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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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December 16, 2011

11-NWP-153

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EDMC

Mr. Jonathan A. Dowell, Assistant Manager for the Central Plateau
Richland Operations Office
United States Department of Energy
P.O. Box 550, MSIN: A5-11
Richland, Washington 99352

Re: *Remedial Investigation/Feasibility Study for the 100-KR, 100-KR-2, and 100-KR-4 Operable Units,* DOE/RL-2010-97 Draft A (RI/FS) and pending 100-D/H draft RI/FS
0099843

Dear Mr. Dowell:

The Department of Ecology (Ecology) is submitting comments on the above RI/FS. Enclosed are two comment records containing our current comments. Our review focused on potential major issues if carried over to the upcoming RI/FS for the 100-D and 100-H Areas (draft expected in January 2012). Ecology is concerned with several over-arching assumptions and issues throughout the RI/FS. Several of these items are listed below:

- Recharge and infiltration rates are assumed to drop to 4-8 mm/yr within 30 years. This is based on the assumption of achieving a mature shrub-steppe community quickly, which does not appear supported in the literature.
- The modeling documentation does not contain adequate detail about how the regulatory requirements for alternative fate and transport models are being met for the soil pathway to groundwater. Ecology requires each element of Washington Administrative Code (WAC) 173-340-747(8) to be discussed. Also, site-specific documentation is not contained in DOE/RL-2001-50-R0, aka "Graded Approach document".
- Partition coefficient (K_d) values used seem inconsistent and are sometimes unreferenced. They are not the default values in Cleanup Levels and Risk Calculation database (CLARC), and sometimes are not site-specific as required by WAC 173-340-747(8).
- The process of screening out contaminants eliminates risk contributors and therefore potentially underestimates risk. The Native American and tap water evaluations did not screen out contaminants; this is appropriate for all scenarios.
- The Model Toxic Control Act (MTCA) Method A values were used as preliminary remediation goals for arsenic and lead. MTCA Method B values and Hanford Site background data are available and more appropriate for arsenic.
- Many referenced documents should be in the Administrative Record to support final decisions, but are currently unavailable.

- United States Environmental Protection Agency's ProUCL guidance was not used consistently when evaluating data. This could lead to a non-conservative estimation of risk in multiple sections throughout the document.
- Data adequacy concerns include:
  - Use of data from a very limit number of sites compared to all the sites (16 of 165).
  - Eliminating data inappropriately such as: "J" qualified data, based on frequency of detection, detection limits.
  - Using a large number of very small sample sizes (i.e., less than 10).

Ecology also requests data from the 100-D and 100-H Remedial Investigation be submitted prior to the Draft RI/FS. Our review of the upcoming RI/FS and Proposed Plan will be facilitated by receipt of the following information in a table or database:

a. Waste site or location of contaminant detections
b. Contaminant
c. Number of samples analyzed for the contaminant
d. Dates of sampling for the contaminant
e. Dates of detection of the contaminant
f. Concentration of each detection of the contaminant
g. Detection limit (mean and standard deviation for the contaminant)

Ecology does not expect responses to these submitted comments. Again, the intention is to make the United States Department of Energy aware of Ecology concerns prior to submission of Draft A of the RI/FS for 100-D and 100-H Areas. Ecology will participate in comment resolution at that time.

If there are any questions, please contact me at 509-372-7941.

Sincerely,

Nina M. Menard

Nina Menard, Environmental Restoration Project Manager
Nuclear Waste Program

ab/dbm
Enclosures (2)

cc w/enc:

Dennis Faulk, EPA
Jim Hansen, USDOE
Mike Thompson, USDOE
Stuart Harris, CTUIR
Gabriel Bohnee, NPT
Russell Jim, YN
Susan Leckband, HAB
Ken Niles, ODOE
Administrative Record: 100-D, 100-H, 100-K
Environmental Portal
USDOE-RL Correspondence Control

#	Document Location	Comment	Modification
1.	General	Ecology does not accept the assumed base case recharge values. Recharge will not drop to 8 mm/y or less until steady-state and soil horizonation returns to the pre-disturbed condition, which would be at least 100 years (Birkeland, P.W., 1984, Soils and Geomorphology, p. 223-225). The assumption that the site will be mature shrub-steppe in 30 years (as implied by the assumption of 4 to 8 mm/y recharge after 30 y) is not accepted. The burden of proof for establishing that infiltration (as required by WAC 173-340-747(8)(vii)) has been derived in a defensible manner has not been met. Furthermore, an unrestricted land use would allow irrigation for lawns and crops, resulting in an even larger recharge.	Use an infiltration rate of at least 50 mm/y for the base case for post remediation and long term, based on the research of Gee et.al, 2005, Vadose Zone Journal, 4:32-40 and Gee et al., 2005, Vadose Zone Journal, 4:72-78. Additionally, add the amount of recharge from irrigation to that of the revised base and use the total recharge for determining PRGs.
2.	General	The Kd values used are generally not site-specific, and in some cases also not the default values in CLARC, and they are often not referenced. For instance, the uranium Kd value of 2 mL/g does not appear to be site specific for this portion of the Hanford site and does not address WAC 173-340-747(8)(b)(i) or meet the burden of WAC 173-340-702(14). It is significantly larger than the lower 10th percentile of values in PNNL-13895 (Rev.1), which Ecology has used to select 0.3 mL/g in the absence of site-specific values. Also, the cadmium Kd value is very large and has not been supported with a site-specific reference traceable to Hanford-specific measurement. Additionally, the benzo(a)pyrene Kd (5500ml/g) is quite large compared with the CLARC value of 969mL/g.	Discuss how the selection of Kd values meets the requirements of WAC 173-340-747(8)(b)(i) and -702(14). Use uranium Kd values measured for waste sites in the vicinity of each waste site of interest, and/or use a Kd value of 0.3 mL/g for uranium in the absence of site-specific data. Use a site-specific Kd value for cadmium and provide the reference for the value to Ecology. If there is no site-specific Kd value, use 6.7 mL/g from CLARC for cadmium. Also, use the CLARC Kd value of 969mL/g for benzo(a)pyrene in the absence of a site-specific value.
3.	General	In preparation for our review of the D/H area RI/FS, we are requesting all RI/FS sample concentrations for the D/H area in a table or database.	Please provide Ecology with all soil and groundwater data for the D/H area in a table or database with the following information: a. Waste site or location of contaminant detects b. Contaminant c. Number of samples analyzed for the contaminant d. Dates of sampling for the contaminant e. Dates of detection of the contaminant f. Concentration of each detect of the contaminant g. Detection limit (mean and standard deviation for the contaminant)
4.	General	The process of screening out contaminants eliminates risk	Please do not screen out contaminants for groundwater and

		contributors and is not necessary. The screening process was not used for the Native American scenarios or for the tap water evaluation (both covered in Appendix G). Therefore, the screening process is also not necessary for groundwater and waste sites.	waste sites beyond the screening steps used for the Native American and tap water evaluations, including consideration of Hanford site background and availability of toxicity data. As pointed out for Appendix F, for water, contaminants should be grouped according to time of peak concentration, with risk assessed for various time bins. Subsequent comments on Appendix F and G re-iterate this point.
5.	General	Ecology is missing many references used throughout the document and specifically in the evaluation in CHPRC-01311, Table 2-1. As this is a site-specific evaluation, Ecology is requesting a number of references in accordance with WAC 173-340-7493(4)(b), "Copies of literature cited in the table that are not in the possession of the department shall be provided with the report." Documents are cited in the following areas of the report: p. 6-40, line 30 p. 6-42, line 27 p. 6-43, line 28 p. 6-71, line 36 p. H-337 Appendix H, Table 2-1	Provide the following "internal" references: ECF-HANFORD-11-0142. ECF-HANFORD-10-0446. ECF-HANFORD-10-0445. ECF-HANFORD-11-006 ECF-100NPL-10-0462 ECF-100NPL-10-0463 Provide the following references from Appendix H, Table 2-1: Purdue and Haines, 1977 Stegeman, 1955 Jackson et al., 2000 Dunning, 1993 Nagy, 2001 Jackson and Jackson, 2000 Beyer et al., 1994 O'Farrell et al., 1975 Silva and Downing, 1995 Scheffer, 1938 Schreiber, 1978 Kritzman, 1974
6.	General	<u>Numerous issues have been identified on data analysis including:</u> • Use of data from a very limit number of sites compared to all the sites (16 of 165) • A large amount of data with very small sample sizes (i.e., less than 10) • Eliminating data inappropriately ("J" qualified data, based on frequency of detection, detection limits [1,1-DCE, 1,1,2-TCA, perc, VC, Hg])	Please justify any similar data analysis issues in the 100-D/H RI/FS.
7.	General	EPC estimation should follow ProUCL guidance. As such, EPC should be estimated by using an average value (e.g., an appropriate UCL95). In cases where a UCL95 cannot be	Follow EPA's ProUCL guidance to estimate EPC and handle non-detects.

		reliably calculated (i.e., data sets with a large proportion of non-detects), the 90th percentile is acceptable. Simple substitution methods (e.g., MDL) should not be used to evaluate non-detects. According to ProUCL, other methods are better (e.g., KM, bootstrap). This was discussed in the Senior Executive Team meetings on groundwater and never resolved.	
8.	Page 3-122, Lines 29-30	The text states that the groundwater samples from both of these wells (199-K-135 and 100-K-110A) have major chemistry that is notably distinct from the other samples evaluated. However, upon review of Table 3-43, it is not evident that these two wells have data that are notably distinct for the analyses that have been presented.	Please list the specific contaminants that were detected in wells 199-K-135 and 100-K-110A which make these wells unique from the other wells that were analyzed.
9.	Page 3-124, Table 3-41, Test Type/Analysis Method	The description of Slug/KGS has not been provided in the source reference section.	Please provide the description of Slug/KGS.
10.	Page 3-126, Table 3.42	Several of the wells show empty cells for wet weight and dry weight measurements and moisture content, with no explanation of the omissions.	Either include the missing information or provide the basis for its non-existence.
11.	Chapter 4 General	Nature and extent of contamination and the characterization: The document does not provide adequate information on how the vast extent of soil/deep vadose zone contamination created by billions of gallons of contaminated effluent discharges creating a mound of ~33 ft high and the overland flows covering a vast area around the K Reactors containing both mobile (e.g. chromium) and highly absorptive contaminants likeSr-90 was characterized. It is to be noted that most of the 33 feet (the highest possible) thick zone immediately above the currently water table is now in the vadose zone. The document did highlight uncertainties about the continuous sources of contamination possibly in the vadose zone but failed to address this overarching concept/question on the nature and extent of contamination. It also should be noted that the billions of gallons discharged created overland flows and covered an extensive area (and also created a 33 feet mound). One should not assume that the source of contamination is only at the "point source (ditch, ponds, cribs or trenches)". It is a "non-point" source issue.	Provide necessary information to address the comment

12.	Section 4.2	Primary contaminants vs. Secondary contaminants: Provide adequate explanations/descriptions why primary contaminants are no longer present at this time although the type of contaminants and the nature of the released mechanism are more or less the same (e.g. discharged to the same trench, ditch, etc,) for the secondary waste as well. It seems, from the history of the disposal, it is difficult to distinguish the primary waste from the secondary waste. Please provide adequate explanation to address the issue and how the characterization approach so far is adequate to explain any differences and similarities between primary and secondary waste.	Provide necessary information to address the comment
13.	Section 4.3	**Columbia River Studies**: The document did not include all the pertinent data gathered through the Columbia River RI and related work. The document did include some studies made earlier on the river but not the latest information reported/presented to the regulators.	Provide necessary information to address the comment
14.	p. 4-208, lines 11-16	The statement that Cr+6 in groundwater is the only contaminant of ecological concern for riparian and nearshore media for evaluating alternatives in the 100-K FS appears overly simplistic, given the many sources of uncertainty in ERA.	Please acknowledge uncertainty in this statement identifying a single COPC.
15.	p. 4-208, line20	According to the document title, DOE/RL-2004-09 should be DOE/RL-2004-49.	Please correct and add to References.
16.	p. 4-212, lines 2-4	Although salmon are not resident species, overall interest in salmon may warrant their inclusion.	Consider including salmon, despite their migratory behavior.
17.	p. 4-239 to 4-240, Figures 4-94 to 4-96	Explain why the dashed line (detection limit) is a negative value.	Please clarify why the detection limit is negative.
18.	p. 4-241, lines 17-19	Provide more information on a C-14 exposure pathway from 100-K riparian soil to fish tissue without a groundwater link (e.g., overland transport, wind transport).	Provide exposure pathway details for C-14.
19.	Chapter 5/ ECF-Hanford - 11-0063, REV.1	Modeling for the determination of preliminary remediation goals: The following needs to be clarified: • Peak groundwater concentration (section 2.4): It is not clear how the average concentration over the 5 meter thickness would give the most conservative groundwater concentration (section 2.3) • Recharge: The text mentions about three	Provide necessary information to address the comment

		recharge periods in the post-2010 simulations. There is no rationale behind the selection of these three scenarios and the selection of those periods (section 3.2.1). • Aquifer flux: The hydraulic gradient for the 100K source area is too far off (in order of magnitudes) of the mean value (section 3.2.2). • Hydraulic and transport parameters (section 3.3): Provide a better rationale to for why the 100 K Horizontal saturated hydraulic conductivity for the Ringold formation is 10 times less than Hanford formation, without any field or lab data. Please note that the numbers sometimes exceed more than two orders of magnitude.	
20.	Pg. 5-40, line 4-7	The assumption of a 1mg/kg contaminant concentration vadose zone distribution leads to some unrealistically high PRG's that are shown in table 3 of the proposed plan. This leads to a false conclusion that the contamination is evenly spread throughout the vadose from the limited data set used.	The 1 mg/kg contaminant concentration does not represent any known distribution of contamination in the vadose zone. Use known contaminant distributions for 100-K waste sites.
21.	p. 6-8 to 6-12, Table 6-4	It is unclear why methods and assumptions differ between RCBRA vs. the RI/FS.	Provide rationale for inconsistency between RCBRA vs. RI/FS methods.
22.	p. 6-15, Table 6-5	Show the calculation for soil ingestion rate in local and broad areas for RCBRA and RI/FS methods. Clarify if this is related to time spent in local and broad areas.	Show how soil ingestion was partitioned in local vs. broad areas.
23.	p. 6-17, lines 7-9	Re soil As, note that MTCA Method B CUL for groundwater protection (0.34 mg/kg) is far below MTCA Method A and IAROD CULs (20 mg/kg), as well as below Hanford background (6.5 mg/kg).	Place 20 mg/kg into context with other limits for soil As, as well as its background value.
24.	p. 6-17, lines 25-26	Excluding food chain pathways for PRG development for nonrads (e.g., As) introduces uncertainty into PRG values.	PRG development should not exclude complete exposure pathways.
25.	p. 6-25, line 23 AND p. 6-82, lines 16-20	Analytes without toxicological info should be treated as an uncertainty.	Include analytes with no tox data in an uncertainty analysis.

26.	p. 6-27, lines 16-32; p. 6-28, line 5 and lines 33-34; p. 6-29, Figure 6-3	The UCL95 should be used to estimate EPC, rather than the maximum. The UCL95 captures population variability, whereas the sample maximum does not. ProUCL recommends against using the maximum for estimating EPC. Only when a UCL95 cannot be calculated (e.g., n<5 for detects), should the max be considered to represent EPC.	For estimating EPC, use UCL95, rather than the maximum.
27.	p. 6-28, lines 11-13 and Appendix G, ECF-100KR1-11-0008, p. G-737 (top), Section 4.9	Text 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." This statement is untrue. There is always uncertainty in these situations (unless all of the soil in the decision unit is sampled). Furthermore, there have been repeated instances of inadequate historical information to locate contamination at Hanford; spills and errors have occurred during the river corridor cleanup as a result of uncertain historical information. A focused sample design is generally a design of guessing where the contamination is based on indirect information. It is extremely uncertain.	Acknowledge uncertainty in both focused and statistical sampling analysis. Delete the quoted statement. Also, where a focused sample design has been used, calculate risk on a per sample basis.
28.	p. 6-30, line 6	Exposure to external gamma radiation does not require an environmental transport medium (travels in a vacuum).	Qualify the requirement for an environmental transport medium for a complete exposure pathway.
29.	p. 6-31, Figure 6-4	Footnotes "a" and "b" appear mislabeled. Vegetation and livestock consumption is not part of the MTCA resident exposure (change "C" to "N" for this).	Clarify footnotes and MTCA resident pathways.
30.	p. 6-32, Figure 6-5	Footnote "a" appears in the Notes box but not in the figure itself. Please clarify why receptors differ in Figure 6-4 (100-K Source OU) vs. Figure 6-5 (100-KR-4 Groundwater OU). Also, the "Fish Consumption" exposure route should be linked to groundwater via surface water.	Clarify footnote "a," why receptors differ in Figures 6-4 vs. 6-5, and fish consumption linkage to surface water.
31.	p. 6-35, lines 16-17	Text indicates that the Monument Worker is exposed to contaminated groundwater, but Figure 6-4 shows only an irrigation pathway (no drinking water).	Reconcile text and Figure 6-4 for the Monument Worker.
32.	p. 6-35, line 27	Text indicates that the Monument Worker scenario does not include food chain pathways, but Figure 6-4 shows a complete exposure pathway for this receptor for food consumption.	Reconcile text and Figure 6-4 for the Monument Worker.
33.	p. 6-36 lines 26-28	Clarify why the MTCA Method A soil CUL is used as a PRG for As (20 mg/kg), when MTCA Method B CULs for soil ingestion (0.67 mg/kg) and groundwater protection (0.34 mg/kg) are available, albeit below Hanford background (6.5	The PRG for As should equal site background.

		mg/kg).	
34.	p. 6-37, Table 6-7	Explain why RBSLs (and PRGs) for the Residential Monument Worker are calculated only for rads (and not nonrads).	Provide RBSLs for both rads and nonrads for the Residential Monument Worker.
35.	p. 6-39, line 13	This section on MTCA CULs should also include soil CULs to protect groundwater (WAC 173-340-747).	Include MTCA soil CULs protective of groundwater.
36.	p. 6-42, line 12	This section on total PRGs should also include soil PRGs (for both rads and nonrads) developed for groundwater protection (for human drinking water ingestion), as a result of the leaching pathway. Much of this information appears to be in Appendix F (ECF-HANFORD-11-0063, Rev 1).	Include soil PRGs protective of groundwater.
37.	p. 6-42, lines 14-17	RAGS Part B is cited as the basis for the total PRG equation (for all exposure routes), although I could not locate relevant information on this equation.	Please provide specific page numbers in RAGS Part B to support derivation of the total PRG equation.
38.	p. 6-44, lines 6-10	List EPA carcinogens with mutagenic effects, and describe age dependent adjustment factors (ADAFs). This same comment applies to ingestion, dermal, and inhalation exposure routes.	Describe PRGs for mutagenic chemicals in more detail.
39.	p. 6-44, lines 11-15, and Appendix G, p. G-197, Table 4-2	Explain why a separate PRG equation is needed for vinyl chloride. One could assume lifetime exposure from birth and simply use the PRG for carcinogens with CSFo=1.5 (mg/kg-d)-1. This same comment applies to ingestion, dermal, and inhalation exposure routes.	Use the PRG equation for carcinogens for vinyl chloride with the lifetime CSFo.
40.	p. 6-46, lines 18-19	Include the default VF for H-3 (http://rais.ornl.gov/tools/rais_rad_risk_guide.html).	Specify VF for H-3 (17 m3/kg).
41.	p. 6-50, lines 14-17	Text indicates that PPRTVs are not available to the public, yet an accessible database is cited where PPRTVs are compiled (EPA, 2009b).	Re PPRTVs, please revise text for consistency.
42.	p. 6-50, lines 28-30	Tier 3 toxicity values include all values that do not fall into Tiers 1 and 2. Preference is given to Tier 3 values which are derived with similar methods as Tier 1 and 2. As such, RAIS data are not necessarily ranked below HEAST data.	Accurately represent the hierarchy of toxicity data as specified in Cook (2003).
43.	p. 6-50, lines 31-38	NO3 and NO2 are conventionally evaluated as NO3-N and NO2-N.	Evaluate NO3 and NO2 in terms of their N fraction.
44.	p. 6-50, line 41	Re MTCA TEFs, "WAC 173-340-708(8)(D)(iii)(A)" should be "WAC 173-340-708(8)(d & e)."	Revise WAC citation for dioxins, furans, and PAHs.
45.	p. 6-51, lines 4-13; Appendix F, ECF-Hanford-	TCE toxicity factors were updated in Sept 2011 on IRIS.	Recalculate all values for TCE using the revised toxicity factors in IRIS (ex. oral slope factor = 4.6E-02 kg-day/mg).

	11-0063, p. 31, Table 13; Appendix G, ECF-HANFORD-11-0033, Section 4.2, p. G-254; Appendix G, ECF-100KR4-10-0476, Section 4.3.1, p. G-664, 3rd bullet		
46.	p. 6-51, lines 21-26 AND p. 6-62, lines 42-43	In addition to NJDEP, EPA has also proposed an oral slope factor for Cr+6 (0.5 [mg/kg-d]-1). (http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433	Use the updated oral CSF for Cr+6.
47.	p. 6-51, lines 27-34	Regional EPA toxicity factors should be used in no others are available. MTCA/CLARC lists an oral RfD for 1,1,-DCA (0.2 mg/kg-d).	Utilize Regional EPA toxicity factors when no others are available.
48.	p. 6-51, lines 35-44	The most current toxicity values in IRIS for CCl4 should be used.	Use current toxicity values in IRIS for CCl4.
49.	p. 6-52, line 1	Looks like "Table 6-15" should be "Table G-14" (although decay constants for rads are not listed).	Fix the wrong table citation.
50.	p. 6-53, lines 21-29	Note that HI should only be calculated for noncarcinogens with a similar mode of action.	Sum HQs only for noncarcinogens with a common mode of action.
51.	p. 6-54, lines 10-13	The 90th percentile soil concentration for As in WA state is 7 mg/kg (not 20 mg/kg), as listed in Ecology Pub. No. 94-115.	Correct text for background soil As value.
52.	p. 6-60, lines 40-41	Looks like this sentence is backwards. That is, risks may be understated for sites that did not implement a methods-based approach.	Check this sentence and revise, if warranted.
53.	p. 6-61, line 9; p. 6-83, lines 13-18	The max should not be used when UCL95>max (UCL95 should be used). If max is used, risk may be understated.	Use UCL95 when UCL95>max.
54.	p. 6-62, line 29	Mode of action is better described by "toxicodynamics" (rather than toxicokinetics).	Revise description of mode of action.
55.	p. 6-63, lines 1-2	Using the proposed oral slope for Cr+6 ([0.5 [mg/kg-d]-1), the MTCA Method B soil concentration to protect groundwater is	Please note this soil CUL to protect groundwater, in addition to the direct contact CUL.

		7E-4 mg/kg (which is likely well below background).	
56.	p. 6-64, lines 36-37	In addition to direct contact (i.e., ingestion, inhalation, dermal contact) and fish consumption, the CEM (p. 6-31 to 6-32) also shows exposure to groundwater contaminants via external radiation, along with irrigation and subsequent vegetable and livestock consumption.	List all groundwater pathways.
57.	p. 6-73 to 6-79, Table 6-10	Footnotes lack letters, corresponding to superscript letters in table.	Add letters to footnotes, corresponding to superscript letters in table.
58.	p. 6-82, lines 32-34 AND p. 6-83 lines 7-12	Because the maximum detection limit is higher than the action level for benzene, 1,1-DCE, 1,1,2-TCA, perc, VC, and Hg (Table 6-12), these COPCs should be retained and treated as a uncertainty.	Retain COPCs with detection limits higher than action levels.
59.	p. 6-83, lines 23-44; p 6-84, lines1-21	This discussion (Uncertainty Analysis) would be unnecessary if the comparison to action levels was eliminated in the COPC identification step and implemented during EPC assessment.	Eliminate screening against action levels in the COPC identification step.
60.	p. 6-89, lines 12-13	EPC estimation and comparison to action levels should follow COPC identification.	EPC assessment should follow COPC identification.
61.	p. 6-89, lines 24-26; p. 6-90, lines 8-14	Rationale for estimating EPC with a 90th percentile appears inadequate. Spatial and temporal heterogeneity of COPC distributions are common to all media and do not preclude UCL95 calculation. EPC estimation should follow ProUCL guidance.	Follow EPA's ProUCL guidance to estimate EPC and handle non-detects. As such, EPC should be estimated by using an average value (e.g., an appropriate UCL95). Also, simple substitution methods (e.g., MDL) should not be used to evaluate non-detects. According to ProUCL, other methods are better (e.g., KM, bootstrap).
62.	p. 6-94, Table 6-15	There is no footnote for superscript "a" in the table.	Add footnote "a."
63.	p. 6-95, Figure 6-10	"Co-located" is misspelled. (DD)	Spell check.
64.	p. 6-98, lines 25-27	Rationale for excluding Zn (i.e., association with well casings) is unconvincing, and Zn should be included as a groundwater COPC.	Include Zn as a groundwater COPC.
65.	p. 6-99, Table 6-16	Re C-14, note that [90th Percentile<Action Level] but [UCL95>Action Level].	Use UCL95 when possible to estimate EPC.
66.	p. 6-101, figure 6-11	The diamond on the right has "Yes" exiting twice.	Fix flow chart.
67.	p. 6-102, Table 6-17	Although the footnote states, "EPC did not exceed action level...," this is not true for TCE (see Table 6-16).	Revise footnote for TCE.
68.	p. 6-105, line 11	Looks like Section 6.3.2.2 should be Section 6.3.3.4. (DD)	Fix Section number.

69.	p. 6-106, lines 21-24	Text states, "a risk evaluation is not conducted for refined COPCs that are radionuclides," presumably because radiological limits for the drinking water pathway are expressed in terms of dose (beta/photon emitters) or activity (alpha emitters), rather than risk. However, exposure to rads in groundwater can occur via other pathways (besides drinking water), including external gamma, inhalation, dermal contact, as well as consumption of irrigated vegetation and livestock (see Figures 6-4 and 6-5), which should be evaluated against the NCP risk range (1E-6 to 1E-4).	Note that exposure to groundwater rads occurs through multiple pathways (not limited to drinking water) which should be evaluated against the NCP risk range.
70.	p. 6-108, lines 11-12	The last sentence should be revised to, "Each fraction is converted to a dose equivalent by multiplying the fraction by 4 mrem/y."	Revise last sentence.
71.	p. 6-111, lines line 8	The 90th percentile of Cr+6 in groundwater exceeds that MTCA noncancer CUL (see Table 6-18).	State that the Cr+6 in groundwater exceeds the MTCA noncancer CUL.
72.	p. 6-111,, lines 43-44	Please clarify this sentence relating MCLs and protection of aquatic organisms (since MCLs are derived to protect humans). If the intent is to note that MCLs for rads are generally below aquatic BCGs, state this.	Please clarify this sentence.
73.	Table 8.2 General	The ARAR table must establish the regulations that are applicable, relevant and appropriate for the 100-K operable unit. Throughout the text in the column rationale for including is the use of the work "**may**". This is an FS for the final cleanup action and the FS must state the contaminants and the remedy that is needed to meet the RAOs for those contaminants. With that knowledge, it should be apparent which regulations apply. The word "may" is not appropriate for a final decision.	Remove the word "**may**" though out the test in the column named the rationale for including.
74.	Pg. 8-9, Table 8-2	The ARAR WAC173-303-64620(4) regulatory requirement column is not correct. The corrective action requirement takes into account more than standards for groundwater protection.	Rewrite as follows: Requires Corrective Action to be "consistent with" specified sections in WAC173-340. Locate this ARAR with the rest of the WAC173-303 regulatory requirements.
75.	Pg. 8-9, Table 8-2	The ARAR WAC173-303-64620(4) rational for including column is incorrect. Corrective Action applies to the entire Hanford site. Corrective Action applies to all releases of dangerous waste and dangerous constituents. WAC173-303-64620(1). Although CERCLA may be the authority being used to clean up the release, that clean up must be "consistent with" corrective	Rewrite as follows: The substantive portions of WAC173-340 establish minimum requirements for HWMA corrective action.

		action.	
76.	Pg. 8-9, Table 8-2	The ARAR WAC173-303-64620(4) possible application column is incorrect. Corrective Action applies to the entire Hanford site. Corrective Action applies to all releases of dangerous waste and dangerous constituents. WAC173-303-64620(1). Corrective action does not apply only to groundwater.	Rewrite as follows: corrective action applies to environmental media on the Hanford site where dangerous waste and dangerous constituents have been placed whether intentional or unintentional.
77.	Pg. 8-32, Lines 34-35	For technical clarity, the sentence should be edited as follows: "PRGs are numerical values expressed as concentrations for a chemical or activity for a radionuclide in an environmental media."	Please make edits as shown.
78.	Pg. D2-16, Table 6-1, Mercury	The Preliminary Cleanup Goal for Groundwater Protection for mercury is listed as 2.09 mg/kg. This value is not consistent with the approved Sampling and Analysis Plan.	Provide the technical basis for the Groundwater Protection level for mercury.
79.	Pg. D2-16, Table 6-1, Hexavalent Chromium	The Preliminary Cleanup Goals for Direct Exposure, Groundwater Protection and River Protection for hexavalent chromium are listed as 240 mg/kg, 18.4 mg/kg, and 7.7 mg/kg, respectively. These values are not consistent with the approved Sampling and Analysis Plan.	Please use the correct values that are shown in the approved Sampling and Analysis Plan for the 100 Area.
80.	Pg. D2-23, Table 6-2, Nitrate and Nitrite	The table only lists EPA method 300.0 for nitrates and nitrites. Previous sections also listed EPA method 353.3 for these constituents. Please list the performance requirements for method 353.3 within Table 6-2.	Please add the requested information to the table.
81.	Pg. D2-30, Line 20	The text states that groundwater samples were analyzed for VOCs, TPH-D and PAHs. However, the PAH method was not listed on page D2-2, Table 1-1. Analytical Methods	Include the PAH method in Table 1.1.
82.	Pages D18-1 - D18-2341, Table D-18	All of the cells in the Date column have 00:00.0 listed. Please enter the correct dates.	Enter the correct dates in the table.
83.	Page D19-1 - D19-2466, Table D-19	All of the cells in the Date column have 00:00.0 listed. Please enter the correct dates.	Enter the correct dates in the table.
84.	Page D20-2 – D20-2495, Table D20-	The specified pages of Table D-20 are missing the title. (NSJ)	Show the table title on the specified pages of Table D-20
85.	General Appendix F	The process of screening out contaminants eliminates risk contributors and is not a beneficial use of resources. It is also not clear how many sites were used to represent the OU and what characteristics of those particular sites make them	Abandon the screening process. Instead, group contaminants according to time of peak concentration, and assess the risk for the various time bins.

		representative of the OU.	
86.	General Appendix F	Appendix F describes the use of the ASTM 3987 neutral leach method to calculate Kd values. Ecology Publication No. 03-09-107 "An Assessment of Laboratory Leaching Tests for Predicting the Impacts of Fill Material on Ground Water and Surface Water Quality" evaluates this method. Two issues that stand out are that ASTM 3987 is the least expensive of all the tests evaluated and no reproducibility test data could be found. This test is similar to the TCLP only with a neutral extraction fluid used. A Kd value can be calculated but compared to column and lab batch testing this is a qualitative test. This is why in appendix F scatter plots of the data were developed and the Kds are only estimated. Appendix F states that a conservative value was used based on Kds found in the literature.	Justify the statement that this is a conservative value.
87.	General Appendix F, ECF-100KR-1-0073	For all of these issues, changes may impact risk results. The Kds as listed in Table 4-1 are for the most part, taken directly from those used in the Interim Work Plan (DOE-RL 96-17, Rev 6, App E). This Kd documentation contains numerous errors including incorrect references and incorrect values. 1) New Kd values have also been issued for Hanford-specific sites since the references used in the work plan. Many Kds reference to Ames & Serne (1991). Kincaid (1998) is in some cases but not other, with no explanation. Newer references include PNNL-16100 and PNNL-18564.	1. Justify why old Kd values were used when newer Hanford-specific values are available. 2. Justify why some of the new values are lower (i.e., more conservative) such as Co-60 which is listed as 50 mL/g in Ames & Serne (1991) and PNNL-18564 which lists values between 4.8 and 10 mL/g (Table 6-9). Justify the value used. 3. Explain why a Kd for beryllium of 790 mL/g is used (Ecology, 2009) when Hanford specific values are available which are an order of magnitude lower (e.g., Ames & Serne (1991) lists a value of 20 mL/g). 4. The Kd for Ni is incorrect. It is listed as 30 mL/g for Ni-63 and 65 mL/g for Ni metal. DOE-RL 96-17 lists the reference as Ames & Serne (1991) for both values. Ames & Serne (1991) lists one value, 30 mL/g for Ni (not specific to Ni-63). Explain or correct this value. 5. The Kds for U (U-233/234, U-235, U-238) all equal 2 mL/g. The reference given in DOE-RL 96-17 lists Serne and Woods (1990) which does not contain those values. Newer references such as PNNL-18564 show Kds varying between 0.26 and 4 mL/g depending on the assumed soil composition. Correct that reference and justify the values.
88.	Appendix F, pg.	The text states "Those non-radionuclide analytes with a time to peak groundwater concentration of greater than 10,000	Modify the statement to the following: "Those non-radionuclide analytes with a <u>minimum</u> time to

	F-7, Section 4.1	years are removed from further consideration." Table 4-1, however, gives both minimum and maximum times until peaks. The text does not indicate which were used.	peak groundwater concentration of greater than 10,000 years are analyzed as a separate group of contaminants and discussed in the uncertainty analysis."
89.	Appendix F, p. F-8, Section 4.2.2, last paragraph	The text states "The STOMP 1D 100:0 Contaminant Source Model uses an irrigation recharge scenario and ..." The annual recharge is not stated.	Provide the assumed annual recharge. This value should be no less than annual winter recharge. If the value is less than 50 mm/y, increase the value to at least 50 mm/y (see . Gee et.al, 2005, Vadose Zone Journal, 4:32-40).
90.	Appendix F, pg. F-13, Table 4-1	No references for the Kd values in this table are provided.	Cite the references in the table. Also discuss how the selection of Kd values meets the requirements of WAC 173-340-747(8)(b)(i) and -702(14).
91.	Appendix F, pg. F-13, Table 4-1	The uranium Kd value of 2 mL/g does not appear to be site specific for this portion of the 100 areas and does not address WAC 173-340-747(8)(b)(i) or meet the burden of WAC 173-340-702(14). It is significantly larger than the lower 10th percentile of values in PNNL-13895 (Rev.1), which Ecology has used to select 0.3 mL/g in the absence of site-specific values.	Use uranium Kd values measured for waste sites in the vicinity of each waste site of interest; and/or use a Kd value of 0.3 mL/g for uranium in the absence of site-specific data.
92.	Appendix F, p. F-13, Table 4-1	The cadmium Kd value is very large and has not been supported with a site-specific reference. The Ames and Serne (1991) reference does not provide a value that can be traced to Hanford-specific measurements for cadmium. Additionally, the Ames and Serne (1991) reference provides a range of values, rather than the value of 30 mL/g.	Use a site-specific Kd value for cadmium and provide the reference for the value to Ecology. If there is no site-specific Kd value, use 6.7 mL/g from CLARC.
93.	Appendix F, p. F-16, Table 4-3	Several of the values in the Fixed-Parameter Three-Phase column do not match values that would be calculated with the CLARC default values. The regulations allow for use of other values calculated using site-specific parameters. However, in cases where the defaults are not used, the method is the Variable Parameter Three-Phase model. Additionally, in WAC 173-340, both the values obtained with the Fixed-Parameter and Variable-Parameter Three-Phase models are considered cleanup levels, rather than screening levels.	Change the column title to Variable Parameter Three-Phase Soil Cleanup Level for Groundwater Protection.
94.	Appendix F, ECF-100KR1-11-0074, p. F-82, Section 2 and p. F-84, Section 4.2	The document states (on p. F-82) "The STOMP 1D 100:0 Contaminant Source Model was used to develop PRGs for a base case scenario. The recharge rate for the base case scenario represents a site re-vegetated with natural (shrub steppe) land cover." No recharge value has been given. The waste sites will be backfilled with disturbed soil that has no natural soil horizons,	Provide the assumed annual recharge. This value should be no less than annual winter recharge. If the value is less than 50 mm/y, increase the value to at least 50 mm/y (see. Gee et.al, 2005, Vadose Zone Journal, 4:32-40).

		and, therefore, will have a higher recharge rate than that for undisturbed mature shrub steppe.	
95.	Appendix F, ECF-100KR1-11-0074, p.F-83-84, Tables 4-2 and 4-4	For waste site 100-K-33, the arsenic exposure point concentration is 6700 µg/kg, which is slightly above the Hanford site background value of 6500 µg/kg, and well above the WAC 173-340 (2007) direct contact level for unrestricted land use (667 µg/kg), and above the 3-phase model soil value for protection of groundwater (339 µg/kg) and the soil value for protection of surface water (11 µg/kg). Consequently, the soil concentration protective of groundwater and surface water has to default to 6500 µg/kg. Table 4-4 shows that using modeling the STOMP 1D 100:0 value would be 164µg/kg. However, the document does not discuss how the EPC for 100-K-33 compares with background, as it clearly exceeds the value in Table 4-4.	Compare the EPC for site 100-K-33 with the Hanford site arsenic background value for soil.
96.	Appendix F, ECF-100KR1-11-0063, p. 2, Section 2.5	The text states "K_D is constant in time and space," This statement is not true. K_D varies with very slight changes in soil or sediment characteristics and the concentration of the contaminant, all of which vary in space. K_D is also dependent on water content, which varies in both time and space.	Delete the quoted phrase.
97.	Appendix F, ECF-100KR1-11-0063, p. 5, Section 2.6	Equation 8 is not accepted for setting PRGs. PRGs are concentrations, rather than masses (or activities). No reference has been provided that indicates that this specific equation has been used elsewhere in environmental cleanups. This does not meet WAC 173-340-747(8)(c) , -702(14)(b), or -702(16)(b) requirements.	Do not set PRGs as masses or activities. Set PRGs as concentrations, using methods that have been directly accepted by the scientific community and widely applied. Alternatively, use the default or variable parameter methods in WAC 173-340-747(methods (4) and (5)).
98.	Appendix F, ECF-100KR1-11-0063, p. 15, Section 3.2.1	The text states "The net infiltration into the vadose zone, which is used in the model to represent the recharge into the aquifer, is driven by the competition between precipitation, potential evaporation, transpiration, run-off and run-on." This sentence does not clearly indicate how water balance was calculated in the modeling. The potential evaporation is only achieved when water is actually available to evaporate; use of potential evaporation values in calculations will overestimate evaporation. Actual evaporation, rather than potential evaporation, should be used in calculations.	Change the text to a statement of the water balance equation that was used in the modeling.
99.	Appendix F, ECF-100KR1-	Ecology does not accept the assumed base case recharge values. Recharge will not drop to 8 mm/y or less until steady-	Use an infiltration rate of at least 50 mm/y for the base case for post remediation and long term, based on the research of

	11-0063, p. 16-17, Section 3.2.1 and Tables 5 and 6	state and soil horizonation returns to the pre-disturbed condition. The time period for an A horizon of the Entisols (Burbank and Rupert) and the Aridisol (Ephrata) to develop, as existed prior to disturbance of the soil, would be at least 100 years (Birkeland, P.W., 1984, Soils and Geomorphology, p. 223-225). The assumption that the site will be mature shrub-steppe in 30 years (as implied by the assumption of 4 to 8 mm/y recharge after 30 y) is not accepted. There are no references cited that establish a 30-year time of development for mature shrub-steppe and A horizon for Hanford soils. The burden of proof for establishing that infiltration (as required by WAC 173-340-747(8)(vii)) has been derived in a defensible manner has not been met.	Gee et.al, 2005, Vadose Zone Journal, 4:32-40 and Gee et al., 2005, Vadose Zone Journal, 4:72-78.
100.	Appendix F, ECF-Hanford-11-0063, p. 23, 2nd paragraph	The reference for the development of the Kd for hexavalent chromium does not indicate where the samples were taken and does not provide leachate concentrations for the samples.	Please provide a map of the sample locations used in the Kd determination for hexavalent chromium (the samples used in ECF-Hanford-11-0165). Also, please provide the hexavalent chromium concentrations in the leachates for each dilution that was used to in the determination of the hexavalent chromium Kd in ECF-Hanford-11-0165.
101.	Appendix F, ECF-Hanford-11-0063, p. 23, 2nd paragraph	The Kd value of 0.8 mL/g for Cr (VI) is a desorption value. Sorption (uptake) was not measured. In this case, if it is assumed that the entire vadose zone is contaminated, then there would be desorption throughout the vadose zone. However, for any modeling that assumes that some portion of the vadose zone is not contaminated, sorption Kd values are needed and they are not provided.	For any modeling that assumes that some portion of the vadose zone is not currently contaminated with Cr (VI), use a Kd value of 0 mL/g in the absence of sorption data for Cr (VI).
102.	Appendix F, ECF-Hanford-11-0063, p. 24, top; p. 25, top	The document references DOE/RL-2011-50 for point of calculation, protectiveness metric, exposure point and point of compliance. DOE/RL-2011-50 generated many comments from Ecology, and will need revision.	Delete the reference to DOE/RL-2011-50. Use other documents as references instead, or define all necessary terms in this document.
103.	Appendix F, ECF-Hanford-11-0063, p. 25, bullets 1 and 2	The term "representative columns" is not defined.	Define in the document what is meant by "representative columns."
104.	Appendix F, ECF-Hanford-11-0063, p. 26, bullets	This is not a complete list of non-conservative assumptions. For instance, currently the base case recharge rate of 8 mm/y is highly non-conservative, when compared with lysimeter drainage rates. Also, new science is leading to the derivation of an oral slope factor for hexavalent chromium, which will likely lead to a significantly lower cleanup level for hexavalent	List all assumptions but do not label them as conservative or not conservative.

		chromium.	
105.	Appendix F, ECF-Hanford-11-0063, p. 31, Table 13	The values calculated as screening levels and preliminary remediation goals in this table are not accepted because the recharge rates are not accepted.	Use an infiltration rate of at least 50 mm/y for the base case for post remediation and long term, based on the research of Gee et.al, 2005, Vadose Zone Journal, 4:32-40 and Gee et al., 2005, Vadose Zone Journal, 4:72-78. For the irrigation recharge rates, add the recharge from the irrigation season to that of the base case.
106.	Appendix F, ECF-Hanford-11-0063, p. 31, Equation 11	Since the modeling effort and its application have not been demonstrated to meet the criteria in WAC 173-340-747(8) for this document, an alternative approach would be to show all of the calculations that were used to determine the flow rates for the dilution calculation in Equation 11. This could eventually allow calculation of a defensible dilution factor (after revision of the recharge rate as indicated in prior comments). This could be used with the 3-phase equation to determine defensible cleanup levels. For instance, assuming a dilution factor of 100 can be defended, the revised hexavalent chromium value for protection of surface water would be roughly 1 mg/kg. Considering the revised status of hexavalent chromium as a carcinogen by ingestion, the value should err on the side of protection of human health.	Please provide all of the calculations that were used to determine the flow rates for the dilution calculation in Equation 11, to satisfy the requirements in WAC 173-340-747(8)(b)(vi).
107.	Appendix F, ECF-Hanford-11-0063, p. 31, Table 13	The benzene groundwater cleanup level from WAC 173-340-720 is 0.8 µg/L, rather than 1.59 µg/L. The inhalation correction factor is 2 for benzene.	Revise the groundwater standard to 0.8 µg/L and recalculate the benzene value.
108.	Appendix F, ECF-Hanford-11-0063, p. 32, Figure 7	The figure legend refers to Hanford; set 1 and Hanford; set 2. The document does not explain these terms.	Include an explanation for Hanford; set 1 and Hanford; set 2.
109.	Appendix G, General	Each reference in the document about MTCA Method B *must* specify that all comparisons with MTCA Method B are for the direct contact pathway only. MTCA Method B requires consideration of the soil pathway to groundwater, which appears to be omitted in general. Without consideration of the soil pathway to groundwater, the method would not be MTCA Method B, so it is incorrect to refer to it that way. This especially applies to ECF-HANFORD-10-0444.	Revise *all* references to MTCA Method B (in text and tables) to MTCA Method B <u>Direct Contact</u>.
110.	Appendix G, p. G-1, Residential	The text states "A total of 18 shallow zone decision units (from 16 waste sites) are included in the 100-K Source OU." This seems like an extremely low number of waste sites for	State that the 16 waste sites are the interim remediated waste sites (if this is the case), or explain why there are only 16 waste sites in 100-K. Explain how these 16 waste sites are

	Scenario, Shallow Zone	100-K. Are the 16 waste sites the interim remediated waste sites? Also, the definition of decision unit is not given.	representative of all 100 K waste sites. Also, define or redefine decision unit soon before or after using this term.
111.	Appendix G, p. C-3	The table shows generally low sample numbers for organics. Frequency of detection is not meaningful when total sample numbers are low.	Maintain organics in risk assessments since the data set is inadequate for eliminating them.
112.	Appendix G, p. G-25, Table 6-7	It appears that the table is mis-numbered, carcinogen values are missing for metals for the Resident Monument Worker, and noncarcinogen values for the Resident Monument Worker are missing.	Fix the table numbering, add carcinogen values for metals for the Resident Monument Worker, and add noncarcinogen values for the Resident Monument Worker.
113.	Appendix G, p. G-124, Section 1, 2nd paragraph	The text states "Potentially complete exposure pathways associated with this scenario include direct contact and food chain (i.e., the consumption of homegrown produce and livestock) pathways." However, a complete scenario includes groundwater ingestion, which is not discussed here.	Include groundwater ingestion for residential and unrestricted scenarios.
114.	Appendix G, p. G-126, Section 4, bullets	It is not clear that the hydrogeologic parameters used for RESRAD modeling are the same as those used for 1-D STOMP modeling.	Discuss the differences between the RESRAD and STOMP modeling hydrogeologic parameters.
115.	Appendix G, p. G-128, Section 7	The text states "A generic site area of 10,000 m^2 and a generic site thickness of 4.6 m were assumed for developing the PRGs for protection of human health. A sensitivity analysis was performed (see Attachment 4) to determine how sensitive the PRG values are to changes in site area." However, the sensitivity analyses only appeared to examine increases in site areas, which led to decreases in PRG values, rather than decreases in site area that would likely lead to increases in PRGs.	Include discussion of increases in site area relative to the generic site area.
116.	Appendix G, p. G-135, Attachment 1	Input parameters for RESRAD include an evapotranspiration coefficient of 0.91 (or 91% evapotranspiration). This coefficient does not have a basis. Ecology will not accept this coefficient as indicated in previous comments for this document and the Volume II of the RCBRA report (DOE/RL-2007-21, Draft C). Hanford's precipitation falls largely in the winter, and up to 85% of natural winter precipitation can drain from disturbed soils (Gee, G.W, J.M. Keller, and A.L. Ward. 2005. Measurement and prediction of deep drainage from bare sediments at a semiarid site, Vadose Zone Journal 4:32-40).	Use data from Table 3 of Gee et al., 2005, Vadose Zone Journal 4:32-50 for Hanford sands to calculate the evapotranspiration coefficient or base it on a minimum of 50 mm/y of recharge (from the same reference). See also comments: • General Comment #2, • Appendix F, ECF-100KR1-11-0063, p. 16-17, Section 3.2.1 and Tables 5 and 6 • Appendix F, ECF-Hanford-11-0063, p. 31, Table 13
117.	Appendix G,	Consistent with the general comment made on this appendix,	Change the second bullet to:

	ECF-HANFORD-10-04444, Section 4	the second bullet must indicate that the Method B value calculated here does not represent all of the Method B pathways. It specifies soil ingestion without indicating that other pathways may provide more stringent values. The direct contact pathway rarely determines the Method B soil cleanup level, since it is generally the least stringent pathway. Ecology has stressed this repeatedly.	The only Method B exposure route included in this document for calculating the soil cleanup level for unrestricted land use is incidental soil ingestion (a direct contact exposure route). Other pathways may provide a more stringent cleanup level.
118.	Appendix G, p. G-233, ECF-HANFORD-11-0033, Section 4.1	The text does not state where the final soil to protect air CULs can be found.	Add text indicating where the final soil to protect air CULs can be found.
119.	Appendix G, p. G-417, ECF100KR4-10-0470, Section 2	The document states: "In general COPCs with exposure point concentrations above an action level [see Section 3.3 for a complete list of chemical-specific applicable or relevant and appropriate requirements (ARARs)] were retained as COPCs." This implies that contaminants with concentrations below action levels were not retained. This screening step eliminates risk contributors prior to determining total risk. This does not meet the requirements of WAC 173-340-720(7)(a) regarding total site risk.	For D and H areas do not screen against action levels. Include all contaminants in the risk assessment that were detected, were above Hanford site background, and have toxicity information.
120.	Appendix G, p. G-423, ECF100KR4-10-0470, Section 3.5.2	Pooling all of the data to determine a 90th percentile for comparison with action levels overlooks locations with elevated concentrations where contamination may be present.	Look at groundwater data to identify locations with detects of contaminants and locally elevated concentrations. Include all of the data in the risk assessment (note that risk assessment includes qualitative components such as discussions of data). Calculate risk for all locations with detections of contaminants with toxicity information and concentrations above background.
121.	Appendix G, p. G-428, ECF100KR4-10-0470, Section 7.1.2 and p. G-432, Section 7.1.3; ECF-100KR1-11-0008, Section 3.2	The pre-risk assessment screening process should stop for organic contaminants after identifying those on Table 7-2, as further reduction in the contaminant list eliminates contributors to risk (and costs additional time), especially since the data were derived from only 16 out of 165 waste sites. All other organics should be included in the risk assessment, though they need only be included for the locations where they were detected. For instance, the following organics should have been maintained in the risk assessment at the locations where they were detected: • Bromodichloromethane (detected in 5 samples)	Stop the pre-risk assessment screening process for organic contaminants after identifying those on Table 7-2. Include all other organics in the risk assessment for the locations where they were detected, unless there are data quality problems (certain qualifiers).

		• Bromomethane (detected in 21 samples) • Organics eliminated in further screening steps	
122.	Appendix G, p. G-428, ECF100KR4-10-0470, Section 7.1.2 and p. G-432-G-433, Section 7.1.3; ECF-100KR1-11-0008, Section 3.2	The pre- risk assessment screening process should stop for inorganic contaminants after identifying those on Table 7-2, and considering established Hanford background concentrations, as further reduction in the contaminant list eliminates contributors to risk (and costs additional time). All other inorganics should be included in the risk assessment, though they need only be included for the locations where they were detected. For instance, the following inorganics should have been maintained in the risk assessment at the locations where they were detected depending on a comparison with background concentrations: • lithium (detected in 33 (of 36) samples) • molybdenum (detected in all samples) • silver (detected in 1 sample) • inorganics eliminated in further screening steps	Stop the pre-risk assessment screening process for inorganic contaminants after identifying those on Table 7-2 at concentrations above established Hanford site background values. Include all other inorganics in the risk assessment for the locations where they were detected, unless there are data quality problems (certain qualifiers).
123.	Appendix G, p. G-438, ECF100KR4-10-0470, Table 7-13	The table shows that a summary of groundwater COPCs includes chromium, hexavalent chromium, chloroform, trichloroethene, carbon-14, strontium-90, tritium, and nitrate. While Ecology is not in agreement with the process used to develop this table or the outcome, it seems that these COPCs should be included on Table 4, p. 28 of the Proposed Plan for 100-K (DOE/ RL-2011-82, Draft A). Chloroform is not on the Proposed Plan table.	Revise the Proposed Plan to be consistent with a revised version of Table 7-13 in this appendix. See prior comments about the screening process for revisions necessary for this table.
124.	Appendix G, ECF-100KR4-10-0472, p. G-460, Section 2.1	The text states "An EPC is a conservative estimate of the contaminant concentration at an exposure point or in an exposure area where an exposed receptor may reasonably be assumed to move at random and where contact with an environmental medium (e.g. water) is equally likely at all locations within the exposure area." This can only be represented with a random or systematic random sample design and equal sample numbers and similar sample timeframes for the wells considered. It appears from Figure 4-1 of ECF100KR4-10-0470 that the well distribution does not fit this requirement. It is also not clear that an equal number of samples from each well and similar timeframes for the well data are being considered.	Provide EPC values for each contaminant at each well. This would be consistent with the focused well sample design.

125.	Appendix G, ECF-100KR4-10-0472, p. G-461, Section 4.1	The sampling time period is not stated and should be included. The time period should be at least 10 y of monitoring, to be consistent with the evaluation in DOE/RL-2007-21, Volume II. Also, time trends for contaminants are important information; they are not discussed.	Use a well monitoring time period of at least 10 y for calculating risk. Also, include discussion of time trends for the contaminants.
126.	Appendix G, ECF-100KR4-10-0472, p. G-462, Section 4.2	The text states "In general, EPA Superfund guidance recommends using a 95% Upper Confidence Limit (95 UCL) on the mean for estimating EPCs. However, experience at the Hanford Site indicates that averages and UCLs cannot be reliably calculated for Hanford groundwater data sets, such as the 100-KR-4 OU data, where multiple groundwater contaminants are present in overlapping plumes, and the highest concentrations for different analytes often have different locations within the plumes." This statement prompts concern about the overlapping plumes and the co-contaminants in the plumes.	Provide a map of the contaminant plumes in the K area. Discuss all co-contaminants in the groundwater plumes.
127.	Appendix G, ECF-100KR4-10-0472, p. G-467, Section 7.2, 3rd paragraph and Table7-2; ECF-100KR4-10-0476, p. G-662, Table 4-1	The text states "A groundwater data set is considered robust when the 90th percentile value is greater than the 95 UCL value. The 90th percentile concentrations are greater than the 95 UCL values for all detected analytes/COPCs, except carbon-14, manganese, and tritium." Of significant concern are carbon-14 and tritium, which have 95% UCL concentrations that are twice as large as their 90th percentile concentrations. The 90th percentile concentration for carbon-14 is 1465 pCi/L while its 95% UCL is 3022 pCi/L. The 90th percentile concentration for tritium is 34,500 pCi/L while its 95% UCL is 71,868 pCi/L. The discussion in this paragraph does not mention these two important 100-K contaminants. The 90th percentile is not a conservative measure when important contaminants are the exception by a significant amount.	Include a comparison of the 90th percentile concentrations, 95th percentile concentrations and 95% UCL for carbon-14 and tritium within this paragraph (3rd paragraph of Section 7.2, ECF-100KR4-10-0472). Use ProUCL guidance for selecting the statistic to use for the risk assessment.
128.	Appendix G, ECF-100KR4-10-0472, p. G-478 – G-479, Section B.5 and Table B-3	The use of 90th percentile does not appear to be based on EPA/240/B-06/003, which has been cited to justify using the 90th percentile instead of the 95% UCL. The EPA guidance document specifies certain circumstances for using an upper percentile instead of using a 95% UCL. However, the EPA guidance document does not specify that the upper percentile to use should be the 90th percentile. Also, this document is not consistent with more recent guidance that accompanies ProUCL software. Furthermore, it is not clear how the	Provide all of the following for the contaminants: the 90th percentile concentrations, 95th percentile concentrations and 95% UCL concentrations for information. Use ProUCL guidance for selecting the statistic to use for the risk assessment. Also, further explain how CV influences exposure point concentrations. Finally, do not use frequency of detection as a criterion for eliminating contaminants.

		discussion of coefficient of variability (CV) and Table B-3 influence exposure point concentrations. Finally, frequency of detection is not accepted a criterion for eliminating contaminants from the risk assessment, as it does not consider spatial and temporal trends for contaminants.	
129.	Appendix G, ECF-100KR4-10-0475, p. G-560, Section 4.2	The text states "For this evaluation, comparisons to action levels were not made: any analyte in the (processed) 100-KR-4 OU data set with at least one reported detection was identified as a COPC and assessed in the Native American risk calculations." If this can be done for the Native American risk calculations, it can also be done for the other scenarios.	For all non-Native American scenarios, stop the pre- risk assessment screening process for contaminants after identifying those on Table 7-2 (ECF100KR4-10-0470) at concentrations above established Hanford site background values. Include all other contaminants in the risk assessment for the locations where they were detected, unless there are data quality problems (certain qualifiers).
130.	Appendix G, ECF-100KR4-10-0476, p. G-661, Section 4.2	The text states "For this evaluation, comparisons to action levels were not made; any analyte in the (processed) 100-KR-4 data set with at least one reported detection was identified as a COPC and assessed in the risk calculations." This is a good approach and should be applied throughout the document.	Please take this same approach in sections 7.1.2 and 7.1.of ECF100KR4-10-0470 for groundwater. Also apply this approach for waste sites
131.	Appendix G, ECF-100KR4-10-0476, p. G-668-669, Section 6.2	The text makes several statements that are problematic because they omit important information or discuss contaminant deletions that are based on criteria that are not accepted. The statements are the following: (1) "The nonradiological ELCR is greater than the EPA upper target risk threshold of 1 x 10-4. The individual ELCR for carbon-14, chloroform, strontium-90, trichloroethene, and tritium are within the EPA range of 1 x 10-4 to 1 x 10-6." The actual risk values for each of the contaminants are needed. (2) "Although the individual ELCR value associated with arsenic is greater than EPA's regulatory target risk threshold of 1 x 10-4 and the HQ is greater than 1.0, the 90th percentile value of 5.3 µg/L is considered to be within the range of naturally occurring concentrations of arsenic." The range of naturally occurring concentrations of arsenic in Hanford groundwater is not given and no reference has been cited. (3) "However, bromodichloromethane is not considered to be	Provide in the paragraph the actual risk values for the contaminants in statement (1). Give the range of naturally occurring concentrations of arsenic in Hanford groundwater and cite the source of the information for statement (2). For (3), include bromodichloromethane in the risk assessment for the locations where it was detected.

		a contributor to the ELCR because it was detected in only five of 54 water samples, all of which were flagged with a "J", which indicates that the results are estimated values." Bromodichloromethane was detected, more than once, and a J qualifier is not grounds for eliminating the contaminant. Also, the risk table on p. G-685-686 indicates that bromodichloromethane has a risk contribution of 1.2E-06, which is greater than the individual contaminant risk threshold in WAC 173-340-720.	
132.	Appendix G, ECF-100KR4-10-0476, p. G-688 through end of ECF-100KR4-10-0476, Tables	The tables do not have titles, on this page and in following pages.	Add titles to the tables.
133.	Appendix G, ECF-100KR1-11-0008, p. G-731, Section 3.2.2	The document indicates that the data are evaluated to determine if there were adequate detection limits but does not state how that is done.	State how it was determined that adequate detection limits were used.
134.	Appendix G, ECF-100KR1-11-0008, p. G-737 – G-738, Section 4.9 and 4.10	The document states "When recommended UCL exceeds the maximum detected concentration, ProUCL, however, advises that an alternative UCL (i.e. Chebyshev inequality) to be selected instead of the maximum detected concentration for an EPC." This approach should be applied when the 95%UCL exceeds the maximum. The bullets in Section 4.10 describe a process of picking a UCL that is biased. It is not accepted.	Use the ProUCL approach for determining the 95% UCL. Revise these sections accordingly.
135.	Appendix G, ECF-100KR1-11-0008, p. G-738, Table 4-3	The table applies to 5 contaminants with UCLs that exceed the maximum. However, the total number of samples used for the analysis does not exceed 10. Until additional samples are obtained from further sampling of additional waste sites (since only 16 out of 165 have been sampled), this analysis should be abandoned and these results should not be used.	Delete Table 4-3. Obtain additional 100-K samples from future waste site cleanup and resume the calculation after obtaining a representative and larger data set (see ProUCL for recommendations regarding appropriate sample sizes for calculating 95% UCL values).
136.	Appendix G, ECF-100KR1-11-0009, General	This document does not include an analysis of the WAC 173-340 Unrestricted Use scenario. The framework for this scenario and other WAC 173-340 scenarios is provided in WAC 173-340-708. The scenario equations are provided in WAC 173-340-720 through -760.	Include evaluation of the WAC 173-340 Unrestricted Use scenario in this chapter.

137.	Appendix G, ECF-100KR1-11-0009, p. G-787, Section 2.1.3 and Section 3.3	This section discusses a comparison of lead and arsenic soil concentrations with WAC 173-340 Method A values. While the Method A values are the only direct contact values that are readily available using the regulation for lead (due to the lack of an established reference dose for lead), this approach is not acceptable for arsenic because Hanford sites are not Method A sites and Method B values for arsenic can be derived for all pathways. Cancer slope factors and reference doses are available for arsenic, unlike lead. Standard 100-K waste sites are Method B sites, as Method A sites "involve relatively few hazardous substances" or the cleanup actions are routine as defined in WAC 173-340-200, which are conditions that do not apply at Hanford waste sites.	Use WAC 173-34-740(3) (Method B) for arsenic at waste sites.
138.	Appendix G, ECF-100KR1-11-0009, p. G-792, Section 4.3, Residential Scenario	The text states "For nonradiological analytes in soil the exposure pathways are direct contact from incidental soil ingestion and inhalation of vapors and dust in ambient air." This is not correct. Ingestion of groundwater is a very important pathway in residential and unrestricted use scenarios. This pathway must be included in the risk assessment and is additive with other pathways.	Add ingestion of groundwater as a pathway in the risk assessment for the residential scenario and unrestricted use scenarios.
139.	Appendix G, ECF-Hanford-11-0038, p. G-875, Table ES-2	The table gives a provisional 50th percentile value for background. It is not clear why a 50th percentile, as opposed to the 90th percentile allowed in the regulations, is selected.	Include an explanation in the document for choosing the 50th percentile for background, rather than the 90th percentile.
140.	Appendix G, ECF-Hanford-11-0038, p. G-897, Table 6	The table is confusing. There are check marks and question marks as entries. There are no explanations for these symbols.	Provide explanations for check marks and question marks or just use verbal entries in the table.
141.	Appendix G, ECF-Hanford-11-0038, p. G-900, bottom of page	The text states "Soil samples with analyte concentrations that are either below background, or below risk-based protectiveness levels, are regarded as protective, and are eliminated from further evaluation in the risk analysis (screening) process." Ecology discourages screening contaminants out of the risk assessment in this manner. There are many prior comments about this issue.	Delete this statement. It is not essential to the point being made, which is that contaminants that exceed background concentrations are carried forward in the risk assessment.
142.	Appendix G, ECF-Hanford-11-0038, p. G-	The table has both a column for maximum and overall maximum. There are no explanations for these columns.	Provide an explanation for "Overall Maximum" relative to "Maximum".

	909, Table APP-A2		
143.	Appendix G, ECF-Hanford-11-0038, p. G-909, Table APP-A2	The footnote d on uranium does not have an explanation and only the 90th percentile is filled in for uranium.	Provide footnote d for uranium and fill in the mean, 50th percentile and maximum for uranium.
144.	Appendix H, ECF-100KR-11-0010, p. H-337, para 4	Define "shallow-focused" decision units and "focused study design." Although text indicates that "area and depth" of decision units are defined in Table 2, area does not appear in this table.	Provide definitions and area information.
145.	Appendix H, ECF-100KR-11-0010, p. H-337, para 5	Note that ECF-100KR1-11-008 is contained in Appendix G.	Please clarify that ECF-100KR1-11-008 is in Appendix G.
146.	Appendix H, ECF-100KR-11-0010, p. H-337, para 6	CHPRC-00784 does not propose Tier 1 values for plants and invertebrates (although it lists generic screening levels for plants and invertebrates). Provide ECF-Hanford-11-0060.	Use consistent terminology. Provide ECF-Hanford-11-0060.
147.	Appendix H, ECF-100KR-11-0010, p. H-338, para 1	Consider using the NOAEL-based Tier 1 wildlife values in CHPRC-00784 (rather than LOAEL-based values) as SSLs.	Consider using NOAEL-based Tier 1 wildlife values.
148.	Appendix H, ECF-100KR-11-0010, p. H-338, para 2	HQ or SOF<1 indicates adverse effects are unlikely only if NOAEL-based Tier 1 values are used.	Change to NOAEL-based values.
149.	Appendix H, ECF-100KR-11-0010, p. H-339, para 3	Re the final sentence, Tier 2 values selected should also be based preferentially on NOAELs (rather than LOAELs).	Consider using NOAEL-based values for Tier 2 also.
150.	Appendix H, CHPRC-00784 and CHPRC-01311, General	The titles of these documents do not indicate that the documents only cover wildlife, and not plants.	Revise the titles of the documents to specify wildlife at the Hanford site.
151.	Appendix H, CHPRC-01311,	The barium axis for soil concentration for the invertebrates is different from that for the other biota. It appears that the soil barium concentrations for the invertebrates are too low (well	Revise the axis on the figure.

	Appendix D, p. D-6	below typical Hanford soil concentrations). If the x-axis is correctly labeled, then the BAF for the invertebrates is incorrect.	
152.	Appendix H, CHPRC-01311, p. 2-10, Table 2-1	It is not clear that the EPA, 1993 reference gives the major food items for the deer mouse.	Please provide the page number in the EPA, 1993 reference that gives the major food items (including the 50:50 ratio for plants and invertebrates) for the deer mouse.
153.	Appendix H, CHPRC-01311, p. 2-16, Development of Integrated Bioaccumulation Models	The text states "The Hanford Site-specific plant, soil invertebrate, and small mammal data were integrated with the literature-derived bioaccumulation data." Figures in appendix D show the mixing of literature and Hanford results. It does not appear that the site-specific data were given greater weight than the literature data. This reduces the site specificity of the results, which does not parallel the purpose of developing Tier II values.	Base Tier II values on Hanford-specific results.
154.	Appendix H, CHPRC-01311, p. 2-17 – 2-26, Tables 2-3 – 2-5	This table does not give the references for the results in the table.	Add columns to these tables providing the references for the values in the tables. Also, provide the references for these tables to Ecology.
155.	Appendix H, CHPRC-01311, p. 2-29, Table 2-26	It appears that the LOAEL TRV for cadmium is based on Leach et al., 1979. However, it appears that Blalock and Hill, 1988 had a lower LOAEL.	Please provide the calculations for the avian LOAEL TRV for cadmium and explain why the Leach et al, 1979 result was favored over the Blalock and Hill, 1988 result.
156.	Appendix H, CHPRC-01311, p. 2-29, Table 2-26	For cobalt, most of the Hanford results are greater than the literature results, and the inclusion of the literature results biases the median low.	Please recalculate the BAF values for plants and arthropods for cobalt using just the Hanford results.
157.	Appendix H, CHPRC-01311, p. 2-29 – 2-31, Table 2-26	The manganese LOAL TRV appears to be from Southern and Baker, 1983, yet it appears to be one of their higher values.	Please provide the sources of the LOAEL values for manganese and zinc and provide the following references: Southern and Baker, 1983 Gibson et al., 1986
158.	Appendix H, CHPRC-01311, p. 2-29 – 2-31, Table 2-26	The sources of the NOAEL value for zinc do not appear to be provided. Also, the derivation of the LOAEL TRV for zinc is not clear.	Please provide the calculations for the zinc NOAEL and LOAEL TRV values and provide the Gibson et al., 1986 reference.
159.	Appendix H,	The values in this table are based on LOAELs.	Please indicate in the table heading that the table values are

	CHPRC-01311, p. 4-3 – 4-5, Table 4-1		based on LOAELs.
160.	Appendix H, CHPRC-01311, p. 4-5, Table 4-1	For lead it is not evident why the Great Basin pocket mouse was chosen as the basis for the risk-based soil concentration. All of the birds and the deer mouse had lower risk-based soil concentrations.	Please select the killdeer for lead instead, since it has the lowest risk-based soil concentration.
161.	Appendix H, CHPRC-01311, p. 4-5, Table 4-1	For uranium, the lowest risk-based concentration was obtained for the badger, not the red-tailed hawk.	Use the badger result for tier II, instead of the higher result for the red-tailed hawk.
162.	Appendix H, CHPRC-01311, p. D-17, Figure D-17	For lead, though the literature values for small mammals produce a regression result that appears linear, the Hanford data do not appear linear. The Hanford data are not represented by the line generated with the mixture of literature values and Hanford data.	For the food chain involving small mammals, use only the Hanford data for determining small mammal BAFs for lead.
163.	Appendix L, p. L-6, line27	Figure L-3 is cited but does not appear to be included.	Include Figure L-3.
164.	Appendix L, p. L-7, lines 36-39	The sentence, "The daily and seasonal water level....", does not make sense grammatically.	Please clarify this sentence.
165.	Appendix L, p. L-11, lines 39-40	Explain in more detail why "radionuclides were not identified as COPECs" (in riparian soils at 100-K), despite several detects. Also, it appears that C-14 is identified as a soil COPEC (Section L3.4.4).	Describe why rads are not soil COPCs.
166.	Appendix L, p. L-13, line 12	Insert "Table" before "L-1." (DD)	Please correct.
167.	p. L-15	Page line numbers disappear here to the appendix end. (DD)	Add page line numbers.
168.	Appendix L, p. L-15, para 4	Note that 40 CFR 131 is also referred to as the "National Toxics Rule" (NTR).	Please add NTR descriptor.
169.	Appendix L, p. L-15, para 5	Re ecorisk, WAC 173-340-730 (3)(b)(i & ii) cites WAC 173-201A, Clean Water Act, NTR, and WAC 173-205 (WET testing).	Note interrelationships of citations.
170.	Appendix L, p. L-17, para 2	Re wildlife ESLs and PRGs, cite the Tier 1 (CHPRC-00784) and Tier 2 (CHPRC-01311) reports (in addition to EcoSSLs and MTCA Table 749-3).	Please add Tier 1 and Tier 2 report citations.
171.	Appendix L, p. L-18, para 6	Re the last sentence, Section 4.3.2 does not discuss Cr, C-14, TCE, and nitrate (as stated here). (DD)	Please revise sentence to make it accurate.
172.	Appendix L, p.	Text states analytes on these pages were not reported in	Make text and tables consistent.

	L-19 to L-24	surface water, yet Table L-27 shows otherwise for some (e.g., Cu, Fe, Li, Mn, Ni, Zn).	
173.	Appendix L, Section L3.4	Starting with this section, there is an error in consecutive page numbering. Because of this error, I have referenced my comments to Section number (rather than page number) from here through Section L5 of Appendix L.	Fix pagination.
174.	Appendix L, Section L4.1	Text notes that As soil concentration was greater than the plant ESL, but Table L-32 data show otherwise.	Make text and tables consistent.
175.	Appendix L, Section L4.2	Sediment and porewater COPCs that exceed ESLs (listed in text) do not exactly match those COPCs in Tables L-41 and L-25, respectively. Note uncertainty with sediment bioassay data which are derived from a non-aquatic and non-Hanford plant species (Pak Choi).	Reconcile text and table data. Note bioassay uncertainty due to test species.
176.	Appendix L, Section L4.4.1, para 1	Porewater COPCs that exceed ESLs (listed in text) do not exactly match those COPCs in Table L-25.	Reconcile text and table data.
177.	Appendix L, Section L4.4.1, Cadmium	The conclusion of no complete pathway for Cd from the 100-K riparian area to aquatic invertebrates in sediment (via groundwater) appears to be in conflict with seep/spring data for Cd (Section L3.3.4.2).	Reconcile Cd seep data with pathway conclusion.
178.	Appendix L, Section L4.4.1, Endosulfan I	Although text states, "One detected concentration exceeds the ESL," Table L-41 shows two exceedences for endosulfan I.	Please reconcile text and table.
179.	Appendix L, Section L4.4.1, Zinc	The conclusion of no complete pathway for Zn from the 100-K riparian area to aquatic invertebrates in sediment (via groundwater) appears to be in conflict with groundwater and seep/spring data for Zn (Section L3.3.4.13).	Reconcile Zn groundwater and seep data with pathway conclusion.
180.	Appendix L, Section L4.4.3	Define "EPT data."	Provide a definition for "EPT."
181.	Appendix L, Section L4.4.5	Text states, "…..both abiotic and biotic measures collected for the RCBRA represent only a snapshot in time…" As such, acknowledge that uncertainty exists over time (e.g., diurnal, seasonal, annual, decadal) in both abiotic and biotic data.	Discuss temporal uncertainty in data.
182.	Appendix L, Section L4.4.5, Risk to Wildlife	Re C-14 in riparian soil, text states, "This concentration is above the site-specific thresholds developed for Hanford for seven of eight wildlife species." Refer here to CHPRC-00784 (Table 6-12).	Cite CHPRC-00784 (Table 6-12).

183.	Appendix L, Section L5	The final list of COECs (i.e., Cr+6 in groundwater, C-14 in soil) seems short. In addition to the analytical uncertainty described, uncertainty in conclusions should be emphasized, given the mixed evidence in biotic measures (exposure and effects), as well as limited spatial and temporal sampling of abiotic media.	Re final COEC identification, highlight uncertainty in exposure and effects endpoints (as well as in the limited sampling in time and space).
184.	Appendix L, p. L-70 to L-72, Table L-12	Please clarify why several rads with water BCGs (for riparian and aquatic animals) are listed in this table (e.g., Am-241, Sb-125, Cs-137, Ra-228).	Clarify why several rads with water BCGs are listed in Table L-12.
185.	Appendix L, p. L-89 to L-93, Tables L-28 and L-29	Please clarify why several rads with soil BCGs (for terrestrial plants and animals) are listed in these tables (e.g., Zn-65, Sb-125, U-233/234).	Clarify why several rads with soil BCGs are listed in Tables L-28 and 29.
186.	Appendix L, p. L-102 to L-104, Table L-38	Please clarify why several rads with sediment BCGs (for riparian and aquatic animals) are listed in this table (e.g., Sb-125, Ra-228, Th-232, Zn-65).	Clarify why several rads with sediment BCGs are listed in Table L-38.

Ecology's Comments Record on
Draft A 100-K Feasibility Study Appendix H

December 16, 2011

Contains Comments on the following Documents:

1. ECF-Hanford-11-0158: Tier 2 Terrestrial Plant and Invertebrate PRGs for Nonradionuclides for Use at the Hanford Site
2. CHPRC-00784: Tier 1 Risk-Based Concentrations Protective of Ecological Receptors at the Hanford Site
3. CHPRC-01311: Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site

#	Page, Paragraph	Document #1: Comments on ECF-Hanford-11-0158: Tier 2 Terrestrial Plant and Invertebrate PRGs for Nonradionuclides for Use at the Hanford Site
1.	p. 4	List Appendices, Tables, and Figures in Table of Contents.
2.	p. 5, para 1	Re the first sentence, it is noted that this document pertains only to nonrad COPCs. Please describe Tier 2 efforts for rad COPCs for plants and invertebrates (or state that there is no need, since generic BCGs are sufficient for plants and BCGs for invertebrates are unavailable, if this is the case).
3.	p. 6, para 5	Provide ECF-Hanford-11-006.
4.	p. 7, para 1	Because generic screening levels are now here recommended as Tier 1 PRGs, please clarify this in CHPRC-00784 during its next revision.
5.	p. 7, para 4	List pros and cons of a non-statistical sampling design in relation to a statistically based approach.
6.	p. 8, last bullet	If available, provide information on the sensitivity of Sandberg bluegrass (relative other Hanford plant species) that makes it suitable for a bioassay test species. Data on species sensitivity distributions with Hanford species and COPCs would be ideal to guide bioassay design and inform eco risk at Hanford.
7.	p. 9, para 3	Table 2-3 is cited but does not appear to be included.
8.	p. 10, para 2	Similar to pesticide and background screening, describe how bioassay samples were screened for radioactivity.
9.	p. 11, para 3	Describe "laboratory and field-collected negative control samples." In particular, note if the lab control is comprised of artificial soil and describe its composition.
10.	p. 12, para 3	List criteria for outlier designation. Describe pros and cons of eliminating data for statistical analysis. It is unclear why high values are eliminated.
11.	p. 12, para 4	Please clarify why correlation analysis is performed prior to regression analysis (since regression analysis also provides correlation information). With a large number of correlation analyses, it would be prudent to reduce the statistical significance level (from alpha=0.05) to minimize experimental-wise error (e.g., Bonferroni method) and avoid spurious

#	Page, Paragraph	Document #1: Comments on ECF-Hanford-11-0158: Tier 2 Terrestrial Plant and Invertebrate PRGs for Nonradionuclides for Use at the Hanford Site
		correlations, as performed by Ingersoll et al (2009). This type of Bonferroni correction should also be applied to other sets of multiple tests (i.e., Wilcoxon, regression).
12.	p. 13, para 1	Although regression analysis is performed, a true concentration-response function for a given analyte/response combination can only be obtained from testing a dilution series of a single soil sample (resulting sub-samples have same co-contaminants), rather than testing multiple independent soil samples (having different co-contaminants). Note this limitation. Please explain how "Bioassay responses were scaled to the median of the laboratory and field control samples that comprised the reference envelope."
13.	p. 14, para 1	Table 1-2 is cited but does not appear to be included (maybe should cite Table 2-1 here).
14.	p. 14, para 4	Text states, "The final recommended PRG represented the most appropriate value which was usually the highest value. The highest value was selected because all site-specific thresholds were no effect concentrations….." Therefore, the role of EC20 is unclear (since it signifies a 20% effect). Please provide rationale for deriving a PRG, clarifying selection of EC20 vs. NOEC data.
15.	p. 15, para 5	Provide rationale for using EC20 as a PRG, considering the relatively large effect.
16.	p. 15, para 7	The boron analytical problem in waste site samples should be regarded as an uncertainty, rather than an assumption.
17.	p. 16 , para 3	Note that cumulative frequency distributions (CFDs) for analyte soil concentrations (Figures A-1 to A-33) are contained in Appendix A, and nonparametric Spearman correlations are contained in Appendix B.
18.	p. 16, para 4, bullet 5	Note that plant dose response scatterplots (Figures C-1 to C-33) are contained in Appendix C.
19.	p. 17, para 1, bullet 5	Note that invertebrate dose response scatterplots (Figures D-1 to D-33) are contained in Appendix D.
20.	p. 20, para 2	The first sentence in the "Plant Weight" section should refer to Table 5-5 (not Table 5-6).
21.	p. 20, para 7	Refer to Table 5-10 for "Invertebrate Reproduction" results.
22.	p. 20, para 8	Under first paragraph of "Spearman's Rank Correlation," cite Tables 5-6, 5-10, and 5-11 (in addition to Table 5-5).
23.	p. 21, para 7	Under "Invertebrate Reproduction," refer to Table 5-10.
24.	p. 22-23, Section 6.2.3	Under "Regression Analysis," refer to relevant data tables.
25.	p. 22, para 3	For clarity, revise the sentence "Slopes of the significant regressions were mostly insignificant (orders of magnitude below 1)…." to "Slopes of the

#	Page, Paragraph	Document #1: Comments on ECF-Hanford-11-0158: Tier 2 Terrestrial Plant and Invertebrate PRGs for Nonradionuclides for Use at the Hanford Site
		statistically significant regressions were mostly biologically insignificant (orders of magnitude below 1)…." This comment for regression analysis for plant germination also applies to regressions for other responses below (plant height, plant weight, invertebrate survival).
26.	p. 23, para 1	Re first sentence, replace "germination" with "survival."
27.	p. 23-24, Table 6-3	Delete "NOEC" under "Plant" and Invertebrate" columns, because not all of these PRGs are NOECs. For example, Ecology and ORNL values are based primarily on LOEC values (e.g., plant PRGs for Ba, Be, Hg, Mo, Tl). Also, 3 significant figures for PRGs seems unrealistically optimistic.
28.	p. 23-32, Table 6-3 and text	Several PRGs are inconsistent, as specified in Table 6-3 vs. text (B [invertebrates], Cd [invertebrates], Sn [text specifies 2 PRGs). Describe the uncertainty, inherent in PRGs which are unbounded NOECs (Sb, As, Ba [invertebrates], B, Cd, Cr, Cu [invertebrates], Pb [plants], Mn, Hg [invertebrates], Mo [invertebrates], Se [plants], Ag [invertebrates], Tl [invertebrates], Sn, V [invertebrates], Zn [invertebrates]).
29.	p. 27, para 4	The plant PRG selected for Pb is 9090 mg/kg. This soil concentration appears high, relative to the EPA EcoSSL for plants (120 mg/kg), Ecology recommended values for plants (50 mg/kg, MTCA Table 749-3; 390 mg/kg, Ecology Pub. No. 11-03-006), as well as the RCBRA PRG (125 mg/kg). These data are listed in Table 5-8. 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.
30.	p. 31, para 1	The first sentence specifies 838 mg/kg as the PRG for Sn (for both plants and invertebrates), while the last sentence specifies 1260 mg/kg.
31.	Figure 2-2	Re Spearman box on right (second and third bullets for $p \leq 0.05$), text states null hypothesis is "accepted" (should state null hypothesis is "rejected").
32.	Tables 5-5 5-6, 5-10, 5-11, 6-2	Define color shading.
33.	Table 5-7 footnotes	Regression models should all include scaled y variable (germination, height, weight), consistent with description on p. 13. Re "Notes," text states "p-value <0.05 is not significant." (should state "p-value <0.05 is significant"). Re "NA" acronym, text states, "P-value was <0.5 indicating relationship between chemistry and median measure (germination, height, weight) is not significant…." Looks like text should state, "P value was >0.05…….").

#	Page, Paragraph	Document #1: Comments on ECF-Hanford-11-0158: Tier 2 Terrestrial Plant and Invertebrate PRGs for Nonradionuclides for Use at the Hanford Site
34.	Table 5-9	Include "invertebrate" in table title.
35.	Appendix C	Y axis in bottom panel of scatterplots should be labeled "Weight" with appropriate mass units (not "Height").
36.	Appendices C and D	Clarify legends for scatterplots (i.e., explain symbols in more detail).

#	Page, Paragraph	Document #2: Comments on CHPRC-00784: Tier 1 Risk-Based Concentrations Protective of Ecological Receptors at the Hanford Site.
37.	p. 1-3, para 2	In contrast to the text, EPA's ERAGS "recommends the more conservative NOAELs, instead of LOAELs, are used to determine a screening exposure level that is unlikely to adversely impact populations" (p. 1-9 to 1-12 in EPA/540-R-97-006). EPA's SLERAP for Hazardous Waste Combustion Facilities also advocates NOAELs over LOAELs for TRV identification (p. 5-26 to 5-27 in EPA 530-D-99-001A). In addition, EPA's Guidance for Developing EcoSSLs for wildlife preferentially use NOAELs when available (p. 4-16 in OSWER Directive 9285.7-55). Finally, Ecology prefers NOAELs for substitute receptor species (WAC 173-340-7493[7][f][i]), as proposed in this report for the Hanford Site. Suter (1996. HERA 2:331-347) has noted, "Even at NOELs, effects commonly occur that would be considered severe by most observers." The magnitude of the biological effect that NOECs typically cause is 10-30% (Warne and van Dam. 2008. Autstral J Ecotoxicol 14:1-5). NOEC and LOEC values are controlled by the concentrations of the test chemical used in the treatments, variability in the data, selected significance level, and sample size.
38.	p. 1-3, para 5	OSWER Directive 9385.7-28P should be 9285.7-28P.
39.	p. 2-1, para 1	An EPC may be better represented by 95UCL, rather than max soil concentration.
40.	p. 2-3, para 1	Note that EcoSSLs for plants and invertebrates, based on MATC, are based on both NOAECs and LOAECs (since MATC=geo mean of NOAEC and LOAEC).
41.	p. 2-6, para 3, bullet 1	The MTCA citation looks slightly off. Perhaps it is WAC 173-340-7493(1)(c).
42.	p. 2-7, para	Note that Ecology prefers NOAELs for substitute receptor species (WAC

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	1	173-340-7493[7][f][i]), as proposed here.
43.	p. 2-7, para 4	WAC 173-340-7493(f) should be WAC 173-340-7493(3)(f).
44.	p. 2-8, para 1	The rad limit sentence is poorly stated (limit for aquatic animals and terrestrial plants is 1 rad/d, while limit for terrestrial animals is 0.1 rad/d). More recently, the EU has proposed a generic screening value (PNEDR) of 10 μGy/h (0.024 rad/d) for nonhuman biota (Anderson et al. 2009. JER 100:1100-1108).
45.	p. 3-2, Figure 3-1	An external radiation pathway from rads in shallow soil is not shown. Another potential pathway that has been omitted is exposure to contaminants in groundwater that has been pumped to the surface for irrigation of crops.
46.	p. 3-3. para 1	Provide a citation for the statement, "The maximum acceptable adverse effect levels generally selected for population and community level assessment endpoints are LOECs or LOAELs." Other references note the use of NOAELs for wildlife (e.g., p. 438 in Suter, 2007).
47.	p. 3-6, para 1	Provide a citation to support the statement, "Additionally, a wildlife receptor's exposure to contaminants by inhalation and dermal contact usually contributes little to its overall exposure." Note possible exceptions (e.g., airborne tritiated water vapor may be absorbed dermally in burrowing mammals).
48.	p. 3-6, para 3	Although ingestion of contaminated water may contribute to exposure, it is not addressed in this analysis. As result, Tier 1 soil concentrations may underestimate exposure.
49.	p. 3-8, para 1	Re equation definitions, "sediment EPC" should be "soil EPC."
50.	p. 3-9 para 4, bullet 3	BAFs for rads are in Table 6-4 (not Table 6-3).
51.	p. 3-9, para 5	The assumption of 100% site use does not overestimate exposure for plants (i.e., non-mobile biota).
52.	p. 3-11, para 4	Please explain why NOECs were excluded from measures of effect for plants and soil invertebrates.
53.	p. 3-12	Equation is incorrect. SSL term should be grouped with Ps. Please see EPA EcoSSL Attachment 4-1 (p. 1-1 in OSWER Directive 9285.7-55). Also, the equation is inverted (more typically, HQ=exposure/effects).

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54.	p. 4-6, para 2	Text states, "Developing a screening level for inorganic mercury based on methyl mercury toxicity represents an uncertainty in that value." Tier 1 values for inorganic Hg should use a TRV for inorganic Hg, rather than methyl Hg (e.g., Heinz, 1979; Verschuuren et al, 1976). Tier 1 values could be developed specifically for methyl Hg (using TRVs and BAFs for methyl Hg). MTCA Table 749-3 provides wildlife soil concentrations for both inorganic and organic forms of Hg.
55.	p. 4-7, para 2	Re uranium (U) and citing Sheppard et al (2005), text states, "…a dose of 1.3 mg/kg BW/d was recommended as an NOAEL for renal damage to small mammals (e.g., 1 kg in mass)." However, the Summary (Section 10.3) of Sheppard et al (2005) indicates that renal damage occurs at 0.06 mg/kg BW/d (for a 1 kg body mass), while growth and development effects occur at 1.3 mg U/kg BW/d (for a 1 kg body mass). Therefore, 1.3 mg U/kg BW/d represents a LOAEL (not a NOAEL) for growth and development for small mammals. This value is divided by a 10 fold safety factor to derive a PNEC (0.1 mg U/kg BW/d) for small mammal growth and development.
56.	p. 4-7, para 3	Text indicates that uncertainty factors are not typically applied in ERAs in the United States. However, both EPA's ERAGS (p. 1-10 in EPA/540-R-97-006) and SLERAP for Hazardous Waste Combustion Facilities (p. 5-29 in EPA 530-D-99-001A) state otherwise.
57.	p. 4-8, para 2	Re uranium (U), text recommends 2.8 mg/kg BW/d (Paternain et al, 1989, as cited in Sheppard et al, 2005) as the LOAEL (for growth) to develop Tier 1 U values for mammals. This contradicts the LOAEL (1.3 mg U/kg BW/d), recommended by Sheppard et al (2005) in their Summary (Section 10.3), for small mammal growth and development. Furthermore, this latter value is divided by a 10 fold safety factor to derive a PNEC (0.1 mg U/kg BW/d) which could be used to derive Tier 1 U values for mammals.
58.	p. 4-8, para 4	Text notes that Tier 1 values for uranium (U), based in part on Sheppard et al (2005) and BAFs from USACHPPM (2004), ES/ER/TM-220, and ORNL-5786, may be overly protective. However, the possibility exists that Tier 1 values may also be under protective (e.g., text in the preceding paragraph notes that BAFs may either overestimate or underestimate actual tissue concentrations found at Hanford).
59.	Table 6-2	Units for soil ingestion look goofy (should be kg/kg BW/d?).
60.	Table 6-4	It would be useful to list P values for regression models. Column heading for "Soil to Terrestrial Invertebrates" did not carry over on p. 6-15 to 6-17. Similarly, column heading for "Soil to Small Mammals" did not carry over on p. 6-18 to 6-21.

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61.	App A	Looks like there is a duplication of tables in this file (i.e., pages A-53 to A-112 are duplicated). Also, the horizontal alignment is off a bit in some of the Tables, making it difficult to read (e.g., Table A-1 for Sb). When there is no TRV (e.g., Table A-1 for Sb), it looks like "1.00" (in Soil PRG column) represents no PRG calculated. Please clarify.
62.	App B, Table B-2	Explain why the RAIS reference is given when these DCFs are calculated with RESRAD-Biota. Provide units for DCFs.

#	Page, Paragraph	Document #3: Comments on CHPRC-01311: Tier 2 Risk-Based Soil Concentrations Protective of Ecological Receptors at the Hanford Site
63.	p. 1-4, para 5	Text states that Tier 1 wildlife values were lower than MTCA Table 749-3 values for Be, Co, Hg, Li, and Ni. However, there are no corresponding MTCA wildlife soil values for Be, Co, and Li.
64.	p. 2-2, Figure 2-1	An external radiation pathway from rads in shallow soil is not shown. Another potential pathway that has been omitted is exposure to contaminants in groundwater that has been pumped to the surface for irrigation of crops.
65.	p. 2-3. para 3	Provide a citation for the statement, "The maximum acceptable adverse effect levels generally selected for population and community level assessment endpoints are LOECs or LOAELs." Other references note the use of NOAELs for wildlife (e.g., p. 438 in Suter, 2007).
66.	p. 2-6, para 3	Provide a citation to support the statement, "Additionally, a wildlife receptor's exposure to contaminants by inhalation and dermal contact usually contributes little to its overall exposure." Note possible exceptions (e.g., airborne tritiated water vapor may be absorbed dermally in burrowing mammals).
67.	p. 2-7, para 2	Although ingestion of contaminated water may contribute to exposure, it is not addressed in this analysis. As result, Tier 2 soil concentrations may underestimate exposure.
68.	p. 2-8, para 4	Although sample size (as well as soil and tissue concentration ranges) are increased by combining Hanford data with literature data, site specificity is compromised.
69.	p. 2-16, para 4	Regression criteria are listed as "$p>0.05$, $r2>0.1$, and a positive slope." Statistical significance is typically considered at $p<0.05$ (not $p>0.05$). Also, EPA EcoSSL guidance (Attachment 4-1, OSWER 9285.7-55) specifies $r2>0.2$ (not $r2>0.1$) as a criteria for selecting a regression model to estimate bioaccumulation (rather than selecting a median BAF).
70.	p. 2-27, footnote 20	Re the study used for the avian EcoSSL (Holcman and Stibilj, 1997), the footnote states, "the study within the EcoSSL document was an NOAEL TRV with no upper bounded test concentration." However, Appendix E for

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		Holcman and Stibilj, (1997) appears to contradict this statement, noting that the NOAEL TRV "is the highest bounded NOAEL lower than the lowest bounded LOAEL for reproduction, growth or survival." Please clarify. In addition to this issue, the two studies (Stanley et al, 1994; Holcman and Stibilj, 1997) evaluated different forms of As (As+3 vs. As+5).
71.	p. 2-28, para 5	Text states, "This section presents the methodology used to calculate Tier 2 values for nonradionuclide COPECs…" This is the first mention of nonrads. This should be stated earlier with an explanation as to why Tier 2 values are not derived for rads, as well.
72.	p. 2-55	Equation is incorrect. SSL term should be grouped with Ps. Please see EPA EcoSSL attachment 4-1 (p. 1-1). Also, the equation is upside down (HQ=exposure/effects=dose/TRV).
73.	p. 2-55, para 2	In addition to LOAEL based Tier 2 values (Table 2-8), NOAEL based Tier 2 values should also be calculated and presented (see comments for Tier 1 document, CHPRC-00784).
74.	p. 2-55, para 3	The last sentence should specify that Tier 2 concentrations could not be calculated (for Be, Sb, Sr, Tl, methoxychlor, phenol) <u>for avian receptors</u>.
75.	p. 3-2, bullet 5	When toxicity data are not available for some COPCs, bioassays may be useful with site specific soils.
76.	p. 4-1, para 2	Text refers to Table 3-1 as presenting Tier 1 and Tier 2 values. Looks like this reference should be to Table 4-1.
77.	p. 4-2, para 2	The last sentence states, "….Cd in plant tissue within the diet of the California quail decreased in deriving the Tier 2 value…." However, data in Table 4-2 show no change in Cd in plant tissue within the diet of the California quail. Please clarify.
78.	App A	Tables need more explanation. For example, for first block of tables in file, provide units for soil concentration. Explain why soil concentration is tabulated when Matrix specifies BIOTA. For second block of tables, provide COPC name (in addition to CAS ID). Explain qualifier and detect symbols.
79.	App C	Tables needs more explanation. For example, please explain columns for Diet, Plant, Water, Qual, Ref. Concentrations (under Diet, Plant, Water, Soil, Bug) are for what COPCs? What is "123" in first line under Diet, Plant, Water, Soil, Bug? Last column is Bug/Soil ratio (BAF), but for what COPC?
80.	App D	Please explain why Hanford data are combined with non-Hanford data from the literature in scatterplots for deriving BAFs and regressions. Although sample size is increased, site specificity is diminished. Maybe should not calculate BAF or regression stats when n<5 (e.g., plants [BkF, aldrin, alpha-chlordane, beta-HCH, DDT, dieldrin, endosulfan SO4, endrin, phenol], inverts [F, Sn, fluroanthene, fluorene, phenanthrene, DDE, DDT, endosufan I, endosulfan SO4, methoxychlor], mammals [PCB-Aroclor 1260, aldrin]).

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81.	App F	Units are needed for soil concentration. Define blue highlights. One footnote equation reads, "Estimated Concentrations in Biota (method 1)=B1*(ln[Site Specific Soil Concentration])+B0, where: B1=slope and B0=intercept." I believe Estimated Concentrations in Biota should be ln[Estimated Concentrations in Biota].