**Comment:** Provide the high river stage and low river stage for 2012 to compare to the water table for Spring 2012. Comments 50, 51, 52, and 53 are related. **Basis/Justification:** Comparing water table highs and lows to another year is meaningless. For consistency and appropriate representation, the same year is needed. Use year 2012.	See comment.

Item 52 P: 3-39 Fig. 3-25	**Comment:** The water levels are for 2010. Please change and make consistent with other cross-sections for 2012. Comments 50, 51, 52, and 53 are related. **Basis/Justification:** Water levels should be consistent for all maps to compare. Since most of the cross-sections have 2012 measurements and that data is available, use 2012 water level elevations.	Provide the water level elevations for this cross-section for the year 2012 for consistency.
Item 53 P: 3-40 Fig. 3-26	**Comment:** The river stage water levels are for 2010. The water level elevation is for Spring 2011. Please change and make consistent with other cross-sections for 2012. Provide the high river stage, low river stage and the spring level for 2012 data. Comments 50, 51, 52, and 53 are related. **Basis/Justification:** Water levels should be consistent for all maps to compare. Since most of the cross-sections have 2012 measurements and that data is available, use 2012 water level elevations.	Provide the water level elevations for this cross-section for the year 2012 for consistency. Provide high-river stage, low river stage and spring level.
Item 54 P: 3-42 S: 3.4.3.4 L: 2-4	**Comment:** "This unit forms an aquitard within the suprabasalt sedimentary sequence that confines the deeper unit A and basalt confined aquifers within the Columbia River Basalt Group." In the previous section, it states Unit A is overlain by Rlm. Here it states the other way around – Rlm is the bottom unit and Rwia is above it.	Please change this sentence or the one in the previous section to make them consistent.

Item 55 P: 3-42 S: 3.4.3.6 L: 21-23	**Comment:** "The RUM is an informal local name assigned to the first significant fine-grained unit encountered immediately beneath the deepest coarse grained deposits." This sentence indicates that the RUM is the lowest fine-grained unit, not the first encountered fine-grained unit in the Ringold Fm. This is inaccurate. **Basis/Justification:** This sentence indicates that the RUM is found "beneath the deepest coarse-grained deposits." This deposit would be Ringold Formation Unit A member, not Ringold Fm. Unit E member.	Change the sentence to read, "The RUM is an informal local name assigned to the first significant fine-grained unit encountered immediately beneath the unconfined aquifer ~~deepest coarse grained deposits~~."
Item 56 P: 3-59 S: 3.5.3 Table 3-7	**Comment:** The sieve sizes presented in Table 3-7 seem out of alignment with one another. Sizes go down from 3", 1.5", to 34". **Basis/Justification:** Was the 34" supposed to ¾"?	Please review and correct.
Item 57 P: 3-67 S: 3.6 L: 1	**Comment:** The waste disposed states "hazardous or radiological liquid waste". Some of this waste was mixed waste, both hazardous and radiological. Add "or mixed liquid waste". **Basis/Justification:** Mixed waste was received to the ground at numerous times from 1987 to 1991. Mixed waste needs to be added.	Change text: "volumes of hazardous, ~~or~~ radiological, or mixed liquid waste to the ground"
Item 58 P: 3-67 S: 3.6.1.1 L: 26-28	**Comment:** Three sentences are combined into one. Divide this sentence into separate sentences for clarity. **Basis/Justification:** Three separate thoughts occur for this one sentence. Divide it into three sentences for clarity.	Divide sentence to read, "The RUM (aquitard) underlies the entire area. It is a thick, relatively low transmissivity unit. The RUM forms the base of the unconfined aquifer."

Item 59 P: 3-68 S: 3.6.1.1 L: 10	**Comment:** SGW-47786 needs to be placed in the TPA AR. This document provides the basis for the vadose zone and groundwater modeling conducted for this RI/FS and needs to be accessible by the public and the regulatory agencies.	Provide SGW-47786 and place it on the TPA AR.
Item 60 P: 3-69 S: 3.6.1.1 L: 21-36	**Comment:** Here and elsewhere in the document, the Rwie is referred to as "gravelly sediment". In geologic terms, this has no meaning. **Basis/Justification:** Geologic term "sediment" and regulatory term "sediment" have different meanings. Sediment as a geologic term serves no purpose in this section. This section should be describing the Hydrostratigraphic Units and "sediment" does not provide this description.	Please specify whether it is a gravelly sand, gravelly silt, or gravelly clay. Please be specific in your description.
Item 61 P: 3-72 Fig. 3-36	**Comment:** The text states 100-K pump and treat has influenced the water table; however, it appears a radial low and high existed in 2009. The low got bigger in 2010 down in the southern portion of 100-N. These data were taken in March, before the pump and treat had any influence. **Basis/Justification:** Water table lows and highs do not match discussion in the text on page 3-71 lines 11 through 15.	Please discuss this radial low in the southern portion of 100-N more and provide the hydrostratigaphy information in this section that discusses this phenomenon.
Item 62 P: 3-74 S: 3.6.1.3 L: 4-6	**Comment:** Remove the term "former" from all the sites referenced. These sites are still referred to as 1301-N LWDF, 1325-N LWDF and 1324-NA percolation pond. This is how they are in the Dangerous Waste Permit for Hanford. 120-N-1 and 116-N-1 are simply waste site codes from WIDS. **Basis/Justification:** These sites are still referred to as 1301-N, 1325-N and 1324-NA in the Hanford Federal Facility Dangerous Waste Permit and this designation needs to be included..	Change all references to one designation with the other designation in parenthesis. For example 116-N-1 (1301-N).

Item 63 P: 3-77 S: 3.7.6.1 L: 7-9	**Comment:** The anions are missing their associated charges. **Basis/Justification:** The cations do have their associated charges listed.	Either add the charges for the anions or delete the charges associated with the cations.
Item 64 P: 3-79 Fig. 3-41	**Comment:** For the letters on the Piper diagram, please make them more readable. Currently it is hard to see what the letters are. Familiarity is needed with how the information is plotted to understand which letter is which. **Basis/Justification:** Cannot read letters on the Piper diagram.	See comment.
Item 65 P: 4-4 S: 4.1 Table 4-2	**Comment:** Cyanide, fluoride, uranium, strontium-90 and tritium have not been identified as being unfiltered, or filtered. Please provide the sample type information for these constituents.	List if the data for cyanide, fluoride, uranium, strontium-90 and tritium were of unfiltered or filtered samples.
Item 66 P: 4-7 S: 4.3.1 L: 38	**Comment:** Line 38 text & Table 4-4 infer that all waste sites listed have CVPs as closure documents. This is incorrect. **Basis/Justification:** Most of the sites listed used a "Remaining Sites Verification Package as part of their closure documentation.	Recommend changing the "CVP" term to "closure documents".
Item 67 P: 4-39 S: 4.3.2.3	**Comment:** Provide the concentrations range for plutonium isotopes and discuss the zones that exceed concentrations protective of groundwater and direct contact. Provide a map showing the concentration values for plutonium-238 and plutonium-239/240. **Basis/Justification:** Required by the regulations.	Provide a comparison of soil concentration values that are protective of groundwater and direct contact to the maximum soil concentration values from the RI boreholes.

Item 68 P: 4-43 Table 4-13	**Comment:** Plutonium-238 and -239/240 are at 57 to 60 ft. bgs at this facility, yet no value was calculated in the RDR/RAWP (DOE/RL-2005-93) for plutonium-238 and -239/240. No value was provided in Table 8-3 of this RI/FS for a proposed PRG for Plutionium-238 or -239/240. **Basis/Justification:** Conceptual site model is no longer valid for waste sites 116-N-1 and 116-N-3 and needs to be re-evaluated.	Provide the value for Plutonium-238 and -239/240 needed for soil concentrations to be protective of groundwater/surface water.
Item 69 P: 4-45 & 4-47 Fig. 4-15 & 4-16	**Comment:** Provide a vertical line that shows the value 27.6 pCi/g for the Sr-90 on the graph. In the text for this borehole, discuss the fact that in this borehole, Sr-90 in the soil column extends into the groundwater at values exceeding 27.6 pCi/g. **Basis/Justification:** Data shows that at depth, Sr-90 is a contributing source to groundwater. The water table in this area is only 72.6 ft bgs.	See comment.
Item 70 P: 4-64 S: 4.3	**Comment:** For all of Section 4.3, provide a comparison of whether the concentration levels in the RI boreholes exceed the Interim Action cleanup values provided in the N Area RDR/RAWP. As written, it is difficult to determine if Sr-90, cobalt-60, plutonium-238/plutonium-230-240/uranium-235 and americium-241 exceed these values under 116-N-1, and 116-N-3 and the other waste sites for Sr-90 and cobalt-60. **Basis/Justification:** CERCLA requirements of whether more cleanup is required to meet direct contact and protection of groundwater	Provide a column on the tables or a new table that provides the maximum value and compares to the cleanup value established in the interim action RDR/RAWPs.

Item 71 P: 4-62 S: 4.3.3.2	**Comment:** Sr-90 concentrations exceed the soil concentration values for soil that is protective of groundwater in borehole C8190 below the water table. Provide a discussion of this fact in the text and on figure 4-23 provide a vertical line showing the 27.6 pCi/g concentration line, similar to the background 90th percentile line. **Basis/Justification:** Interpretation of data is needed to aid in the decision for the remedy and to classify the nature and extent that the contaminant exceeds cleanup standards based on the interim action RDR/RAWP.	See comment.
Item 72 P: 4-97 Table 4-27	**Comment:** Based on the soil results for the shoreline, please add uranium-235 (see p. 4-90) to the radionuclides and uranium as a chemical to the metals list for analyses. Also, add TPH-gasoline range. **Basis/Justification:** These constituents have been detected above background concentration and action level concentrations that warrant them being carried forward in the FS.	Add uranium-235 and TPH-gasoline range to Table 4-27.
Item 73 P: 4-105 Tables 4-29 - 4-38	**Comment:** Please provide what the dash '—' represents in the footnotes. **Basis/Justification:** Clarity.	
Item 74 P: 4-131 S: 4.4.2.1 L: 10	**Comment:** Discussion is about ethylbenzene, but the comparison to action levels is to tetrachloroethene. Please change to ethylbenzene and the correct action level of 4 µg/L for it. **Basis/Justification:** Wrong analyte being referenced.	

Item 75 P: 4-131 S: 4.4.2.1 L: 13-25	**Comment:** For 100-N, please state whether plutonium-238, -239/240, cobalt-60, and technetium-99 were detected in groundwater samples. **Basis/Justification:** High soil concentrations exist in the area around 116-N-1 and 116-N-3 and needs to be discussed.	
Item 76 P: 4-133 – 4-134 S: 4.4.2.2 General	**Comment:** Arsenic was released near the apatite barrier very close to the river, yielding groundwater concentrations that were above both the MCL and AWQC. Some high levels appeared in aquifer tubes. Other metals were also mobilized to concentrations above risk-based levels and/or MCLs during roughly the same time period, and were present in samples from the same aquifer tubes: lead, manganese, silver and vanadium. **Basis/Justification:** The following concentrations of arsenic were present in aquifer tubes: ATP-1 360 µg/L 6/29/2007 filtered APT-2 270 µg/L 6/16/2007 filtered APT-5 59 µg/L 11/14/2007 filtered	Considering that the apatite barrier will be expanded, add discussion in the document about how similar arsenic and other metal concentration excursions in groundwater will or will not be prevented in the future.
Item 77 P: 4-161 S: 4.4.2.5 L: 26-32	**Comment:** For plutonium and other alpha emitters, 15 pCi/L is not the standard. One must show the cumulative alpha emitter is less than 15 pCi/L. Please evaluate for all alpha emitters for their cumulative effect. Provide the wells that plutonium-239/240 were detected for completeness. **Basis/Justification:** Wrong use of the DWS is being applied for alpha emitters.	Reevaluate using a cumulative approach. Please provide the wells that plutonium-239/240 were detected.
Item 78 P: 4-168 S: 4.4.2.5 L: 16	**Comment:** Arsenic is not retained as a COPC, yet there are exceedances above background.	in why arsenic is not retained as a COPC.

Item 79 P: 4-176 S: 4.4.2.7 Table 4-39	**Comment:** Gross beta is not shown in the table. Please add gross beta in the table, where appropriate. Gross beta was detected at numerous wells and discussed in the previous sections but is not shown in this table. **Basis/Justification:** Gross beta does not fit into any of the categories on the table.	Please add gross beta to the table.
Item 80 P: 4-195 Table 4-46	**Comment:** Well 199-N-182 is not located on Figure 4-1, 4-2 or any other figure in Chapter 4. **Basis/Justification:** An important well pair to 199-N-184 is not being shown on the table.	Please include well 199-N-182 on Figure 4-1 and the appropriate associated waste site figure.
Item 81 P: 4-203 S: 4.4.3.1 L: 19	**Comment:** Text states the TPH diesel is associated with 116-N tank farm. This is incorrect. **Basis/Justification:** The correct association is 166-N.	Please correct.
Item 82 P: 4-204 S: 4.4.3.1 L: 20	**Comment:** The text refers to 16-N-1. **Basis/Justification:** The correct call out should be 116-N-1.	Please correct.
Item 83 P: 4-205 S: 4.4.3.2 L: 22+	**Comment:** Text speaks to the continuous Sr-90 exceedances (290+ pCi/L) up river of the main plume in aquifer tubes 7934, 7935, and 7936, yet the RI/FS does not provide direction on whether or not this area of high Sr-90 will be addressed. **Basis/Justification:** Overall the document relays that the Sr-90 at the river interface will be treated.	Describe what, if any, are the proposed actions to mitigate the Sr-90 at this portion of the river interface.
Item 84 P: 4-207 S: 4.4.3.2 L: 25-26	**Comment:** The referenced table should be 4-54, not 4-51. **Basis/Justification:** Incorrect table reference. Table 4-54 provides the plume size.	Please reference Table 4-54.

Item 85 P: 4-210 Fig. 4-42	**Comment:** Depth as feet bgs is nice, but cannot be correlated to changes in elevation amsl to recognize trends in plume migration. Comments 85, 87, & 94 are related. **Basis/Justification:** Clarity of Sr-90 plume migration	Please provide the elevations for each of the sample results in addition to the depth below ground surface.
Item 86 P: 4-222 S: 4.4.3.3 L: 15	**Comment:** The text calls the 116-N-3 the "N-3" LWDF **Basis/Justification**: This is not common nomenclature that has been presented in the document.	Please revise and use one nomenclature consistently.
Item 87 P: 4-236 Fig. 4-60	**Comment:** Depth as feet bgs is nice, but cannot be correlated to changes in elevation amsl to recognize trends in plume migration. Comments 85, 87, & 94 are related. **Basis/Justification:** Clarity of nitrate plume migration	Please provide the elevations for each of the sample results in addition to the depth below ground surface.
Item 88 P: 4-239 S: 4.4.3.4 L: 9-10	**Comment:** Text states the nitrate plume appears to have stabilized and references Table 4-54, but no justification has been provided. This comment is related to Comment #4. **Basis/Justification:** This table does not provide a basis or data for comparison to support the plume stabilization statement. Plume stability is a key component of whether MNA can be applied to a COC.	Provide a basis for the statement that the nitrate plume is stable.
Item 89 P: 4-242 S: 4.4.3.4 L: 10	**Comment:** The text states a sample value has been flagged as a "bad value" because it doesn't agree with other depth discrete results. **Basis/Justification:** The "bad value" is not proper flagging (e.g., qualifying) nomenclature. Was the result suspect? Rejected? Estimated? Have a Potential issue?	Please review and provide proper flagging (qualified) nomenclature. If the result was not qualified, remove statement.

Item 90 P. 4-242 L: 30-32	**Comment:** Provide basis for statement that petroleum plume both shrinks and remains within the same historical footprint/flowpath to the river. **Basis/Justification:** Data is limited on petroleum in groundwater. Basis should be provided for this assumption and limitations of data discussed.	Provide basis for petroleum plume stability statement. Discuss any limitations of data. Discuss TPH-D concentration fluctuations over time.
Item 91 P: 4-243 Fig. 4-66	**Comment:** Please explain why well 199-N-183 has the highest tritium concentration compared to wells within the 116-N-1 and 116-N-3 waste sites. **Basis/Justification:** Clarity is needed to explain this phenomenon.	Explain how tritium has migrated downgradient to well N-183 from the waste sites.
Item 92 P: 4-243 Fig. 4-66	**Comment:** Please change the ft bgs for well N-186 to 77.5 to be consistent with Table 4-51a. **Basis/Justification:** Consistency.	See comment.
Item 93 P: 4-244 & 4-245 Figs 4-67 & 4-68	**Comment:** Figures 4-67 & 4-68 are drawn on completely different scales and appear to be using different data sets (4-68 states information is specifically from RI Wells). Figures should be redrawn in similar scales for comparison.	Redraw Figures 4-67 & 4-68 in similar scales and with similar data sets to aid in comparison.
Item 94 P: 4-245 Fig. 4-68	**Comment:** Depth as feet bgs is nice, but cannot be correlated to changes in elevation amsl to recognize trends in plume migration. Comments 85, 87, & 94 are related. **Basis/Justification:** Clarity of TPH-D plume migration	Please provide the elevations for each of the sample results in addition to the depth below ground surface.

Item 95 P: 4-246 S: 4.4.3.6 L: 23-27	**Comment:** This section states that more information regarding the RUM is required. What type of information, how will it be collected and when will it be collected. What will this information be used for? Clarify if this statement was intended to describe the need for more information during the RI/FS work plan stage. **Basis/Justification:** Clarification of data need.	Clarify data needed for RUM. Has this data need been satisfied or is it a current need? If current, answer the following questions: • What type of data will be collected? • When will it be collected? • What will the data be used for?
Item 96 P: 4-250 S: 4.4.3.6 L: 35-37	**Comment:** Ecology is not convinced that enough data has been collected from the RUM to determine "there are no significant permeable layers". **Basis/Justification:** Units B and C of the RUM are comprised of sands and gravels as stated on page 3-41 of this document.	Restate the sentences to indicate that based on very limited sampling results many portions of the RUM formation are comprised of silts which indicate they are not significantly permeable. However, RUM units A, B, and C, which contain sands and gravels are most likely permeable.
Item 97 P: 4-254 S: 4.5.1.2 L: 43	**Comment:** The text calls out strontium. **Basis/Justification:** The text should read strontium-90.	Please correct.
Item 98 P: 4-261 S: 4.8 L: 2-10	**Comment:** Additional COPCs are also part of the CSM, including Metals, other radionuclides besides Sr-90, pesticides, VOA's, Semi-VOAs and anions. **Basis/Justification**: Sections 4.4.2.1 and 4.4.2.2 of this document identify other COPCs that are carried through to the FS portion that begins in Chapter 8 and thus part of the CSM in Chapter 4.	Add a sentence to line 10 that lists the other groups of COPCs present.
Item 99 P: 4-261 S: 4.8 L: 27	**Comment:** Table 4-54 and line 26 on page 4-207 states the plume size is 0.57 km^2 (0.22 mi^2). Please change to make consistent. **Basis/Justification:** Consistency.	See comment.

Item 100 P: 4-262 S: 4.8.1.1	**Comment:** Reasonable arguments are made that geophysical logging to detect Cs-137 and Co-60 (gamma emitters) can be used to estimate the presence, location, and relative concentration of Sr-90; due to the analogous chemical retardation factors for all three elements. Has this hypothesis been validated by sampling, where relative concentrations estimated by geophysical logging are compared to actual sample concentrations?	Please discuss estimating Sr-90 via geophysical logging in the text, indicating if the hypothesis has been validated or not.
Item 101 P: 4-262 S: 4.8.1.1	**Comment:** The conceptual site model for Sr-90 is based on a combination of actual Sr-90 data (CVP and borehole depth discrete sampling), geophysical logging which estimates Sr-90 from the presence of gamma radiation from Co-60 and Cs-137, and extrapolations.	The uncertainty of estimated and extrapolated Sr-90 concentrations should be discussed; in particular how the uncertainty may affect any subsequent calculations (for example, estimated groundwater and river water concentrations) or comparisons to SSLs or PRGs. If this has already been done, please reference the section where it occurs.
Item 102 P: 4-262 S: 4.8.1.1	**Comment:** Concentrations for Sr-90 in the vadose zone are listed throughout this section.	Please indicate whether Sr-90 concentrations are from actual data or estimates from geophysical logging
Item 103 P: 4-263 S: 4.8.1.1 L: 32-33	**Comment:** Numerous cations are competing for sorption sites. As a result, strontium and Sr-90 are competing for sorption sites in the vadose zone and saturated zone. Please provide in this section, a discussion of how this may make strontium-90 migrate further in the vadose zone and into the saturated zone soils. **Basis/Justification:** At present, geochemical phenomenon that would play a major role in contaminant migration has not been presented in this document. Cation Exchange Capacity has not been addressed adequately in this document.	Discuss in detail how cation exchange from geochemical mobility plays a major role in contaminant migration.

Item 104 P: 4-265 S: 4.8.1.1 L: 46	**Comment:** Here the dates are given as 1963 and 1991; however, on line 17 of this page the dates are given as 1964 through 1990. **Basis/Justification:** Specific dates of operation for the 116-N-1 and N-3 are needed to specify when discharges occurred at these facilities.	Specify the correct dates for beginning and ending of discharges at 116-N-1 and 116-N-3.
Item 105 P: 4-267 S: 4.8.1.1 L: 29	**Comment:** Please provide cross-section A-A' since it supports Figure 4-81. **Basis/Justification:** Completeness.	Provide a reference to cross-section A-A' (Figure 3-31).
Item 106 P: 4-267 S: 4.8.1.1 L: 39-45	**Comment:** Residual concentrations over 100 pCi/g is not considered "low concentrations". Please rewrite this section providing the ranges in concentrations for all the RI wells, instead of referring back to Chapter 3. **Basis/Justification:** Concentration levels exceed protection of the groundwater based on remedial action goals in DOE/RL-1005-93.	Provide concentration ranges for all the RI boreholes and state that these values are not protective of groundwater (exceeding 27.6 pCi/g) based on Interim Action RDR/RAWP values found in Table B.7.
Item 107 P: 4-268 S: 4.8.1.1 L: 16-39	**Comment:** The text states "two major features" yet three items are discussed. Please rewrite to show how these three points address "two major features". As written three major features are addressed 1. Vertical extent in the Hanford fm. 2. Residual concentrations in the lower vadose zone and groundwater. 3. Comparison between 116-N-1 and 116-N-3 related to mass in the soil/groundwater. **Basis/Justification:** Confusing to the reader and more clarity is needed.	Reword text.

Item 108 P: 4-272 S: 4.8.1.1 Fig. 4-79	**Comment:** Update plot E-E' to include RI well 199-N-185 (C8187) by the river. This will provide a better understanding of contaminant thickness with previous discussions in the text. Basis/Justification: A new RI well has been drilled with current sampling data so use this new information for the cross-section as design from the work plan.	Use the new data from RI well 199-N-185
Item 109 P: 4-273 S: 4.8.1.1 Fig. 4-80	**Comment:** The legend in the figure denotes variations in color based both on concentrations of Sr-90 and geology. It is very difficult to understand the figure.	Recommend changing colors for ease of viewing or using shading/hashing for one type of information and color for the other.
Item 110 P: 4-274 S: 4.8.1.1 Fig. 4-81	**Comment:** Provide the apatite barrier on this figure. Provide the RI wells on this map to help coordinate RI work with this figure. This figure is not supported by the RI wells data (Tables 4-46 through 4-53). **Basis/Justification:** The RI wells and apatite barrier locations provide whether these facilities are in the correct locations and provide data points needed for evaluating effectiveness of the remedy.	Provide the apatite barrier and RI wells for completeness and clarity.
Item 111 P: 4-275 S: 4.8.1.1 Fig. 4-82	**Comment:** Explain why the footprint of Sr-90 does not laterally expand at the Hanford fm-Ringold Fm contact. Show the apatite barrier in this figure. Provide an explanation of the dark blue numbers and the teal numbers that go down vertically. Show the RI wells associated with this figure. **Basis/Justification:** Completeness, accuracy and clarity of discussion.	Provide the requested information in the comment for completeness.

Item 112 P: 4-277 S: 4.8.1.1 L: 13-17	**Comment:** This sentence is very confusing and appears to be misleading. This discussion makes it difficult to understand what is really happening geologically. Provide a better discussion of what is occurring geologically with the Hanford fm and the Ringold Fm associated with the "many millions of liters of water were flushed through the vadose zone". **Basis/Justification:** Clarify what is being discussed.	Rewrite this section for clarity or delete the sentences.
Item 113 P: 4-277 S: 4.8.1.1 L: 30-32	**Comment:** Without proper understanding of the geochemistry of Sr-90 related to the cation exchange capacity it has, this statement is an assumption, opinion, or at best an educated guess. This statement does not take into account ongoing geochemical effects. **Basis/Justification:** This sentence cannot be supported by facts. Currently vadose zone is contaminating the groundwater and will continue in the future.	Delete this sentence.
Item 114 P: 4-277 S: 4.8.1.1 L: 35-39	**Comment:** Explain how this "mobile Sr-90" occurs with a Kd of 7 or greater. It should not be occurring. Therefore, a different phenomenon is occurring, like cation exchange capacity or similar geochemistry. Please discuss the geochemistry concepts for this occurrence instead of relying on Kds. **Basis/Justification:** The basis for the argument is flawed. Kds greater than 7 ml/g would provide a non-movable substance.	Provide an adequate discussion of geochemistry effects that would keep Sr-90 in solution or available to desorb and add to the groundwater. Provide net contribution that is being discussed.
Item 115 P: 4-278 S: 4.8.1.2 L: 35-39	**Comment:** Provide a discussion related to the high concentration of tritium at the depth discrete zone of 74.2 ft bgs to this section and how it relates to the conceptual site model. This concentration exceeds the DWS and is outside the 2011 tritium plume. **Basis/Justification:** Accuracy and completeness.	Provide a discussion why the highest concentration from a depth discrete sample is located outside the 2011 tritium plume that exceeds DWS.

Item 116 P: 4-281 S: 4.8.1.3 L: 32-39	**Comment:** Influences on the Sr-90 plume of the 1989 Cold Standby preparations should be discussed.	Please discuss back in section 4.8.1.1 for strontium-90, how this 1989 cold Standby preparation affected the Sr-90 plume and other contaminant plumes causing an increase in vertical migration.
Item 117 P: 4-282 S: 4.8.1.3 L: 10-12	**Comment:** The paragraph discusses the time frame from 1996 to 2012; however the discussion stops at 2005. **Basis/Justification:** Time frames are referenced but not discussed.	Please discuss from 2006 to 2012. If this time period is incorrect, please correct.
Item 118 P: 4-282 S: 4.8.1.3 L: 13-15	**Comment:** Based on the statement, high river stage river water goes all the way to the 116-N-1 and 116-N-3 waste site. Provide the data that supports this claim. If this is true, a continuous source of strontium-90 and nitrate are available in the vadose zone to continue to feed the groundwater contaminants that would be higher in concentration than previously addressed in this report. Comment 3 is related. **Basis/Justification:** Based on the statement, the conceptual site model would be incorrect in its assertion that limited amounts of strontium-90 are reaching the groundwater.	The conceptual site model would need to be re-evaluated with PRZ extending from the river all the way to these waste sites.
Item 119 P: 4-282 S: 4.8.1.3 L: 21	**Comment:** Text reads, "(need to add reference to two surface remediated figures)". **Basis/Justification:** Missing figures cited.	Either delete statement or add the appropriate figures and provide more discussion.
Item 120 P: 4-283 S: 4.8.1.3 L: 19-44	**Comment:** Provide the status of sanitary sewage system related to 124-N-5, N-7, and N-8 and the basis for stating that the nitrate plume south of the reactor is from these units. **Basis/Justification:** Poor supporting data to validate claim that the source is from these sanitary sewage systems.	Provide supporting data for the claim the source of nitrate is from these sanitary sewage systems. Include information regarding WIDS status for these sanitary systems.

Item 121 P: 4-286 S: 4.8.1.5 L: 28	**Comment:** Add "Formation–Hanford formation" after "to the Ringold" to read, "to the Ringold Formation-Hanford formation contact, which..." **Basis/Justification:** Correctness and completeness of discussion	See comment.
Item 122 P: 4-287 S: 4.8.1.5 L: 9	**Comment:** Please define "shallow vadose zone". **Basis/Justification:** Accuracy.	See comment.
Item 123 P: 4-287 S: 4.8.1.6 L: 45	**Comment:** The statement "strontium-90 contamination is located within sediment in the deep vadose zone away from the river . . ." is not true. **Basis/Justification:** Well 199-N-185 has strontium-90 in vadose zone at a concentration value up to 10.3 pCi/g.	Describe Sr-90 contamination that exists in the deep vadose zone soils both near the river and inland.
Item 124 P: 4-288 S: 4.8.1.6 L: 44	**Comment:** Provide the location of well 199-N-122 on a map and change the word "crystalizes" to "precipitates". This is a more accurate description of what occurs associated with strontium going through the apatite barrier. **Basis/Justification:** Accuracy and completeness.	See comment

Item 125 P: 4-289 Fig. 4-85	**Comment:** Please modify this figure. The greater than 80 pCi/L comes all the way down to the river based on 2012 Annual Groundwater Report. This figure does not show that fact. The wells appear to be completed in the vadose zone. Provide the elevation of the N-Spring low river stage next to the words. I assume it is 122 m amsl. The y-axis needs to be labeled as elevation for clarity. Please show that apatite was injected into the vadose zone. This figure only shows it is injected below the strontium plume in the unconfined aquifer. **Basis/Justification:** Additional information is needed to support a clear understanding of the conceptual model.	Modify figure to show: • >80 pCi/L reaching the river • Describe apatite barrier well screened intervals in comparison with low and high river stages • Approximate elevation of historic N springs • Clarify elevation labels on y-axis • Clarify that apatite is injected into both the vadose zone and unconfined aquifer • Label two shades of gold for Sr-90 contamination
Item 126 P: 4-290 Fig. 4-86	**Comment:** Please provide where this well is located in 100-N Area. **Basis/Justification:** This is not an RI well and its location is unknown to the reader to have understanding how it applies to the discussion on page 4-289.	
Item 127 P: 4-291 S: 4.8.1.6 ¶: 2	**Comment:** Please provide appropriate citation of report title and report number to the "(see annual performance report, in publication)". **Basis/Justification:** No report title or report number is provided in this citation.	
Item 128 Chapter 5	**Comment:** ECF-100NR1-12-0017 is not found in Appendix F or anywhere in the RI/FS. This important document is not found in the TPA AR. This document needs to be placed in the AR and provided in the document in the Appendix. Document is referred to on Page 5-22, 5-25, 5-28, and throughout Chapter 5. **Basis/Justification:** TPA AR requirements from Chapter 9 of the TPA.	Add ECF-100NR1-12-0017 to Appendix F and to the TPA AR.

Item 129 S: 5 & App. F General	**Comment:** The document does not show compliance with WAC 173-340-747. Several of the elements in -747(8) are not addressed in this document. **Basis/Justification:** This document does not fully address WAC 173-340-747(8)(b) or (c), or the referenced WAC 173-340 sections of -702(14), (15) and (16). Comments 130, 131, & 146 are related.	Provide an appendix or section in this document that specifically addresses each element of WAC 173-340-747(8) Alternative Fate and Transport Models. This section is related to, and should resemble, the final "crosswalk" that is being developed for the 100-D/H RI/FS.

Item 130 S: 5 & App. F General	**Comment:** The document describes setting PRGs for the soil leaching pathway based on an alternative fate and transport model based on a 1-dimensional (1-D) STOMP code. STOMP has multiple operating modes and can be tailored by the user. Ecology has not been provided with all of the equations and sufficient detail to understand how the code was tailored for use in the River Corridor. At this time, the modeling information provided by USDOE does not meet the burden of proof requirements in WAC 173-340-702(14)(b), (required under section -747(8)(c)). Furthermore, Ecology cannot verify that the modeling is based on an accepted theory or technique (WAC 173-340-702(16)(b)(i)), even though the flexible STOMP code is capable of meeting the regulatory requirements when used properly. Dilution factors from the 1-D STOMP modeling effort are roughly 1000 to 10,000 times higher for the base case (and 10 to 1000 times higher for irrigation) than the default assumption in WAC 173-340-747(4) of 20 (based on DOE/RL-2010-95 "Crosswalk"). Consequently, the base case PRGs (and irrigation soil screening levels (SSLs)) are many times to orders of magnitude higher than WAC 173-340-747 default soil cleanup levels. In the absence of the model equations, readers (and Ecology) do not have completely defensible documentation showing the relevant details of the site-specific model that produces the very large SSLs and PRGs proposed in this document for the leaching pathway. **Basis/Justification:** Mathematical models for contaminant fate and transport use equations to predict contaminant behavior in the subsurface. WAC 173-340-747(8) lists requirements for using alternative fate and transport models. Per WAC 173-340-702(14), which is referenced in -747(8)(c), using alternative fate and transport models carries a burden of proof in cases	Please provide a list of equations used in the 1-D STOMP modeling done to calculate leaching pathway SSLs and PRGs for the River Corridor. The list could be prepared by using the equation numbers in PNNL-12030 (White and Oostrom (2000)). It would not be necessary for the full equations to be provided on the list. Also, please add text addressing the bulleted list at the end of this comment.

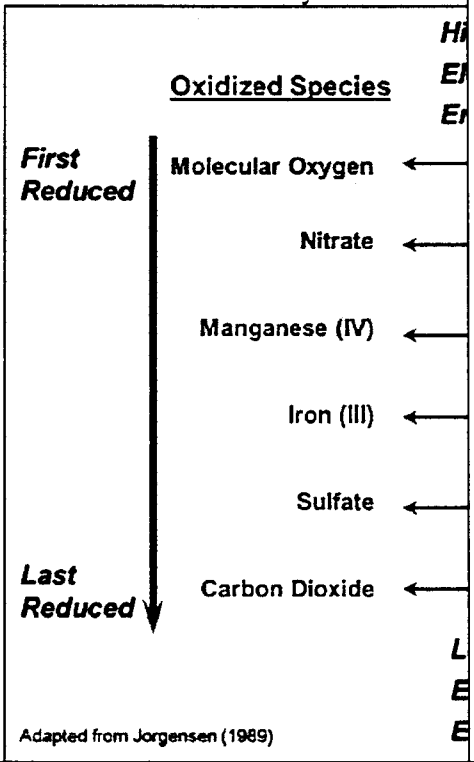
Item 131 S: 5 & App. F General	**Comment:** The Hanford Site River Corridor has many plumes (of many sizes) of contaminated groundwater, near the river and upgradient in the Central Plateau (Hulstrom, 2011, *Data Summary Report for the Remedial Investigation of Hanford Site Releases to the Columbia River*, WCH-398, Revision 0, Washington Closure Hanford. [Figures 5-7 through 5-14]; USDOE, 2012, *Fact Sheet: Proposed cleanup plan to address contaminated groundwater in Hanford's central area.* http://www.hanford.gov/files.cfm/CAL_200-UP-1_FactSheet.pdf). These plumes have not been considered in setting PRGs for the leaching pathway in the River Corridor. The STOMP 1-D vadose zone fate and transport modeling models the receiving groundwater as if it has undetectable concentrations of any contaminants. However, the 100-N groundwater contains carcinogens (example: PAHs, arsenic and radionuclides), as well as noncancer contaminants that may have similar target organs (example: blood toxins nitrate, nitrite and antimony) to contaminants derived from waste sites overlying groundwater. In these cases, risks and hazards of contaminants within groundwater would be additive with those coming from vadose zone waters (WAC 173-340-708(6)(a)). **Basis/Justification:** An important requirement for WAC 173-340-747(8) is consideration of dilution (-747(8)(b)(vi)): "Dilution shall be based on site-specific measurements or estimated using a model incorporating site-specific characteristics. If detectable concentrations of hazardous substances are present in upgradient ground water, then the dilution factor may need to be adjusted downward in proportion to the background (upgradient) concentration." The soil cleanup level is proportional to the dilution factor, with lower dilution factors yielding lower soil cleanup levels.	At least three possible approaches could be used to adjust cleanup levels to account for upgradient contamination and multiple pathways of contamination: (1) adjust soil cleanup levels to protect groundwater (leaching pathway) downward based on dilution with groundwater having current contaminant concentrations (as an estimate of future risk or hazard) (2) adjust soil cleanup levels to protect groundwater (leaching pathway) downward based on modeled future contamination in groundwater (which may require sophisticated modeling, and may be as uncertain as using current contamination) (3) adjust groundwater cleanup levels downward, allowing groundwater to accommodate more contamination from waste site sources. (The first approach is likely the easiest.)

Item 132 Chapter 5	**Comment:** Provide the more familiar well name instead of the ID number. The well name provides where this well is located in most supporting documents on maps. Well IDs are not provided on most maps in the supporting documents and in this RI/FS.	Provide well names in addition to ID numbers where used.
Item 133 P: 5-7 Fig. 5-2	**Comment:** All these figures should be labeled 5-2a through 5-2d; not 5-1a through 5-1d. **Basis/Justification:** Disagreement between figure and figure label.	See comment.
Item 134 P. 5-7 Fig. 5-1a	**Comment:** For Figure 5-1a, the groundwater table should be higher than shown. If past operational activities raised the water table, then it would also be raised at the Columbia River shoreline. **Basis/Justification**: N-springs, or thermal springs, support the fact that the water table was elevated higher than shown at the Columbia River.	Redraw with a higher water table at the Columbia River than shown.

Item 135 P: 5-9 S: 5.2.1.1 L: 3	**Comment:** The document focuses on the 116-N-1 and 116-N-3 as the main chemical and radiological release points. Releases from the fuel storage basin have contributed to high Sr-90 exceedances in the aquifer tubes (7934, etc.). Text acknowledges the spillway acting as a conduit from the fuel storage basin to the river, yet does not provide a meaningful discussion. **Basis/Justification:** The RI/FS Work Plan (DOE/RL-2008-46 Addendum 5) discussed concerns with Sr-90 concentrations in the vicinity of the fuel storage basin and the 1908-N Outfall spillway. Data gap #3 (Table 4-7) in the work plan specifically spoke to additional data needs from beneath the fuel storage basin (characterization including a potential borehole to be completed as a well). Contamination associated with the fuel storage basin leaks had been included in waste site UPR-100-N-35. UPR-100-N-35 has been consolidated with 100-N-66 (WSRF 2013-013 signed 4/10/13). Although this additional characterization need was not outlined in the RI/FS SAP due to interim remedial schedule conflicts, an updated discussion of all current information should be included in the RI/FS. A conceptual site model specific to the fuel storage basin leaks traveling along a preferential pathway formed during construction of the 1908-N Outfall Spillway was included in both the 100-N-79 Work Instruction for Verification Sampling (0100N-WI-G0061, Fig. 1) and the 2010 Hanford Site Groundwater Monitoring Report (DOE/RL-2011-01).	Vadose Zone and groundwater contamination associated with fuel storage basin leaks should be discussed in detail in the RI/FS. Discussion should include: • UPR-100-N-35 waste site history and consolidation with 100-N-66 • CSM discussing preferential pathway for contaminant migration from FSM along 1908-N Outfall spillway • Data gap from RI/FS work plan regarding FSB, whether installing a borehole/well should be a ROD requirement, and discussion of inclusion of data in 2016 CERCLA 5 Year ROD Review • Whether installation of apatite barrier in the area to attain DWS for groundwater entering the river is necessary

Item 136 P: 5-13 S: 5.2.3.1 L: 1-3	**Comment:** Delete redundant phrase: "Without appropriate mitigation measures, strong winds can disperse contaminated surface soil while waste sites are exposed during excavation and demolition ~~while waste sites and facilities are exposed during excavation and demolition~~.	See comment.
Item 137 P: 5-13 S: 5.3.2.3 L: 17-19 & 25-27	**Comment:** Lines 17-19 state: "Owing to these characteristics, the boundary between the Ringold Formation unit E (Rwie) and overlying Hanford formation would have acted as a barrier to infiltrating water and contaminant transport in the portions of 100-N where the boundary lies above the water table." However, lines 25-27 state: "While the elevated groundwater mound existed, the water table rose up to the top of the Ringold Formation unit E and into the Hanford formation in some parts of 100-N" These two statement seem to be in conflict as to whether water will or will not be able to penetrate into the Rwie. **Basis/Justification:** No justification for the statement. Lacks supporting evidence. Conflicting conclusions.	Delete statement on lines 17-19 or re-write Section 5.3.2.3 to clarify.
Item 138 P: 5-14 S: 5.2.3.3 L: 31-32	**Comment:** Low river stage begins in September or October and extends to March. This is half the year, therefore remove the word predominately and replace with "one-half the year (low river stage period) **Basis/Justification:** One half the year, low river stage is in process and the other half, high river stage is in process.	Reword to recognize the influence on groundwater movement near the river as high river stage period and low river stage period.

Item 139 P: 5-16 & 5-17 S: 5.3.1.1	**Comment:** The denitrification discussion does not discuss if it will work in 100-N. Please add more discussion on its practicability in 100-N in both the biodegradation and abiotic degradation subsections. Instead of the denitrification discussion, this section should be presenting the nitrate plume at 100-NR-2 and its overall presence in the vadose zone. **Basis/Justification:** The process is discussed here, but appears to be better suited for Chapter 8 under technology development. After a very long discussion, whether it is feasible in 100-N is not provided, leaving this reader to wonder why this is discussed in the modeling section of the document.	Move this discussion to Chapter 8 or 9 or provide why this discussion is in Chapter 5, Contaminant fate and transport.

Item 140 P: 5-17 S: 5.3.1.2	**Comment:** Nitrogen, often in the form of nitrate is consumed directly or used as a common nutrient for many microorganisms in various bioremediation processes and are often consumed during both aerobic and anaerobic bioremediation processes. **Basis/Justification:** Various references and guidance documents state this fact and this document in the second bullet of page 9-27 notes that commercial fertilizer is often used to increase the nitrogen and potassium levels for the microorganisms in landfarming. As noted in Jorgensen 1989's reference on Electron Tower Theory. 	Add a paragraph to this section that states that nitrogen, often in the form of nitrate, is consumed directly or as an essential nutrient by various microorganisms to form various enzymes needed by the microorganisms to degrade TPH-D and other COCs.
Item 141 P: 5-17 S: 5.3.1.2	**Comment:** Need discussion of NAPL. **Basis/Justification:** Tables 8.1, 8.8 from Pete Kmet, *Guidance for Remediation of Petroleum Contaminated Sites*, Ecology Publication 10-09-057, October 2011.	Check for NAPL by comparing TPH type to solubility limits. Add text discussing absence or presence of NAPL in groundwater.

Item 142 P: 5-17 S: 5.3.1.2 L: 23-3	**Comment:** Discuss how this discussion of persistence relates to 100-N. Discuss what type of release occurred so the reader knows whether it is C6 through C12 or greater than C12. Provide discussion that relates it back to 100-N situation. **Basis/Justification:** The section is a theoretical discussion with no link to how it relates to 100-N. The reader has no way of relating this discussion to how it applies to 100-N.	Provide more detail in the total petroleum hydrocarbons discussion of persistence to 100-N.
Item 143 P: 5-19 S: 5.3.2.1 L: 5	**Comment:** Remove the word "slightly" and replace with "moderate." **Basis/Justification:** Moderate mobility is more consistent with Section 5.4.1.4 text.	Edit text to read, "As such, it has **moderate** mobility and tends to be retained on soil particles near its point of release.
Item 144 P: 5-19 S: 5.3.2.2 L: 7-13	**Comment:** Discuss how persistent tritium is in 100-N Area. **Basis/Justification:** This section is called Persistence of Radionuclide Constituents, yet the persistence is not discussed as it relates to 100-N.	See comment.
Item 145 P: 5-19 S: 5.4 L: 15-23	**Comment:** Vadose zone contamination and migration can occur from leaking pipelines and other man-made systems. These systems and processes need to be acknowledged. Please discuss these man-made processes and their aspect to contribute to migration of contaminants in the vadose zone. **Basis/Justification:** Processes have been ignored that can contribute more significantly to contaminant migration than natural processes. The irrigation scenario will have pipelines that run water to various spigots for irrigation along with other man-made systems that could drive existing contamination downward.	See comment.

Item 146
P: 5-19 – 5-24
S: 5.4.1.1
General
	Comment: The document describes setting PRGs for the soil leaching pathway based on a recharge scenario with mature shrub steppe vegetation. This scenario represents a "best case" and is not protective, in general, for land under unrestricted use.
	
	Basis/Justification: For unrestricted land use there are many possible fates for the waste sites; future disturbances could include:
	• human excavation activities (e.g., excavations for buildings, utilities and/or road construction)
	• tillage and agricultural activities (e.g., physical disturbance, input of nutrients and pesticides)
	• mining operations (e.g., exposure of contamination, destruction of vegetation)
	• wildfires (e.g., the Hanford site had 302 wildfires in the years 1990-2010 (USDOE, 2011))
	• invasive species (e.g., cheatgrass, a common invasive species after fire).
	Because of these potential disturbances, setting PRGs based on a recharge scenario with mature shrub steppe vegetation is not protective.
	
	Other considerations include:
	• The initial disturbance of soils when waste sites were created and remediated:
	  • Disturbed soils and backfill are not the same as their pre-disturbed counterparts, since topsoil has been mixed with subsoil (or lost entirely) and the material has no soil horizons.
	  • Recharge will not drop to the pre-disturbance levels until soil horizonation returns to the pre-disturbed condition.
	  • The time period for an A horizon for materials that resemble the Entisols
		Please delete discussion of rapid succession to mature shrub steppe vegetation (30 years) as a basis for setting PRGs, and delete the associated PRGs. Base PRGs on an irrigation recharge rate.
		If an irrigation recharge rate is not applied, natural recharge should be set to a value no lower than 50 mm/y for all time periods after remediation, consistent with lysimeter data for unvegetated sands (Gee et.al, 2005a (Table 3, sand and sandy gravel) and Gee et al., 2005b). This value is close to the WAC 173-340-747(5)(f)(ii)(A) default approach for locations east of the Cascade Mountains (multiply the annual precipitation rate by 25%, giving an annual recharge of 44 mm/y). This recharge rate would more realistically accommodate human disturbances, fires, and domination by invasive species than the low recharge rates associated with mature shrub steppe vegetation.

Item 147 P: 5-21 S: 5.4.1.1 L: 1-23	**Comment:** The 100-Area re-vegetation efforts should be highlighted instead of the Hanford Prototype Barrier. **Basis/Justification:** The Hanford Prototype Barrier is surveyed and maintained annually. New seedlings are planted as needed.	Reference the re-vegetation efforts that are ongoing in the 100 area as part of the interim actions.
Item 148 P: 5-23 Table 5-1	**Comment:** Add another row that includes the disturbed soils by excavation and provide the recharge rates of 63 mm/yr for no vegetation. **Basis/Justification**: All of the 100-N Area has been excavated at one time or another. Soil types listed in the referenced document, PNNL-14702; state that the soil type is only 1-m thick. All soils types have been removed and Hanford Sand recharge rates (63 mm/yr.) shall be used to reflect better recharge rates through Operational Period of 1944 to 2015.	Change recharge rates to a Hanford sand as used in the referenced document. This recharge rate is 63 mm/yr. (no vegetation/bare soil).
Item 149 P: 5-23 & 5-24 Tables 5-1 and 5-2	**Comment:** Cite the reference document, PNNL-14702 that provided the rates used in this table. **Basis/Justification:** Provide credit to where the data was obtained.	See comment.
Item 150 P: 5-24 Table 5-2	**Comment:** Add another row that includes the disturbed soils by excavation and provide the recharge rates of 63 mm/yr. for no vegetation during Period 1. Since vadose zone modeling was applied only to waste site, only the recharge rate of 63 mm/yr. should be used for Period 1 (2010 to 2015). **Basis/Justification:** All of 100-N has been excavated at one time or another. Soil types listed in the referenced document, PNNL-14702; state that the soil type is only 1-m thick by being disturbed, should use Hanford Sand recharge rates. All soils types have been removed and Hanford Sand recharge rates shall be used to reflect better recharge rates.	Change recharge rates to a Hanford sand as used in the referenced document. This recharge rate is 63 mm/yr. (no vegetation/bare soil).

Item 151 P: 5-24 S: 5.4.1.2 L: 18	**Comment:** Add to the beginning of the sentence "In the vadose zone, the stratigraphic sequence identified . . ." A simple reminder that this section is about the vadose zone would be useful. **Basis/Justification:** Clarity.	See comment.
Item 152 P: 5-25 S: 5.4.1.2 L: 8	**Comment:** Provide why the 2008 water table "represent the highest water table". **Basis/Justification:** Statement made with no justification for it representing "the highest water table."	Provide basis for the statement "represent the highest water table".
Item 153 P: 5-25 S: 5.4.1.2 L: 10	**Comment:** It is debatable that "This is conservative with respect to SSL and PRG values because a minimum vadose zone thickness yields earlier and higher peak groundwater concentrations." The higher water table depending on how calculated could give a more dilute groundwater concentrations. This sentence is an opinion and is strongly influenced with how the calculation was done to derive the groundwater concentration. If mixing or dilution was accounted for in deriving the groundwater concentration, then this is not a true statement. Please provide more detail.	
Item 154 P: 5-26 Fig. 5-6	**Comment:** Provide which stratigraphic section was used near the river, which one was used mainly inland, and the purpose of the other two profiles. It is difficult to understand the selection process simply based on the text and this figure. A total difference of 3 meters (9.8 feet) is the difference between all four profiles. Since the ECF is NOT provided in the document, the less than 10 ft difference in the text needs more discussion here in text. **Basis/Justification:** Clarity of the profiles used in the 1-D Modeling.	See comment.

Item 155 P: 5-28 S: 5.4.1.4 Table 5-3	**Comment:** The table does not list the K_d for $Iron^{+2}$ (ferrous) and manganese $^{+4}$. It is also missing the unit of measure for the TPH-Diesel K_d of 1.	List the K_d for $Iron^{+2}$ (ferrous) and manganese $^{+4}$. List the unit of measure for the TPH-Diesel K_d of 1.
Item 156 P: 5-28 S: 5.4.1.4 L: 22	**Comment:** For technical accuracy, provide unit of measure for the K_d=0. Also provide unit of measure for K_d=30 on page 5-29 Line 13.	Provide the unit of measure for the K_d.
Item 157 P: 5-29 S: 5.4.1.5 L: 32-46	**Comment:** Based on the last few sentences, provide the K_d values that were used for this document, especially Cr(VI), arsenic, selenium and silver. **Basis/Justification:** No clear indication of what K_d values were used based on the last few sentences of this section.	Provide the K_d values for arsenic, barium, cadmium, chromium, Cr(VI), lead, selenium, and silver.
Item 158 P: 5-30 Table 5-4	**Comment:** With all the discussion of how fast contaminants move through the Hanford formation compared to the Ringold Fm Unit E, it appears that the parameter values are the same for these two units. Provide additional information to explain why these values are the same in the previous discussion before this table. **Basis/Justification:** It appears the two major vadose zone units have the same values for each of the parameters evaluated.	See comment.
Item 159 P: 5-30 Table 5-4	**Comment:** Change the recharge rate to 63 mm/yr for the disturbed areas of 100-N for the time period of 1944 to 2010 and 2010 to 2015 for both Native Vegetation Recharge Scenario and Irrigation Recharge Scenario. **Basis/Justification:** PNNL-14702 justifies using 63 mm/yr for each case with disturbed soil profiles.	See comment.

Item 160 P: 5-30 Table 5-4	**Comment:** Please explain how using 4 mm/yr for a recharge rate in native vegetation supports a flux into the groundwater of 6 mm/yr. ECF-100NR2-12-0053, 2012, *Saturated Zone Flow and Transport Modeling in Support of 100-N RI/FS Document*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Does not provide enough detail in its sensitivity case to adequately address this concern. **Basis/Justification:** Information on p. 5-40 for the table nor the ECF document provides the information to address this comment.	Provide more detailed discussion how 4 mm/yr recharge rate supports 6 mm/yr or 12 mm/yr flux to the groundwater.
Item 161 P: 5-30 Table 5-4	**Comment:** In the footnotes, ECF-100NR1-12-0017 appears to have the incorrect title. ECF-100NR1-12-0017, STOMP 1-D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 100 Area B and C Source Areas. Please modify to change the document title to the correct one. **Basis/Justification:** Wrong document title.	Change document title to the correct title "*STOMP 1-D Modeling for Determination of Soil Screening Levels and Preliminary Remediation Goals for 100 Area N Source Area*".
Item 162 P: 5-32 S: 5.5 L: 8-10	**Comment:** How is the Hanford formation simulated in the 1-D model along the river that were impacted as mentioned in chapter 3 when the water table rises into the Hanford fm. **Basis/Justification:** In Chapter 3, the water table rises into the Hanford formation. This situation needs to be addressed.	Provide a soil column for near the river in which the water table is in the Hanford formation.
Item 163 P: 5-33 S: 5.5.2 L: 14	**Comment:** Provide when Ecology agreed and during what discussions that a maximum duration of 1,000 years was acceptable. **Basis/Justification:** No basis for the statement is provided.	Provide justification in the document to support statement or change text to match D/H RI/FS Section 5.6.2 Simulation Duration.

Item 164 P: 5-33 S: 5.6 L: 22-25	**Comment:** this one sentence is four lines long. This sentence is so long that the essence of the thought the author is trying to present is lost. Divide this sentence up into multiple sentences with each expressing one idea at a time. **Basis/Justification:** A four line sentence with multiple breaks and parenthesis gets lost in its point it is trying to communicate.	Suggested text: "This includes a 100:0 initial source profile for lower Kd contaminants. The 100:0 initial source profile includes selected waste sites with strontium-90 distributed across the vadose zone, periodically rewetted zone (PRZ) and aquifer. The 70:30 profile includes waste sites with higher Kd contaminants and strontium-90 present in the vadose zone only."
Item 165 P: 5-33 S: 5.6 L: 25	**Comment:** Provide the maximum depth used for the 70:30 profile with "strontium-90 present in the vadose zone". **Basis/Justification:** The vadose zone covers from the ground surface down to groundwater. This is 85 feet of sediment that needs to be classified as to what depth the contamination is assumed to reach. Sr-90 will migrate downward to the groundwater, even with a K_d of 25 ml/g.	Provide the maximum depth interval that is being specified.
Item 166 P: 5-34 S: 5.6.2 L: 32	**Comment:** ECF-100NR1-12-0056 needs to be in Appendix F as well as in the TPA AR. **Basis/Justification:** This modeling document supports the TI waiver as well as the preferred alternative.	Add document ECF-100NR1-12-0056 to Appendix F and the TPA AR.
Item 167 P: 5-37 Table 5-5	**Comment:** Provide where the "Groundwater Standard (μg/L)" is derived at the end of the table or for each contaminant presented. Provide where the "Surface Water Standard (μg/L) is derived at the end of the table or for each contaminant presented. **Basis/Justification:** The basis for the groundwater standard and surface water standard needs to be provided. Not all of these have groundwater standards that are shown. The source for these numbers need to be provided.	Provide the "Groundwater Standard" reference for all the values presented on the table. Provide the Surface water standard reference for all the values presented on the table.

Item 168 P: 5-42 Table 5-5	**Comment:** Provide what "d" stands for as it relates to the superscript d by hexavalent chromium. **Basis/Justification:** The d by the 6 under the column Groundwater PRG is not explained at the end of the table.	Provide what "d" represents under the "Groundwater PRG" column by the 6 for hexavalent chromium.
Item 169 P: 5-44 & 5-45 Table 5-5 & 5-6	**Comment:** Provide footnotes that explain where the EQL, Standards, Kds and other important information were obtained to construct these tables. As is, it is severely lacking supporting information. **Basis/Justification:** No supporting information is provided. Needs supporting information for tables with PRG and SSL values on them.	Provide adequate supporting information for tables.
Item 170 P: 5-47 S: 5.6.2.2 L: 18-22	**Comment:** Provide a more detailed explanation why a SSL was not developed for strontium-90 for the irrigation land use scenario. Comment #3 is related. **Basis/Justification:** Based on DOE's current position of an irrigated land use scenario, a SSL seems appropriate for this COC.	Provide a SSL for strontium-90 under an irrigation land use scenario for the 2D model.
Item 171 P: 5-48 S: 5.7.1.1 L: 38-39	**Comment:** Provide here and elsewhere in the document (Chapter 4) that the fuel and foam lines are currently in the process of being removed. **Basis/Justification:** Remediation of a preferential pathway is important to reduce future contaminant migration.	Provide general current status.
Item 172 P: 5-48 S: 5.7.1.1 L: 40-43	**Comment:** Provide a complete list of these redox sensitive metals besides iron and manganese. The formation of secondary groundwater plumes is an important aspect that needs further discussions. **Basis/Justification:** If metals are mobile from generating a reducing environment they need to be more thoroughly discussed.	Provide a full listing of these "redox sensitive metals".

Item 173 P: 5-63 Fig. 5-7	**Comment:** Provide the isocontours in meters as well as ft. **Basis/Justification:** Since the groundwater table is provided in meters and comparison in meters is needed for a full effect. The reader should not be forced to change the values for comparison.	Provide the isocontours in meters as well as shown in ft.
Item 174 P: 5-64 Fig. 5-8	**Comment:** Add a secondary y-axis in meters for comparison to current groundwater elevations. **Basis/Justification:** Current groundwater elevation is given in meters not feet.	See comment.
Item 175 P: 5-64 S: 5.7.1.1 L: 16	**Comment:** Add to this sentence "and COPC concentrations can increase." **Basis/Justification:** Low river stage has shown that contaminant concentration levels can increase in the aquifer.	Change text to read: "Depending on the location within 100-N, direction variability in flow occurs because of these competing influences and COPC concentrations can increase during low river stage.
Item 176 P: 5-65 S: 5.7.1.2 L: 15-21	**Comment:** Provide a discussion on contaminant concentration effects as it relates to Columbia River Stage Fluctuations. This concept plays a major role in the conceptual site model throughout the 100 Areas. To not discuss this concept is leaving a significant contributor to ongoing and future impacts to the unconfined aquifer. **Basis/Justification:** Columbia River stage is a major component of fate and transport of contaminants within the 100 Area and not discussing the contaminant concentration effects from this concept is leaving out a major component of the conceptual site model for any waste site.	See comment and basis.

Item 177 P: 5-65 Table 5-9	**Comment:** For the row "Simulation of future conditions" 77 years is given from a time span of 2011 to 2077, this is actually only 67 years, not 77. For it to be 77 years another 10 years is needed to the year 2087. Change the duration to 67 or the timeframe to 2087. **Basis/Justification:** Wrong calculations are given for the duration stated.	Change the duration or time frame depending on what duration was actually conducted.
Item 178 P: 5-66 Table 5-9	**Comment:** Under Pumping stress, add DX to the list. It started in December 2010. **Basis/Justification:** DX begin pumping in December 2010.	Add DX to the list
Item 179 P: 5-67 Table 5-9	**Comment**: Provide what is meant by terms "Mobile Domain" and "Immobile Domain". **Basis/Justification:** Terms are used with no understanding of how they are being applied.	See comment
Item 180 P: 5-67 Table 5-9	**Comment:** For Sr-90, these numbers do not represent the Kd values stated in Table 5-3. These conflicting values appear to show that different values were used for the same parameter.	Please correct this inconsistency
Item 181 P: 5-67 Table 5-9	**Comment:** Explain why no value is given for TPH under the "Immobile Domain" column. If no value is correct, put N/A and explain why N/A is applicable.	Explain and/or elaborate on TPH.
Item 182 P: 5-67 S: 5.7.2 L: 7-10	**Comment:** Rewrite the last sentence and specify this is the method being used. **Basis/Justification:** Clarity. As currently written, it is uncertain which method is chosen	See comment and basis
Item 183 P: 5-70 Fig. 5-11	**Comment:** Please define "FHB" or remove it. It is not defined in the figure and I could not find it in the text. **Basis/Justification:** Clarity	Either define FHB or remove it from the figure.

Item 184 P: 5-75 Fig. 5-14	**Comment:** No call-out to figure 5-14 exists prior to the figure. **Basis/Justification:** Clarity	Provide a call-out to Figure 5-14 before this section or move the figure to come after the call-out to it on page 5-76 in Section 5.7.3.2.
Item 185 P: 5-76 S: 5.7.4.1 L: 33-39	**Comment:** The contaminant transport simulations should be conducted for 1,000 years similar to the vadose zone simulations to calculate peak groundwater concentrations. This is needed to provide the long term impacts to surface water.	Run the groundwater model to ensure groundwater contamination results are sufficiently addressed for long-lived radionuclides.
Item 186 P: 5-77 S: 5.7.4.4 L: 15-18	**Comment:** Provide the in-depth discussion of the observed nitrate concentration data from the soil source and explain why it is not based on the observed nitrate concentration data. Historical matching is an acceptable method of providing this information than estimating mass flux. **Basis/Justification:** Concentration data is a basis for what is observed in the soil column and provides a correlation to the contaminants that are migrating down into the aquifer. Using another method to provide this information needs further discussion than provided in Section 5.7.6.2.	See comment.
Item 187 P: 5-77 S: 5.7.4.4 L: 34-42	**Comment:** Provide why the same groundwater monitoring report was not used. In line 36 it cites 2011 and in line 40 it cites 2010 Groundwater Monitoring Report. Provide why the water table map in 2011 was not suited to match the lateral extent of the 3D plume from 2011.	
Item 188 P: 5-79 S: 5.7.4.4 L: 32-35	**Comment:** Provide the basis for using a 0.25 and 0.75 fractional split between the low and mobile domain versus a 0.8 and 0.2 or a 0.9 and 0.1 fractional split. **Basis/Justification:** No justification is provided for choosing the selected split.	See comment and justification.

Item 189 P: 5-81 Fig. 5-17 & Fig. 5-18	**Comment:** Provide whether these maps represent the average concentrations for the Sr-90 and nitrate plume in groundwater or maximum values. Specify the monitoring year for these maps. This comment is related to Comment #2. **Basis/Justification:** Remedial alternative timeframes should include both average and bounding conditions.	Provide the maximum concentration values for all COCs to determine the bounding condition for remedial alternative timeframes. Maximum, rather than average, concentrations should be used as model input to provide for bounding conditions of the amplitude of the plumes as well as the horizontal footprint.
Item 190 P: 5-82 Fig. 5-19	**Comment:** Groundwater contour maps for 2012 exceed 500 µg/L in the river for TPH-D. Use the 2012 data to compare against and provide a better understanding in the conceptual site model why in 2012 it exceeded, yet the modeling for this FS does not show an exceedance for the entire 80 years. Redo the conceptual site model for TPH-D. This is related to Comment #1. **Basis/Justification:** Current conceptual site model indicates that it does not represent monitoring data one year later.	Conceptual site model needs to be corrected.
Item 191 P: 5-84 S: 5.7.4.5 L: 3-5	**Comment:** Provide the explanation for the fractional split chosen. Based on Sr-90 split is not an adequate explanation. **Basis/Justification:** Lack of supporting information to explain fractionalization split	See comment and justification.
Item 192 P: 5-85 S: 5.7.4.5 L: 13	**Comment:** The text appears to be distorted in the first portion of Equation 5.1.	Modify the text in the equation.
Item 193 P: 5-85 S: 5.7.4.5 L: 31	**Comment:** Provide where "e-2" comes from? Please explain in greater detail if this is natural log or other constant. Is "-2" supposed to be a negative exponent. **Basis/Justification:** Provide clarity.	Provide and define e-2 in equation 5.3.

Item 194 P: 5-88 S: 5.7.6.1 L: 21-24	**Comment:** This sensitivity needs to be added to this document and thoroughly discussed. **Basis/Justification:** Clarity	Sensitivity analysis needs to be discussed here and not in an appendix or some other document.
Item 195 P: 5-90 S: 5.7.6.2 L: 14-26	**Comment:** A mass balance using 2009 to 2011 data from one well does not adequately represent a mass flux to the aquifer. Other wells have TPH contamination and the plume has spread laterally since the spill. The current conceptual model is inconsistent with groundwater plume data for 2012. Soil mapping of the plume in the vadose zone with the plume in the groundwater is required to perform historical concentration mapping. In addition, the amount of mass removed from the trench is also needed to successfully estimate the amount released, the amount removed to date and what the current vadose zone and aquifer plumes resemble to provide an estimated mass to perform mass flux calculations. This is related to Comment #1.	More information needs to be provided to perform mass flux calculation on the TPH-D plume.
Item 196 P: 5-90 S: 5.8 L: 30	**Comment:** Provide what is meant by the term "upgradient of the river"? Does it mean the upland plume? **Basis/Justification:** Clarity	See comment.
Item 197 P: 5-91 Fig. 5-21	**Comment:** Mass is measured in g or mg, not pCi. Change the average concentration graph to display in g or μg instead of pCi/g compared to pCi/yr and total mass in the Column in pCi. **Basis/Justification:** Curies is an activity level, while grams are a unit mass.	Change from curies to grams.

Item 198 S: 5.8.2 & Fig. 5-22 & Fig. 5-25	**Comment:** The Strontium-90 plume appears to reach the river over a 200 year timeframe. Wells used to indicate the compliance on Figures 5-22 and 5-25 are only slightly downgradient of 116-N-1 and no wells within the apatite barrier are used to support that no groundwater from the upland plume is reaching the river over this time period. Provide the highest concentration wells based on 2012 strontium-90 map in the Annual Groundwater Report and remodel using wells slightly downgradient (B2408) and wells directly downgradient from the B2408 well to show both migration and radioactive decay over the 300 year period of simulation as well as defining the lateral extent of the plume as was done. Provide a comparison of the upland monitoring wells compared to the near-river monitoring wells similar to figure 5-25. (This comment affects the text on p. 9-3, lines 16-20).	Redo the modeling using 2012 data and use the highest Sr-90 concentration in a well directly downgradient from well B2408 (N-105A), like well N-280 (C7373) to illustrate the Sr-90 upland plume does not reach the river over the 300 year time period. On the plume map illustrate with a line the separation between upland and near-river boundaries for the reader.
Item 199 P: 5-93 & 9-15 Figs. 5-22 & 9-2	**Comment:** Map shows exceedance of 8 pCi/L at 300 years. Provide for Alternative 1 when Sr-90 will be below the DWS throughout the plume. Assuming that the concentration is up to 80 pCi/L for the plume, it would take another 120 years to reach 8 pCi/L. **Basis/Justification:** The map indicates it could take another 120 years to reach DWS.	Provide for Alternative 1 when Sr-90 will be below the DWS throughout the plume.
Item 200 P: 5-97: 5. 8.3.1 L: 16-18	**Comment:** The identified wells that are called out do not align with the Figures 5-29a through c. They align with -29b, e, and a. Please align the call-out to wells to match the well ID to the letter in alphabetical order. This would mean, A4664 is "a", A4711 is "b" and B2408 is "e", NOT "c" as stated. Correct the call-out if the author wanted to call-out "c" well ID A4720.	Call out the correct wells in alphabetical order and change the well IDs to well names. Well B2408 is letter "e", not "c", please change accordingly.

Item 201 P: 5-98 Fig. 5-27	**Comment:** This map does not indicate maximum nitrate values and may not fully extend outward to the entire plume footprint.	Provide the map that shows the maximum nitrate values during low river stage.
Item 202 P: 5-99 S: 5.7.4.5 L: 3-5	**Comment:** Provide the basis for the estimated cumulative mass of nitrate. Provide a pointer back to any section that supports where the source(s) of the nitrate migrated into the vadose zone and finally the aquifer. Provide how much mass is still in the vadose zone and how much is still in the aquifer. Provide the time period for this mass entering the river. It is unclear if this is yearly, monthly, weekly or daily. **Basis/Justification:** No basis of how the nitrate mass is derived that is entering the river and how much mass is in the aquifer and vadose zone. No pointer to a section where this calculation was done or how it originated is provided.	See comment and justification.
Item 203 P: 5-99 S: 5.8.3.2 L: 13-14	**Comment:** Wrong call out for wells. 5-29e refers to well ID B2408, not A9878. The callout should be for 5-29c and d to represent well ID A4720 and A9878. Please change callouts. Basis/Justification: Callouts to wells do not match the figures being referenced.	See comment and justification.
Item 204 P: 5-101 S: 5.8.3.2 Fig. 5-31.	**Comment:** Provide the information that matches the discussions on page 5-99, lines 6 through 8. Provide where this information is obtained with a map of the wells or what wells were used to make this graph. As is, it is difficult to understand the supporting evidence of this graph. **Basis/ Justification:** Clarity	See comment and justification.

Item 205 P: 5-102 S: 5.8.4.2 L: 21	**Comment:** The concentration value is the measure for performance. The mass entering the river does not provide this information. Is this mass based on yearly, monthly, weekly or daily?	Provide what 205 Kg equates to in a concentration entering the river. Is this mass based on yearly, monthly, weekly or daily?
DC 206 P: 5-102 S: 5.8.4.2 L: 21-27 & P: 136 S: 9-19 Fig. 9-6	**Comment:** "Adjacent to the river" is still within the aquifer as well. As written, text implies these concentration values are not associated with the aquifer. The concentration values are above the 500 µg/L as of 2012. Therefore, the initial concentrations are not "below the regulatory standard". The river concentration exceeds 500 µg/L currently and text should be modified to acknowledge this. Comment #1 is related. **Basis/Justification:** Conceptual site model does not match current groundwater concentration values at the river and within the plume area inland for the TPH-D plume. Groundwater modeling results do not match current measured conditions.	Text describing model results should be modified to discuss differences between modeled and measured current conditions. Groundwater modeling should be redone to address discrepancies between modeled and measured current conditions.
Item 207 P: 5-105 Fig. 5-34	**Comment:** Please provide a discussion of the 2nd peak for Figure 5-34b. Basis/Justification: More information is needed to explain the increased concentration.	See comment and justification.
Item 208 P: 5-107 S: 5.9.1 L: 7-12	**Comment:** These lines are a repeat of lines 15-17 on p. 5-104 within this same section. Delete these sentences here since they are redundant. **Basis/Justification:** Redundancy within the same section.	See comment.

Item 209 P: 5-107-108 S: 5.9.2	**Comment:** Discuss in this section the impact of high and low river stage effects on concentration values as it related to uncertainty in initial contaminant distributions. This aspect is of importance within the 100-N Area. In addition lines 1 through 7 is a repeat within this section. Please delete these lines. **Basis/Justification:** Repeated sentences and understanding of the uncertainties related to high and low river stages	See comment and justification.
Item 210 P: 5-107 S: 5.9.2 L: 11-13	**Comment:** These lines state an opinion. Please delete these lines. They do not support uncertainties in the conceptual site model. **Basis/Justification:** Sentence is an opinion and does not support uncertainty in conceptual site model.	See comment.
Item 211 P: 5-109 S: 5.9.4.1 L: 37-42	**Comment:** Please ensure that this assumption matches similar assumptions used in other 100 Area RI/FS documents. I do not think this assumption was used in 100-D/H. **Basis/Justification:** Accuracy	Provide basis for this assumption.
Item 212 P: 5-112 S: 5.9.4.1 L: 1-2	**Comment:** Please provide whether this includes MORE time steps or LESS time steps. **Basis/Justification:** Clarity and accuracy.	Explain what "time stepping restriction" entails.
Item 213 P: 5-112 S: 5.9.4.1 L: 8-13	**Comment:** Provide how this relates to 100-N. **Basis/Justification:** Clarity and accuracy.	See comment and justification.
Item 214 P: 5-112 S: 5.9.5 L: 15-17	**Comment:** Include the continuing source related to TPH-D. It is well established that the diesel plume is a continuing source from the vadose zone to the aquifer and should be recognized as well as the continuing sources of Sr-90 and nitrate. Provide a detailed discussion of it.	See comment and justification.

Item 215 P: 5-112 S: 5.9.5 L: 18-31	**Comment:** Provide evidence that supports the assumption related to the first meter of Sr-90 above the water table reaching groundwater within the simulation period. Provide the Sr-90 maximum concentration that migrates and reaches the aquifer after 300 years out to 1,000 years from now. Please provide the nitrate maximum concentration that migrates and reaches the aquifer over the next 1000 years through the vadose zone.	See comment.
Item 216 P: 5-113 S: 5.9.5 L: 3-6	**Comment:** The discussion talks about 3 to 30 feet scale for various structures. Clearly, the groundwater model can provide structures on "tens of meter scale". This is greater than 30 feet. **Basis/Justification**: Scale discretization needs to be fine-tuned to address changes that can distinguish features that are "tens of meter scale".	Provide the level that the model was designed to account for heterogeneity.

Item 217 General Chapter 6 Chapter 7	**Comment:** In calculating exposure point concentrations (EPCs), the 95% UCL should be used, including when the 95% UCL is greater than the maximum and including when the 95% UCL exceeds the 90th percentile. Ecology has consistently stated that the 95% UCL should be used in both of these cases. Locations throughout the RI/FS with language pertaining to this issue include: • Section 5.8.1.1, Page 5-92, Lines 2-14 • Section 6.2.2.2.4, Page 6-26, Lines 35-37 • Section 6.2.2.2.4, Page 6-27, Lines 1-3 • Section 6.2.2.3, Page 6-27, Lines 13-14 • Section 6.2.2.3.1, Page 6-27, Lines 24-28 • Section 6.2.2.3.1, Page 6-28, Figure 6-3 • Section 6.3.2.3.10, Page 6-126, Lines 12-34 • Section 6.3.2.3.10, Page 6-129 • Section 7.4.9, Page 7-59, Lines 34-40 **Basis/Justification:** Use of the 90th percentile to calculate EPCs is not consistent with OSWER 9285.6-10. EPA's ProUCL methods should be followed. Ecology has consistently stated it is not acceptable to use the maximum for an EPC in cases where a 95% UCL is greater than the maximum. This generally occurs when the data set is small, creating uncertainty about the concentration because small data sets are often not representative of a population. Ecology is required to err on the side of protection. In this case that would be to use the 95% UCL. Comparisons of EPC values against WAC 173-340 values should be done following WAC 173-340-720(9)) and -740(7). The 95% UCL should be used based on the Chebyshev inequality (ProUCL version 4.1,	Use the 95% UCL rather than the 90th percentile for calculating EPCs. Use the 95% UCL rather than the maximum detected concentration. Only in cases of n<5 and/or n'<2 should the maximum be used for the EPC (where n is the number of observations and n' is the number of detections).

Item 218 P: 6-4 S: 6.1.1	**Comment:** It is noted that calculations in Chapter 2 or the RCBRA differ from those in CVPs.	Please discuss why there is a difference.
Item 219 P: 6-18 S: 6.2.1.3 L: 5	**Comment:** The text states that all analytes detected at least once in a waste site decision unit for the 28 waste sites included in the risk assessment are identified as COPCs. Please explain the basis of the 28 waste sites. The previous sections refer to the number of sites being 33.	Please explain the basis of the 28 waste sites. The previous sections refer to the number of sites being 33.
Item 220 P: 6-24 Fig. 6-1	**Comment:** The flow chart states that if results are from a field duplicate, they will process parent and duplicate results to represent a single set of results per location and time. Please explain what the process entails. Is it the averaging of the two results, the selection of the highest result, or another form of data evaluation?	Please explain what the process of data reduction for the parent and duplicate results entails. Is it the averaging of the two results, the selection of the highest result, or another form of data evaluation?

Item 221 P: 6-27 S: 6.2.2.3.1 L: 30-34	**Comment:** The document states "Because the sampling design for these decision units focused on areas of suspected contamination, the conclusion that maximum detected concentration exceeds the true population mean in a focused decision unit can be made with certainty. Additionally, the closeout documentation for the focused decision units used the maximum detected concentration to determine whether the remedial action.. goal has been attained..." This text is misleading. The text is also not from the quoted source (Section 3.6.3 of DOE/RL-96-17 Rev. 6). **Basis/Justification:** A suspected area is not a certain area of contamination, and is not inclusive of all of the site contamination. The areas chosen for focused sampling are often chosen on the basis of indirect evidence, such as geophysical anomalies, and not based on analytical data for all of the contaminants. Furthermore, the maximum detected concentration is not necessarily a conservative result, since the limited coverage in focused designs may miss the areas of highest contamination.	Please delete the quoted text.

Item 222 P: 6-33 S: 6.2.3.3 L: 6-33 & through-out document	**Comment:** Given the Hanford site soil background value for arsenic in Table 4-1 (6.47 mg/kg), the appropriate value to use for arsenic background is Hanford site background. This can be done easily for 100-N as it appears from the data that soil and vadose zone solid samples are all below 6.47 mg/kg. **Basis/Justification:** Hanford waste sites typically include mixtures of many chemicals used at Hanford. These waste sites generally do not qualify for use of Method A (WAC 173-340-704): "Method A may be used to establish cleanup levels at sites that have few hazardous substances and that meet one of the following criteria: (a) Sites undergoing a routine cleanup action as defined in WAC 173-340-200; or (b) Sites where numerical standards are available in this chapter or applicable state and federal laws for all indicator hazardous substances in the media for which the Method A cleanup level is being used." The Method A cleanup level for arsenic in soil (unrestricted land use) is given as 20 mg/kg (Table 740-1 [WAC 173-340]). However, waste sites in the River Corridor are neither routine (according to WAC 173-340-200, especially due to ecological considerations) nor consist of only contaminants that are listed in Table 740-1 (WAC 173-340). Therefore, Method B equations are applicable (WAC 173-340-705). Method B arsenic cleanup levels and related levels for human health protection are listed below: • Direct contact: 0.67 mg/kg (WAC 173-340-740) (Equation 740-2) • Protection of groundwater using a default model (WAC 173-340-747, Equation 747-1): • 0.034 mg/kg (risk = 1E-06) • 0.34 mg/kg (risk = 1E-05) • Hanford site Background: 6.47 mg/kg (90th percentile: Table 4-1) (direct contact risk	In general, human health cancer risk and hazard indices should be calculated both with and without arsenic in the calculations to allow an evaluation of whether or not a remedy will address excess arsenic even if arsenic is not the target contaminant. However, it appears that vadose zone soil samples are all below 6.47 mg/kg, so please revise the text on page 6-33, line 21 as follows: "Arsenic was not included in the risk calculations because it was not detected above the Hanford Site background value of 6.47 mg/kg (Table 4-1) in the 100-N area soil samples. For ~~arsenic and~~ lead, Table 740-1 Method A..."

Item 223 P: 6-41 S: 6.2.3.4.2 L: 19	**Comment:** The title of this section should specify direct contact. **Basis/Justification:** Only direct contact pathways for MTCA are discussed in this section. Standard Method B includes calculations for soil for the protection of groundwater (leaching) and ecological receptors, and groundwater, surface water, and air.	Change the title of the section to Calculation of Unrestricted Land Use Direct Contact PRGs using 2007 MTCA Equations.
Item 224 P: 6-45 S: 6.2.4.2.3 L: 15-17	**Comment:** The document states "For several nonradionuclide analytes, the toxicity value used was obtained from a different source than recommended by the EPA Superfund hierarchy (Superfund HHT Risk Assessment Values [Cook, 2003])." However, the text goes on to discuss toxicity information that would qualify as Tier 3 according to OSWER 9285.7-53 (Cook, 2003). **Basis/Justification:** The text discusses Cal EPA OEHHA, NJDEP and HEAST. These generally qualify as Tier 3. Also see OWER 9285.7-86.	Revise the text considering OSWER guidance for Tier 3 toxicity values.
Item 225 P: 6-45 S: 6.2.4.2.3 L: 18-31	**Comment:** The document discusses that the recent change in the cancer slope factor for trichloroethene (TCE) would result in increases in cleanup levels. However, this is superseded by the recent reduction in the noncancer reference dose and inhalation reference concentration. **Basis/Justification:** The revised noncancer reference dose in IRIS is 5E-04 mg/kg/day for TCE, and the revised RfC is 2E-03 mg/m^3. Ecology PCE and TCE guidance of September, 2012 ("Trichloroethylene Toxicity Information and MTCA Cleanup Levels (TCE), CAS # 79-01-6," September 2012, <https://fortress.wa.gov/ecy/clarc/FocusSheets/TCE%20PCE%20Oct%2004%20Final.pdf>, accessed on September 23, 2013).	See comments 234, 235, & 236 and revise this section to be consistent with section 6.3.8.4.1, p. 6-178-6-179; use the same toxicity factors in both sections.

Item 226 P: 6-46 S: 6.2.4.2.3 L: 6-16	**Comment:** The document states "When evaluating toxicity, 1,1-dichloroethane is not considered a carcinogen by Ecology." This is not correct. **Basis/Justification:** Though no slope factor value is given in CLARC on-line for 1,1-dichloroethane, a link is provided to an explanation about toxicity database hierarchy, with discussion about using Tier 3 values based on OSWER Directive 9285.7-53. The slope factor given in the Regional Screening Levels qualifies as a Tier 3 carcinogenic slope factor. Therefore, this is a defensible value that is consistent with CLARC on-line. Ecology considers 1,1-dichloroethane to be a carcinogen.	Delete the quoted text, and use the slope factor from the Regional Screening Levels.
Item 227 P: 6-46 S: 6.2.5 L: 32-34	**Comment:** "-4" and "-6" should be in superscript as it is representing 10^{-4} and 10^{-6} risk. This issue repeats itself on pages 6-46, 6-64, 6-66, Table 6-35, Table 6-51, Basis/Justification: Consistency throughout the document.	Correct locations throughout the document where numbers should be in superscript text.
Item 228 S: 6.3.2 General	**Comment:** The method for selecting groundwater COPCs is not accepted. The rejection of contaminants based on comparison with action is not accepted. **Basis/Justification:** Ecology has consistently rejected comparisons with action levels as a basis for selecting contaminants because this approach overlooks spatial and temporal trends and additive risks associated with multiple contaminants.	Contaminants for which there is insufficient information to calculate risk can be eliminated and discussed as uncertainties. Eliminated contaminants can include the following: 1) chemicals not detected in all measurements (where the practical quantitation limit [PQL defined in WAC 173-340-707] is below the EPC) 2) chemicals without toxicity factors 3) chemicals with EPCs below background concentrations (as defined in WAC 173-340-709). All other contaminants should be included in risk calculations for the locations where they have been detected, including chemicals with a combination of detects and nondetects.

Item 229 S: 6.3.2 General	**Comment:** Pooling of data from multiple wells for calculation of EPCs is not accepted. **Basis/Justification:** Risk should be evaluated at the scale encountered by receptors, according to the exposure scenarios used for risk assessment. For example, for a residential scenario, the assessment scale for groundwater should be no larger than a single drinking water well.	Exposure point can be defined as "a location of potential contact between an organism and a chemical or physical agent" (Risk Assessment Guidance for Superfund, USEPA, 1989). The exposure point concentration (EPC) has been defined as a "conservative estimate of the average chemical concentration in an environmental medium.....The EPC is determined for each individual exposure unit within a site. An exposure unit is the area throughout which a receptor moves and encounters an environmental medium for the duration of the exposure" (OSWER 9285.6-10, USEPA, 2002; Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites). Comparisons of EPCs with PRGs should be done on a well by well basis, rather than by pooling data from multiple wells, to maintain consistency with the definition of exposure point for a residential scenario.
Item 230 P: 6-63 S: 6.3.2 L: 7-12 & P: 6-64 L: 27-28 & P: 6-65 L: 15-16	**Comment:** The text states "As shown in Table G-20 (Appendix G), all arsenic EPCs are less than the Method A arsenic soil cleanup level of 20 mg/kg for unrestricted use." This can be a stronger statement, indicating that all of the arsenic values are less than the Hanford site background value of 6.47 mg/kg (Table 4-1). **Basis/Justification:** Table A-1 of ECF-100-NR1-12-0042, Draft A, p. G-646-654 shows that all arsenic concentrations in soil are less than Hanford site background. (Note: Table G-20 could not be located).	Please rephrase the quoted text to 'As shown in Appendix G, all arsenic EPCs for soil are less than the soil cleanup level of 20 mg/kg and also are less that the Hanford site background value of 6.47 mg/kg."
Item 231 P: 6-103 Table 6-22	**Comment:** All but one isotope in the table has a "Minimum Detection Limit" that is negative. This is also true with many other tables that include "Minimum Detection Limit". This should be explained.	Explain negative minimum detection limits.
Item 232 P: 6-103 Table 6-22	**Comment:** "gross beta" has units of "µg/L". There are a number of other tables in which some of the radioactive material has units of "µg/L".	Check units for accuracy.

Item 233 P: 6-169 & 6-170 Table 6-48	**Comment:** There may be errors in the chloride and fluoride data. **Basis/Justification:** The 90th percentiles reported are somewhat higher than the maxima for chloride and fluoride.	Check chloride and fluoride data for errors.
Item 234 P: 6-178 S: 6.3.8.4.1 L: 37-39	**Comment:** The text states "Accounting for kidney cancer risks from early-life exposure would result in slightly more conservative value (by a factor of 2) for the oral slope factor." It is not clear what is meant by "accounting for." **Basis/Justification:** The composite slope factor of 0.046 $(mg/kg\text{-}day)^{-1}$ is about half of the former slope factor of 0.089 $(mg/kg\text{-}day)^{-1}$, which would make the new cleanup levels higher and less conservative than the old. Is the statement referring to only early-life exposures, using a slope factor of 0.093 $(mg/kg\text{-}day)^{-1}$?	Please add more explanation to the text to indicate the meaning of "accounting for."
Item 235 S: 6.3.8.4.1 P: 6-178 L: 43-44 & P: 6-179 L: 13	**Comment:** Text states "..., the groundwater concentration would increase from 0.49 µg/L to 0.95 µg/L." The 0.95 µg/L should be corrected to 0.54 µg/L. Cleanup level for TCE is again incorrectly listed as 0.95 µg/L on Page 6-179, Line 13. **Basis/Justification:** Ecology PCE and TCE guidance of September, 2012 ("Trichloroethylene Toxicity Information and MTCA Cleanup Levels (TCE), CAS # 79-01-6," September 2012, <https://fortress.wa.gov/ecy/clarc/FocusSheets/TCE%20PCE%20Oct%2004%20Final.pdf>, accessed on September 23, 2013).	Please correct the 0.95 µg/L to 0.54 µg/L.

Item 236 P: 6-179 S: 6.3.8.4.1 L: 18-19	**Comment:** The text indicates an increase in the TCE HQ by a factor of almost 200. However, the oral reference dose increase has only been roughly a factor of 5/3. Has inhalation been considered? **Basis/Justification:** The old oral RfD was 0.0003 mg/kg/day, while the revised is 0.0005 mg/kg/day.	Please explain the HQ values presented in the text and show the derivation.
Item 237 P: 6-196 S: 6.5.1.1 L: 38-41	**Comment:** The text states "The concentrations of arsenic in vadose zone material posing risks greater than 10^{-6} are consistent with sitewide naturally occurring background in vadose zone material." A comparison is needed with Hanford site background. **Basis/Justification:** The data provided with this RI/FS for the vadose zone show no soil results exceeding the Hanford site arsenic background value of 6.47 mg/kg (DOE/RL-92-24, Volume 1, Rev. 4). A text change is needed to bring this in line with the definition of natural background (specified in WAC 173-340-740(5)(c)), in WAC 173-340-200.	Change the text to: "The concentrations of arsenic in vadose zone material posing risks greater than 10^{-6} are less than Hanford site background concentrations of 6.47 mg/kg in vadose zone material (DOE/RL-92-24, Volume 1, Rev. 4)."

Item 238 P: 6-197 S: 6.5.1.3 L: 27-39 & Table 8-10	**Comment:** Americium-241 and plutonium-239/240 should be contaminants of concern (COCs) and remedies should be included for these contaminants at 116-N-3 and 116-N-1.They would be a risk to inadvertent intruders through excavations. **Basis/Justification:** The text states "As a result of the presence of americium-241 and plutonium-239/240, activities of all radionuclides will not decay to a cumulative ELCR of less than 1.0 x 10^{-4} within a reasonable period." Discrete locations of long lived isotopes in the deep zone above direct exposure PRGs may warrant institutional controls not for 200-300 years, but for thousands of years. Public opinion has been that ICs for very long timeframes in the river corridor are unacceptable.	Include americium-241 and plutonium-239/240 as soil COCs and describe remedies for these radionuclides. Retain deep excavation for the 116-N-1 and 116-N-3 waste sites as a technology in Table 8-10. Evaluate excavation of these sites to remove long lived radionuclides. A full comparison of deep excavation vs. very long term ICs should be made. All retained technologies should have associated bulleted lists, tables, figures, and text updated.
Item 239 P: 7-6 S: 7.1.3 L: 20-34	**Comment:** The pH range cited (5.8-8.7) for the Tier 2 study (ECF-HANFORD-11-0158) overlaps with the pH range for potential Fe bioavailability (pH>8). **Basis/Justification:** The bioavailability of Fe is a function of soil pH.	Acknowledge that Fe may be bioavailable in high pH soils on the Hanford Site (pH>8) and may mediate potential toxicity of other metals.
Item 240 P: 7-12 S: 7.2.3 L: 16-17	**Comment:** For wildlife, screening values are more appropriately based on NOAELs, rather than LOAELs. **Basis/Justification:** MTCA allows Ecology to recommend NOAEL-based TRVs for substitute receptor species (WAC 173-340-7943[7][f][i]). In addition, ERAGS recommends use of NOAELs as screening ecotoxicity values for protection of wildlife, and EcoSSLs for wildlife select TRVs based on NOAELs.	Use NOAELS as a screening ecotoxicity value for wildlife populations.

Item 241 P: 7-13 S: 7.2.3 Fig. 7-1	**Comment:** External exposure (rads) is missing in Figure 7-1 from seeps and upwelling sites (surface water, porewater, sediments) for aquatic biota. Note too that external exposure from soil does not apply to aquatic biota (as indicated in the figure). The groundwater exposure point (which includes a crop irrigation pathway [per footnote d]) should result in complete pathways for many pathway/receptor combinations (e.g., direct contact and uptake by plants/soil biota for soil biota, invertebrates, plants; incidental/preferential ingestion and food web transport for herbivores, insectivores, omnivores, carnivores). Also, the exposure point for seeps/upwelling sites (surface water, porewater, sediments) should include complete pathways for incidental ingestion and food web transport for aquatic invertebrates, fish, and amphibians. **Basis/Justification:** All complete pathways should be shown. These include pathways related to external exposure (rads) and groundwater (via seeps and upwelling sites, including surface water, porewater, and sediment).	Add external exposure (rads) from seeps and upwelling sites for aquatic receptors. Delete external exposure from soil for aquatic receptors. Re groundwater-based pathways, mark those described in the comment as complete.
Item 242 P: 7-20 S: 7.3.1.2 L: 14-15	**Comment:** Text states, "The use of the EC20, MATC, and EC10 as toxicity parameters means that Eco-SSLs for plants and soil invertebrates are not based directly on no observed adverse effects...." However, because some Eco-SSLs for plants and invertebrates are based on MATC (and MATC is the geometric mean of NOAEC and LOAEC), MATC is directly based on NOAEC and LOAEC. **Basis/Justification:** The relationship between EcoSSL and NOAEC for plants and soil invertebrates needs clarification.	Clarify text on the relationship between EcoSSL and NOAEC for plants and invertebrates.

Item 243 P: 7-28 S: 7.3.1.2 L: 16-20	**Comment:** Consistent with EcoSSL derivation for wildlife, NOAELs should be used to derive Hanford SSLs and PRGs for wildlife. **Basis/Justification:** EcoSSL methodology should be followed, and MTCA allows Ecology to recommend NOAEL-based TRVs for substitute receptor species (WAC 173-340-7943[7][f][i]).	Hanford SSLs and PRGs should be based on NOAELs for wildlife.
Item 244 P: 7-28 S: 7.3.1.2 L: 21-36	**Comment:** In a departure from the arsenic EcoSSL, text recommends using Stanley et al (1994) to select a TRV (rather than Holeman and Stibilj, 1997), based on a longer exposure duration and a bounded NOAEL in Stanley et al (1994). However, note that Stanley et al (1994) evaluated sodium arsenate (As+5), while Holeman and Stibilj (1997) evaluated arsenic oxide (As+3). **Basis/Justification:** EcoSSL methods should be followed for evaluating As+3, as well as As+5.	Consistent with the EcoSSL, use the Holeman and Stibilj (1997) study to select a TRV for As+3. The Stanley et al (1994) study could then be used to select a TRV for As+5.
Item 245 P: 7-30 S: 7.3.2.2 L: 18-24	**Comment:** It is unclear why ingestion of soil and food are evaluated separately from ingestion of water for wildlife. **Basis/Justification:** Contaminant exposure from all media and pathways should be evaluated in a coherent manner.	Clarify why ingestion of seep water was evaluated separately from ingestion of soil and food. Consider evaluating all exposure pathways in a single exposure model.
Item 246 P: 7-31 S: 7.3.2.2 L: 5	**Comment:** Equation is incorrect. "SSL or PRG" term should be grouped with "$Frac_s$" term. Please see EPA EcoSSL Attachment 4-1 (see Equation 4-2 in OSWER Directive 9285.7-55). Also, the equation is inverted (more typically, HQ=exposure/effects). **Basis/Justification:** Equations should be accurate in terms of dimensional analysis.	Correct the equation, according to the comment.

Item 247 P: 7-32 S: 7.3.2.2 L: 1-4	**Comment:** Contrary to text, incidental soil ingestion is included as part of the total dietary composition (Ps term). In the example of the California quail, total food intake (plants plus soil) should sum to 100% (not 106.1%). **Basis/Justification:** Ps is the proportion of total food intake that is soil (kg soil/kg food).	State that incidental soil ingestion was included as part of the total dietary composition.
Item 248 P: 7-38 S: 7.3.2.2 L: 11-12	**Comment:** According to Efroymson et al (2001), hyperaccumulators were excluded from the plant bioaccumulation database. Provide rationale for adopting this exclusion. **Basis/Justification:** Exclusion of metal hyperaccumulators would result in a biased distribution of plant species, comprising the bioaccumulation database.	Please explain why plant species that hyperaccumulate metals were excluded (i.e., biasing BAFs low).
Item 249 P: 7-41 S: 7.3.2.2 L: 22-23	**Comment:** NOAELs (rather than LOAELs) should be used to derive wildlife SSLs. **Basis/Justification:** EcoSSLs for wildlife are based on NOAEL TRVs (see p. 7-28). Re PRGs, overriding the NOAEL vs. LOAEL debate, a recent SETAC workshop ("Ecological soil levels-Next steps in the development of metal cleanup levels," Sept 2012) notes that exposure-response functions (e.g., ECx) are preferred to threshold approaches (e.g., NOAEL, LOAEL) when establishing wildlife TRVs to be used for site cleanup (i.e., beyond the screening stage). NOAEL can correspond to potentially large and potentially biologically important magnitude of effect (LOAEL would correspond to an even larger effect). The advantage of the regression method for the estimation of ECx is that information from the complete exposure-response function can be taken into account and confidence intervals can be calculated.	Use NOAEL TRVs to derive SSLs for wildlife, and acknowledge that exposure-response functions are preferred for wildlife PRG derivation.

Item 250 P: 7-47 S: 7.3.4 Table 7-5	**Comment:** The plant PRG selected for Pb (9090 mg/kg) appears high, relative to the EPA EcoSSL for plants (120 mg/kg), Ecology recommended values for plants (50 mg/kg [MTCA Table 749-3] and 390 mg/kg [Ecology Pub. No. 11-03-006]), as well as the RCBRA PRG for plants (125 mg/kg). **Basis/Justification:** Although the current study (9090 mg/kg) is site-specific (Sandberg bluegrass), EPA (120 mg/kg) considered multiple species with a systematic process, Ecology (390 mg/kg) was partly site-specific (soil but not test organism), and RCBRA (125 mg/kg) was site-specific (Sandberg bluegrass). Given the variability in soil and plant factors, a weight of evidence approach argues for a lower plant PRG for Pb. Also, the 9090 mg/kg is based on bioassay results. It appears that this result is from a waste sample from the Old Central Shop Area (OCSA) north of the 200 areas. In fact, 58 out of the 71 samples used for the lead bioassay analysis were from the OCSA. There were many other high lead samples from the OCSA and there was a large range of concentrations from this site. Without a description of this site and knowledge of the potential forms of lead at this location it is not possible to determine if this area represents most of Hanford lead-contaminated soil. Lead concentrations from the samples from the other 5 waste sites range from 4 to 87.2 mg/kg.	Reduce the plant PRG for Pb (Table 7-5), based on a weight of evidence approach. Also, add the following to this document: discussion of the OCSA, the other sources of soil for the plant and invertebrate bioassays, the potential forms of lead at the soil sampling locations, how representative these samples are of Hanford lead and other contaminants.

Item 251 P: 7-50 S: 7.4.1 L: 16-23	**Comment:** PCB data are preferentially expressed as congeners for ecological risk assessment, rather than as Aroclor mixtures. Also, the last sentence (lines 21-23) does not make sense, since HI>1 implies risk (rather than no risk). **Basis/Justification:** Aroclor data are imprecise, due to analytical limitations (e.g., chromatogram pattern recognition), as well as weathering in the environment. Furthermore, a congener approach is needed to assess toxicity of dioxin-like PCBs (e.g., as TEQ) and non-dioxin-like PCBs. Total PCBs is also more accurately quantified by summing individual congeners, rather than summing Aroclors (which contain overlapping congeners).	Acknowledge the uncertainty and limitations of evaluating PCBs with Aroclor vs. congener analysis. Please clarify the final sentence too (lines 21-23).
Item 252 P: 7-54 S: 7.4.8	**Comment:** Although drinking water is largely shown to be negligible in terms of total exposure, a single exposure model (including all pathways) is less fragmented and more transparent. **Basis/Justification:** A single exposure model, including all pathways, is more economical.	Consider including drinking water exposure in a single wildlife exposure model.

Item 253 P: 7-59 S: 7.4.9 L: 34-40	**Comment:** A 95UCL should be calculated to represent EPC, independent of receptor type when local populations are considered. For example, a population of individuals of an immobile species (e.g., a terrestrial plant) may be distributed over a range of contaminant concentrations in soil. Therefore, a UCL95 (rather than the max) is the best estimate of EPC for an immobile species (just as it is for a mobile species). In addition, use of the max ignores most of the information in the data set. When the number of measurements is small (e.g., n<5) or the detection frequency is low (<5%), ProUCL ultimately recommends collection of more samples to compute defensible statistics. **Basis/Justification:** EPA's ProUCL methods should be followed.	When possible, 95UCL should be calculated to represent EPC. Only in cases of small sample size (e.g., n<5) or low detection frequency (<5%) should EPC defer to the observed max, noting the uncertainty in EPC.
Item 254 P: 7-70 S: 7.5.5.2 L: 26-28	**Comment:** In this section on "Risks to Aquatic Plants," text states, "For the 100-N Area nearshore sampling sites, no COPECs were detected in nearshore sediment at concentrations greater than the upper threshold sediment biota ESL (Appendix M, Table M-37)." However, sediment ESLs are typically derived for invertebrates (e.g., Chironomous, Hyalella [Ecology Pub No 11-09-054]), not aquatic plants. **Basis/Justification:** Risks to aquatic plants should be assessed against relevant ESLs, (derived for aquatic plants).	Please revise text, noting the uncertainty contributed by the assumed relevance of sediment ESLs to aquatic plants.
Item 255 P: 7-70 S: 7.5.5.2 L: 36-42	**Comment:** The description of lab plant bioassays with field-collected sediments needs more detail. **Basis/Justification:** Bioassays need to be described in adequate detail.	Provide more details on lab bioassays with field-collected sediments (e.g., plant species, bioassay design, endpoints, numbers of plants, replicates, and so on).

Item 256 P: 7-74 S: 7.6 L:4-7 & 12-14	**Comment:** Text states, "Within the 100-N, 10 waste sites were retained for additional consideration in the SMDP based on EPC exceedances of 6 COPECs (barium, copper, lead, TPH-DR, and TPH-DR extended to C36, and high boiling hydrocarbons), as presented in Sections 7.4.7 and 7.4.9." However, in addition to the 6 COPECs listed, Table H-14 also includes vanadium, as well as several PAHs (acenapthene, BaP, BbF, chrysene, fluoranthene, pyrene). Please reconcile this discrepancy. Text goes on to say, "The final recommendation for the SMDP is a conclusion that there were no potential risks to terrestrial ecological receptors within the upland remediated waste sites and 100-NR-1 source OU warranting further evaluation in the FS." Therefore, 10 waste sites show EPCs>PRGs, along with several additional contaminants (e.g., V, PAHs), yet none of these waste sites are carried into the FS on the basis of SMDP arguments. This elimination of remediated waste sites (from being carried to the FS for remedy evaluation) appears unbalanced with respect to uncertainties inherent in the risk assessment process which are intrinsic to a weight of evidence approach. **Basis/Justification:** First, this exclusion of waste sites (with EPC>PRG) undermines the utility of PRGs as a criterion to identify COPECs, since these waste sites are not retained. Second, Table H-14 appears to systematically reject observed results (EPC>PRG) by invoking SMDP considerations (e.g., sample depth in relation to ecological receptors, magnitude and frequency of PRG exceedances, confidence in PRG, data quality, spatial factors [e.g., home range, adjacent unimpacted habitat], potential cross contamination) in a unilateral direction to eliminate COPECs and waste sites. That is, SMDP concerns are never employed to include a	COPECs with EPC>PRG should generally be retained for further evaluation in the FS with few exceptions (e.g., EPC<background).

Item 256 P: 7-78 S: 7.6.4 L: 40-43	**Comment:** Re radionuclides, the EU has proposed a more stringent generic screening value (predicted no effect dose rate [PNEDR]) of 10 μGy/h (0.024 rad/d) for nonhuman biota (Andersson et al. 2009. JER 100:1100-1108). **Basis/Justification:** The EU value is based on a probabilistic species sensitivity distribution (SSD), applies a cut off value for this distribution at the 5th percentile (hazardous dose rate [HDR5]), and divides HDR5 by an assessment factor (AF) of 2 to derive a generic PNEDR screening value. Therefore, the resulting PNEDR is assumed to protect 95% of all species.	Acknowledge the EU radiological dose recommendation for nonhuman biota.

Item 257 P: 7-80 S: 7.6.5 L: 13-25	**Comment:** It is unclear how NOECs and LOECs were derived for nitrate from the cited studies on fish (McGurk et al, 2006), invertebrates (Camargo et al, 2005), and amphibians (Johannsen et al, 2002). The CRC (p. 7-3 in DOE/RL-2010-117) states the following, "The nitrate and nitrite NOEC values are both obtained from study results obtained from the scientific literature, and uncertainty factors were applied to obtain a chronic NOEC. A greater amount of uncertainty is associated with these NOECs than with other values." Re invertebrate nitrate toxicity, the nitrate LOEC value (i.e., 37.6 mg NO3/L [8.5 mg NO3-N/L]) is apparently a 120 hr LC10 for a gammarid (E. echinosetosus) (Camargo et al, 2005) which is not a particularly sensitive measure (10% lethality). This same study (Camargo et al, 2005) reports a 120 day LC0.01 (2.8 mg NO3-N/L) for E. echinosetosus which is similar to their recommendation (2.0 mg NO3-N/L) for protection of freshwater biota. **Basis/Justification:** Methodology to derive NOECs and LOECs should be described with sufficient detail for understanding their basis, including an explanation of uncertainty factors.	Please clarify how NOEC and LOEC values were derived from the literature cited.

Item 258 P: 7-81 S: 7.6.5.1 L: 8-18	**Comment:** Text states, "Risk to aquatic life, including plants, was evaluated exclusively through the comparison of surface water concentrations to benchmarks in Section 7.2.1 of the CRC (DOE/RL-2010-117). Since surface water concentrations of nitrate were below benchmarks (Table 7-10), no risk to aquatic plants from nitrate was identified." This conclusion is not warranted. **Basis/Justification:** First, ESLs in Table 7-10 are not specific to aquatic plants (listed ESLs are for invertebrates and fish). Second, it is possible that plants can take up nitrate from other aqueous media (e.g., near shore pore water and seeps, rather than exclusively surface water) for which there were several exceedances of ESL benchmarks (Table 7-10). In addition, plants may take up nitrate from sediment (which is not presented in Table 7-10). Finally, bioassays in RCBRA were performed with Pak Choi which lack site specificity at Hanford.	Note that risks to aquatic plants are uncertain, due to lack of relevant benchmarks and possible nitrate uptake via pore water and seeps with resultant toxicity.
Item 259 P: 7-82 S: 7.6.5.2 L: 4-10	**Comment:** Use of the term "normal distribution" is unclear with respect to taxonomic groups (e.g., mollusks, insects, invertebrates). **Basis/Justification:** A statistical distribution refers to an arrangement of values of a variable, showing their frequency of occurrence.	Please define a "normal distribution of mollusk species" and a "normal distribution of insects and other invertebrates."

Item 260 P: 7-82 S: 7.6.5.3 L: 24-27	**Comment:** If reference to "(subsequent Table 7-11)" was intended to be to "Table 7-10," it is unclear how a conclusion of no risk to amphibians was reached. **Basis/Justification:** ESLs in Table 7-10 are not specific to amphibians (listed ESLs are for invertebrates and fish). Also, it is possible that amphibians can take up nitrate from other aqueous media (e.g., near shore pore water and seeps, rather than exclusively surface water) for which there were several exceedances of ESL benchmarks (Table 7-10).	Note that risks to amphibians are uncertain, due to lack of relevant benchmarks and possible nitrate uptake via pore water and seeps with resultant toxicity.
Item 261 P: 7-82 S: 7.6.5.3 & 7.6.5.4 L: 27, 42	**Comment:** Reference is made to "(subsequent Table 7-11)," but Table 7-11 lists freshwater sediment PRGs (unrelated to nitrate benchmarks). **Basis/Justification:** Reference to tables and tables should match.	Clarify reference to "(subsequent Table 7-11)."
Item 262 P: 8-1 S: 8 Text box	**Comment:** Text box should include information regarding both of the Interim Action RODs at 100-N. **Basis/Justification:** 116-N-1 (1301-N), 116-N-3 (1325-N), and UPR-100-N-31 were remediated under the authority of the 2000 TSD ROD.	Update text in 4th bullet to include both the 1999 and 2000 interim action RODs.
Item 263 P: 8-4 Table 8-1	**Comment:** The table has cyanide classified as "Other Analytes". However, previous tables and text (specifically, Tables 4-27, 4-29-4-32; and page 4-142, Line 1, etc.) have cyanide classified as an Anion. Since the Anion classification is listed in Table 8-1, please explain why cyanide has not been classified as such in this section of the document.	Please explain why cyanide has not been classified as an Anion in this section of the document, when previous chapters have identified it as such.
Item 264 P: 8-7 S: 8.1.2.3 L: 24-27	**Comment:** WAC-173-200 Water Quality Standards for Groundwaters of the State of Washington does not apply to clean up actions under MTCA or CERCLA. **Basis/Justification**: WAC 173-200-010(3)(c)	Remove WAC-173-200 from the potential ARARs list.

Item 265 P: 8-8 Table 8-2	**Comment:** Table 8-2 is missing some ARARs. Since CERCLA excludes petroleum the authority that allows for petroleum cleanup is corrective action. All petroleum cleanup must meet WAC 173-340-900 requirements for petroleum. **Basis/Justification:** Washington Administrative Code WAC 173	Add the following ARARs: WAC 173-400-113 WAC 173-218-120 WAC 173-340-900; Table 830-1 and Table 747-4
Item 266 P: 8-9 S: ARAR Table 8-2	**Comment:** An additional citation to the ARAR for Compliance Monitoring is required. Also missing the #9 in the current citation. **Basis/Justification:** WAC 173-340-720	Change to: "Compliance Monitoring" WAC 173-340-720 (9)(a-f)
Item 267 P: 8-12 Table 8-2	**Comment:** Table 8-2 is missing some ARARs. **Basis/Justification:** WAC 173-340	Add the following ARARs: WAC-173-340-730(1) WAC-173-340-730(7)(d) WAC-173-340-730(7)(e) WAC-173-340-730(7)(f)
Item 268 P: 8-16 Table 8-2	**Comment:** Include all of WAC 173-340-7490 and WAC 173-340-7493 as an ARAR. **Basis/Justification:** The ecological citation come from the cleanup standard in WAC 173-340-740 and -745 which is include all of the citation and is appropriate for ecological protection.	WAC 173-340-7490 ~~(2)~~ WAC 173-340-7493 ~~(3)~~
Item 269 P: 8-26 Table 8-2	**Comment:** TSD closure authority comes from the Site-wide permit not a CERCLA ROD. **Basis/Justification:** The decision to integrate closure action with CERCLA are determined by the state under WAC 173-303-610(1)(e) and WAC 173-303-645(1)(e). This integration requires a director's determination.	Closure of TSD units ~~will~~ may be coordinated with the remedial actions at 100-N.
Item 270 P: 8-26 Table 8-2	**Comment**: Include the text in modification column for completeness. **Basis/Justification:** WAC 173-303 Dangerous Waste Regulations	These requirements are applicable to the closure of RCRA TSD unit within 100-N. The authority for the closure comes from the Dangerous Waste Regulation WAC 173-303 applied through the Site-wide Permit.

Item 271 P: 8-35 S: 8.1.4 L: 10-12	**Comment:** Text states that in Table 8-3 each analyte has a PRG for groundwater/surface water protection highlighted in green. This statement is not true; many analytes have no highlighted PRG for groundwater/surface water protection. **Basis/Justification:** Statement is incorrect.	Either clarify text on p. 8-35 or update table 8-3 to adequately highlight PRGs for groundwater/surface water protections.
Item 272 P: 8-36 S: 8.1.4.2 L: 16-17 & Table 8-3 & P: 9-27 S: 9.2.2.4 L: 36	**Comment:** Using the MTCA Method A cleanup values for TPH fractions is inappropriate. **Basis/Justification:** 100-N has multiple co-contaminants in many locations. MTCA Method B is a more appropriate basis for direct exposure cleanup values. Department of Ecology guidance (Pete Kmet, *Guidance for Remediation of Petroleum Contaminated Sites*, Ecology Publication 10-09-057, October 2011) directs a calculation of a Method B cleanup value by using the MTCA TPH spreadsheet (http://www.ecy.wa.gov/programs/tcp/tools/toolmain.html)	Change the cleanup levels for all pathways of TPH fractions to the corresponding MTCA Method B values. Use Dept. of Ecology guidance to calculate Method B petroleum cleanup levels in all relevant matrixes.
Item 273 P: 8-48 S: 8.1.4.5 L: 31-38	**Comment:** For the Diesel Plume Exposure Area "TPH-diesel range" is listed as a COC and "TPH-diesel" and "TPH-gasoline" are listed as COPCs. However, Table 8-5 lists "TPH-diesel" as a COC and lists "TPH-gasoline" as a COPC. **Basis/Justification:** Inconsistencies on what analytes are listed as COCs and COPCs.	Modify text on p. 8-48 and Table 8-5 to clarify exactly what are considered COCs and COPCs in the diesel plume exposure area.
Item 274 P: 8-53 S: 8.1.4.5 L: 9-11; 18-20; 29-31	**Comment:** The sentence that starts, "Measures taken to remediate TPH-D...." should be deleted. These statements cannot be supported. **Basis/Justification:** Remedial measures will not necessary take care of a metal that sinks when remediating a contaminant that floats.	Provide basis how metals would be remediated via the same method as TPH-D or remove sentence.

Item 275 P: 8-55 S: 8.2.1.1	**Comment:** Include a summary of conclusions from 5.10 Summary of Contaminant Fate and Transport in Section 8.2.1.1 Waste Sites. **Basis/Justification:** Section 5.10 provides part of the basis for which waste sites were identified for further action as opposed to those identified for no further action.	Include a summary of conclusions from 5.10 Summary of Contaminant Fate and Transport in Section 8.2.1.1 Waste Sites.
Item 276 P: 8-55 S: 8.2.1.1 L: 19-21	**Comment:** Text describing the lack of verification sampling is not completely accurate. The 100-N-50, 100-N-51, and 100-N-51B waste sites were all located inside the 185-N Building. Verification Samples were collected below the 185-N Building. The 100-N-78 waste site was similarly closed out with the closeout verification package for HGP 100-N-4 Tile Field, which had verification samples taken. **Basis/Justification:** *Cleanup Verification Package for the Hanford Generating Plant UPR-100-N-37 Transformer Yard (SWMU #1), 100-N-51 Oil Storage Area (SWMU #2), 185-N Building Drains and Sumps (SWMU #3), and 100-N-50 Turbine Oil Filter Unit (SWMU #4)*, June 2004. *Cleanup Verification Package for the Hanford Generating Plant 100-N-4 Tile Field (SWMU #5); 100-N-1 Settling Pond (SWMU #6); 1908-NE Outfall (SWMU #7); 1716-NE Maintenance Garage (SWMU #8) and 100-N-52 Underground Storage Tank; 100-N-3 Maintenance Garage French Drain, 100-N-41 Gate House Septic Tank, and 100-N-45 Office Building Septic Tank (SWMU #9); 100-N-5 Bone Yard (SWMU #10); and 100-N-46 Underground Storage Tank*, June 2004.	Include text to describe that although verification soil samples were not specifically collected for these waste site, they were co-located and closed out with other waste sites. These co-located sites had verification samples taken.

Item 277 P: 8-55 S: 8.2.1.1 L: 19-32	**Comment:** Describe what actions are needed, if any, for closure of these SWMUs. **Basis/Justification:** If remedial actions are still needed at the SWMUs for closure, they should be included in this text and other chapters as remedial actions.	Add text to describe what additional remedial actions, if any, are needed for the SWMUs.
Item 278 P: 8-56 S: 8.2.1.1 L: 10-12	**Comment:** Many waste sites did have soil samples that demonstrated soils were "clean" down to 15 ft or more bgs. However, contamination remains at deeper intervals in the vadose zone. **Basis/Justification:** This contamination will continue to drain from the vadose zone and impact groundwater.	Add text to describe the impacts of this residual contamination at these sites and what type of monitoring will be performed and what ICs such as maintaining vegetation cover will be in place and for how long in this section or other appropriate portions of the document, but then add a reference to that section.
Item 279 P: 8-56 S: 8.2.1.1 L: 15	**Comment:** Institutional Controls (IC) are noted for these 3 sites, but the ICs are not specified. If ICs are an aspect of the alternative, the specific ICs from Table 8-11 should be identified for each waste site. **Basis/Justification:** EPA guidance (Fact Sheet OSWER 9355.0-89, December 2012: *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites*, Section 3.1) states "the proposed restriction and need for ICs should normally be identified in the Proposed Plan, for notice and opportunity to comment by potentially affected landowners and the public. Such use restriction or notices typically are then selected and memorialized in the ROD." In order to include this level of detail in the Proposed Plan it should be evaluated in the Feasibility Study.	Specify what ICs will be put in place for all waste sites requiring ICs.

Item 280 P: 8-56 S: 8.2.1.1 L: 17-25	**Comment:** Discussion of 100-N-65 does not speak to contaminants of potential concern at this waste site. Since it is associated with the UPR-100-N-17 diesel spill it is assumed that TPH components are a primary COC/COPC. Why did the evaluation only consider institutional controls (IC) and remove-treat-dispose (RTD), but not bioremediation of one form or another? **Basis/Justification:** A TPH based waste site should be evaluated against the in-situ bioremediation alternative in addition to RTD and ICs.	Consider bioremediation option in the evaluation for 100-N-65.
Item 281 P: 8-57 S: 8.2.1.1 L:12-13	**Comment:** Text states that the remediation for six sites will not begin until the ROD is signed. However, the sites are not listed and it is not specified why the remediation for these 6 sites must wait. **Basis/Justification:** This information is missing.	Add text to describe why these sites are not anticipated to have interim remedial action completed until after the ROD is signed.
Item 282 P: 8-63 S: 8.3.1 L: 14	**Comment:** Remove the word "existing". The baseline pump and treat system no longer exists as of 2011. Remove the word existing to indicate this fact. **Basis/Justification:** Correctness.	
Item 283 P: 8-63 S: 8.3.1 L: 29	**Comment:** Last sentence is incomplete.	Update text to include complete thought.
Item 284 P: 8-67 S: 8.3.3 L: 41-44	**Comment:** Provide the reference for the various quotes in this section. It is not clearly cited. **Basis/Justification:** Citable reference is needed for these direct quotes. Quotes from the IROD regarding petroleum cleanup are misleading because cleanup standards have significantly changed since the time the IROD was signed.	Clearly state when quotes are from the IROD throughout the document.

Item 285 P: 8-69 Table 8-10	**Comment:** Deep excavation should be a retained technology for petroleum. Text on p. 8-98 discusses as well as Table 8-10. **Basis/Justification:** There is significant new information on petroleum from the 100-N-84:2 Foam and Fuel pipelines remediation that is ongoing.	New information gathered from remedial action at 100-N-84:2 should be incorporated into the RI/FS. Deep excavation should be retained and evaluated for petroleum waste sites (specifically 100-N-84:2). All retained technologies should have associated bulleted lists, tables, figures, and text updated.
Item 286 P: 8-70 Table 8-10	**Comment:** The implementability section of the ex-situ bioremediation (land farming) should be modified to discuss implementability in relation to Bunker C, which appears to be widespread. **Basis/Justification:** Bunker C is not easily bioremediated. One study determined Bunker C bioremediation to be "very slow and incomplete" and the "the components of Bunker C were structurally resistant to biodegradation" (Song, Hong-Gyu, Wang, Xiaoping, and Bartha, Richard "Bioremediation Potential of Terrestrial Fuel Spills." Applied and Environmental Microbiology. v. 56 no. 3 (1990) p. 652-656).	Update implementability of land farming to include discussion of Bunker C.
Item 287 P: 8-71 Table 8-10	**Comment:** Stabilization/sequestration lists petroleum as one of the applicable COCs, but there is no discussion of stabilization regarding petroleum.	Either include discussion about stabilization for petroleum products or remove petroleum from the "COC Applicability" column.
Item 288 P: 8-72 Table 8-10	**Comment:** Biological Reduction should be a retained technology for nitrate. **Basis/Justification:** All criteria showed moderate readings, thus these remedial actions should be retained. Justification for not retaining this technology is sparse. Section J1.4.4.2 discusses applications of technology on uranium, with no discussion of nitrate.	Biological reduction should be retained and evaluated to treat nitrate in the soil. All retained technologies should have associated bulleted lists, tables, figures, and text updated.

Item 289 P: 8-74 Table 8-10	**Comment:** The screening comment in the row for gas delivery of reagents in inaccurate. No gas delivery of reagents was specified in the interim record of decision (IROD). **Basis/Justification:** Although amendments of bacteria and nutrients was part of the IROD, no discussion of delivery method was made.	Modify text to discuss applicability of gas delivery without pointing to the IROD.
Item 290 P: 8-75 Table 8-10	**Comment:** Capital costs of surface barrier should be listed as "low/moderate" rather than "low/high". **Basis/Justification:** Text box lists RCRA Subtitle C or C as moderate and asphalt/concrete cap as low.	Modify text to agree.
Item 291 P: 8-75 Table 8-10	**Comment:** Screening comment for surface barrier has a citation that is unclear what it means or is referring to.	Modify or explain the (2027) reference in regards to caps.
Item 292 P: 8-84 – 8-85 Table 8-12	**Comment:** Pump and treat appears to have been not retained due to cost. Pump and treat should have a much more thorough discussion of its applicability. It should be retained as a technology and fully evaluated to determine applicable costs/remedial timeframes. Comment 298 is related.	Pump and treat as a technology should be separated by COCs. It is not acceptable to have discussion concerning nitrate and petroleum state "not applicable because pump-and-treat extraction system not retained" when P&T was not retained specifically for strontium-90. Retain pump and treat for Sr-90 and evaluate for costs/remedial time frames. Expand the discussion regarding pump and treat as a technology for nitrate.
Item 293 P: 8-84 Table 8-12	**Comment:** Reference to using a Smart Sponge is not present in the text. Smart sponge language also needs to be included on p. 8-95, lines 8-9. This is related to Comment 332. **Basis/Justification:** During the RI/FS coordination meeting held 7-10-12 it was agreed to include disposal Smart Sponges to collect any LNAPL floating about groundwater in applicable wells.	Add Smart Sponge to "Removal of LNAPL" and retain it. All retained technologies should have associated bulleted lists, tables, figures, and text updated.

Item 294 P: 8-86 Table 8-12	**Comment:** Screening comment for in situ chemical oxidation (ISCO) doesn't make sense. It states that ISCO was screened out based on cost/implementability of biosparging. But text in the description column states that ISCO is commonly applied via sparge wells. Shouldn't these two technologies be evaluated together?	Expand discussion of ISCO and application through sparge wells.
Item 295 P: 8-86 Table 8-12	**Comment:** In situ chemical reduction should be a retained technology to treat nitrate. **Basis/Justification:** This is an effective and affordable way to treat nitrate.	In situ chemical reduction should be retained and evaluated to treat nitrate in the groundwater. All retained technologies should have associated bulleted lists, tables, figures, and text updated.
Item 296 P: 8-94 S: 8.4.2 L: 26-30	**Comment:** Nitrate exists in the soils and contributes to groundwater. Explain here in Chapter 8 or in more detail in Chapter 9 how MNA can be used for the nitrate plume in groundwater with contributions from a source unit. Comment #4 is related. **Basis/Justification:** Provide justification for use of MNA.	See comment and justification.
Item 297 P:8-100 Fig. 8-5	**Comment**: The 116-N tank farm is called out on Figure 8-5. It should be 166-N.	Provide correction.
Item 298 P: 8-101-102 S: 8.5.3.1 L: 31-23	**Comment:** A full scale pump & treat system was neither evaluated nor sufficient discussion given as to why. Based on the small size of the historical pump and treat and the area it covered, the justification for not retaining a pump and treat system for Sr-90 is inadequate. Comment 292 is related. **Basis/Justification:** The historical pump and treat system was undersized. Pump and treat is a proven remedial technology. A full-scale system should be evaluated as a remedial technology.	A full-scale pump and treat system to treat Sr-90 in the groundwater should be evaluated.

Item 299 P: 8-110 Fig. 8-9	**Comment:** The example box doesn't contain any examples. A non-Hanford example would be acceptable.	Either include relevant examples or remove the text box.
Item 300 P: 8-116 & 8-119 Figs. 8-15 & 18	**Comment:** It is unclear what the differences are between a permeable reactive barrier and in-situ chemical stabilization. It seems like these two descriptions could be combined into one. **Basis/Justification:** Apatite sequestration is discussed in both sections.	Combine in-situ chemical stabilization and permeable reactive barrier or discuss the differences between the two.
Item 301 Chapter 9 General	**Comment:** TPH-D cannot be addressed through groundwater monitoring or MNA. Exceedances are occurring upland and along and in the river. An effective remedy is needed. This is related to Comment #1. **Basis/Justification:** Groundwater monitoring does not reduce, treat or address ongoing groundwater contamination of TPH-D or meets CERCLA requirements and values.	See comment and basis.
Item 302 Chapter 9 & Chapter 10	**Comment:** Alternatives analysis should be broken up by individual waste sites or waste site type. Several waste site types exist even amongst the 6 remaining after the anticipated ROD: shallow petroleum, deep petroleum, non-petroleum. Alternatives analysis can also be broken up into groundwater alternatives and soil alternatives. The resulting recommended alternatives for groundwater and soils can then be combined into the preferred alternative in the proposed plan.	Consider reorganizing alternatives analysis based on media and waste site type.

Item 303 P: 9-2 S: 9.1 L: 23	Comment: Several locations in the RI/FS mention a lack of technologies to achieve drinking water standards within a "reasonable timeframe" for remediation of the upland Sr-90 plume. Text in Chapter 10 states that a reasonable timeframe is 100 years, but gives no basis. A reasonable timeframe should be discussed and the basis for the determination given. Text locations include: • Section 9.1, Page 9-2, Line 23 • Section 10.1.1, Page 10-3, Line 11 • Throughout 10.2 alternatives analysis **Basis/Justification:** Lack of basis for this statement.	Provide the guidance, regulations, documents that support 100 years as a cutoff for a "reasonable timeframe".
Item 304 P: 9-3 S: 9.1.1.3 L: 33-36	**Comment:** Text incorrectly states that remediation for UPR-100-N-17 is not expected to begin until after the ROD date in 2014. Bioventing has already begun. This waste site is listed here because interim action is not expected to be complete by 2014.	Modify text to more accurately describe UPR-100-N-17.
Item 305 P: 9-4 S: 9.1.1.3 Table 9-1	**Comment:** Table 9-1 does not list the 100-N-35 (Hanford Generating Plant substation) as a waste site to be remediated after the ROD is approved. **Basis/Justification:** The M-016-164 lists the remedial action for 100-N-35 waste site as complete by 2017. The 100-N-35 is an active site with no remedial actions scheduled in the near future. Page 9.1.13. line 33 states the ROD is assumed to be signed by June 30th 2014, yet the RI/FS is silent on the waste site.	Provide the disposition of 100-N-35 in the RI/FS.
Item 306 P: 9-4 Table 9-1	**Comment:** Explain why the 2607-FSM is listed as an accepted waste site. Why should a currently operating septic system be listed under CERCLA at all?	Provide discussion as to why the 2607-FSM is listed as an accepted waste site and why it is intended to be remediated under CERCLA as opposed to closed under current Washington State Department of Health requirements for septic systems.

Item 307 P: 9-4 to 9-6 Table 9-1	**Comment:** The text does not specify how the six sites to be remediated after the ROD is signed will be remediated.	Please add a reference to the section where it is discussed.
Item 308 P: 9-7 S: 9.1.2 L: 11-16	**Comment:** Text describes "shoreline compliance wells". More description is needed of what wells we are discussing.	List wells being discussed. Cite what document lists these as compliance wells and when that determination was made. Barring a citation, the term "compliance" should be removed in line 11.
Item 309 P: 9-7 S: 9.1.2 L: 29	**Comment:** Text lists in error an area of 2.5 acres as a volume.	Modify text so that area is discussed.
Item 310 P: 9-9 S: 9.1.2 L: 11-36	**Comment:** Chromium section mixes discussion of remaining 100-NR-2 chromium in the groundwater with the nearby 100-KR-4 hexavalent chromium plume. Although it is important to discuss nearby 100-KR-4 actions, these discussions must be separated for clear understanding. **Basis/Justification:** Clarity	Separate discussions of NR-2 chromium and KR-4 chromium. Include a figure of the KR-2 plume that includes all KR-2 wells and nearby NR-2 wells for reference. Include reference to the ambient water quality criteria for hexavalent chromium in addition to drinking water standards in both discussions.
Item 311 P: 9-10 S: 9.2 L: 27	**Comment:** Delete the word "flow" it is synonymous with "transport". **Basis/Justification:** This sentence is redundant with predictive flow and fate and transport. Transport means flow as well.	Modify sentence to read "Simulations of the historical flow and predictive fate and transport are included as part of the evaluation of each alternative."
Item 312 P: 9-11 Table 9-2	**Comment:** Table 9-2 has many issues. No clear explanation is provided for what the "X" represents in the boxes or what the white/shaded boxes represent. Floating product removal should be given its own line. Nitrate should have MNA marked for Alternatives #2 & #3. MNA appears to be checked too many times for TPH-D and ethylbenzene. Apatite PRB applies to Alternatives #2 through #5. This is related to comment #4. **Basis/Justification:** Table is not clear.	a. Clarify what the "X" represents in the boxes. b. Clarify what the white vs. shaded boxes mean. c. Removal of floating product should be given a line and marked for appropriate alternatives. d. Nitrate should be marked as "MNA" for alternatives #2 & #3, not just monitoring. e. Clarify why MNA for TPH-D and ethylbenzene is checked for Alternatives #3, #4, and #5, when biosparging has also been applied. f. apatite PRB in GW & VZ should be checked for Alternatives #3, #4, and #5, not only #2.

Item 313 P: 9-14 S: 9.2.1.1 L: 34	**Comment:** Text states that both the average and 90th percentile Sr-90 concentrations are well below the aquatic benchmark at time zero.	Clarify if this statement refers to concentrations throughout the plume or concentrations at the river boundary.
Item 314 P:9-22 Table 9-3	**Comment:** The table "Apatite PRB in Vadose Zone" row does not specify if any re-injection of apatite PRB will be performed. **Basis/Justification:** The DO's and subsequent sampling results have indicated that amendments are needed in groundwater, why would amendments not be needed in the vadose zone?	Either justify why apatite amendments are not needed for the vadose zone PRB or add re-injections to the table.
Item 315 P: 9-22 S: 9.2.2 Table 9-3	**Comment:** The description for elements common to Alternatives 2-6 includes the following in the description for waste site RTD: "Treatment before disposal at ERDF (land farming when appropriate)". No explanation of what this note means or when land farming would be "appropriate" is given. This statement does not appear to refer to the aerobic bioremediation (land farming) plate in Figure 8-8. Figure 8-8 is describing a separate remedy of land farming to reduce petroleum contamination. This remedy, as described in Ch. 8 is not merely a treatment prior to disposal at ERDF. It appears that land farming as described in Ch. 8 (specifically Fig. 8-8) was not evaluated in the alternatives, even though it was retained as a technology. **Basis/Justification:** Figure 8-8 described a remedial technology that is an alternative to disposal, not a treatment step during disposal. These are two completely separate ideas.	Separate the concept of land farming as a disposal step from the remedial technology describe in Ch. 8 that was an alternative to disposal. Evaluate land farming as a technology. Revise Ch. 9 text that mentions land farming as a potential disposal process. Describe when land farming (either or both meanings) would be "appropriate".

Item 316 P: 9-22 & 9-23 Table 9-3	**Comment:** The table notes that ICs will be used to prevent Sr-90 exposure at the shoreline for vadose zone and groundwater plumes. What ICs will be used? **Basis/Justification:** If the ICs do not prevent exposure to Sr-90 at the shoreline then additional remedial actions are needed.	Specify what ICs will be used and how they will prevent exposure to HHE from Sr-90 present in the vadose zone and groundwater plumes at the shoreline.
Item 317 P: 9-22 & 9-23 Table 9-3	**Comment:** No containment or surface barriers of waste sites were listed. **Basis/Justification:** Surface barriers were retained as a technology in Table 8-10 (p. 8-75) but not discussed again in a meaningful way in the document except for the "Surface Barriers" plate in the technology summary section (Fig. 8-13). A full evaluation of barriers for 116-N-1 and/or 116-N-3 could be considered adequate basis for requiring a barrier or using alternative closure requirements [WAC 173-303-610(1)(e)] under the RCRA permit. RCRA/CERCLA integration is encouraged at Federal Facilities ("Improving RCRA/CERCLA Coordination at Federal Facilities," memo. December 21, 2005. (OSWER Directive 9272.0-22)	Perform a more thorough evaluation of surface barriers as a technology. Also evaluate barrier alternatives that would be protective of human health and the environment. Add containment including surface barriers to this table.
Item 318 P: 9-24 S: 9.2.2.1 L: 5	**Comment:** Modify the text to include over and around waste sites for vegetative cover. Text in section 9.2.2.2, Page 9-25, Lines 15-19 should also be modified. **Basis/Justification:** Infiltration leading to recharge can come from around waste sites as well as directly over them in the 100-N Area.	Modify the text to read "over and around"...

Item 319 P: 9-25 S: 9.2.2.2 L: 12-13	**Comment:** Text states that soil will be removed until contaminant levels reach RAOs to a depth of 15 feet, and further that the extent of remediation will ensure that contaminant levels remaining below 15 feet are protective of groundwater. Assuming an excavation goes to a depth of 15 feet to meet direct contact RAOs, please describe how concentrations below the excavation (below 15 feet) will be measured to determine if deep zone soil meets groundwater protection criteria. Further, describe how the situation will be handled if deep zone soil concentrations are above groundwater protection criteria all the way down to the water table.	See comment.
Item 320 P: 9-25 S: 9.2.2.2 L: 15-19	**Comment:** Text discusses revegetation activities as the last step in remove-treat-dispose remedy. No mention is made whether vegetative cover will need to be maintained or not. **Basis/Justification:** Vadose Zone modeling includes assumptions regarding infiltration based on vegetative cover, irrigation restrictions, etc.	Evaluate modeling input and results to determine if maintaining vegetative cover is important to the long term fate and transport of remaining contaminants.
Item 321 P: 9-27 S: 9.2.2.4 L: 26	**Comment:** "Significantly" is a very subjective term. **Basis/Justification:** It implies that enough data was collected to derive a statistical meaning of the data.	Delete the term "significantly".

Item 322 P: 9-27 S: 9.2.2.4 & P: 9-41 S: 9.2.3.1	**Comment:** There is significant new information on petroleum in the 100-N area including recent microbial testing. This information should be reviewed and incorporated. Updated information should be used to determine whether petroleum bioventing and/or biosparging should include allowing or requiring addition of nutrient or microbes. **Basis/Justification:** The Interim Action ROD included amendments of nutrients and microorganisms. Testing to determine if this requirement can be waived is now underway.	New information gathered from remedial action at UPR-100-N-17 should be incorporated into the RI/FS. Evaluate the need for addition of nutrients or microorganisms. If a determination cannot be made at this time, amend the "bioventing" and "biosparging" descriptions to include the option of adding nutrients and/or microorganisms as performance enhancements if determined necessary. Modify all sections of the RI/FS as necessary to include these updates.
Item 323 P: 9-27 S: 9.2.2.4 L: 28	**Comment:** "clearly" is a very subjective term. **Basis/Justification**: Not enough data is present for this conclusion. Recent data suggest that only a handful of microorganisms actually are degrading the TPH-D and other microorganisms are inhibited by the bioventing according to lab results.	Delete the term "clearly" and add "and potentially low nutrient levels" to the end of the sentence.
Item 324 P: 9-27 S: 9.2.2.4 L: 35	**Comment:** The bioventing system is not designed to run continuously. **Basis/Justification**: To test the results/impact the bioventing is having, the system must be shut down for a week or so for respirometery tests.	Describe system operations in more detail, including down time due to weather, testing, etc.
Item 325 P: 9-36 Table 9-5 Top row, middle box	**Comment:** For the consideration of whether the timeframe of remediation is reasonable, the table indicates the Sr-90 DWS at the river boundary will be met by 2125.	Please indicate if this timeframe is for maximum, 90th percentile, or mean Sr-90 concentrations.

Item 326 P: 9-36 Table 9-5 2nd row, middle box	**Comment:** The second row text box for Sr-90 is noting the potential damage to the groundwater and river that apatite PRB injections to the vadose zone in up gradient and inland plumes may cause…yet; this is the method that is employed in very close proximity to the river with the same risks. **Basis/Justification:** This circular reasoning to discredit this technology as applied to up gradient plumes is invalid. State that it is cost prohibitive only.	Modify the text to include: "PRB in the vadose zone would greatly sequester and inhibit Sr-90 transport." to show both the benefits along with the risks…or simply state that it is cost prohibitive.
Item 327 P: 9-36 Table 9-5	**Comment:** Bottom center text box speaks to institutional controls (ICs) for Sr-90. It is true that ICs are expected to exist at Hanford for the duration of the MNA remedy timeframe for Sr-90. However, the proposed MNA timeframe is significantly longer than any other IC timeframe currently required in the 100 Areas. This fact should be discussed. It is not okay to simply state that ICs are expected to remain in place for any amount of time. **Basis/Justification:** 200+ years will see pump-and-treat systems complete their mission and be dismantled, the cocooned reactors removed from their current locations in the river corridor, etc. Most other ICs that are currently required in the river corridor will not need to be in place for such a long time period.	Add conversation related to relative timeframes for ICs in the river corridor.

Item 328 P: 9-36 & 9-49 L: text box and line 12	**Comment:** The basis for the timeframe of degradation for TPH-D in the groundwater once the secondary soil sources are removed is not explained in detail. **Basis/Justification**: The groundwater has not been sampled for the type of microorganism species and it is unknown if aerobic or anaerobic degradation mechanisms are taking place. Recent lab results indicate that a wide variety of microorganisms that are enhanced or inhibited by bioventing are present at depths below 15 feet bgs.	Fully explain the basis that supports a remedial timeframe of 3 years for degradation of TPH in groundwater.
Item 329 P: 9-37 S: 9.2.2.6 L: 6-7	**Comment:** Monitoring of the inland plume in Alternative 5 is not part of monitored natural attenuation (MNA). Rather, it would be monitoring of the active remedy. **Basis/Justification:** Monitoring up upland plume degradation in Alternatives 2-4 may be associated with MNA, but Alternative 5 has an active remedy in the upland plume.	Differentiate between monitoring of the active remedy and monitoring as part of MNA.
Item 330 P: 9-37 S: 9.2.2.6 L: 8-13	**Comment:** None of the alternatives that include biosparging for TPH in the groundwater have discussed MNA of the distal plume. If this is to be included in the remedy please include in other section descriptions of Alternatives 3-5. Each remedy description should include "biosparging and MNA of TPH" **Basis/Justification:** Biosparging descriptions in the alternatives do not include a description of MNA of the distal plume. Biosparging remedies appear to address the entire plume above PRGs. If monitoring of the distal plume below cleanup levels is what is proposed, this is simply continued monitoring, not MNA.	Differentiate between monitoring of the active remedy, monitoring of low concentration plume areas, and monitoring as part of MNA.

Item 331 P: 9-38 S: 9.2.2.8 Table 9-6	**Comment:** Remove Table 9.2.2.8. This level of detail on groundwater wells and sample frequency is not appropriate in the RI/FS. **Basis/Justification:** Groundwater wells and sampling frequency should be determined in the RDR/RAWP or a related groundwater monitoring plan. Groundwater sampling (constituents, well location, frequency) will be determined based on the chosen remedy and will change over time.	Remove Table 9.2.2.8.
Item 332 P: 9-38 S: 9.2.2.8 L: 8-20	**Comment:** LNAPL recovery is not explained fully. Smart sponges were eliminated as a technology in Chapter 8. Other sections list LNAPL recovery is listed within the groundwater monitoring description. The intended mechanism for LNAPL recovery needs to be fully described and included in alternatives descriptions. This comment is related to 293.	Include full description of what "LNAPL recovery" is intended to mean throughout document, especially in alternatives descriptions.
Item 333 P: 9-39 Fig. 9-11, etc.	**Comment:** All alternative figures that include the vadose zone application of the apatite barrier (jet injection) should be modified. The vadose zone portion of these figures should be represented by two vertical lines of coverage, rather than a vertical line to the inland side and a line that slopes with the groundwater surface to the river side. **Basis/Justification:** The sloping line in the CSM represents the partial coverage achieved by applying the apatite mixture in the saturated zone, not the application method of jet injection in the vadose zone.	Modify Figures 9-11, 9-16, 9-20, and 9-24 to reflect vertical application of apatite in the vadose zone.

Item 334 P: 9-42 S: 9.2.3.1 L: 38	**Comment:** Operational duration is listed as 3 years. However, previous sections described that the 3 year timeframe was dependent on having the source area removed. In essence, this means that the remedial timeframe for biosparging is however many years are required to remove petroleum from the lower vadose zone plus 3 years. **Basis/Justification:** Figure 9-6 and Text in 9.2.1.1.	All references to a remedial time frame of 3 years should be modified. Each location should acknowledge that the 3 year time frame is dependent upon removal of source term and what the expected time frame is for source term removal.
Item 335 P: 9-46 Fig. 9-15	**Comment:** More justification is needed for the proposed biosparging injection well coverage area. **Basis/Justification:** No justification is given for where biosparging wells are located and not locating biosparging wells closer to the river in the area of the former burn trench.	Include justification for application area for biosparging wells.
Item 336 P: 9-47 Fig. 9-16	**Comment:** The Title for Alternative 3 does not match the title for Alternative 3 from the Proposed Plan (p. 4). **Basis/Justification:** Clarity needed.	Verify both the title and details of alternative 3.
Item 337 P: 9-63 S: 9.4 L: 13	**Comment:** Misprint. Only 4 remedial alternatives are being evaluated in addition to the No Action alternative.	Edit language to reflect actual number of remedial alternatives
Item 338 P: 9-65 Table 9-7	**Comment:** Discuss the purpose of this table. No alternative analysis has been performed for waste sites, so there is no reason to include columns for Alternatives 2, 3, 4, and 5 separately. If an alternative analysis had been performed for any of the waste sites (for example analyzing 100-N-106 for RTD vs. land farming or 100-N-85 for deep excavation vs. bioventing) this complete table would add value. **Basis/Justification:** Under the current configuration it masks the fact that all alternatives are the same for soil waste sites.	Either consolidate columns for Alternatives 2-5 into one column and expand on the fact that there are no differences or perform some alternative analysis for one or more waste sites and update table.

Item 339 P: 9-66 Table 9-8	**Comment:** The length of treated area for the apatite riverfront PRB should be the additional treated area. Any costs associated on the 5 yr re-injection should be associated with re-injection of the entire barrier, both existing and new. **Basis/Justification:** Cost estimates are based on the information in Table 9-8. To accurately reflect cost, the correct injection length should be summarized here.	Modify table for length of treated length of apatite barrier to include discussion of initial injection vs. reapplication.
Item 340 P: 10-10 Table 10-3 General	**Comment:** TPH-D is not the only analysis for petroleum spills. This contaminant is overly simplified in all of the alternative descriptions. **Basis/Justification:** WAC 173-340-900 Table 830-1 and Table 747-4.	Describe all the contaminants that need to be evaluated to meet cleanup standard in the alternatives.
Item 341 P: 10-26 Table 10-8	**Comment:** The table states for all alternative that TPH-D restoration timeframe is zero years. TPH is currently not being met to protect surface water. How will the CULs being met by 2015 with no action, and the other alternative. Table values do not meet MTCA regulations. This is related to Comment #1. **Basis/Justification:** The regulations do not allow a mixing zone to demonstrate compliance with surface water cleanup levels. [WAC 173-340-720(8)(d)(i)(C)]	Change table to meet the WAC requirements.
Item 342 P: 8-4 S: 8.1.1.2 L:11 & P: 10-26 Table 10-8	**Comment:** TPH is <u>not</u> the only parameter used to determine that the remedy has satisfied the cleanup standard for petroleum spills. **Basis/Justification:** WAC 173-340-900 Table 8-3. CERCLA excludes petroleum as a hazardous substance under section 101(4). Therefore the state's corrective action requirements must be followed.	Include an evaluation of the other parameters such as the BTEX, PAHs and PCBs. These should be also be includes as COCs.

Item 343 P: 10-30 S: 10.3.5 L: 43-44 & Table 10-9	**Comment:** Adverse effects to HHE associated with in situ treatment for nitrate were not explained well enough to be compared to adverse effects of other technologies. **Basis/Justification:** Provide information/studies to substantiate the amount of metals released during biological reduction of nitrate.	More fully explain the low rating for short-term effectiveness for Alternative 4. Explain the potential for adverse effects to HHE associated with the in situ treatment for nitrate.
Item 344 P: 10-38 S: 10.5 L: 3-4	**Comment:** Text states that soil samples are generally collected after D4 removal actions. This is incorrect. **Basis/Justification:** Removal Action Work Plan (DOE/RL-2002-70 Rev. 3) requires a sampling determination form to be filled out for each removed facility. Most of the facilities do not require sampling except as required by co-located waste sites.	Modify text to include more accurate details regarding sampling performed at D4 removal locations.
Item 345 P: 10-38 S: 10.5 L: 20-23	**Comment:** Text states: *In order for these actions to be consistent with the final action remedy selection, the current interim action RD/RAWPs will be modified using the TPA (Ecology et al., 1989a) change notice process to include the cleanup levels specified in the final action ROD.* The above statement is not the correct process for changes to decisions that have been made in a ROD. The CERCLA process for changes in cleanup values in a ROD requires, at a minimum, an Explanation of Significant Difference (ESD) and maybe a ROD amendment. The TPA cannot short change the required CERCLA process. **Basis/Justification**: EPA "A guide to preparing superfund proposed plans, Records of Decisions, and other remedy selection decision documents." 40 CFR 300.430 and 40 CFR 300.435	Change sentence in the RI/FS to be consistent with the federal regulations.

Item 346 P: 10-38 S: 10.6 L: 25-27	**Comment:** *The TPA (Ecology et al., 1989a) states the intent of the Tri Parties' CERCLA remediation at the Hanford Site is to fulfill the corrective action requirements for the Site as a facility containing permitted TSD units.* The above sentence is incorrect or not written clearly. Corrective action (WAC-173-303-64620) is for past practice units and not for Treatment, Storage, and Disposal units (TSDs). TSDs use WAC 173-303-610 for closure not corrective action (-64620). **Basis/Justification:** Incorrect statement regarding corrective action for TSDs.	The TPA (Ecology et al., 1989a) states the intent of the Tri Parties' CERCLA remediation at the Hanford Site is to fulfill the corrective action requirements ~~for~~ at the Site for past practice units remediated under CERCLA authority. ~~as a facility containing permitted TSD units.~~
Item 347 P: 10-39 S: 10.6 L: 5-6	**Comment:** *In particular, "Overview of Cleanup Standards" (WAC 173-340-700) through "Sediment Cleanup Standards" (WAC 173-340-760) functions as ARAR standards for CERCLA remedial actions on the Hanford Site.* The above statement is misleading as the corrective action ARARs for cleanup are the list provided in IIY.1.a,b,c,d,e,f,g,. **Basis/Justification:** Sitewide Permit II.Y.1 corrective regulatory citations.	Change sentence for accuracy to: In particular, "Overview of Cleanup Standards" (WAC 173-340-700) through "Sediment Cleanup Standards" (WAC 173-340-760) functions as ~~ARAR~~ cleanup standards for ~~CERCLA remedial~~ corrective actions on the Hanford Site and therefore are an ARAR under CERCLA.
Item 348 P: F-167-F-173 Table A-1	**Comment:** There are several sample locations shown that have nothing listed in the Sample Depth (m) column. Please explain what a blank cell indicates (i.e.; the sample was collected at the surface.) List the information for the Sample Depth cells that have been left blank. Comment 350 is related.	List the information for the "Sample Depth" cells that have been left blank.

Item 349 P: F-174 – F-204 Table A-2	**Comment:** There are several sample locations shown that do not have a HEIS sample number or "Unknown" listed in the Sample column. Please explain what a blank cell indicates. Provide information within the empty "Sample" cell.	Provide information within the empty "Sample" cell.
Item 350 P: F-205 – F-227 Tables A-3 & A-4	**Comment:** There are several sample locations shown that have nothing listed in the Sample Depth (m) column. Please explain what a blank cell indicates (i.e.; the sample was collected at the surface.) List the information for the Sample Depth cells that have been left blank. Comment 348 is related.	List the information for the "Sample Depth" cells that have been left blank.
Item 351 P: G-30 L/¶: 6-7	**Comment:** The text states that antimony was reported above the action level but less than background in one filtered sample from Well 199-N-18 (17.4µg/L) analyzed by the trace method. List the analytical method that was used to provide the trace concentration of antimony. And since it has been determined that antimony will be retained as a COPC and it warrants further evaluation in the FS, please explain if Method 6010 or the trace method will be used.	List the analytical method that was used to provide the trace concentration of antimony. Also, explain if Method 6010 or the trace method will be used to analyze for antimony in the FS.
Item 352 P: G-120 ¶: 6th	**Comment:** 4. "Strontium-90" section on uses units of "µg/L". Are these the correct units, or should they be "pCi/L"?	Check units for accuracy.
Item 353 Table G-44	**Comment:** "EPC" appears used as an abbreviation for both "exposure point concentration" and "estimated soil concentration", see columns E and K. This can cause confusion.	Please correct or change the use of "EPC" in column E.
Item 354 Table G-44	**Comment:** In Excel tables (such as G-44) where successive columns are the result of operations on previous columns, the operations should be in the spreadsheet, to allow readers to follow what was done, rather than use the spreadsheet simply to display numbers from someplace else.	Please provide calculations used in tables.

Item 355 P: H-162 Table 6-7	**Comment:** In the "Form" column for Europium-154 and Europium-155, the abbreviations for europium-153 and europium-152 are listed as E-152 and E-153. The correct abbreviations are Eu-152 and Eu-153. Please correct the error.	Correct the abbreviation for europium-152 and europium-153 to Eu-152 and Eu-153.
Item 356 Table I-1	**Comment:** In Table I-1 most waste sites have a note stating "Not evaluated. Site assumed to pass PRGs." Several waste sites warrant specific evaluation in the FS based on updated information gathered during the remediation process. The 100-N-79 and 100-N-104 spillways should be evaluated based on current data. **Basis/Justification:** 100-N-79 and 100-N-104 spillways were only removed above the ordinary high water mark for interim remedial action. Because portions of the structures still exist, each waste site should be evaluated in the FS. Final disposition (including any recommendation for "no action") should only be made after considering updated information on sampling results and remaining structure. A conceptual site model specific to the fuel storage basin leaks traveling along a preferential pathway formed during construction of the 1908-N Outfall Spillway was included in both the 100-N-79 Work Instruction for Verification Sampling (0100N-WI-G0061, Fig. 1) and the 2010 Hanford Site Groundwater Monitoring Report (DOE/RL-2011-01).	Provide an analysis in the FS to support the final dispositioning of the 100-N-79 and 100-N-104 spillways. Include updated information from remedial action on remaining structure and sampling results.

Item 357 Table I-1 & P: 8-55 S: 8.2.1.1 L: 14-18	**Comment:** In Table I-1 most waste sites have a note stating "Not evaluated. Site assumed to pass PRGs." Several waste sites warrant specific evaluation in the FS based on updated information gathered during the remediation process. UPR-100-N-42, 184-N Day Tank Area Unplanned Release and 100-N-84:2, Foam and Fuel Pipelines should be evaluated based on current data. **Basis/Justification:** There is significant new information on petroleum from the 100-N-84:2 Foam and Fuel Pipelines remediation that is ongoing, Washington Closure Hanford. (2013, July 21). 100-N Interface Meeting Minutes. Washington Closure Hanford. (2013, September 3). 100-N Interface Meeting Minutes. Work Instruction for Phase III Verification Sampling of the UPR-100-N-42, 184-N Day Tank Area Liquid Unplanned Release (0100N-WI-G0074).	Provide an analysis in the FS to support the final disposition of UPR-100-N-42 and 100-N-84:2. Include updated information from remedial action on nature and extent of contamination and sampling results.
Item 358 Table I-1 & P: 9-65 Table 9-7	**Comment:** Line for 100-N-106: Assumptions for RTD area may be invalid due to new information. RI/FS should be updated to include new information derived from interim remedial action on 100-N-106 and 100-N-84:2. **Basis/Justification**: Much new information regarding nature and extent of petroleum products in the soil has been discovered over the last few months. RI/FS text on page 4-67, lines 6-8 state that "if petroleum contamination is found at >4.6 m bgs, further discussions between Ecology and DOE-RL will identify site dispositions (for example, bioventing, soil removal, or other options)." At this time, many locations with petroleum associated either with 100-N-84:2 or 100-N-106 appear to have contamination > 4.6 m bgs.	Assumptions for remedial action should be updated. Remedial alternatives for 100-N-106 should be re-analyzed based on new information.

Item 359 App. O	**Comment:** Section 4.4.2 of the guidance states the TI evaluation should specify the horizontal and vertical extent of the area for which the TI determination is sought. Delineation of the TI zone based on the location of a particular mapped contamination contour interval generally should be avoided. (such as isoconcentration line.) **Basis/Justification:** Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. Directive 9234.2-25	Define the limits of the TI zone using fixed space, both horizontally and vertically for the 8 pCi/L concentration boundary.
Item 360 P: O-23	**Comment:** The Alternative 1 paragraph seems to have an error such as a missing sentence. It states 225 years for strontium-90 and then states 125 years for strontium-90 to decline below DWS.	Correct paragraph for accuracy.

References

Code of Federal Regulations. 40 CFR §141.66 *Maximum contaminant levels for radionuclides.*

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Simskin, H. 2010. *Yakama Nation ERWM Program Comment Letter on the Draft Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (USDOE/EIS-0391).* Letter to Mary Beth Burandt, EIS Document Manager. March.

U.S. Department of Energy. 2010. *Integrated 100 Area Remedial Investigation / Feasibility Study Work Plan Addendum 5: 100-NR-1 and 100-NR-2 Operable Units Draft B.* (DOE/RL-2008-46 Draft B). April.

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