United States
Environmental Protection
Agency

START

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0038661

EPA

October 26, 1992

Steven H. Wisness
Tri-Party Agreement Manager
U.S. Department of Energy
Richland Field Office
P.O. Box 550, A5-15
Richland, Washington 99352

Re: 200 West Groundwater Aggregate Area Management Study Report

Dear Mr. Wisness:

The U.S. Environmental Protection Agency (EPA), the Department of Ecology (Ecology), and their contractors have completed the review of the 200 West Groundwater Aggregate Area Management Study. Enclosed are the combined comments on the technical and regulatory content of this report.

A WordPerfect diskette (Version 5.1) is enclosed for your convenience.

If you have any questions, please call Dibakar Goswami (Ecology) at (509) 546-2997 or Doug Sherwood at (509) 376-9529.

Sincerely,

Dibakar Goswami
Unit Manager
Washington State
Department of Ecology

Douglas R. Sherwood for
Unit Manager
U.S. Environmental
Protection Agency

Enclosure

cc: A. DeAngeles, PRC
D. Goswami, Ecology
D. Jansen, Ecology
D. Nylander, Ecology
P. Pak, DOE
W. Staubitz, USGS
Administrative Record (200 West Area AAMS)

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200 WEST GROUNDWATER AGGREGATE AREA MANAGEMENT STUDY REPORT

GENERAL COMMENTS

In general, the report thoroughly addresses the scope of the 200 West Groundwater Aggregate Area Management Study (AAMS). The following statements summarize our general concerns with the report:

- The primary deficiency of the report was that data gathered during the study to verify and evaluate the existing nature and extent of contamination beneath 200 West Area waste sites was not available during report preparation. The geophysical data would have been valuable in supporting the breakthrough of contaminants from the vadose zone into the groundwater. This data would lend support to the calculations used to support contaminant release to the groundwater and help evaluate the distribution of gamma-emitting radionuclides in or near the watertable.

- Additional information dealing with continued discharges of Hanford liquid effluents is required. Most wastewater discharges in the 200 West Area are scheduled to cease prior to June 1995. Many of these discharges have severe flow restrictions between now and 1995 and still others will undergo early treatment prior to rerouting. The current discussion of existing liquid discharges is limited to a brief summary of Project W-049 and its associated discharges. Additions need to be made to Chapter 2 that reflect the substantive requirements of the M-17 milestone for 200 West Area liquid effluents.

- The criteria used to evaluate groundwater quality data collected by the groundwater monitoring program should be included in a separate table for chemical compounds identified in Table 4-1 or in the same table (Table 4-1). The criteria should be provided to evaluate whether the compounds that exceeded groundwater quality standards have been properly identified. The lack of clearly identified water quality standards have also created some confusion with regard to the plume maps and the interpretation of nature and extent of contamination. For each contaminant plume discussed in the report, the water quality criteria and the contour level needs to be clearly identified. Without the criteria, the contour interval, and the quantitation limit the reader is left with a significant degree of uncertainty as to the extent of contamination.

- Average chemical concentration values at each well are compared with groundwater quality criteria to identify contaminants of concern and to indicate the extent of gross contamination for each constituent. This approach is acceptable for screening and prioritization of groundwater contaminate plumes, but this method is inconsistent with the Hanford baseline risk assessment methodology for determining contaminants of concern.

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The approved method requires that maximum detected contaminant concentrations be compared to risk-based concentrations (groundwater quality criteria in this case) and that contaminants present in concentrations that exceed groundwater quality criteria are retained as contaminants of concern.

- Well construction information including depths and screened intervals are not consistent between reports referenced in this document. Accurate information about the screened interval is an important factor in interpreting data presented in this report. Data pertaining to depths and screened interval need to be reconciled.

- Although EPA and Ecology agree with the approach used to identify contaminant plumes as candidates for ERAs and IRMs, in certain cases sufficient information may not be available to develop remedial action plans. These deficiencies may be in terms of data gaps such as extent of contamination with depth, the impacts of proposed actions on adjacent contaminant plumes, or the availability of remedial technologies. These factors will likely have a profound influence on potential for near-term remediation of groundwater contamination beneath the 200 West Area.

- Water quality and hydrologic data for the deep portion of the unconfined aquifer and the confined aquifer system represents a major unknown. This information may be critical for remediation of Dense Nonaqueous Phase Liquids (DNAPLs) disposed to the soil column in the Z-Plant area. Identification of locations where DNAPLs may be pooling is a near-term need. The program to characterize the extent of DNAPL contamination (carbon tetrachloride, chloroform, and trichloroethylene et.al.) in the deeper portion of the groundwater flow system will require a well thought out plan to limit the potential to create pathways for DNAPLs to reach those depths. EPA has issued guidance for investigation, interim action, and remedy implementation for Nonaqueous Phase Liquid Contaminants. The approach outlined in EPA Memorandum on Groundwater Remediation at Superfund Sites, May 27, 1992 (Directive No. 9283.1-06) should be used as guidance for development of the 200-ZP-1 operable unit investigation.

- In Chapter 9, Recommendations, a wide variety recommendations are made to fill data gaps, to prioritize investigations, and to identify groundwater operable units. Recommendations to fill data gaps are only given in the most general terms and serve to downplay the significance and the magnitude of the data gaps. EPA and Ecology will use these recommendations to guide the scope of ERAs, IRMs, and LFIs, but the final decision on the appropriate scope of these activities will rest with the lead agency. Recommendation on operable unit definition and priorities will require further discussion and agreement by all three parties. This activity will be best performed after the review of the 200 East Groundwater Aggregate Area Management Study Report.

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TECHNICAL COMMENTS

Section 1.2.1 Third paragraph on page 1-4

Comment: There seems to be some confusion concerning 200 North Source Unit groundwater. In the paragraph it is referenced as "...and two groundwater aggregate areas delineated in the 200 East, West, and North areas." In the following paragraph, it is listed as one of the eight source aggregate areas. Since 200 North groundwater is not addressed in the 200 West Groundwater report, will it be covered in the 200 East Groundwater AAMS report?

Recommendation: Please clarify where the 200 North groundwater will be addressed.

Section 2.1 Last paragraph on page 2-1

Deficiency: The 200 West Area areal extent is "loosely defined" and includes as much of the administrative 600 Area "as needed." Yet the MCL for carbon tetrachloride, "has been exceeded over the entire area of the plume." (Section 4.1.1.6.7.)

Recommendation: Define the boundary of the 200 West groundwater unit including the 600 Area when groundwater is impacted. State if there has been any overlap observed between the 200 West and 200 East groundwater plumes.

Section 2.2.4 Page(s) 2-5 Lines 27..29

Deficiency: Reference to the "sealed canyon...entombed in the building" is unclear.

Recommendation: Define the "sealed canyon," or otherwise clarify the sentence.

Section 2.3 Page(s) 2-9 Lines 4-8

Deficiency: The discussion of unplanned releases states that only those releases of sufficient volume to reach the water table are of interest. This should not be a criteria for eliminating potential contaminants of the ground water. It might be presumed that these unplanned releases were located in areas where other artificial recharges occurred and, thus the driving force to move contaminants down to the ground water could come from other sources.

Recommendation: Qualify this paragraph to allow for potential driving forces, other than the actual unplanned releases. The actual contents and area of release of the unplanned discharges then would require evaluation before they could be eliminated as potential contaminants of the ground water.

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Section 2.3 Page(s) 2-9..10 Lines 35-42/1-27

Comment: The cited AAMS paragraphs discuss the soil column pore volume calculations as used to estimate the relative level of concern at each disposal site. Non-polar organic compounds will generally exhibit much smaller specific retention than water, due to lack of capillarity. Therefore, compounds such as carbon tetrachloride may migrate more readily to groundwater than is suggested by the pore volume calculation.

Recommendation: Qualify the validity of the pore volume calculation as applied to organic chemicals.

Section 2.3 Page 2-10 First paragraph, lines 9 and 10

Comment: It is stated that based on hydraulic conductivity of Hanford soils, the transit time is too long for contaminants to have reached the groundwater via unsaturated flow. It is also stated that the "hydraulic conductivity of Hanford soils in the vadose zone is very low (Section 3.5.2.1.3),". The referenced section gives a saturated hydraulic conductivity range of .02 ft to 160 ft/day (page 3-48, lines 24 and 25). This hydraulic conductivity would not be considered "very low".

Recommendation: Describe how transit time for unsaturated soil was determined, and the assumptions that were used. Also discuss how the transit times vary with the type of contaminant. What would be considered low for a hydraulic conductivity?

Section 2.3 Second paragraph on page 2-11

Deficiency: While section 2.3 describes the waste management units and unplanned releases, and Section 2.4 describes the waste generating processes, they do not relate how much and what type of contaminant determines the impact, i.e., a release of a large volume of water with a small concentration of constituents may be determined to have a significant impact on groundwater, while a small volume of liquid with a high concentration of constituents would be determined as not having an impact on groundwater.

Recommendation: Define the relationship between the quantity of contaminants discharged and the risks from the radionuclides discharged.

Section 2.3 Last paragraph on page 2-10, lines 1-3 on page 2-14

Deficiency: There is a poor correlation between the gross gamma logs and the quantity of reported radionuclides disposed of in each waste management unit. The paragraph on page 2-14 states that gross gamma logs do not provide evidence that contaminants have reached the ground water at 216-U-14 ditch or 216-U-10 pond. However, there is mounding at U-pond and nearby wells indicate contamination moving from that area.

Recommendation: Place less emphasis on negative elevated gross gamma levels. Evaluate effectiveness and document the existing gamma screening program. As stated on page 2-11, the geophysical logs serve better as positive proof of

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contaminant migration and failure to detect elevated gross gamma levels in monitoring wells does not disprove downward contaminant migration.

Section 2.3 Page 2-10 Paragraph beginning on line 13

Comment: We realize that this is, among other things, a scoping document, and several broad assumptions must be made to limit the areas in which to expend scarce resources. However, we find that the selection process for defining sites with "potential for migration of liquid discharges to the unconfined aquifer" listed in Table 2-2 apparently leaves some important contamination sites out of the investigation phase that will follow this report.

This problem centers around the arbitrary criteria established to select sites that will be the subject of further evaluation. One criteria is that no site is considered to have an effect on groundwater flow unless there is a history of at least 100,000 square ft. of waste effluent dumped there. The criteria ignores the total cumulative impact of the numerous lower volume waste sites and there is no justification in this report for the selection of this amount for limiting criteria. An example of how this criteria will effect future investigation is crib 216-Z-7. This crib is shown in Table 2-1 as having received 79,000 m^3 of laboratory wastes (page 2T-1f). Table 2-2 lists "No" as an answer to "Significant impact on groundwater flow?" (Page 2T-2b).

The crib is also shown on Table 2-3 as having an elevated Gamma log response indicating contamination as deep as 100 meters below land surface (page 2T-3a). The water table is at about 60 meters below land surface at that location (Hydrogeologic model supporting document, figure 3-2). It can be concluded that contamination from the crib or some other as yet undetermined source has migrated at least 40 meters below the water table under 216-Z-7. This would indicate that the volume of waste discharged to this crib may have had an effect or at least may have contributed to an effect on groundwater flow causing contaminants to move to such a depth below the water table.

The discharge from this crib may not in itself have had a significant influence on the flow system in the 200 West Area, however, along with many other similar waste units it may have contributed to a significant cumulative impact. Any impact at all is overlooked in the use of the 100,000 m^3 numerical criteria.

The Gamma log "hit" to about 40 m below the water table also points out that contaminants have moved considerably deeper below the water table than is considered later in this document as the thickness of the waste plumes (10 m).

Section 2.3.1.1 Page(s) 2-11..12 Lines 40-42/1-3

Comment: The soil column pore volume calculation is not applied to tank leaks because the area of the leak cannot be determined.

Recommendation: An arbitrarily small area should be used in the calculation for comparison with other disposal units. An area equivalent to that used for the reverse wells would probably be appropriate.

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Section 2.3.4.1 Page(s) 2-26 Lines 31-33

Comment and Recommendation: Same as Comment on Section 9.2.4.2, first paragraph on page 9-16 below.

Section 2.5 Last paragraph on page 2-43

Deficiency: The 200 West groundwater AAMS area should contain the whole plume originating from facilities in the 200 West area.

Recommendation: Enlarge study area to cover whole plume. If 200 West and 200 East or North plumes overlap, then define boundary and justify in text.

Section 2.5 Page(s) 2-44 Lines 10-33

Comment: The two paragraphs cited discuss potential hydrologic interactions between the 200 West and the 200 East and 100 Areas. In the first paragraph, hydraulic effects of containment remedial alternatives are estimated to probably be minor. The second paragraph, discussing northward groundwater flow through Gable Gap, indicates a very uncertain, long-term, and limited possibility of significant interaction between the 200 and 100 areas.

If a 402-foot contour is sketched in on Figure 3-78, it is apparent that a potentially large portion of groundwater flow from both the 200 West and 200 East Areas is northward through Gable Gap under present conditions.

Recommendation: Expand this discussion to address large scale hydraulic interactions between the 200 West and other Areas, under both existing conditions and intentionally induced hydraulic gradients.

Section 2.6 Page(s) 2-46 Lines 22-35

Comment: LLWMA 4 is identified as a RCRA groundwater monitoring project that may be encompassed in the 200 West Groundwater Aggregate Area; however, the aggregate area boundaries shown on Fig. 1-4 and Plate I exclude LLWMA 4. As discussed in Comment 19, a multi-contaminant plume encompasses this disposal unit, and it should probably be included in the groundwater aggregate area.

Recommendation: Include LLWMA 4 in the 200 West Groundwater Aggregate Area, revising the boundaries as appropriate.

Section 2.7.2 Page(s) 2-48 Line 35

Deficiency: Reference to section 7.3.3 is invalid (no such section).

Recommendation: Correct reference.

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Section 2.8

Comment: The description of the present groundwater monitoring activities and groundwater monitoring networks could be improved. At present it is not clearly stated why there are so many different networks operating nor what the specific purpose of each is. The disjointed nature of these various networks without clearly defined objectives leaves the reader wondering why so many networks exist and how anyone could evaluate the effectiveness of the entire groundwater monitoring program.

Recommendation: Include a figure or tabular listing that correlates the various monitoring networks with their associated wells.

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Section 2.8.1 Third paragraph on page 2-53 and Table 2-8

Deficiency: There are several discrepancies between the screened intervals listed for several wells on Table 2-8 and the same wells listed on Table 2-16. For example:

Well Number	Table 2-8 Screen Interval	Table 2-16 Screen Interval
299-W19-17	230-255	230-355
299-W19-16	225-175	225-275
299-W22-22	0-210	255-300
299-W18-7	190-288	190-298
299-W15-6	0-350	175-408
299-W23-7	0-210	180-300
299-W23-2	184-225	150-260
299-W23-4	180-300	184-265
299-W22-10	203-311	195-305
299-W22-1	190-280	221-290
299-W23-9	164-230	165-230
299-W23-10	165-230	164-230
299-W11-24	200-250	210-250
299-W11-7	0-265	245-290
299-W14-10	260-275	195-230
299-W7-6	209-220	209-229
299-W9-1	266-296	266-286
299-W18-22	416-417	416-447
299-W6-2	224-225	224-244
299-W11-24	200-250	200-210
299-W19-1	320-370	178-299
299-W23-4	180-300	184-265
299-W23-7	170-248	180-300
299-W23-2	184-234	150-260
299-W23-8	165-230	170-248

Not all wells were listed on both tables, so it is unknown how many other wells' screen intervals may be in disagreement.

Recommendation: List correct screen interval on both tables. Check screen intervals for wells not on both lists.

Section 2.8.2.1 Page(s) 2-55 1st and 4th paragraphs

Comment: Lines 6-8 in the first paragraph of this section state that moisture transport studies indicate any leachate generated at the Low Level Waste Management Areas (LLWMAs) has probably not reached groundwater yet. However, lines 40-41 in the fourth paragraph indicate detection of 8 constituents above background levels in LLWMA 4.

Recommendation: Clarify whether leachate from LLWMA 4 is the suspected source of groundwater contamination in that disposal unit. If the moisture transport studies have given an invalid indication of groundwater contamination risk, state this explicitly here and in section 2.3 (see Comment 6).

Figures 2-4 through 2-10

Deficiency: No groundwater gradient direction on figure to assist in evaluating whether wells are properly located.

Recommendation: Place groundwater gradient direction arrow on figures.

Figures 2-11 (WHC) and 2-12

Deficiency: Locations of some wells are not the same on both map figures, notably 699-3570, 299-W12-1, 299-W10-5, 297-W18-3, and 299-W22-9.

Recommendation: Place correct locations on figures.

Table 2-2

Comment: A number of assumptions are made in developing Table 2-2. These are:

- Assumed soil porosity(s)
- Assumed groundwater depth of 164 feet
- Soil acts as a homogenous column (homogenous permeability of soil)
- One-dimensional flow (no lateral flow)
- Liquid effluent volume accurate
- Area for infiltration equal to the dimension of the base of crib, trench, tile field, drain, or well

Based on these assumptions, the estimated soil column pore volume range (Column 3) and the indication of possible migration to groundwater (Column 4) were determined. These estimates are very conservative and should only be used for providing a relative indication of potential impacts (indeed, this is stated in the text).

Recommendation: That the wording in Column 5 be changed to "relative potential impact on groundwater flow." Furthermore, a ranking of the relative potential impact of the various discharge sources is recommended. Such a ranking could be used for determining cleanup priorities.

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Table 2-2

Comment: In Column 5, are you concerned with impact on groundwater flow or groundwater quality?

Recommendation: Modify column 5 heading in Table 2-2.

Table 2-2

Deficiency: Since ditches 216-U-14, 216-U-1D, 216-2-11, and 216-Z-19 transferred 165,005,000 cubic meters of liquid effluent to the 216-U-10 pond, the volume of water received by the soil would be very high, indicating possible migration to uppermost possible aquifer, and significant impact on groundwater flow. To say no migration or significant impact would occur is not conservative.

Recommendation: When the effluent amount is undetermined, possible migration to aquifer and a significant impact should be assumed.

Section 3.3.2 Paragraph on top of page 3-5, lines 3-5

Comment: This sentence reads like the Snake and Walla Walla rivers are tributaries to the Columbia and Yakima rivers.

Recommendation: Rewrite this sentence to reflect that the Yakima, Walla Walla and Snake rivers are tributaries to the Columbia River.

Section 3.4.1.3 line 38 on page 3-9

Comment: "Western Washington" should be Eastern Washington.

Recommendation: Please make the appropriate change.

Section 3.4.1.3 Paragraph on top of page 3-10

Comment: Two earthquakes occurred near Walla Walla, the first a magnitude 4 on November 27, 1991 and the second a magnitude 3 on December 15, 1991.

Recommendation: Include reference to these earthquakes in the text.

Section 3.4.2.1.1 Page(s) 3-13..14 Lines 42/1-5

Deficiency: The sentence beginning on line 42 of page 3-13 is unclear. If the drilling referenced in DOE (1986 and 1988) has already been conducted, what was the result?

Recommendation: Resolve the above confusion.

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Section 3.4.4.1, page 3-27, line 33-34

Deficiency: The short discussion here, and elsewhere in this document, point out the lack of data concerning water quality, stratigraphy, hydraulic characteristics, and water levels in confined aquifers (including the Columbia River Basalt Group) in the area.

Recommendation: More data are needed.

Section 3.5.1.1, page 3-31, line 38

Comment: The reference to Section 3.4.2.1 probably should be 3.4.2, the general heading section about stratigraphy.

Section 3.5.1.1, page 3-32, line 36

Comment: The reference to Section 3.4.2.1.1 probably should be 3.4.2.1.2, the section describing intraflow structures.

Section 3.5.1.1., page 3-33, line 8

Comment: The reference should be 3.4.2.1.2

Section 3.5.1.2, page 3-34, paragraph beginning line 30

Comment: In testing wells to determine aquifer properties, another complicating factor can be storage of water in the well bore. This should be mentioned in this paragraph which already clearly states the other factors involved.

Section 3.5.1.2, page 3-34, line 17-18

Comment: The ranges of values for hydraulic conductivity and transmissivity for the Hanford Formation are inconsistent with the values presented in Tables 3-1, 3-2, A-7, and A-8. If the range is based on some other data set it should be so stated, if not the minimum and maximum should be reflected in the data presented in this report.

Section 3.5.1.5.1, page 3-37, line 23

Comment: The amount of "natural groundwater recharge" listed here (130,000 L/yr) is inconsistent with the value listed on page 3-51, line 6 (130,000,000 L/yr).

Section 3.5.2.1.2, page 3-43,lines 15 and 18

Comment: Two separate errors here, line 15 reference to Figure 3-49 probably should be referring to 33-55 and line 18 listing saturated thickness of "67 to 112" is inconsistent with Figure 3-52. A range consistent with the figure would be "40 to 80."

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Sections 3.5.1.2 and 3.5.2.1.3 Page(s) 3-35 and 3-48

Deficiency: Page 3-35, lines 16-17 state that hydraulic conductivities for the Hanford Formation vary from 1.8×10^{-3} to 0.7 m/s. Page 3-48, lines 24-25, indicates hydraulic conductivities in the Hanford Formation between 7×10^{-8} and 5.5×10^{-4} m/s.

Recommendation: Resolve the above contradiction.

Section 3.5.1.5.1 Second paragraph on page 3-38

Comment: Is the soil with high moisture content indicating local saturation with natural groundwater, or with contaminated water? Since this section is titled Natural Groundwater Recharge, it should not be contaminated but it does appear to be an anomaly.

Recommendation: State if water is natural groundwater or is contaminated.

Section 3.5.2.1.2 First complete paragraph on page 3-44

Comment: Table 3-1 is referenced, however this table does not appear in the back of Section 3. Where is this table located?

Recommendation: Please include this table in the document.

Section 3.5.2.1.3 pages 3-44 through 3-48 and Figure 3-56 through 3-65

General Comments: This section discusses unsaturated conductivity and unsaturated flow. In addition, conductivity curves for various Hanford soils are presented. It is never clear how this data is going to be used.

Section 3.5.2.1.4 First paragraph on page 3-50

Deficiency: Crib 216-Z-20 is discussed as being part of the Z Plant Aggregate Area. It is also discussed in the Z Plant Section 2.3.2.7, in U Plant Section 2.3.1.2, and in Table 2-1 under the U Plant Aggregate area. It is unclear which Aggregate area includes Crib 216-Z-20.

Recommendation: Clarify in which Aggregate Area Crib 216-Z-20 will be included.

Section 3.5.2.2.1 lines 1-9 on page 3-51

Comment: Why is 0.10 cm/yr considered more conservative than 10 cm/yr when considering natural recharge to the 200 West Area? It would appear that the more conservative estimate would be the higher recharge rate that would tend to mobilize contamination within the soils of 200 West, especially if there is very little vegetation and the soils tend toward the coarser fractions (underlying the finer eolian sands).

Recommendation: Answer the above question.

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Section 3.5.2.2.1, page 3-51, line 6

Deficiency: "Natural recharge" is either 130,000 L/yr or 130,000,000 L/yr.

Recommendation: Make the text consistent.

Section 3.5.2.2.2 Third paragraph on page 3-51

Comment: Why is the 216-U-14 ditch currently receiving water from a hydrant?

Recommendation: Answer the above question.

Section 3.5.2.2.2, page 3-51, paragraph beginning on line 28

Deficiency: The per day value (12,120) does not match the historic total value (166 billion). 12,120 L/day for 1944 to 1992 is 212 million.

Recommendation: Explain the calculation in more detail or correct the error.

Section 3.5.2.3.1, page 3-56, paragraph beginning on line 1

Comment: Rather than only giving the quotient of the vertical gradient, please give the head difference and the vertical separation of the screened intervals.

Section 3.5.2.3.1, page 3-56, lines 16-18

Deficiency: "The thickness ... and ... low hydraulic conductivity" of the Lower Mud Unit is "sufficient to preclude a significant amount of recharge" is a rather broad statement concerning downward movement of groundwater and contamination. Although the hydraulic conductivity is low and the gradient is unknown (but probably low) the area is large (several square miles). Since the flux is the product of the gradient, the conductivity, and the area, a large area may mean significant flux.

Recommendation: It would be better to state that the Lower Mud will limit downward recharge rather than "preclude" downward recharge. At this time are there water quality data from wells screened in the Ringold Unit A to support this statement that no downward movement (contamination?) has occurred?

Section 3.5.2.3.1 line 17 on page 3-56

Comment: 2×10^{10} m/s should probably be 2×10^{-10} m/s.

Recommendation: Please make the editorial change.

Section 3.5.2.3.2, page 3-57, lines 41-42

Comment: Hydraulic properties are not discussed in Section 3.5.2.1.4, Section 3.5.1.1 does.

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Section 3.5.2.3.2, page 3-58, lines 24-25

Comment: Throughout this report it is stated that the groundwater system is changing. Water levels and volumes of waste were going up from the 1940s to the 1980s, now they are going down due to operational changes. In the discussion about the degree of connection between the unconfined and the confined aquifers a report (Ledgerwood and Deju, 1976) is cited to support the lack of interaction. If the system is changing, the Ledgerwood and Deju (1976) report is probably out of date. If so, this points out that more current data is needed to make decisions concerning contaminant transport. This is a significant gap in the available data and, as such, is appropriately identified in Section 8.2.3. Specific recommendations should appear in Section 9.0 detailing what data to collect.

Section 3.7.2 Last paragraph on page 3-64

Deficiency: The future land use of the Hanford site is under discussion; to state that, "the entire Hanford site is administratively controlled and is expected to remain this way," is premature.

Recommendation: Remove paragraph.

Section 3.7.3, page 3-66, line 4-5

Deficiency: It is stated that there is water used from the basalt and interbeds "upgradient", but in general little is known about groundwater in the confined system underlying the 200 West Area.

Recommendation: More information is needed about these important units.

Section 3.7.3, page 3-66, line 8

Comment: The phrase "may also be used to supply drinking water" is of concern. We assume someone is monitoring the water use in an area where contamination of the groundwater is so common and suggest that more specific data be presented in this report.

Section 3.0, Figures 3-25 to 3-43

Comment: A single map scale, a single scale of units for contouring (metric or English, Figure 42 is the only metric of all these figures), and a consistent orientation (North up?) would help the reader to compare these figures to each other. Since these figures appear to be digitally encoded products, this should be easily done. Figure 3-29 has no contour interval in the explanation.

Section 3.0, Figures 3-25 to 3-41

Deficiency: Summing thicknesses downward and subtracting that from the land surface altitude appears to be the method used to determine the top of all units. We believe that this introduced errors in these figures. An example of this occurs as a series of "Bull's eye" contours in Figures 3-31, 33, 35,

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37, and 39. These feature occur in the northwest corner of the 200 West Area and as shown in Figure 3-31 center on the closed 600-foot contour.

If the sequence of figures is followed up through the stratigraphic column, it is apparent that the closed contours occur in all maps. The telling aspect of this error is that there is a small hill in that area (at land surface) and no wells to confirm a "hill" in the underlying geology.

Additionally, the "Bull's eye" on Figures 3-28, -29, -30 near the center of the figure appears to be the result of an uncertainty in what is the bottom of the Lower Mud. The geologic sections that include this well (299-W18-21?) indicate that no pick was made on the bottom of the unit, therefore, the "Bull's eye" does not represent an actual thickness or tops or thicknesses of lower units.

Similar errors are found in figures in the supporting document concerning the Hydrogeologic Model.

We understand that the geology is relatively unknown in these areas and that the contouring program probably produced these artifacts. Our primary concern is that this data set will be used in the future to construct a digital simulation model of the groundwater flow. In this case, seemingly harmless machine artifacts may have wide reaching effects on simulated flow.

Recommendation: We recommend that an experienced geologist examine these maps for computational artifacts that do not represent real physical features. Adding "data points" to the map based on best professional judgement could reduce the change for machine induced errors. In the case mentioned above, the lack of well control on the top, the Hanford Formation-Lower Fine Unit could be taken into account for Figure 3-39. Stratigraphically lower units would then not be subject to the error in thickness of these units above.

<u>Section 3.0, Figures 3-46 to 3-50 and 3-52 to 3-55</u>

Comment: Again, a mixing of scales, orientation, and units will confuse the reader.

<u>Section 3.0, Figures 3-52 to 3-54</u>

Deficiency: Several points in Figures 3-52, 3-53, and 3-54 were examined in detail. At one such point, at the approximate location of well 299-W18-22, Figure 3-52 shows an aquifer thickness of about 65 meters (about 210 feet), Figure 3-54 shows a hydraulic conductivity of about 1000 ft/d, and Figure 3-53 shows a transmissivity of about 50,000 square ft/d. The standard relationship of [transmissivity = hydraulic conductivity x saturated thickness] should yield a transmissivity of 210,000 square ft/d.

In Table 3-1, data indicate two aquifer tests were made on well 299-W18-22. The calculated hydraulic conductivity values were 1.7 and 20 ft/d. Calculated transmissivity values for the same well are shown to be 400 and 420 square ft/d.

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Recommendation: These discrepancies should be resolved and/or an explanation should be given to keep the reader informed of how these figures, tables, text, and theory fit together.

Section 3.0, Figures 3-66 to 3-72 and 3-78

Comment: Mixing scales and orientation should be avoided if possible. Also, there is no consistency between these figures in the area of "Estimated basalt outcrop above water table". Water levels change from one figure (and time) to another, but these changing areas are more likely due to the base map for a particular figure. A consistent base map or a further explanation of the changing areas would help the reader understand the point.

On Figure 3-72, the source is listed as Kipp and Mudd (1974). It is likely that the base is from Kipp and Mudd and the 1987 water levels are from ..... (fill in reference)?

9413293.4021

Section 3.0, Figures 3-73 to 3-76

Comment: A bar graph showing estimating water disposal rates would be superior to the history of operation. Some processes must have generated more or less waste water than others, this information would help the reader to understand the fluctuations in the well hydrographs.

Section 3.0, Table 3-1

Comment: The relationship of transmissivity, hydraulic conductivity and thickness is unclear. An example is well 299-W15-16: an open interval of 10 feet, a transmissivity of 12,000 square ft/d, and in the remarks column a hydraulic conductivity of "52".

Tables 3-1 through 3-3

Comment: Missing from report.

Recommendation: Include Tables 3-1 through 3-3 in report.

Section 3.0, Table 3-2

Comment: For the 200 West Area, this table lists a hydraulic conductivity (ft/d) range of "2,000-10,000". Table 3-1, which lists the data, indicates 10 values in the 200 West Area in the unconfined aquifer that range from >240 to 5,000. These tables should agree or an explanation should be presented.

Section 4.0 Second paragraph on page 4-1

Deficiency: Two potentially affected media not addressed are atmosphere and biota.

Recommendation: Include both as potential media.

Section 4.1

Comment: The title of this section suggests that there will be discussion of known contamination of groundwater (i.e., that documented by monitoring) and suspected or potential contamination. This section only covers that contamination identified by monitoring. There are discussions elsewhere in the document that indicate that there are essentially no waste disposal records from the early years of operation of most of the facilities (1940s through early 1950s?). Consequently, there would seem to be a significant potential for unknown contamination. This could involve both the types of contaminants and areas of disposal. The report includes little discussion, and none in this section, of the potential for occurrences of groundwater contamination outside of that identified to date by the existing monitoring programs.

Recommendation: This issue should be addressed somewhere in the report. It is not discussed in Section 8, Data Quality Objectives, and is not mentioned as a data gap. There is discussion as a data gap of chemicals that are known to have been used on site that have not been detected in groundwater, but this is not the same issue. It would seem appropriate to define an approach to provide some level of assurance that there are not significant undocumented wastes and waste disposal sites within the 200 West Area.

9413293.4022

Section 4.1.1.1, page 4-2, paragraph starting on line 31, Section 4.1.1.4, page 4-5, lines 13-15, and Section 4.1.1.5, page 4-5, lines 31-32

Comment: Since 10 meters is used as the thickness of all contaminant plumes it should be stated here whether any exceptions to that assumption occur. Five monitoring wells are finished in the Lower Ringold E, were there any contaminant "hits" in those wells? If so, we question the credibility of the assumption about thickness of the plumes.

Section 4.1.1.1, page 4-3, lines 8-10

Comment: Any talk of plugging this well or the annular space in the wellbore? We saw no mention in Section 9.0.

Section 4.1.1.6.4, page 4-11

Comment: Within this section the discussion of concentrations seems to be confusing at times. On line 12 concentrations "range from 45 to 1,265;" on line 13 the "maximum sample concentration" is 2,810 mg/l; on line 14 "maximum average" is 1,322 mg/l; and on line 18 "the highest concentration" is 1,265 mg/l. There should be a single maximum concentration and it should be what is listed as the upper end of the range.

Also note that Sections 4.1.1.6.5, .6, .8, .9, .10, .11, .12, and .14 use the term "maximum average concentration" while Table 4.1 uses "Average of reported values" for the same number. Which is it or do you intend the reader to accept that they mean the same?

Section 4.1.1.2 pages 4-3 and 4-4.

Comment: The plume maps were developed by averaging detected concentration values at each well for chemical compounds and radionuclides and drawn with contours that reflect concentrations above some ground-water quality criteria. More information would be available for drawing the contours and delineating the plumes if the contours included data above detection levels where DLs are below the water quality criteria. This would mean that, for example, nitrate could be mapped down to levels around .5 ppm, rather than 45 ppm. Tritium contours would not stop at 20,000 pCi/l but could go down to approximately 500 pCi/l. Rather than single wells for some constituents, there could be more.

Recommendation: Please examine the possibility of using contours down to lesser values to better delineate the various plumes.

9413293.4023

Section 4.1.1.2, pages 4-3 and 4-4

Comment: Average detected concentration values at each well are used to identify chemical compounds that exceeded groundwater quality criteria and to prepare groundwater contaminant plume maps. This approach provides neither a gross indication of the extent of contamination for each constituent nor sufficient data for contouring. A statistically estimated value based on 95 percent upper confidence limit (similar to the one proposed for soil and groundwater in the Washington State Department of Ecology guidance (Ecology 1992) or the maximum concentration of constituent should be compared to the groundwater quality criteria wherever applicable to select the contaminants of concern. Those contaminants with maximum concentrations greater than the maximum concentration level (MCL) and average concentrations less than the MCL should be considered for ERA or IRM. However, averaged concentration values or results from the most recent groundwater sampling round can be used to develop the groundwater isoconcentration contaminant plume maps.

Section 4.1.1.1, page 4-4, line 2

Comment: Contaminant plume maps were developed by averaging detected concentration values at each well and identifying these compounds that exceeded groundwater quality criteria. Since the detected concentration averaging may affect the determination of areal extent of contamination, the method of data averaging should be described.

Section 4.1.1.1, page 4-4, lines 9-11

The areal plume distributions were based predominantly on sampling data collected from monitoring wells screened within the upper 20 feet of the unconfined aquifer. Site contaminants that exhibit densities greater than water that may not be detected by this sampling methodology should be identified. The vertical distribution of contaminants should be considered when estimating contaminated groundwater volumes and evaluating remedial alternatives such as pump and treatment.

Section 4.1.1.4, page 4-5, lines 5-8

Comment: The text states that in some cases the detection limit was above the lowest cleanup level, and the area of contamination was mapped based on the lowest concentration contour set slightly above the detection limit. The cases in which the detection limits were higher than the most stringent regulatory level should be identified.

Section 4.1.1.5, page 4-5, lines 29-35

Comment: The text states that some contamination of the lower portion of the unconfined aquifer has occurred. Selected deep and shallow sample results are presented in Table 4-2, (e.g. for nitrate and carbon tetrachloride). However, a nominal value of 10 meters (33 feet) was assumed as the vertical extent of contamination in all of the 14 groundwater plumes identified. Changes to the assumed vertical extent of groundwater contamination greatly impacts the volume of contaminated groundwater, required treatment rates and estimated cleanup times. The rationale for assuming this vertical extent, rather than providing a reference, should be provided for contaminants that have been detected at deeper sampling locations.

Section 4.1.1.5 page 4-5, line 29 and line 32.

Deficiency: The reference to Eddy et al. (1976) should be to Eddy et al. (1978). ^{106}Rb should probably be ^{106}Ru.

Recommendation: Please make the appropriate changes.

Section 4.1.1.5 page 4-7, lines 23-25.

Deficiency: The end of this sentence requires clarification. What is "the two thirds' relative immiscibility?"

Recommendation: Please explain what "two thirds' relative immiscibility" means.

Section 4.1.1.6.1, page 4-7, line 40

Comment: The acronym WWQC is not defined and a definition should be provided.

Section 4.1.1.6.2 page 4-9, lines 29-30.

Deficiency: There is no evidence, to our knowledge, that Cr(VI) "would be expected to complex with organic carbon, however, decreasing its overall dissolved concentration." However, it is well documented that Cr(III) will form complexes with organics in the environment. Perhaps the authors just confused the two distinctly different forms of chrome.

As far as specific chemical data is concerned, since hexavalent chromium is the more mobile of the species, it may conservatively be assumed that the total chromium found in ground water would be primarily Cr(VI). This may or may not be a data gap for ground water.

9413293.4024

Recommendation: Either provide evidence that this is a common complex for Cr(VI) or delete the statement. Evaluate whether specific chemical data is necessary for ground water samples containing undifferentiated chromium.

Section 4.1.1.6.2, page 4-9, lines 34 through 42

Comment: The text references table 4-2 for chromium concentrations in deep wells 299-W15-17 and 299-W18-22. Results of sample analyses are not presented for either of these wells in the table. This discrepancy should be addressed.

Section 4.1.1.6.5 Page(s) 4-13 Line 6

Deficiency: A word is missing after "located."

Recommendation: Insert appropriate word.

Section 4.1.1.6.7 Page 4-16 Line 3

Deficiency: m^3 should be m^2.

Recommendation: Insert appropriate number.

Section 4.1.1.6.9 page 4-18, lines 13-16.

Deficiency: The list of beta decay radionuclides to which "gross beta levels can commonly be attributed" in groundwater is incomplete.

Recommendation: If there is a reason why the list is incomplete, please state so. Otherwise complete the list including, for example, tritium which is by far the largest source of beta decay radioactivity in the groundwater.

Section 4.1.1.6.9 page 4-18.

Deficiency: The gross beta minimum contour is based on the 50 pCi/l water standard for gross beta. However, if ^{90}Sr is the contributor to the gross beta activity the standard is 8 pCi/l, and the activity has to be specifically differentiated to this more restrictive DWS. The minimum contour of the gross beta plume should be 8 pCi/l.

Recommendation: Please reevaluate the gross beta plume using the lower 8 pCi/l as your bottom contour.

Section 4.1.1.6.10 page 4-19 to 4-21.

Deficiency: The tritium units have been converted to nCi/l to apparently accommodate the contour plume map on Figure 4-10. The pCi/l units should probably be retained to be consistent with the Hanford sitewide plume maps and with reported data.

Recommendation: Please keep the units consistent, pCi/l units for radionuclides should be used throughout the text and in Figure 4-10.

Section 4.1.1.6.11 page 4-22, lines 8-14.

9413293.4025

Deficiency: The ^{99}Tc levels shown in Figure 4-11 are generally higher than the gross beta values in Figure 4-9. Since ^{99}Tc is only a portion of the total beta decay emitters in the groundwater, why isn't the gross beta activity greater than the ^{99}Tc activity?

Recommendation: Please explain this discrepancy.

Section 4.1.1.6.12 Page 4-23 Line 1

Deficiency: The statement that no data are available on the vertical distribution of ^{129}I is incorrect. Refer to Comment on Section 9.4.1, page 9-28.

Section 4.1.1.6.13 page 4-23, line 6 and Figure 4-13.

Deficiency: The isotope of uranium being discussed in this section is not presented.

Recommendation: Present the uranium isotope discussed in this section.

Section 4.1.2.3.1, page 4-32, line 17

Comment: Reference to 4.1.1.6.9 probably should be to 4.1.1.6.8.

Section 4.1.2.3.2 page 4-33, first paragraph in this section.

Deficiency: The ^{234}Th and ^{234}Pa isotopes are not considered fission products but rather decay products. ^{106}Ru would be considered probably relatively short-lived with a half-life of approximately one year. This radionuclide may have decayed away in certain gross beta plumes, as well as ^{131}I.

Section 4.1.2.3.2, page 4-33, line 17

Comment: Reference probably should be to 4.1.1.6.9.

Section 4.1.2.3.4 page 4-34, also Sections 4.1.2.3.5 and 4.1.2.3.6.

Deficiency: The ^{14}C isotope is not considered a true fission product but is formed from nitrogen or from ^{17}O. Cobalt-60 and nickel-63 would probably be considered activation products.

Recommendation: Please check your information and make the appropriate changes, if necessary.

Section 4.1.2.3.8, page 4-35, line 18

Comment: Reference probably should be to 4.1.1.6.11.

Section 4.1.2.3.8 page 4-35 lines 27-28.

9413293.4026

Deficiency: The net electrical charge on soil organic matter is generally negative and does not tend to adsorb anionic species. However, oxyanions such as the technetate would tend to form complexes via ligand exchange with mineral oxyhydroxides such as iron or aluminum. Adsorption would increase with decreasing pH.

Recommendation: Correct the statement.

Section 4.1.2.3.10, page 4-36, line 4

Comment: Reference probably should be to 4.1.1.6.12.

Section 4.1.2.3.13 page 4-37 lines 16-27.

Deficiency: The description of events here does not quite jibe with those conditions described in Section 4.1.1.6.13. What about the lack of annular seals in the monitoring wells adjacent to the cribs in question? The wells are not mentioned in Section 4.1.2.3.13.

Recommendation: Please clarify the discrepancy between the two sections.

Section 4.1.2.3.13, page 4-36, line 40

Comment: Reference probably should be to 4.1.1.6.13.

Section 4.1.2.3.14 page 4-38, lines 1-18.

Deficiency: Are/are not organics found in the soils of the 200 West Area? This section reports organics present in the liquid discharges and yet several sections have alluded that organics are not present in the Hanford Site or 200 West soils to complex with various constituents. Are the organics present below the water table? It appears there may be some confusion between the presence or organic matter in Hanford soils and the disposal of organic wastes.

Recommendation: Include some discussion of this apparent discrepancy in this section or elsewhere in this document.

Section 4.1.2.3.14, page 4-37, line 38

Comment: Reference probably should be to 4.1.1.6.14.

Section 4.1.3.1.1., page 4-39, line 35

Comment: Figure citation should start at 3-66

Section 4.1.3.1.1, page 4-39, line 39

Comment: Citation of Figure 3-65 probably should be to Figure 3-66 and onward.

Section 4.1.3.1.2, page 4-40, lines 14-15

9413293.4027

Comment: On the comment that the "declines ... have been much less than expected" two factors come to mind. They are: 1) has delayed drainage from the partially saturated soil column been accounted for in the model, and 2) if the porosity is not correct the amount and timing of drainage may be incorrectly simulated.

Section 4.1.3.1.3, page 4-41, lines 6-7

Deficiency: This relationship is not proven as far as we know. A "may have" should be added to the statement.

Recommendation: Provide data to support or remove.

Section 4.1.3.2, page 4-43, whole section

9413293.4028

Comment: Two aspects of releases from the unsaturated zone are not adequately addressed. They include: 1) carbon tetrachloride free product is probably still in the soil in large quantities and may continue to migrate as a liquid and add to contamination a long time into the future, and 2) gravity drainage of contaminated groundwater containing a variety of contaminants may be greater than expected and may continue to be a problem into the future. The later depends on the concentration of contaminants in the pore water, the volume of pore water, and the timing of the drainage from the soil column.

Line 21 -- Also note that vapor phase transport may be occurring for other volatile compounds not necessarily DNAPL compounds as described.

Section 4.1.3.3, page 4-44, line 22

Comment: Reference to 200 West probably means 200 East.

Section 4.1.3.3, page 4-44, line 31

Comment: Word "savings" seems out of place, substitute "decrease" for it.

Section 4.1.3.3.6, page 4-45, line 33

"Chloroform also degrades..." to what?

Section 4.1.4, page 4-47, line 19

Comment: Reference to Figure 4-16 is unclear, that figure has nothing to do with gradient.

Section 4.2.2

Comment: This section discusses the transport pathways expected to affect contaminants in the 200 West Groundwater Aggregate Area. A rationale should be provided for not including migration to sediments and uptake by biota. these pathways are included in Hanford Site Baseline Risk Assessment Methodology (DOE-RL 1991).

Section 4.2.2.1, page 4-49, paragraph beginning on line 37

Comment: Why not refer to Figure 3-55, "Isopach of the Vadose Zone"? On that figure the range of thicknesses is 55-100 meters.

Section 4.2.2.1.3, page 4-51, line 18

Comment: The text refers to Section 3.5.4 for a discussion of the accumulation of soil moisture and liquid waste in perched water zones. There is no Section 3.5.4. The appropriate section to reference is likely 3.5.2.1.4. This discrepancy should be addressed.

Section 4.2.2.1.4 page 4-52, lines 30-36.

Deficiency: Ionic strength also has a very important role in colloidal transport. As ionic strength goes up, suspended colloids (0.001 to 1 um) will coagulate to form larger particles which can be filtered out of suspension. Colloidal transport can be a large fraction of the total solution transport.

Recommendation: Include ionic strength effects on colloidal transport in the discussion.

Section 4.2.2.1.6, page 4-54, line 22

Comment: Assuming "soil vapors" are largely made up of nitrogen with some carbon dioxide and water, there are very few volatile organic chemicals and no volatile radionuclides that are expected to be "lighter" than "soil vapors". Vapor transport, especially in the upward direction (toward the atmosphere) is more directly controlled by the vapor pressure of the volatile chemical and diffusion driven by a concentration gradient. Advection due to barometric pumping may also have some secondary influence on transport.

Section 4.2.2.2, page 4-54, line 37

Comment: Reference to Section 4.1.1.6.6 is unclear since it does not mention DNAPLs.

Section 4.2.2.4 page 4-56.

Deficiency: This section probably should be labelled 4.2.2.3 rather than 4.2.2.4. The section 4.2.2.3 is apparently missing.

Recommendation: Please make appropriate corrections.

Section 4.2.2.4, page 4-56, line 39

Comment: The text states that lateral migration of carbon tetrachloride vapors was proposed as an explanation for detecting this chemical at distant locations. A reference for this explanation should be provided.

Section 4.2.2.5 page 4-57, lines 23-27.

9413293.4029

Comment: This sentence states that based on the current plume configurations of tritium, ground-water contamination from the 200 West Area has not yet reached the Columbia River. However, nitrate concentrations if contoured down to 20 ppm might indicate that this constituent originates at sites other than U-pond within the 200 West Area and merges with the nitrate plume from the 200 East Area to flow to the Columbia River to the southeast.

Recommendation: Please reevaluate this statement and make appropriate corrections, if necessary.

Section 4.2.3, page 4-59, line 10

Comment: The text states that absorption and desorption reactions may greatly retard lateral contaminant migration. Because of the possibility that desorption reactions may enhance lateral migration of contaminants, the text should be changed from retard lateral migration to alter lateral migration.

9413293.4030

Section 4.2.3, page 4-59, line 24

Comment: This section discusses routes of exposure to contamination found in groundwater. Exposure to sediments is not mentioned. The text should be changed to indicate possible exposure to sediments. these exposure routes are included in Hanford Site Baseline Risk Assessment Methodology (DOE-RL 1991).

Section 4.2.4 First paragraph on page 4-60 and Table 4-5.

Deficiency: Candidate Contaminants of Potential Concern does not contain all of the radionuclides and chemicals disposed of to S Plant (Table 2-10), T Plant (Table 2-9), Z Plant (Table 2-10), and U Plant (Table 2-9). The elimination of any chemical or radioactive constituent should be justified.

Recommendation: Expand list to contain all radionuclides and chemicals dispersed at each source unit. Any elimination should be justified, and reason for elimination discussed.

Section 4.2.4 Third paragraph on page 4-60 and Table 4-6

Deficiency: The rationale for eliminating individual chemicals must be fully discussed in the text. Chemicals with no EPA toxicity criteria should not be eliminated, because they may have been released in large quantities to the environment.

Recommendation: Discuss rationale for eliminating each chemical or radionuclide in sufficient detail to support decision.

Section 4.2.4 Last paragraph on page 4-60

Deficiency: The selection of the contaminants of concern is based on groundwater regulations that were developed to protect human health, not environmental health. Thus, the screening procedure for the selection of the contaminants of concern is flawed.

Recommendation: The criteria for selection should be expanded to include environmental receptors.

Section 4.2.4.2 Top paragraph on page 4-62

Deficiency: Since it is likely that additional radionuclides were deposited to 200 West groundwater Aggregate Areas that were not included in the waste inventory, the development of the list of contaminants of potential concern (Table 4-6) may be premature.

Recommendation: Propose a way to evaluate other radionuclides that were not included in the waste inventory that may have been introduced to the 200 West groundwater.

Section 4.2.4.2 page 4-64 lines 15 and 16 and Table 4-7

9413293.4031

Deficiency: Cesium and cobalt are listed in the low mobility class with K_d > 100 based on the literature survey of Cantrell and Serne. This drastically conflicts with the classification based on the survey of Strenge and Peterson also shown in Table 4-7. The probable K_d of 500 mL/g for Cs from Table 4-7 also seems high based on previous laboratory work for Hanford soils reported in the Final EIS for the "Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes" (USDOE, 1989) which report a typical value of 26 mL/g which is more in line with the Strenge and Peterson estimate of 51 mL/g.

Recommendation: Explain why the particular values for Cs and Co K_ds were chosen even though they conflict with other site-specific data which are more conservative. This explanation should be held in a context surrounding the correct usage of the K_d as a retardation factor in transport calculations. This usage requires that the K_d represents an instantaneous reversible equilibrium condition as discussed in Appendix P of the Final EIS. If the values listed are adsorption or desorption constants rather than true K_ds, then this should be clearly stated.

Section 4.2.4.3 page 4-62

General comment: In discussing the mobility of contaminates in soil, there is no mention of the importance of the soil's oxidation/reduction potential. The chemical and biochemical states of many contaminants are highly dependent upon the redox status of the local soil environment. For example, technetium (Tc) is very sensitive to redox potential. Under well oxidized conditions, Tc exists as the pertechnetate anion which is characterized as being highly mobile. Under reducing conditions, Tc may become cationic and tends to be relatively immobile.

Section 4.2.4.5.1 page 4-66, line 27

Comment: The isotopes ^{210}Po, ^{210}Pb and ^{227}Ac should probably not be considered as fission products, but rather, decay products.

Recommendation: Please change the wording "fission products" to "decay products".

Section 4.2.4.5.2, page 4-66, line 40

Comment: This section discusses the carcinogenic and noncarcinogenic health effects of the candidate chemicals of concern. The references for this information, summarized in Table 4-11, should be provided.

Figures 4-1 through 4-14

Deficiency: Wells used for contouring should be from the same depth in the aquifer. Using data from two wells adjacent to each other that sample the top and bottom of the water table will produce an erroneous concentration isopleth.

Recommendation: Use only data collected from wells located in the upper portion of the water table aquifer.

Figures 4-1 through 4-14

Deficiency: Some value just above the lower limit of detection LLD or more reflective of the MCL should be used for minimum concentration isopleth value.

Recommendation: Add new isopleth contour(s) that reflect levels below those shown. The added data would provide additional definition to the plumes and may change some of the conclusions and recommendations in the text.

Figures 4-1 to 4-16

Comment: Figures that are meant to be compared and show similar areas and ideas should share the same scale and orientation.

Figure 4-3, page 4F-3

Comment: The concentrations of fluoride in most of the wells are reported as zero value. The actual reported minimum detection limits or not detected should be indicated on the map. This comment is applicable wherever appropriate on other figures.

Figure 4-5

Comment: The concentration isopleths shown on the figure extend far outside the area of monitoring wells shown on this or figs. 2-2, 11, and 12.

Recommendation: In section 4.1.1.6.5, describe the basis for the extent of the plume as depicted on fig. 4-5.

Table 4-1, page 4T-1b

Comment: Negative values are presented for minimum reported detection limits for many of the radionuclides. A footnote should be provided explaining the negative values used to report the minimum detection limits.

Section 5.1 Third paragraph on page 5-2

Deficiency: This paragraph stresses that this screening process is different from an evaluation of potential risks without explaining the difference.

Recommendation: Clarify the difference between the steps in the screening and a full risk assessment. A check list comparison of each process would be helpful.

Section 5.1, page 5-2, lines 21-28

Comment: Planning priorities for remediation should not ignore the confined aquifers (basalt and interbeds). Little is known about contamination concentrations in those aquifers and these represent real pathways from the 200 Areas to the accessible environment. These aquifers may be future sources of drinking or irrigation water at Hanford and they discharge to the Columbia River system.

Section 5.2.1 Third and fourth bullet

Deficiency: There is not sufficient detail on exposure pathways to determine if the screening process is adequate.

Recommendation: List exposure pathways and assumptions. Additional information on MEPAS should be included in an appendix so the reader can make an evaluation without seeking other sources.

Section 5.2.1, page 5-3

Comment: The section describes the Multimedia Environmental Pollutant Assessment System (MEPAS). It appears that MEPAS only considers human health effects. The method that MEPAS uses to determine ecological impacts should be explained in the text.

Section 5.2.1, page 5-5, lines 9-10

Comment: The text states that risks from chemical carcinogens are based on cancer potency factors (CPF) defined in the Health Effects Assessment Summary for 300 Hazardous Constituents (EPA 1982). The CPFs should be obtained from the Integrated Risk Information System (EPA 1992a), if available or from the Health Effects Assessment Summary Tables (HEAST) (EPA 1992b). The rationale for not using the most recent data available should be provided.

Section 5.2.1, page 5-5, lines 10-11

Comment: The text states that relative health risk index (RRI) for noncarcinogens is derived by multiplying the ratio of estimated dose to reference dose by 1×10^{-6}. Rational for using this technique should be provided.

Section 5.2.1, page 5-5, lines 28-30

Comment: A CPF of 1.7×10^{-2} is assigned to trichloroethylene based on HEAST. This value should be referenced to the appropriate HEAST document.

Section 5.2.1, page 5-6, line 6

This paragraph describes the use of K_d values to predict the mobility of inorganic contaminants in groundwater. The rational for not using the default K_d should be provided. Also, the text states that the K_d values in column three of Table 4-7 were used. The text should state what values were used when the values in the table were not available.

Section 5.2.1 First paragraph, page 5-5; Section 5.2.2, Second paragraph, page 5-6; Section 5.3.1 First paragraph, page 5-7.

9413293.4034

General Comment: There are areas where the methodology is not clear or appears inconsistent.

Deficiency: The process described suggests that concentration is included in the RRI twice or three times--the first time to calculate the RRI, a second time for point RRI values, and a third time.

Recommendation: Clarify and present the equations for unit RRI, total RRI, and any other types of RRI. Concentration should not be used more than once in calculating an RRI.

Section 5.2.2, page 5-6, line 17

Comment: The text states that contaminants detected only once were not evaluated by MEPAS. An explanation for not evaluating these contaminants should be provided.

Section 5.2.3, page 5-6, paragraph beginning on line 40

Comment: Again, only unconfined aquifers are mentioned as potential pathways from the 200 Areas to the accessible environment. The confined aquifers are a subject that really needs to be more fully investigated.

Section 5.3.1, page 5-7, line 40

The text states that detections for some compounds were considered questionable, and those compounds were therefore not ranked. The reason for considering these detections questionable should be included. Also, describe any uncertainty that is added to the recommendation as a result of not including these compounds.

Section 5.3.1, page 5-7, line 42-43

Comment: The text states that RRI values have been combined for chemical and radiological carcinogens. It is suggested that chemical and radiological carcinogens contours also be presented separately in order to clearly define the relative importance of these carcinogens.

Section 6.0 Pages 6-1 through 6-22

Deficiency: ARARs and action-specific CARS that may be applicable to the site and should be referenced include the following:

> Washington Standards for Protection Against Radiation (WAC 402-24 and 426-221)
>
> Washington Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (WAC 402-80-050)
>
> Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (173-490)

Recommendation: Include the above regulations in the text.

Section 6.0 Page 6-6, line 24. (RECHECK)

Deficiency: There is a reference to Section 6.2.2.2 which does not exist.

Recommendation: Please include the appropriate reference in the text.

Section 6.6 Third paragraph on page 6-21

Deficiency: Point of compliance is not the boundaries of the Hanford site; see MTCA 173-340-720(6).

> (A) For groundwater the point of compliance is the point or points where the groundwater cleanup levels established under Subsections (2), (3), (4), and (5) of this section must be attained. Groundwater cleanup levels shall be attained in all groundwater from the point of compliance to the outer boundary of the hazardous substance plume.
>
> (B) The point of compliance shall be established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest depth which could potentially be affected by the site.

Recommendation: Accept above or reference a federal regulation that states that the point of compliance for groundwater could be the boundary of a hazardous waste site.

Section 6.6 Third paragraph on page 6-21

Deficiency: The assumed point of compliance for radioactive species in groundwater is the point in the plume that exceeds MCL or Drinking Water Equivalent Level.

Recommendation: Remove the last sentence in the paragraph (starting on line 33) and replace with sentence stating that point of compliance would be where MCL or Drinking Water Equivalent is exceeded.

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Section 6.7 First paragraph of page 6-22

Deficiency: Use the actual language stated in CERCLA Section 121 (d)(4)(A through F) rather than an interpretation.

> (A) the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed;
>
> (B) compliance with such requirement at that facility will result in greater risk to human health and the environment than alternative options;
>
> (C) compliance with such requirements is technically impracticable from an engineering perspective;
>
> (D) the remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through use of another method or approach;
>
> (E) with respect to a State standard, requirement, or limitation, the State has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other remedial actions within the State; or
>
> (F) in the case of a remedial action to be undertaken solely under section 104 using the Fund, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration, and the availability of amounts from the Fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats. The President shall publish such findings, together with an explanation and appropriate documentation.

Section 7.0, Figures 7-4 and 7-5

Comment: The well on the left side of both of these figures is labeled as an injection well for pumping treated water back into the aquifer. The line representing the water table should show an elevated cone of impression around this well as opposed to a cone of depression as it is now.

Section 7.1, page 7-3, lines 19 through 21

Comment: The remedial action objectives (RAO) should account for permanent reduction not only in the mobility and toxicity of the contaminants, but also in the volume of the contaminants. The text should be accordingly revised.

Section 7.3.2 Third paragraph in this section, page 7-13.

Comment: Apparently 22 options were retained as potentially applicable. Five were innovative and 16 remaining were retained. Five and 16 do not add up to 22. What happened to the extra option? Please make the appropriate correction.

Section 7-4, page 7T-4

Comment: This table provides summary of retained groundwater technologies. None of the retained technologies except ion-exchange will remove nitrate from groundwater. But ion-exchange is an expensive treatment method. Denitrification is an anaerobic biological process in which the nitrate and nitrate forms of nitrogen are reduced to nitrogen gas. This is a common process routinely used in wastewater treatment plants and should be retained for nitrate removal from groundwater.

Section 7.4.1 Second paragraph on page 7-16

Deficiency: There is known selective membrane technology that can be used to remove tritium from groundwater. One such system was developed by Techna Pacific Corporation, Inc. involving upstream electrolytic decomposition of water into hydrogen and oxygen, followed by the selective separation of hydrogen from other gases. The three forms of hydrogen are then separated into their respective streams: hydrogen, deuterium, and tritium.

Recommendation: Remove sentence starting on line 17 ("Tritium, because...).

Section 7.5 Fourth paragraph on page 7-24

Deficiency: Refer to above comments.

Figures 7-4 and 7-5

Comment: Injection wells will commonly create a mound as opposed to a cone or depression.

Section 8.1.2, page 8-3, line 16

Comment: The topical reports are mentioned here and in 2.0, 3.0, and 4.0, but a comprehensive list of subject areas is never given. Such a list should be in this document. For instance, we did not see any mention of the topical report describing recent water quality sampling.

Section 8.1.2 First paragraph on page 8-5

Comment: When will the 200 West Area borehole geophysical field characterization topical report be available?

Recommendation: Date available should be referenced in this report.

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Section 8.1.2 Second paragraph on page 8-6

Deficiency: All possible future land uses of the Hanford site should be addressed. Data will need to be collected that can be used to evaluate future land use. The issue is not just a regulatory one, and will affect the type and amount of data collected.

Recommendation: Address all future land uses so appropriate amounts and types of data will be collected.

Section 8.1.2, page 8-5, lines 29-32

Comment: The statement that "all these parameters are known to a reasonable degree of accuracy" may be optimistic. As pointed out in the review of Section 3, there is considerable difference between the tabular, text, and figure-based hydraulic data. This will need to be given much more review before being called "reasonable".

Section 8.1.3

Comment: Five PARCC parameters are identified and discussed in this section--Precision, Accuracy, Representativeness, Completeness, and Comparability. This discussion for most of the parameters covers both physical and chemical data, as it should. This discussion for "representativeness" only addresses physical data in the form of hydrogeologic and soils properties. No mention of the chemical monitoring data is made. It would seem that this "representativeness," the degree to which the appropriate environmental parameters or media have been sampled, is a very important aspect to cover. This can be carried back to Comment 42 on Section 4.1 and the potential for undocumented wastes and/or waste disposal sites--is the chemical data fully representative of the location and nature of subsurface contaminants in the 200 West Area?

Section 8.1.3 Bottom paragraph on page 8-6

Comment: Standard fate and transport models have a diffused front end of the contaminant plume, with a "core" of the highest concentrations behind the front.

Section 8.1.4 Second from bottom paragraph on page 8-9 and bottom

Deficiency: Figure 4-18 shows the estimated near-future groundwater flow paths for the 200 Areas, and is not the conceptional model (Figure 4-20).

Recommendation: Cite Figure 4-20.

Section 8.1.4, page 8-9, lines 29 and 36

Comment: Both lines have a reference to Figure 4-18, probably should refer to 4-20.

Section 8.2.2.1 Pages 8-14

Deficiency: This section indicates that "the most important tools for characterization are models to address groundwater and vadose zone flow and contaminant transport" and refers to Table 8-1 as indicating the data requirements for such models. However, the title to the table indicates that it contains "Data Requirements for Modeling Flow and Transport in the Vadose Zone" alone. The table only barely mentions data requirements for modeling saturated flow in the unconfined aquifer (3.5 and 3.6) and completely ignores data requirements for modeling saturated flow in the confined aquifers (which may be required).

Recommendation: Change the title of table 8-1 to include data requirements for modeling flow and transport in the confined and unconfined aquifers, and list the appropriate data requirements in the table. Also note in the text in Section 8.2.2.1 that modeling flow and transport in the confined aquifers will only be done if contaminants are found in these aquifers while addressing the data gaps noted in Section 8.2.3 on page 8-19. Also not in Section 8.2.3 that the physical and hydraulic properties of the confined aquifers exist as a data gap if these aquifers are found to be contaminated.

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Section 8.2.2.2 Top paragraph on page 8-15

Deficiency: Confirmatory sampling and data analysis will be done at Level IV-CLP analysis level.

Recommendation. State that Level IV-CLP analysis will be used for confirming data analysis.

Section 8.2.3

Comment: The presented data gap list is quite inclusive; however, three comments are offered. First, a data gap should be identified that relates to characterization of the geochemical properties of the earth materials in the vadose zone and the shallow unconfined aquifer. These properties may significantly influence contaminant migration and the effectiveness of remedial measures, and the report suggests that little information of this type has been collected to date. Second, a data gap should be identified that relates to identification of undocumented wastes and waste disposal sites (See Comment 42). Third, it would seem appropriate to rank or group/rank the data gaps. At present, all are presented equally and it must be assumed that all have the same priority in the minds of the authors, and that all will be pursued equally in subsequent studies (LFIs, RI, etc.). I would assume that this is probably not the case. The most significant data gaps or information needs, in my opinion, relate to the vertical extent of plumes and the hydrogeology of the lower portion of the unconfined aquifer and the confined aquifers.

Section 8.2.3 Fourth paragraph on page 8-19

Deficiency: Data is lacking in the lower portion of the uppermost, in particular at the interface between the gravel Unit E, and the lower mud sequence of the Ringold Formation. This area is critical in determining if

Dense Nonaqueous Phase Liquid (DNAPL) contaminants have collected on this interface. DNAPL investigation is referenced in the May 27, 1992 EPA memorandum on groundwater remediation at Superfund sites (Directive No. 9283.1-06). The memorandum outlines the activities that should be performed at Superfund sites contaminated by DNAPLs including the evaluation of potential traps formed by soil layers.

Recommendation: Incorporate and reference investigation methodology from the EPA memorandum on groundwater remediation at Superfund sites Directive No. 9283.1-06.

Section 8.2.3 Fourth paragraph on page 8-20

Deficiency: All radionuclides and chemicals disposed to the S, T, U, and Z Plants Aggregate Area Waste Management Units should be investigated.

Recommendation: Investigate all radionuclides and chemicals known to have been disposed in the 200 West AAMS area.

Section 8.2.3, page 8-21, section beginning on line 31

Comment: The term "pump test" is used to describe the test necessary to determine aquifer properties. In the supporting documents, the more correct term "aquifer test" is used.

Section 8.2.3, page 8-23, section beginning on line 23

Comment: DNAPLs are mentioned here, in liquid phase these contaminants can move against the upward vertical gradient (and flow) in the groundwater system in response to geologic structures and gravity. DNAPLs in vapor phase can migrate through the unsaturated zone in the direction upgradient of groundwater flow. Transport in both phases is an important part of the contaminant transport conceptual model for the 200 West Area and this should be described to the reader.

Section 8.2.2.3, page 8-17, line 30

Comment: This section discusses use of statistical package (GEO-EAS) to determine plume concentrations. This section should provide more information on the uncertainty associated with using such packages to facilitate an evaluation of the quality of data generated using this statistical package.

Section 8.3.3, page 8-27

Comment: This section should include methodologies to be used to investigate all data gaps identified in Section 8.2.3. Some data gaps such as affects of old monitoring well construction, soil vapor phase transport, dense non-aqueous phase liquids, enhancement of contaminant transport by complexing, and best available remedial technology, are not addressed in this section, but are issues of concern at the 200 West Area.

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Table 8-4, page 8T-4C

Comment: Analytical methods (ra-04) are proposed for radium and radium-226. Ra-04 is not defined, and a reference for this method is not cited. An explanation for not using the prescribed methods from the EPA guidance (EPA 1980) for analyzing radium and its isotopes should be provided in the text or in a footnote.

Radium-223, -225, -226, and -228 are included in the contaminants of potential concern for the 200 West Groundwater Aggregate Area. But, the data quality objective parameters in this table include only radium, radium-225, and radium-226. Also, the same analytical methods are proposed for radium and radium-226. EPA (1980) prescribes different analytical methods for total radium alpha activity, radium-226, and radium-228. These discrepancies should be address, and the table should be corrected accordingly.

Table 8-4, page 8T-4E

Comment: Method 8240 is listed as the analytical method for methyl isobutyl ketone (MIBK) analysis. However, Method 8240 is not normally used for MIBK analysis. The method used most often for MIBK analysis is Method 8015.

Section 9.0 ERAs, page 9-2

Comment: Carbon Tetrachloride is considered a DNAPL and as such, probably will be difficult to remediate. It is also questionable how this constituent is mobilizing in the ground water. Before an ERA can be conducted there needs to be some degree of characterization of this constituent in the ground water. Is this constituent actually spatially mobile within the ground water? Is it travelling by vapor phase, rather than as a dissolved constituent in ground water? Hopefully, some of the concerns are being answered by the current Phase II Characterization effort which supports the ongoing 200 West Carbon Tetrachloride ERA.

Section 9.1.1 Second paragraph on page 9-5

Deficiency: Rather than use a "theoretical health or environmental risk," the quantitative risk assessment methodology outlined in the MSRS RAM should be used.

Recommendation: Use a quantitative risk assessment methodology.

Section 9.1.1, page 9-6, line 16-24

Comment: The text states that the maximum concentration detected was averaged for all samples collected in a well from 1989 through April 1992. The rationale for evaluating an ERA based on averaged concentrations rather that maximum concentrations should be provided. In addition, contaminants exhibiting concentrations greater than 100 times the applicable standards are considered for ERA. A further explanation for implementing this EPA criteria should be provided.

Section 9.1.1 Second paragraph on page 9-7, and Table 9-1, page 2 of 3

Deficiency: Concerning tritium treatment technology, see comment 84.

Section 9.2.1, page 9-9, lines 37-40

Comment: ERAs are proposed to be implemented with a stopping point based on either a concentration threshold, such as 100 times the applicable standards, or on reaching an asymptote on the remediation production curve. The basis for terminating an ERA upon reaching a point of diminishing returns should be stated (e.g., contaminant removal rates, cost per unit of contaminant treated).

Section 9.2.1.1, page 9-14, line 9

Comment: Reference to Figure 4-6 probably should be 4-5.

Section 9.2.2 Page(s) 9-11 and 12

Comment: This section of the AAMS Report discusses the 5 contaminants proposed for direct application of Interim Remedial Measures (IRMs). As discussed in the second paragraph, IRMs are based on risk reduction. The response objective of an IRM can be a reduction in RRI or effective implementation of containment.

It is our opinion that tritium must be considered for an IRM because it presents a high risk level and exceeds the MCL by more than 300 times. According to section 9.2.4.2 (p. 9-16), tritium has the fifth highest current carcinogenic RRI and the fourth highest future RRI level.

Section 9.2.4.2 states that no ERA is proposed for tritium because "there is presently no commercially viable treatment systems to remove tritiated water from the groundwater". However, we feel that containment using hydraulic barrier and control systems is viable using proven, routine, and cost-effective technology. (We propose an FFS to demonstrate hydraulic containment technology - see Comment 102 below). Moreover, because of the relatively short half-life of tritium, containment will actually achieve a specific reduction in contaminant levels and RRI.

We believe that tritium should be addressed by an IRM rather than ERA because this is most consistent with the approach proposed in the AAMS report. Specifically, a multi-contaminant IRM has been proposed for the overlapping plumes of nitrate, ^{99}Tc, and uranium (see last sentence on page 9-2). Because the tritium plume also overlaps these other IRM contaminants, the most effective approach will be to include tritium in this multi-contaminant IRM. This will also help assure that remediation of nitrate, ^{99}Tc, and uranium does not increase the tritium RRI.

Recommendation: Tritium should be included in the list of proposed contaminants for Interim Remedial Measures in Section 9.2.2. This can be accomplished by appropriately modifying section 9.2.4.2 and making it a subsection of 9.2.2. We further recommend that the last paragraph on page 9-2 and lines 4-5 on page 9-19 be modified to include tritium with nitrate, ^{99}Tc,

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and uranium in the proposed single multi-contaminant IRM for the overlapping plumes of these contaminants. Lines 34-35 on page 9-19 should be omitted. Entries for tritium in Tables 9-1 and 9-2 will require modification.

Section 9.2.1.2, page 9-10, lines 27-28

The remedial alternatives for carbon tetrachloride plume treatment during an ERA include in-situ sparging in conjunction with a vapor extraction system. Carbon absorption is proposed as the method for treating the off gases from this system. However, thermal treatment and catalytic oxidation should also be considered for vapor phase treatment during the engineering evaluation/cost analysis for the ERA.

Section 9.2.2.1, page 9-11, line 15

Comment: Concentration listed as "the highest concentration" is 1,322 mg/l here and is 1,265 mg/l on line 19, page 4-11.

Section 9.2.2.1, page 9-11, line 19

Comment: Reference to Figure 4-5 probably should be 4-4.

Section 9.2.2.2, page 9-11, line 26 and line 30

Comment: Suggest a change from "first place" to "highest risk". On line 30, the reference to Figure 4-14 probably should be 4-13.

Section 9.2.2.3, page 9-11, lines 35-37

Comment: Line 35 - 27,000 should be 40,0000, see page 4-21
Line 36 - "six" should be "ten"
Line 37 - reference to Figure 4-12 probably should be 4-11.

Section 9.2.2.4, page 9-12, line 3

Comment: Reference to Figure 4-7 probably should be 4-6.

Section 9.2.2.5, page 9-12, line 7

Comment: Reference to Figure 4-8 probably should be 4-7.

Section 9.2.3, page 9-14, lines 7-9

The text indicates that a program is underway to determine site background levels. The schedule for the completion of the effort should be provided in relation to approximate schedules for LFIs and IRMs.

Section 9.2.3 Page(s) 9-12..14

Comment: This AAMS Report section lists contaminants proposed for Limited Field Investigations (LFIs). LFIs are required where contaminants appear to be eligible for IRMs, but data are insufficient to confirm this, or where an IRM is known to be justified but existing data are insufficient to support an IRM.

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As stated on page 9-13, lines 27-28, some contaminant plumes for which an ERA or IRM is recommended also have portions where an LFI is recommended.

We believe an LFI is required to evaluate DNAPL behavior and portions of the carbon tetrachloride plume. Section 9.2.1.1 proposes an ERA for this plume, but the ERA remediation alternatives discussed in section 9.2.1.2 appear to address primarily the dissolved phase.

Section 8.2.3, page 8-23, lines 23-34 clearly identifies DNAPL behavior as a data gap. This conclusion is supported by the fact that only about 2% of the known discharge of carbon tetrachloride is accounted for in the mapped contaminant plumes (p. 4-14, lines 1-2).

Recommendation: Include the DNAPL portion(s) of the carbon tetrachloride plumes with the proposed contaminants for LFIs listed in section 9.2.3.

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Section 9.2.3, page 9-14, line 33

Comment: Aquifer or pumping test is preferred over "pump test".

Section 9.2.4.2, page 9-16, line 2

Comment: Reference to 6,800,000 picoCi/l doesn't match same reference on pages 4-19 and 4-20.

Section 9.2.4.2, page 9-16, lines 11 through 13

The text states that no further investigation is required to delineate the tritium plume since it is well enough defined. But, in Section 4.1.6.10, the lateral extent of a small plume northeast of the main plume A in this area is uncertain. Hence, further investigation should be included to collect data for the risk assessment to confirm the need for remedial action in this area.

Section 9.2.4.2 First paragraph on page 9-16

Deficiency: Treatment technology for tritium does exist; refer to comment 84.

Recommendation: See Comment 84.

Section 9.3.1, pages 9-16 through 9-18

Comment: Two groundwater operable units are developed for the 200 West Groundwater Aggregate Area on the basis of the two existing groundwater flow regimes and the distributions of the contaminant plumes in the aggregate area. As seen in Figure 4-5, the carbon tetrachloride plume occupies the entire area of the 200 West groundwater aggregate area and overlaps other contaminant plumes. The data needs and remedial actions required for many of the contaminants may be similar. Hence, the investigation and remediation process would be more cost-effective if the entire 200 West groundwater aggregate area was studied concurrently. EPA and Ecology feel that given the current designation of 200-UP-1 and 200-ZP-1 as groundwater operable units, that additional discussions on the final definition of these operable units is required.

Section 9.3.2, pages 9-18 and 9-19

Comment: Investigation prioritization is discussed for the priority groundwater contaminants in the 200 West Area. It is unclear whether the discussion is applicable for both of the proposed groundwater operable units. This discrepancy should be clarified. The text should also include a discussion on the prioritization of the proposed groundwater operable units.

Section 9.4.1 Page 9-28

Comment: This section of the AAMS Report proposes a Focused Feasibility Study (FFS) on barrier technology for groundwater remediation. We concur with this proposal; however, based on other sections of the AAMS, we suspect that the scope of the barrier FFS may be too limited.

Section 7.4.1 discusses preliminary remedial action alternatives, including containment of groundwater. Lines 15-16, page 7-15 indicate that information on the entire range of remedial alternatives is provided. While Table 7-3 (p. 7T-3b) does list hydraulic containment as effective and implementable, only grouting and ground-freezing are considered among the remedial alternatives.

In our experience, grouting and ground-freezing would be extremely expensive and uncertain technologies for groundwater containment under the depth and geologic conditions required in the 200 West Area. However, hydraulic containment by use of extraction and injection wells is an established and cost-effective technology in both deep underground construction and contaminant remediation.

Use of injection and extraction wells for hydraulic containment is given passing mention in the AAMS as a spin-off of pump-and-treat remediation. While this is certainly a valid context for containment technologies, it must be noted that large sections of the 200 and 600 Areas are clean or relatively uncontaminated. Extraction and reinjection of cleaner groundwater has relatively little volume constraint and could, therefore, effect relatively large changes in hydraulic gradients and groundwater flow patterns. These changes could be engineered for control of contaminant migration, even though clean groundwater is being extracted and reinjected.

Hydraulic containment using clean water extraction and reinjection is also unconstrained by the very complex treatment requirements associated with extraction of contaminated groundwater. In comparison with pump-and-treat systems, extraction of even very large volumes of clean groundwater for hydraulic containment should be relatively cheap.

Hydraulic containment is highly compatible with the observational approach advocated in the AAMS in which implementation is redirected as new information is obtained. In fact, considerable data will be generated on groundwater flow conditions by any hydraulic containment implementation.

A form of hydraulic containment could be implemented by institutional controls on artificial recharge induced by irrigated agriculture upgradient and to the west of the 200 Areas.

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Recommendation: Expand the proposal in section 9.4.1 of a barrier FFS to explicitly include investigation of large scale hydraulic containment systems using extraction and reinjection of cleaner groundwater and using institutional controls on off-site artificial recharge. Similarly expand the discussions of containment alternatives in sections 7.4.1 and add a hydraulic containment alternative to section 7.6.

Section 9.6 page 9-31, lines 24

Comment: It is somewhat premature to assign a number, "about ten wells" to answer the many questions concerning characterization of the "aggregate area". In our experience, the number of observation wells required is mainly defined by thecomplexity of the geology, geochemistry, and flow system; the Hanford Site and the 200 Areas are as complex as they come. Further development of an aggregate area project plan will be required before assigning a specific number of wells to this task.

Section 9.6 Page(s) 9-31..32

Comment: This section of the AAMS Report proposes 4 investigations to be conducted on an Aggregate-Area scale. We believe three additional technical issues require characterization on an Aggregate-Area or broader scale:

I. Accounting for the volume of contaminants discharged on the Hanford site should be improved. Examples of discrepancies in current accounting range from under accounting by a factor of 50 (Known contamination of carbon tetrachloride is only 2% of known releases - p. 4-14, lines 1-2) to substantial over accounting (tritium observed in groundwater is about 15 times documented releases - p. 4-33, lines 31-34). More accurate accounting of contaminant discharges versus plumes would supplement decision-making criteria discussed in section 9.1.

II. The relationship between geology and groundwater hydraulic parameters needs to be better characterized. This data gap was identified in section 8.2.3 (p. 8-21, lines 31-35). For example, the high transmissivity and hydraulic conductivity trends shown on Figures 3-53 and 3-54 appear to parallel structural trends in the basal Ringold units but not in the E gravel unit, the zone of greatest saturated thickness (Figs. 3-25..30).

III. Characterization of the degree of interconnection between the shallow sedimentary and the deep basalt aquifers was identified as a data gap in AAMS Report section 8.2.3 (p. 8-22, lines 33-40) Additional investigation of this issue should utilize the extensive information compiled in 1986-1987 regarding the occurrence of ^{129}I and other radioisotopes in the deep aquifers, as summarized in the Intercontractor Working Group's *Data Compilation: Iodine-129 in Hanford Groundwater* (WHC-EP-0037) and other documents.

Recommendation: Include recommendations for studies I, II, and III discussed above in Section 9.6.

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Section 9.3.2 Fourth paragraph on page 9-19

Deficiency: Justification for the prioritization for the LFIs is not given.

Recommendation: Document the prioritization method used to rank the chemicals for LFIs.

Section 9.6 Third paragraph on page 9-31

Deficiency: Location of all proposed additional monitoring wells and depths should be shown on a figure. Given that some of the contamination is DNAPL, and the lack of information concerning the water table aquifer and the first aquitard, there is a large data gap that cannot by filled by ten wells.

Recommendation: List and show on figure all proposed monitoring wells and the depth of screen interval.

Table 9-2

Deficiency: Maximum concentrations shown on Table 9-2 for many detected constituents do not agree with maximum detections shown on Table A-2.

Recommendation: Reconcile differences.

Appendix A, Table A-7, page AT-7c

Comment: A spot check revealed a discrepancy for well 299-W18-21, the test interval is 215.5-225.5 while the well log in the supporting document shows a screened interval of 195.5-225.5, which is correct?

For well 299-W21-1, the test interval is listed as 239-2537 ft, this is probably an error.

Appendix A

Comment: A spot check of hydraulic characteristics data in Tables A-7 and A-8 reveal the problems associated with interpreting aquifer test data. They also point out that the hydraulic characteristics of aquifers in the 200 Areas are not as well known as stated in the AAMS Report.

This table also has discrepancies in the relationship between hydraulic conductivity, saturated thickness ("distance from water level to bottom of screen"?), and transmissivity.

Appendix A, Table A-7, page AT-7d

Comment: For well 699-36-61B, the third line for that well shows a T value of 53,000. The following line shows a T value of 4200, with a note that the data were reanalyzed. This is a big change in T, although not unusual in our experience, aquifer test data are sometimes ambiguous.

Appendix A, Table A-8, page AT-8a

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Comment: Wells "W15-19" and "W18-21" are of similar depth, have similar appearing lithologic logs and are relatively close together (logs examined were found in the supporting documents). Their respective hydraulic conductivity values in this table are 1 and 5100. One ft/d is representative of sand or sand and gravel, 5100 ft/d is more like cobbles with some sand and/or gravel.

TYPOGRAPHICAL ERRORS

Section 3.4.2.2.1, page 3-15, line 42

Delete phrase "from there" at end of sentence.

Section 3.7.3., page 3-66, line 1

Phrase that begins "at the Hanford..." is a duplicate phrase.

Section 4.1.1.6.12, page 4-23, line 4

Delete "range".

SUPPORTING DOCUMENTS: Hydrogeologic Model for the 200 West Groundwater Aggregate Area:

Page 2-2, second paragraph, blanks where data values should be

Page 2-2, page 2-6, Is this "Uppermost basal.." or "basalt"?

Figures 2-3 to 2-17, see notes on AAMSR concerning similar figures. In that review, errors on figures presenting similar information were noted as a deficiency.

Page 3-4, last paragraph, 2nd line has a reference to Figure 2-13 - does that mean 3-13?

Page 3-5, last paragraph has several blanks were reference information is missing.

Page 3-6, first paragraph has a blank where reference data is missing.
Table 3-1, page 3-29, the K value for well "W26-11c" is 0.006 ft/d. This value is probably more representative of a silty sand and looks like an "outlier" as opposed to being representative of the unconfined aquifer. Was this test done on a saturated portion of the formation?

Unconfined Aquifer Hydrologic Test Data Package

Page 1, last paragraph, third line from the bottom typo after "Formation" "nd amy" may equal "and may."

Table after page 2 is difficult to read to poor reproduction.

Confined Aquifer Hydrologic Test Data

Table 1, footnotes, footnote "h" is cited for well 699-52-57, but does not appear in the table.

REFERENCES

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EPA 1982. Health Effects Assessment Summary for 300 Hazardous Organic Constituents. U.S. Environmental Protection Agency. Environmental Criteria and Assessment Office, Cincinnati, Ohio.

EPA 1992a. Integrated Risk Information System. United States Department of Health and Human Services. National Library of Medicine Toxicology Data Network (TOXNET), Bethesda, Maryland.

EPA 1992b. Health Effects Assessment Summary Tables: Annual FY-1992. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response, Washington, DC.