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CORRESPONDENCE CONTROL

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Mr. Paul T. Day
Hanford Project Manager
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, Washington 99352

Mr. David B. Jansen, P.E.
Hanford Project Manager
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Dear Messrs. Day and Jansen:

RESPONSE TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) AND THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY (ECOLOGY) REVIEW OF THE 200 EAST GROUNDWATER AGGREGATE AREA MANAGEMENT STUDY REPORT (AAMSR) DRAFT A

This letter transmits the responses to comments received from EPA and Ecology on Draft A of the 200 East AAMSR.

If you have any questions, please contact Mr. P. M. Pak at (509) 376-4798.

Sincerely,

Robert S. Holt / for
Steven H. Wisness
Hanford Project Manager

ERD:PMP

Enclosure

cc w/encl:
B. A. Austin, WHC
C. Cline, Ecology (2)
A. DeAngeles, PRC
M. K. Harmon, EM-442
B. Kane, Parametrix
D. D. Teel, Ecology (3)
J. Sprecher, Brown and Caldwell

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R. A. Carlson, WHC
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J. L. Monhart, EM-442

JUN 1993 RECEIVED EDMC

JAN 1993 RECEIVED Becky A. Austin

## ENVIRONMENTAL RESTORATION ENGINEERING
## COMMENT RECORD FORM

1. Date 12/21/92 — 2. Page 1 of 88
3. Document Title/Number 200 East Groundwater AAMSR/DOE/RL-92-19, Draft A
4. Lead Engineer/Scientist DL Parker, WHC/PM Pak, RL — 5. Organization 81320
6. Location/Phone/MSIN 740 STVCN/2-1031/H6-03
7. Reviewer D. Goswami, Ecology / D. Sherwood, EPA — 8. Organization
   Sign and Print Name — Date
9. Location/Phone/MSIN
10. The document was reviewed, and the reviewer had no comments.
    Reviewer _____ 11. Date _____
12. I have reviewed the disposition of comments with the Lead Engineer/Scientist.
    Reviewer _____ 13. Date _____

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| G1 | **General Comment:** The primary deficiency of the report is a lack of information on the 200 North Aggregate Area which is a part of the 200 East Groundwater Aggregate Area Management Study (AAMS). The various maps should identify the 200 North Area separately from the remaining 200 East Area and should incorporate all the available related information. Again, similar to 200 West Groundwater AAMS we find a lack of data on the confined aquifer system and the report makes vague recommendations for further study in section 9.0. Besides these, all other generic comments of 200 West Groundwater AAMS are applicable for 200 East Groundwater AAMS. | **First Point:** Reject. All available information found for the 200 North Area has been included. We agree that these data are not very extensive. This area has never been studied to the same extent the 200 East and West Areas have been. We do not agree that this is a deficiency of the report, however, since it demonstrates this lack of data. An outline of the 200 North Area has been drawn on the figures where appropriate; figures from previous reports do not necessarily have it added, however. |

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| | | **Second Point:** Accept. Similar to 200 West Groundwater General Comment 7, and Specific Comment 167.<br><br>Hydrogeologic properties and the extent of contamination for the confined aquifers are summarized in the report using currently available site data. As discussed in Section 8.0, the relative lack of confined aquifer data is a recognized data gap, and recommendations for further field investigation and data analysis are discussed in Section 9.0 at a level of detail appropriate to the AAMS-level study.<br><br>Future RI and FS work plans planned for the 200 East Groundwater AA will include collection of additional characterization data for the unconfined aquifers. The additional information will be evaluated together with the existing analytical data on a more-detailed basis. The approach outlined in EPA directive No. 9283.1-06 will be cited an used as guidance for development of these work plans.<br><br>**Third point:** Accept. All generic comments were accepted for the 200 West Groundwater AAMSR. Similar responses and resulting text changes will be incorporated into the 200 East Groundwater AAMSR.The two reports were deliberately made as consistent with each other as possible to simplify their future use. |

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| G2 | **General Comment:** The data available to characterize aquifer properties in the 200 East area are generally described as inadequate within the report. In Chapter 3, Site Conditions, aquifer property values are presented and discussed, but it is noted that most of the data are from outside the 200 East Area. The latter sections of the document note that: 1) very few aquifer tests have been conducted within the 200 East Area; 2) slug test data has been excluded from recent assessments because it is not thought to be representative; and 3) the pumping tests that have been conducted are poorly defined. These latter comments suggest that there is essentially no reliable characterization of aquifer properties within the 200 East Area. This significant gap, if one is to plan and design groundwater remediation approaches and systems, seems to be undersold in the descriptive sections of the document and noted, but not appropriately emphasized, in the planning sections of the document. Lack of reliable aquifer properties also places a severe limitation on the ability to predict future plume migration. This factor may not be adequately brought out in the document. | Accept. The latter sections of the document conclude that aquifer properties data are limited and need to be corroborated or supplemented by additional testing data. However, to say that "there is essentially no reliable characterization of aquifer properties" is an overstatement. As discussed in Section 9.0, this data gap will be addressed in depth as part of follow-up investigations (e.g. RI and FS work plans). |
| G3 | **General Comment:** Wells adjacent to Pond 216-A-25 have detected concentrations of Nitrate, Gross Beta, and Strontium-90. The six wells that detected concentrations are not incorporated into any of the four groundwater monitoring programs discussed in Section 2.8. | Accept. The six wells located around the 216-A-25 Pond have been included in the updated Westinghouse Operational Groundwater Monitoring Network. |

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| G4 | **General Comment:** The mass of individual contaminants in the groundwater under the 200 East Area is calculated in Section 4.1.1.7. The difference between the calculated mass and the radioactive and chemical waste inventory quantity (Tables 2-5 and 2-6) is sometimes several magnitudes, as shown below:<br><br>Contaminant Calculated Inventory<br><br>Nitrate 740,000 kg 32,843,894 kg<br>Gross Alpha 0.03 Ci 968.35 Ci<br>Gross Beta 5.2 Ci 48,287.01 Ci<br>Tritium 16,400 Ci 32,521 Ci<br>Cobalt-60 0.43 Ci 7.90 Ci<br>Strontium-9 0.17 Ci 9,466.24Di<br>Iodine-129 0.24 Ci 0.1308 Ci<br>Cesium-137 0.014 Ci 11,598 Ci<br>Plut. 239/240 0.0006 Ci 1,108.12Ci | Reject. The differences shown in the table indicate to us two things: 1) much of the contamination is still bound up in the soil, and 2) the data on this issue are not reliable enough to support any more than this limited conclusion. The truth of the first statement is demonstrated by comparing the $K_d$s for the constituents (see Table 4-to the percentage of inventory accounted for (the ratio of calculated to inventory): those with no adsorption ($K_d$ = 0, i.e., nitrate, tritium, and $^{129}I$) have very high ratios; the other constituents ($^{60}Co$, $^{90}Sr$, and $^{137}Cs$) have progressively higher $K_d$s and lower ratios, i.e., less of the inventory having reached groundwater. (Only Plutonium is out of order in this relationship.) However, despite the apparent success of this semi-quantitative relationship, these data are not accurate enough to use for any more quantitative purposes, and their further use in this regard should not be pushed. |
| G5 | **General Comment:** We find the one major short-coming is the lack of data on the confined aquifer system. There is a marginally better understanding of the confined system in the 200-East as opposed to the 200-West Areas, but we are still concerned that the water quality and hydrogeology are poorly understood because of a lack of existing data. This AAMS report provides little information and makes only vague recommendations for further study in section 9.0. | Accept. See responses to General Comment 1 (Second Point) and General Comment 2. |
| G6 | **General Comment:** The supporting document "Hydrogeologic model for the 200 East Groundwater Aggregate Area" needs more detailed information to have a thorough knowledge on the model and the input data. | Reject. It is premature to expect that "detailed" and "thorough" knowledge is available. This knowledge will be developed to support modeling needs as they become clear during implementation. |

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| | **Technical Comments:** | |
| 1. | Plate 3<br><br>**Comment:** The designations for the monitoring wells located in the B Plant, Purex and Semiworks areas are too small-scale to assist in finding well locations. A scale twice or three times larger would be helpful. | Accept. The map of well locations will be changed to two maps as was done for the 200 West Groundwater Aggregate Area, with Plate 3a showing those wells in the 200 West Area and immediate vicinity, and Plate 3b showing those further afield. |
| 2. | Plate 4<br><br>**Comment:** While the screening process has given the plate a smoother appearance, there are approximately 30 values over 1000 that end up in lower value zones, thus creating the impression that the area of higher relative risk is smaller. The relative risk index area north of the 216-A-25 pond is larger and of higher values than shown. | Reject. The smoothing process was intended to show general trends and not necessarily every detail of the complicated RRI pattern. We do not think a complex figure is appropriate during this screening process for appreciating the general picture presented. |
| 3. | Section 1.2.1 Page 1-5, Lines 13-18<br><br>**Deficiency:** The 200 East Groundwater Aggregate Area boundary is not defined or shown on a figure. The boundary is not large enough to encompass the plume originating from the 200 East Operable Units.<br><br>**Recommendation:** Expand 200 East Groundwater Aggregate Area boundary to encompass Nitrate Gross Beta and Tritium Plume. Boundary should also contain organic compound plume to the Northeast of 200 East Area unless this plume will be addressed by another AAMS report. | Reject. The "boundary" of the 200 East Groundwater Aggregate Area is the extent to which contamination from the 200 East Area has spread in groundwater. As such it reaches the Columbia River. It is inappropriate to try to show this extent in Section 1.0 since the distribution of contamination has not been defined. |

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| 4. | Section 1.2.1 Page 1-5, Lines 24-27 and Figure 1-5<br><br>**Deficiency:** The relationship between the 200 East Area and isolated Operable Unit boundaries 200-IU-3, 200-IU-5, and 200-NO-1 is not explained. Groundwater beneath all of these operable units has been impacted.<br><br>**Recommendation:** Explain relationship. | Reject. Groundwater beneath the isolated Operable Units is included in the 200 East Groundwater Aggregated Area to the extent that it has been impacted by waste disposal in the 200 East Area. Effects of waste management units in those isolated Operable Units has not been included in this study, but will rather await RI/FS activities for those Operable Units. |
| 5. | Section 1.2.2, Page 1-7, Lines 9 and 11<br><br>Reference to 'Hydrologic Model' should be 'Hydrogeologic model.' | Reject. The titles used in Section 1.0 are prospective; minor changes made after the finalization of this Section cannot be included. |
| 6. | Section 2.2.1, First paragraph on Page 2-3<br><br>**Deficiency:** The text states that the 202-A Building resumed operations in November 1983 and is currently in standby mode.<br><br>**Recommendation:** State when the current standby mode began. | Accept. Text will be changed to state that the 202-A Building is still considered an active site. |
| 7. | Section 2.2.4 Page 2-4 Line 13<br><br>**Deficiency:** Reference is made to solid waste stored and sealed in the building. However, no discussion is made with respect to what that solid waste was in terms of volume or composition.<br><br>**Recommendation:** Research, document and define what solid waste is problematic at this location. | Accept. Text will state that the solid waste consists of boxes containing hoods and equipment used for the fabrication of fuels for the Plutonium Recycle Test Reactor (PRTR). |

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| 8. | Section 2.3 Page 2-4 Line 41<br><br>**Deficiency:** Reference is made to "Heads of Field Elements" determining the alpha-contaminated waste peculiar to this specific site which must be managed as a TRU waste.<br><br>**Recommendation:** What is the significance of heads of field and how do they fit in this process. | Reject. The definition of TRU waste in the text is from DOE Order 5820.2. "Heads of Field Elements" is from that definition. DOE Order 5820.2 is referenced in the text. |
| 9. | Section 2.3 Page 2-5 Lines 15-27<br><br>**Deficiency:** At this point in the AAMS, discussion is initiated regarding the unplanned releases that may have occurred in the 200 East Area and the potential sources in the existing and past waste management units. Reference is also made to Tables 2.1 through 2.6, which inventory the wastes and characteristics and volumes. However, in these tables there are numerous voids with respect to volumes of waste and character of waste that may have been released.<br><br>**Recommendation:** Research, document and discuss the character and volumes of these sources and, wherever possible, make reasonable estimates of the character and nature of releases that may have occurred. | Reject. The volume and character of the wastes has been researched to the extent practicable. The character and/or volumes of the sources is not known where it has been omitted on the table. It would be too speculative and beyond the scope of this AAMSR to attempt to make estimates. |

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| 10. | Section 2.3 Page 2-7, Lines 37-42; Page 2-8, Lines 1-12<br><br>**Deficiency:** This section discusses the potential for releases of contaminants to groundwater; however, there is no comprehensive summary or overview involving a volumetric or mass balance approach to estimating total contributions and therefore total potential impacts to the total groundwater regime.<br><br>**Recommendation:** Attempt a volumetric or mass balance assessment of the potential impacts and present in summary form. | Reject. See response to General Comment 4. We do not agree that these data are accurate enough to allow a substantive volumetric or mass balance to be performed. |
| 11. | Section 2.3 Page 2-8, Line 20<br><br>**Comment:** The carbon tetrachloride plume is in the 200 West Area. | Accept. "East" will be changed to "West" in text. |
| 12. | Section 2.3 Page 2-8, Lines 25-27<br><br>**Deficiency:** The "typical depth" from the bottom of the waste management unit is given from 164 to 230 feet, and yet a majority of the wells listed on Tables 2-9, 2-10, 2-24 and 2-25 are less than 164 feet or greater than 230 feet in depth.<br><br>**Recommendation:** Recalculate "typical depth." | Reject. The typical depth from the bottom of the waste management units to the water table is correct to the accuracy required. |

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| 13. | Section 2.3 Page 2-8, Paragraph beginning on line 39<br><br>**Comment:** We find that the selection process for defining sites with 'potential for migration of liquid discharges to the unconfined aquifer' sited in Table 2-2 could leave some contaminated sites out of the investigation phase that will follow this report.<br><br>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 ground water flow unless there is a history of at least 100,000 m of waste effluent dumped there. The criteria ignores the total cumulative impact of the numerous lower volume waste sites. the only justification for the selection of this limiting criteria is that it is 'one or tow orders of magnitude greater than the typical soil column pore volume estimates.'<br><br>An example of how this criteria will effect future investigations is Crib 215-A-21. This crib is shown in Table 2-1 as having received 77,900 m of mixed wastes (p. 2T-11). Table 2-2 lists 'No' as an answer to 'Significant impact on groundwater flow?' (p. 2T-2a).<br><br>The crib is also shown on Table 2-3 as having an elevated Gamma log response indicating contamination at least as deep as 45 meters below land surface (p. 2T-3a). The water table is at about 85-95 meters below land surface at that location (Hydrogeologic model supporting document, fig 3-1). | Reject. The criteria for further evaluation is not 100,000 $m^3$. Sites that received more than 100,000 $m^3$ are considered to have had a significant impact on groundwater flow. Sites that received greater than 100,000 $m^3$ may have caused localized changes in groundwater flow direction by creating a localized groundwater mound. Section 3.5.2.3.1 discusses that the cumulative effect of the waste disposal has altered groundwater flow in the 200 East Area. |

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| | The discharge from this crib may not in itself have had a significant influence on the flow system in the 200-East 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 numerical criteria. | |
| 14. | <u>Section 2.3 Page 2-8, Line 39 and Table 2.2</u><br><br>**Deficiency:** To be conservative, if the liquid effluent volume received and/or the soil column pore volume range is unknown, then a possible migration to the uppermost aquifer and an impact to groundwater quality should be assumed.<br><br>**Recommendation:** Change interpretation of screening process to follow above methodology. | Reject. Assuming all sites where there is a lack of effluent or pore volume data as having affected groundwater quality would be misleading. The methodology is designed to flag sites that are likely to have contaminated the groundwater. |

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| 15. | Section 2.3 Page 2-9 Lines 1-11<br><br>**Deficiency:** At this point discussion begins regarding the approximations of the relative importance of each site and their potential impact on groundwater flow. The estimates made involve total volumetric contribution to the groundwater system; however, no discussion occurs regarding the impact of the upgradient irrigation practices on the overall flow regime and the potential significance with respect to remediation alternatives. This is a subject that re-occurs as a deficiency throughout the document. The water table in the area has been elevated by as much as 50 feet, as referenced within this document. This indicates that, in terms of the overall flow regime, upgradient irrigation may be the most significant force in modifying the groundwater dynamic. Therefore, upgradient irrigation may have a very significant role to play in whatever remediation is finally selected.<br><br>**Recommendation:** Address this question in the report. | Reject. Upgradient irrigation is addressed in Section 3.5.2.3.1. |

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| 16. | Section 2.3 Page 2-9, Lines 5-7<br><br>**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.<br><br>**Recommendation:** Define the relationship between the quantity of contaminants discharged and the risks from the radionuclides discharged. | Reject. We do not believe that risk issues should be introduced at this point, but rather in Sections 4 and 5 as the report is presently constructed. The purpose of this screening is only to select those waste management units with evidence that they may have impacted the groundwater. |
| 17. | Section 2.3.1.3 Page 2-13, Lines 2-3<br><br>The phrases 'well did not receive' and 'volume it received' are contradictory. We suggest rewording the statement to read "volume of uncontaminated waste it received" to avoid any possible confusion. | Accept. The use of gross gamma logs for evaluating impact on groundwater is well qualified in the text. The headings in Tables 2-3 and 2-4 will be changed in order to place less emphasis on negative elevated gross gamma levels. The heading on Table 2-3 will be changed to "Confirms Release to Groundwater" and on Table 2-4 to "Confirmed by Geophysical Logs". |
| 18. | Section 2.3 Page 2-9, Lines 31-37<br><br>**Deficiency:** There is a poor correlation between the gross gamma logs and the quantity of reported radionuclides disposed of in each waste management unit.<br><br>**Recommendation:** Place less emphasis on negative elevated gross gamma levels. Evaluate effectiveness and document the existing gamma screening program. | Accept. Text will be rephrased as noted in response to comment number 17. See response to Comment 17. The existing gamma screening program is addressed in the Geophysical Field Characterization Report. |

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| 19. | Section 2.3.1.4. Page 2-13, Lines 19-25<br><br>Gross-gamma may indicate that gamma emitters are present but do not provide information that contamination is not present.<br><br>**Recommendation:** Modify the text accordingly. | Reject. The text does not state that contamination is not present. |
| 20. | Section 2.3.1.5 Page 2-13<br><br>Do any of the septic tanks drain from labs within 200 East Area? If so, provide the information. | Accept. WIDS reports that the septic tanks and drain fields in the PUREX Plant did not receive hazardous or radioactive waste. No change to the text is necessary. |
| 21. | Section 2.3.2.1 Page 2-16 Lines 8-10<br><br>**Deficiency:** This paragraph identifies the potential for impact to groundwater from releases from tanks but indicates it has not been evaluated using the vadose or pore volume approach. However, no discussion has been presented in terms of how it has been evaluated or if it has been evaluated.<br><br>**Recommendation:** How this issue has been addressed should be discussed, and if it has not been addressed, then it should be based on reasonable assumptions to quantify the relative significance of these potential releases. | Accept. The text states that the unplanned releases have not been evaluated using the pore volume calculation. The unplanned releases associated with the tanks were evaluated using the gross gamma geophysical logs from wells that monitor the tanks. The results of this evaluation are in the text. Any further evaluation would be highly speculative. Distribution of contaminants in the soil around the tanks has been identified as a data gap in the B Plant AAMSR. Future work plans for the B Plant area should address this data gap. The "No" in column 4 of Table 2-3 and in columns 4 and 5 of Table 2-4 will be footnoted when gross gamma logs indicate that gamma emitting radionuclides have penetrated into the vadose zone beyond the bottom of monitoring wells that do not extend to groundwater. |

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| 22. | Section 2.3.2.9 Page 2-20 Lines 15-21<br><br>**Deficiency:** Discussion is presented about contaminants that may migrate from the burial grounds. However, there is no discussion regarding what potential contaminants might be released or what measures are being taken to prevent future problems from arising.<br><br>**Recommendation:** Discuss this issue further as appropriate. | Reject. The purpose of Section 2.3 is to screen potential sources of groundwater contamination. The text discusses why the burial grounds are considered to have low potential as a source of groundwater contamination. Further discussion of the contaminants in the landfill and measures being taken to prevent future problems is beyond the scope of this groundwater AAMSR. |
| 23. | Section 2.3.3.5 Page 2-22 Lines 1-3<br><br>**Deficiency:** Reference is made to the volume of wastes discharged to septic tanks not being known, and impact on groundwater not being possible to determine.<br><br>**Recommendation:** Examining the source of wastes going to the septic tanks, attempt reasonable estimates using reasonable assumptions to establish the relative significance or insignificance of these potential releases and need for further study. | Reject. Assumptions on waste volumes is not within the scope of this report. The text does state that no radioactive or hazardous wastes are reported as being discharged to these septic tanks. Text will also state that these septic tanks received sanitary waste. |
| 24. | Section 2.3.4.8 Page 2-23, line 32 and Table 2T-1-tt<br><br>**Deficiency:** The history of the unknown releases is given in the 200 North report, Section 4.1.2.10, page 4-10. | Reject. Page 4-10 in the 200 North AAMSR describes only the location of these unplanned releases. The report does not describe the history of the unplanned releases. |
| 25. | Section 2.4, First paragraph on page 2-24<br><br>**Deficiency:** In line 2 the report states that the natural recharge in Hanford is "low" without stating what the natural recharge actually is.<br><br>**Recommendation:** Describe the natural recharge in the 200 E area. | Accept. Reference to Section 3.5.2.2.1 will be added to the text. |

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| 26. | Section 2.4.1.1 Page 2-25 Lines 16-18<br><br>**Deficiency:** Reference is made to the building and five liquid effluent streams identified. However, no significant discussion is provided regarding the character and significance of these waste streams and their release potential or impact. Same comment applies to the following sections.<br><br>**Recommendation:** Characterize the significance of these waste streams and present discussion. | Reject. Text does describe the liquid effluent streams and states which waste management units these streams were disposed to. In addition, Table 2-1 provides information on the source of wastes received by each unit. Table 4-5 also summarizes the waste producing processes that potentially contributed contaminants to the groundwater. |
| 27. | Section 2.5 Page 2-44 Lines 17-26<br><br>**Deficiency:** This paragraph discusses the need for future investigation and evaluation of groundwater beneath the 200 East and 200 North Areas.<br><br>**Recommendation:** A detailed investigation of the kind recommended should take place. However, it should address specifically the relationship between the deeper confined aquifer system and the shallow unconfined aquifer system. Although these two systems are discussed throughout this document, their relationship is not well conceptualized with respect to either flow regime or contaminant transport. As contamination has already been documented in the deeper confined aquifer, it is important to establish what this relationship is and address it as remedial alternatives are evaluated. Furthermore, it is important to understand the impact of the irrigation practices upgradient on this system, as this may also play into evaluation of the final remedial options. | Accept. The investigation recommended will be addressed by the GW-OU-3 and GW-OU-4 Work Plans. However, irrigation practices may be better addressed on an aggregate area scale. |

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| 28. | Section 2.5 Page 2-44, lines 19-23<br><br>**Deficiency:** The area covered is not large enough to address the groundwater contamination originating from facilities in the 200 East and 200 North areas. This is shown in Figures 4-7, Gross Beta; 4-3, Tritium; and 4-13, Iodine 129. | Accept. The 200 East AAMS covers the entire area of the plumes emanating from the 200 East and 200 North Areas. "Slightly" will be deleted from "slightly larger" in the text to emphasize that the 200 East AAMS covers a much larger area than just the 200 North and 200 East Areas.<br><br>However, the study area cannot be delineated at this point in the report because the extent of the plumes has not been presented. |

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| 29. | Section 2.8 - Groundwater Monitoring Facilities<br><br>**Deficiency:** Equivalent to comments on the 200 West Area Report, the description of the present groundwater monitoring and groundwater monitoring networks could be improved. It is not clearly stated why there are so many different networks operating, nor what the specific purpose of each is. Is it envisioned that this multiplicity will be maintained, or will consolidation occur? This is briefly addressed, but not carried to any conclusion.<br><br>**Recommendation:** A figure and/or a tabular listing that correlated monitoring network with wells would be useful. At present, the wells are all identified and shown on a figure, and the networks are identified, but which wells go with which network is not defined.<br><br>**Comment:** Another concern related to the existing groundwater monitoring is the variation in the construction of the monitoring wells and the apparent lack of reliable information as to the condition of many of the older wells. Uncertainties regarding well construction/condition cast further doubt on what is already a limited characterization of the vertical distribution of contamination within the unconfined and confined aquifer systems within the 200 East Area. | Accept. A tabular table listing of all monitoring wells and their associated networks has been prepared and included in Appendix A.<br><br>Reject. Pages 2-51 and 2-52 provide a detailed discussion regarding the most current available data regarding well design, fitness, and remediation. |
| 30. | Figure 2-12 Page 2F-12<br><br>This figure needs an explanation of the contour interval and line representing the contours. Also, is there sufficient accuracy in the well casing altitudes to have confidence in contouring to +/- 0.2 feet? | Accept. The legend on this figure will be updated to include a description of the contours and contour intervals. The figure was taken from DOE/RL-92-03, Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities in 1991. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 31. | Table 2.1 Page 2T-1a, Table 2.2, Page 2T-2a<br><br>**Deficiency:** This table summarizes waste management units in the 200 East Area. There are entries in this table which indicate that liquid wastes were discharged to the soil. There is no discussion of waste volumes and character discharged to the soil. Therefore it is difficult to utilize the table to evaluate the impact or relative significance of each of these waste management units. Table 2.2 then follows with an assessment of significant potential impact on groundwater flow from each of these sources. It would be helpful to have a summary of the estimated volumetric and environmental significance involving the discharges. Furthermore, no discussion has been presented in Table 2.2 regarding the basis for determining a significant impact.<br><br>**Recommendation:** Expand Table 2.1 to address this deficiency and to apply reasonable assumptions for estimating the range of potential impacts for those waste management units. Discuss the basis for determining significant impact. | Reject. Table 2-1 does include a description of the waste received by the waste management units, and it does list the volume of effluent when known. Table 2-2 does have volumes listed for liquid effluent received by the soil, and it indicates which possibly had waste migrate to groundwater (column 4). The basis for determining significant impact on groundwater flow is discussed in the text, and the column heading is footnoted. The footnote and text state the criteria for a "Yes" in the column. |
| 32. | Table 2-2<br><br>**Comment:** The soil column pore volume calculation is not applied to tank leaks because the area of the leak cannot be determined.<br><br>**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. | Reject. Using an arbitrarily small area would add an additional assumption that may be misleading in evaluating the unplanned releases. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 33. | Table 2-2<br><br>**Comment:** A number of assumptions are made in developing Table 2-2. These are:<br><br>o Assumed soil porosity(s)<br>o Assumed groundwater depth of 164 feet<br>o Soil acts as a homogenous column (homogenous permeability of soil)<br>o One-dimensional flow (no lateral flow)<br>o Liquid effluent volume accurate<br>o Area for infiltration equal to the dimension of the base of crib, trench, tile field, drain, or well<br><br>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).<br><br>**Recommendation:** That the wording in Column 5 be changed to "relative potential impact on groundwater flow." | Reject. Using the heading "Relative potential impact on groundwater flow" would imply that the units be ranked. Ranking of units would be pushing the screening beyond its capability or usefulness. |
| 34. | Table 2-2<br><br>**Deficiency:** Since ditches 216-B-2-3 and 216-B-3-3 that transferred liquid effluent to the ponds are unlined, 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.<br><br>**Recommendation:** When the effluent amount is undetermined, possible migration to aquifer and a significant impact should be assumed. | Accept. 216-B-2-3 and 216-B-3-3 will be changed to "Yes" with a footnote indicating that even though the volume for each ditch was not determined , the volume was probably great enough to receive a "Yes". |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 35. | Table 2-3<br><br>**Deficiency:** Fourteen sets of wells indicated an elevated gamma log response extending deeper than the well, yet the table indicates no evidence of release to groundwater. If the depth to the bottom of contamination is not known, then it should be assumed that there was a release to groundwater. | Accept. Gross gamma logs were used to confirm the release to groundwater (see response to Comment 17). If the monitoring wells do not extend to groundwater, this method cannot confirm releases to the groundwater. A "No" will still be entered in the table but footnotes will be added to any "No" when gross gamma logs indicate that gamma emitting radionuclides have penetrated into the vadose zone beyond the bottom of monitoring wells that do not extend to groundwater. |
| 36. | Table 2-3 Page 2T-3a (ff)<br><br>It would be helpful to the reader to provide the depth to water table in a column added next to the 'Elevated Gamma Log Response' column. This would allow direct comparison of depth of indicated contamination and depth to water table, a comparison difficult for the reader to do otherwise. | Accept. Column will be added to Table 2-3 indicating depth to groundwater. |
| 37. | Table 2-3<br><br>We have evidence of groundwater contamination from units such as B-Pond, all the ditches and significant number of all the active disposal sites which have been overlooked in this table. | Reject. The 216-B-3 Pond System and other units have not been overlooked. This table does not indicate that the units did not contaminate groundwater. The column heading will be changed to clarify this (see response to Comment 17). Gross gamma logging will only confirm releases when the monitoring well(s) intersect a zone where gamma emitting radionuclides have reached groundwater. Any non gamma emitting contaminants would not be detected. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 38. | Table 2-4 Page 2T-4d<br><br>Section 2.3.1.6 (page 2-14, lines 7 through 11) states that the liquid volume for the unplanned release associated with 241-A-151 diversion box is not known and that the areas covered by the unplanned releases associated with 241-C-152 and 241-CR-151 are not known. Therefore, the potential for liquid reaching the groundwater is not known. On Table 2-4, however, the screening for these three diversion boxes indicates there is no potential for these sources to contribute contaminants to the groundwater. Table 2-4 should be revised to indicate that the potential for groundwater contamination from these sources is unknown. | Accept. The heading of column 5 of Table 2-4 will be changed to "Criteria Indicates Possible Contribution to the Uppermost Aquifer". |
| 39. | Table 2-4 Page 2T-4d and Page 2T-4e<br><br>Geophysical logs were reviewed for the 241-B, 241-BX and 241-BY tank farms to evaluate the potential for migration of gamma-emitting radionuclides to groundwater from unplanned releases from these facilities. Section 2.3.2.1 (page 2-16, lines 5 through 34) states that the areas of unplanned releases associated with the following B-plant aggregate area tanks are unknown: 241-B-107,241-B-110,241-B-203,241-BX-102,241-BX-103,241-BX-108, and 241-BY-108. The text states, therefore, that the potential impact to groundwater from these source areas could not be evaluated, and that because of the limited depths of the wells, the possibility that gamma-emitting radionuclides may have reached the groundwater can neither be ruled out nor confirmed. | Accept. See responses to comments 21 and 38. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 40. | Table 2.6 Page 2T-6f<br><br>**Deficiency:** This is the final page of Table 2.6, which is the chemical waste inventory summary for units potentially contributing contaminants to groundwater. It is difficult to assess from this table and the preceding tables what the total cumulative impact is within each of the aggregate areas or operable units being considered. It is therefore difficult to view these data from the perspective of understanding the overall cause/effect relationships and their significance with respect to potential future remedial actions.<br><br>**Recommendation:** Expand the discussion to address these issues. | Reject. Section 2 and Table 2-6 address the waste management units on an individual basis. Section 4.1.2 addresses the issues raised in this comment in conjunction with the contaminant plumes. |
| 41. | Tables 2-9, 2-10, 2-24, and 2-25<br><br>**Deficiency:** The depth of screened interval and formation within which the well is screened does not correlate between tables.<br><br>Discrepancies are as follows: (Attachment 1) | Accept. Tables will be corrected and discrepancies deleted. |
| 42. | Table 2.24 and Table 2.25 Pages 2T-24a and 2T-25a<br><br>**Deficiency:** Two of the groundwater monitoring networks are discussed in these tables, the CERCLA Network and PNL Network. However, as noted previously, there is no discussion of how these networks are utilized.<br><br>**Recommendation:** Expand that discussion accordingly. | Reject. Program descriptions for both the Pacific Northwest Laboratories (PNL) and the CERCLA networks are provided in Sections 2.8.3 and 2.8.4. A reference to these sections will be included on Tables 2-24 and 2-25. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 43. | Section 3.4.1.3 First paragraph in the section, Page 3-9<br><br>**Comment:** Two recent earthquakes occurred near Walla Walla. The first was a magnitude 4 on November 27, 1991, and the second was a Magnitude 3 in December 15, 1991.<br><br>**Recommendation:** Include these references in the text. | Accept. The recent earthquake information will be added. |
| 44. | Section 3.4.2 Page 3-10 Lines 35-38<br><br>**Deficiency:** At this point the linkage between the upper and lower aquifer systems has been established and discussion limited to the fact linkage appears to be only in localized areas. However, as contamination in the deeper aquifer system has been documented, the significance of contamination entering the deeper aquifer system and then its movement within that deeper system needs to be clearly addressed and understood.<br><br>**Recommendation:** Address this issue in the subsequent phases of work and throughout this document. | Accept. The vertical extent of contaminant plumes is highlighted as a data gap in Section 8.2.3, and is addressed as part of the plume nature and extent investigation described in Section 8.3.3.1. This investigation is part of more detailed follow-on work planned in the 200 East Groundwater Aggregate Area. |
| 45. | Section 3.4.2 Page 3-11 Line 4<br><br>**Deficiency:** The interconnection between the confined and unconfined aquifers is only partially addressed. Page 3-11, paragraph beginning on line 4, states that nitrate, tritium and beta radiation have been detected in the confined (Rattle Snake Mountain) aquifer. Line 12 of the same page states that "previous investigations have not determined "how leaky" basalt intraflow and structures such as faults and erosional windows may be." These comments are presented in the context of providing justification for the discussion on site stratigraphy. | Reject. The text discussion of secondary fracturing in basalt relied upon available information from the supporting documents cited. Secondary fracture data for the Elephant Mountain flow is limited to a few drill hole intercepts in the 200 East Groundwater Aggregate Area. Mention of secondary fracturing as a possible migration pathway in Sections 3.5.1.6.3 and 3.5.2.6.3 is therefore speculative. Detailed descriptions of fracture spacing, penetration, association with other geologic structures are not available for the area, and represent a data gap. The latter point will be clarified in |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | A reasonable discussion is presented on the role of faults and associated brecciated zones as potential conduits into the confined aquifer (section 3.4.3.4). The erosional window in the basalts near Gable Gap and potential interconnection with interbeds of the Ellensburg Formation (confined aquifer) is discussed on page 3-36 on line 34 for the 200 East Area. However, mention of secondary fracture porosity within the folded basalts is only mentioned in passing as a possible groundwater migration path into the confined aquifer on page 3-42 line 30. On page 3-61, Connelly et al. (1992a) is referenced as suggesting that a well developed fracture system in the Elephant Mountain basalt could provide intercommunication between the confined and unconfined aquifers. **Recommendation:** A discussion of secondary fractures in the basalt unit should be included in section 3.4.3.4. This section should include data on fracture spacing, notes on whether the fractures are partially or fully penetrating, and the association of fractures with structural domains, i.e., fold limbs, anticlinal crests, etc. The role of these fractures and estimated leakage should be incorporated in greater detail in section 3.5.2.3.3, Unconfined/Basalt Aquifer Intercommunication. | Section 3.4.3.2 (structures between Gable Mountain the 200 East Area - Elephant Mountain fracture zone), and will also be noted Section 8.3.2 (data gap related to hydraulic interconnections with confined aquifers). Also, the referenced text from Connelly et al. (1992a) describes a specific location in the northeast corner of the 200 East Area. Secondary fracturing will be assessed during follow-up site assessment activities. |
| 46. | <u>Section 3.4.2 Page 3-11, line 7</u><br><br>**Comment:** Detected instead of deferred. | Accept. "Deferred" will be corrected to "detected." |
| 47. | <u>Section 3.4.3 Page 3-21, Line 34 and Section 3.4.3.2 Page 3-22, Line 18</u><br><br>Folds are aligned 'en echelon' not 'an echelon.'<br><br>Supporting Document<br><br>Hydrogeologic Model for the 200 East Groundwater Aggregate Area. | Accept. "An echelon" will be corrected to "en echelon." |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 48. | Section 3.4.4 Page 3-24<br><br>The short discussion here about the geology of the basalt points out the lack of data concerning the stratigraphy and structure of the Columbia River Basalt Group in the area. Elsewhere in this report similarly short discussions of water quality, hydraulic characteristics, and water levels in confined aquifers (including the Columbia River Basalt Group) show a similar lack of data. A strong data collection program for the confined aquifers is needed and should be so noted in SECTIONS 8.0 and 9.0. | Accept. Data gaps related to hydraulic properties, stratigraphy, and water quality (e.g. chemical contamination) data are discussed in Section 8.0. A general comment describing data gaps related to stratigraphic, hydraulic characteristics for deeper aquifers (and referencing Section 8.0) will be added to Chapter 3.0. |
| 49. | Section 3.5.1.2 Third paragraph on page 3-33<br><br>**Deficiency:** The section discusses the upper aquifer system, and states that it has characteristics of an unconfined aquifer with locally confined or semiconfined conditions. The section then describes what appear to be perched conditions because "the water level typically falls below the elevation of the carbonate rich layer as drilling progresses deeper."<br><br>**Recommendation:** Expand the discussion to explain this apparent inconsistency. | Reject. The description of the confining condition for the Ringold E gravels north of the 200 West Area is correct as written, and is based on the borehole data described. These data do not indicate a potential perching condition because groundwater was encountered below the (confining) carbonate-rich horizon, not above. |
| 50. | Section 3.5.1.2.1, Page 3-35 Top paragraph on page<br><br>**Deficiency:** The report states " ...aquifer tests conducted using clustered piezometers in the same borehole may not represent true aquifer responses because of potential hydraulic intercommunication of the tested zones".<br><br>**Recommendation:** State which aquifer tests may be non-representative of the true conditions, make adjustments that may be necessary, and modify table 3-2 as required. | Accept. The information will be checked from Newcomer et al. (1992a), and wells with suspected intercommunication noted on Table A-9 and in the text. Table 3-1 will be modified if necessary. Table 3-2 would not be affected, however. Also, the Newcomer et al. (1992a) reference will be added to Table A-9. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 51. | Section 3.5.1.5.1 Page 3-39, lines 29-32<br><br>**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.<br><br>**Recommendation:** State if water is natural groundwater or is contaminated. | Accept. The sentences that discuss high moisture content in the vadose zone encountered near the single-shell tanks in the 200 West Area will be deleted because it is uncertain whether or not this moisture is the result of natural or artificial recharge. |
| 52. | Section 3.5.1.5.2 Page 3-41 Lines 4-9<br><br>**Deficiency:** While there is some discussion of the artificial groundwater recharge contribution from irrigation, it is not quantified with respect to the flow regime and the Hanford flow system. The impact of controlling this in conjunction with other potential remedial options is not discussed in the context of relative hydraulic significance, or its significance with respect to the impact of the volume of waste discharged from the Hanford site.<br><br>**Recommendation:** Evaluate that significance and discuss in the context of this document. | Reject. Insufficient information exists regarding irrigation recharge and its relative influence on the Hanford groundwater regime to assess its significance. A data gap (Section 8.2.3, p. 8-24, lines 5-9) has been identified to address this gap. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 53. | Section 3.5.1.2.1 Page 3-35, Lines 21 (ff)<br><br>The ranges of values for hydraulic conductivity (HC) and transmissivity (T) for the Hanford formation and the Ringold E are generally consistent with the values presented in Tables 3-1, A-8, and A-9. One exception is the upper end of the HC range for the Ringold, either it is 2E-3 m/s (text) or 2E-2 m/s (table), one value, is wrong. This may account for the discrepancy (units conversion), in Table 3-1, where the upper range for the HC for the Ringold is noted as 2.1E-2 ,/s, and the equivalent value in ft/d is shown incorrectly as 600. It should be 6,000 ft/d.<br><br>Also in Table 3-1, the maximum T for the Unconfined Aquifer for the 200-East Area is 670,000 ft/d and maximum HC is 1,140 ft/d. If the maximum T and maximum HC occur in the same well this indicates a saturated thickness of 588 ft. If the maximum T occurs at a well where the HC is less than the maximum value, this indicates a larger saturated thickness. Figure 3-46 indicates a maximum thickness of 80 m (262 ft). Resolve this discrepancy.<br><br>In Table 3-1 the units for T are m/d, in the text they are m/s, make them consistent. | Accept. Typo for Ringold Formation k value will be corrected on Table 3-1 from $2.1 \times 10^{-2}$ to $2.1 \times 10^{-3}$ m/s.<br><br>T and k values will be corrected on Table 3-1 to 600,000 $ft^2$/day and 25,000 ft/day, respectively. This agrees with data presented by Connelly et al. (1992a) and with saturated thickness shown on Figure 3-46.<br><br>T units in text will converted to $m^2$/day. |
| 54. | Section 3.5.1.5.1 Page 3-38, Line 39<br><br>The amount of 'natural recharge' listed here for the 200-West Area is 130,000 L/yr, later (p.3-51, line 38) it is stated that the recharge for the 200-East Area is '19 million L/yr.' Why is there such a large difference between areas that have similar soils, rainfall, and vegetation? | Reject. The value on page 3-38 is from Gee 1987; the value listed on page 3-51 is an estimate based on 0.1 cm/yr precipitation recharge. Natural recharge rates may be much lower than the estimate calculated on 3-51. The lysimeter study by Routson and Johnson (1990) supports this. The text presents the differing values that have been reached in previous reports. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 55. | Section 3.5.1.6.1 Page 3-42 Lines 12-19<br><br>**Deficiency:** This paragraph discusses relative hydraulic gradients based on historical observations, it would seem that this information could be utilized to estimate total volumes of waste contributed. The relative significance with respect to the volume of releases and remedial options could then be estimated.<br><br>**Recommendation:** Examine the potential for utilizing this historical data to estimate volumes of contribution. | Accept. This information may be used in the calibration of groundwater flow models, in subsequent studies, to back-calculate and derive and estimate of site discharges. This calculation is too complicated, and the data on which it would be based too uncertain, to be carried out in the groundwater AAMS. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 56. | Section 3.5.2.1.2 Page 3-46 Line 19<br><br>**Deficiency:** Figure 3-50 presents a contour map of hydraulic conductivities at the site. On page 3-46, line 19, it is stated that the map represents aquifer pump test results as reported by Connelly et al. (1992a) and the pump test results were analyzed using the Cooper-Jacob straight line method. This paragraph further explains that hydraulic conductivity values obtained from slug tests in the area appeared "much lower" when compared to pumping test data. Several reasons are then listed on lines 26 through 29 that discount the slug tests. However, potential shortcomings of the pump test are not addressed. It is likely that a delayed yield response would be exhibited on the time-drawdown plots of this data. If the delayed yield portion of the curve was analyzed using the Cooper-Jacob straight line method the calculated hydraulic conductivity would be greater than the true hydraulic conductivity.<br><br>**Recommendation:** Section 3.5.2.1.2, Uppermost Aquifer System, should address this possibility and provide an evaluation of the analyses performed by Connelly (1992a). In addition, the test methods used to analyzed the pump test data and the duration of the test should be specified in Appendix A, Table A-9. | ACCEPT. Limitations of pump tests will be added to the text. These limitations are discussed on p.3-10 of WHC 1992 (Hydrogeologic Model for the 200 East Groundwater Aggregate Area) and are as follows: "The majority of the constant discharge/recovery pumping tests were single-well tests using partially penetrating wells, and therefore little information on storage properties for the uppermost aquifer were obtained. Limitations of single-well pumping tests and pumping tests in general include pump influence, well losses, partial penetration, and borehole storage." |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 57. | Section 3.5.2.1.2 Page 3-46, line 8 (ff)<br><br>The stated upper hydraulic conductivity value of 2500 ft/d is inconsistent with the referenced table (3-1). Later in this paragraph Tables A-8 and A-9 are cited as the 'original data tables,' Table 3-1 is inconsistent with the data on transmissivity in those tables. For example, the maximum T on Table A-8 is 600,000, on Table A-9 it is 694,000, and on Table 3-1 is 670,000. determine the proper value and make the text and tables consistent. | Accept. Tables will be checked for consistency and Table 3-1 (and applicable text) revised where appropriate. Text and table will be corrected to list upper k value of 25,000 ft/day from Connelly et al. (1992a); see response to Comment 53. Tables A-8 and A-9 reflect published WHC data; Table A-9 (Newcomer et al. 1992a) represents the original data source from which data in Table A-8 were derived (in part). Table A-9 will, therefore, be used where discrepancies with Table A-8 exist. |
| 58. | Section 3.5.2.1.2, Third paragraph on page 3-47<br><br>**Deficiency:** The water table elevations that are referenced to be shown on Figure 3-50 are really shown on Figure 3-49.<br><br>**Recommendation:** Correct the reference. | Accept. Figure reference will be corrected to Figure 3-49. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 59. | Section 3.5.2.1.3<br><br>**General Comments:** This section discusses unsaturated conductivity and unsaturated flow. In addition, conductivity curves for various Hanford soils are presented. It is not clear how this data is going to be used.<br><br>The quantitative description of water flow through porous media is briefly discussed in Chapter 3. Utilizing the Richards equation and its refinements has resulted in a substantial technology in measuring and predicting water content and movement under controlled laboratory conditions. However, it is increasingly apparent that under field conditions, problems of spatial variability of flow properties and non-homogeneity of the porous media preclude the direct application of classical techniques. Of special concern is the rapid transfer of water and solutes in soils even under unsaturated conditions. Such rapid flow is ascribed to the presence of preferential flow pathways (macropores). Such preferential flow pathways may be pores formed from soil fauna, plant roots, cracks, and fissures. Regardless of the source, there is substantial evidence that in some soils water and solutes can be transported rapidly downward, even under unsaturated conditions. Thus, not all soils behave according to "classical" concepts. It is recommended that the effects of spatial variability and macroporosity (macropores contribute to spatial variability of many soil-water properties) be considered when monitoring soils and when developing contaminant fate models. | Accept. A statement will be added to indicate that vadose zone hydraulic properties are an important factor when considering vadose zone liquid transport and recharge.<br><br>Vadose zone transport issues, including contaminant fate and transport are anticipated to be addressed in further detail as part of future 200 East source area work plans. Data gathered from these studies will be assessed with respect to "classical," predictive transport models such as those utilizing Richard's equation. Where discrepancies with the predictive models occur, macropores will be considered as a plausible explanation of the "non classical" behavior observed. However, it is unlikely that actual field-scale tests to evaluate the spatial variability of soil hydraulic properties due to macroporosity will be feasible. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 60. | Section 3.5.2.2.1 Page 3-51<br><br>**Deficiency:** A great deal of quantitative information is presented on recharge to the upper unconfined aquifer, both natural and artificial, in sections 3.5.2.2.1 and 3.5.2.2.2 on pages 3-51 and 3-52. However, there are no estimates of groundwater discharge rates.<br><br>**Recommendation:** Estimates of aquifer discharge and leakage to the underlying confined aquifer should be made. This data should be presented in a water balance for the 200 East Area. | Reject. Because of the complexity of the hydrogeologic system and the uncertainties of the data involved, we do not believe that a mass balance should be attempted in the AAMSR. |
| 61. | Section 3.5.2.2.2 Page 3-52, Paragraph beginning on line 39<br><br>The per day value does not match the historic total value. 97,650 L/day for 1951 to 1991 is about 1.5 billion: not 720 million as is in the text. Explain the calculation in more detail or correct the error. | Accept. Paragraph will be altered to clarify that the total volume received by the drain fields is estimated to be 1.35 billion liters based on WIDS data in Table 2-1. |
| 62. | Section 3.5.2.2.2 Pages 3-52..53<br><br>**Deficiency:** This section discusses artificial recharge characteristics from the various facilities within the area. However, there is no comparison made of these volumes and the irrigation volumes. In addition, there is no discussion of the relative regional hydraulic significance associated with these volumes.<br><br>**Recommendation:** Evaluate this and make relative comparisons. It appears that several million gallons of wastes have been contributed from the waste management units with major quality impacts. Billions of gallons have likely been contributed from the irrigation practices with major impacts on hydraulic character and potential for hydraulic control of the existing groundwater plumes. | Reject. See response to Comment 52. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 63. | Section 3.5.2.3.1 Page 3-55 Lines 27-32<br><br>**Deficiency:** This section discusses well hydrographs and Figures 3-63 through 3-66, showing the response of specific wells with respect to wastewater discharges. No discussion is presented with respect to the long-term impacts of overall recharge on the total flow regime.<br><br>**Recommendation:** Examine these hydrographs from that perspective and discuss. | Reject. Current groundwater flow conditions as well as a projection of future trends in groundwater flow are provided in Section 3.5.2.3.1, *Current Groundwater Flow*. |
| 64. | Section 3.5.2.3.1 Page 3-60 Lines 36-42<br><br>**Deficiency:** Recognition is given to the elevated water levels associated with irrigation. However, with the termination of artificial discharge from waste management units, no discussion is given to the relative importance of this elevation due to irrigation as it relates to potential remedial alternatives.<br><br>**Recommendation:** Address this issue in more detail. | Reject. See response to Comments 52 and 62. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 65. | Section 3.5.2.3.2 Page 3-61 Line 18<br><br>**Deficiency:** Groundwater contour diagram for the confined aquifer (Rattlesnake Ridge interbed) is shown in Figure 3-68. Page 3-61 line 18 states that this figure shows "the most complete groundwater levels" for this aquifer. This is an important figure as it addresses the areas of vertical gradients. However, none of the well locations used to generate the contours are shown on the figure.<br><br>**Recommendation:** This diagram should be enlarged and reconstructed to show well locations. The static water elevation should also be posted next to each well symbol. Differentiate between the shallow and deep aquifers for each well location on this diagram. | Reject. Contours used to generate this map were obtained from Jackson et al. (1992). Data are not available for posting well locations and head data. |
| 66. | Section 3.5.2.3.2 Page 3-62, Paragraph beginning on line 10<br><br>Throughout this report it is stated that the ground water 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 this discussion about the connection between the unconfined and the confined aquifers, a report (Ledgerwood and Deju, 1976) is cited. 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. Specific recommendations should appear in section 9.0 (and in more detail in subsequent work plan reports) detailing what data to collect. | Accept. More current data are needed regarding groundwater properties, although more because of improvements in methodology than because the groundwater system has physically changed very much. Addressing this data gap is discussed in Section 8.3.3.2. No change required to AAMSR. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 67. | Section 3.6.2 Page 3-68, Lines 23-24<br><br>**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.<br><br>**Recommendation:** Remove paragraph. | Accept. Referenced sentence will be deleted from text. |
| 68. | Figure 3-44<br><br>**Deficiency:** The contour interval on the map is 5 feet, not 10 feet as stated in the legend. Also in the bottom of the figure, one of the wells between the 400 and 405 foot contours is listed as having an elevation of 304.33 feet.<br><br>**Recommendation:** Correct errors in Figure 3-44. | Accept. Figure will be corrected. |
| 69. | Figure 3-49<br><br>**Deficiency:** 200 North Area is not shown.<br><br>**Recommendation:** Place 200 North Area boundary on figure. | Accept. 200 North Area Boundary will be placed on Figure 3-49. |
| 70. | Figure 3-61<br><br>**Deficiency:** 405 Contour between Gable Butte and Gable Mountain is missing.<br><br>**Recommendation:** Place 405 Contour on figure. | Accept. 405 foot contour will be added to Figure. |
| 71. | Figure 3-63<br><br>**Comment:** Figure for Well 299-E25-1 is missing on well location map. | Accept. Well Location for 299-E25-1 has been added to the location map. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 72. | Section 3.0 Figures 3-63 to 3-66<br><br>A bar graph showing estimated water disposal rates would be superior to the history of operation. Some processes must have generated more or less waste water than others and varied discharges through time, this information would help the reader to understand the fluctuations in the well hydrographs. | Reject. Available information is insufficient to derive a detailed history of discharge from each waste management unit. |
| 73. | Table 3-2 Page 3T-2<br><br>Well 699-54-57 is finished in the Rattlesnake Ridge aquifer and water levels in that well and an adjacent well indicate an upward gradient and flow of ground water. In Table 4-2 (p. 4T-2C) water-quality data indicates that this well yields contaminated water; we find no explanation anywhere in the text of the contamination in this well. This is another example of the lack of information concerning the confined aquifer. | Reject. Water quality data for Well 699-54-57 listed on Table 4-2 supports Section 4.1 vertical contamination discussions: Section 4.1.1.7.7. Tritium; 4.1.1.7.9; Strontium-90; and 4.1.1.7.10 Technetium-99. There is not a direct relationship between this information and data presented in Table 3-2 or Section 3.0 text. |
| 74. | Section 4.0 Page 4-1, lines 13-18<br><br>**Deficiency:** Section 1.2.2 discussed air and biota as affected media. However, atmosphere and biota are not addressed in this section as potentially affected media.<br><br>**Recommendation:** Include both as potential media. | Accept. "...and vegetation." will be replaced with "...vegetation, atmosphere, and biota." |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 75. | Section 4.1<br><br>**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.<br><br>**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 East Area. | Reject. It is unlikely for a significant unidentified source area to exist without reference in the historical record. Although there are gaps in the historical record, there is enough information to suggest that a substantial hypothetical unidentified source area does not exist. In addition, although well coverage may be sparse in some areas, if a large source area did exist, there would likely be some indication in the groundwater. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 76. | Section 4.1.1.1 Second Paragraph in the Section, Page 4-2<br><br>**Comment:** The report states that "A detailed evaluation determining the aquifer in which wells are screened in has been started (Ledgerwood 1992)." In the following sentence, the authors state that this has been essentially completed for the 200 East Area report. If this is true, then why is the Ledgerwood study mentioned, and if not why wasn't a detailed evaluation made.<br><br>**Recommendation:** Clarify which of the above scenarios is true. | Accept. The sentence referring to Ledgerwood will be deleted. This will clarify that the unit at which wells are screened was determined using the data of Lindsey et al. (1992) and Connelly et al. (1992a) |
| 77. | Section 4.1.1.2 Page 4-3 Lines 39-40 and Table 4-3<br><br>**Deficiency:** In many cases, the background values for the inorganics in the groundwater are given as the detection limit in Table 4-3. For most of the inorganics, these detection limit values are at least one order of magnitude higher than available with EPA method 200.8, which uses Inductively Coupled Plasma Mass Spectrometry (ICP/MS) rather than the ICP Emission Spectrometry method 6010 noted in Table 8-4. ICP/MS on low ionic strength samples such as groundwater is proven, simple, reliable, and with much lower detection limits at the same cost per sample.<br><br>Background measurements using methods with analytical detection limits above sample concentrations when other cost effective methods are available and appropriate is unacceptable as a data quality objective. | Accept. Use of other methodologies such as EPA method 200.8 appears to be appropriate to promote in future work plan development. No change to AAMSR. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 78. | Section 4.1.1.2 Page 4-4 Lines 24-27<br><br>**Deficiency:** At this point the relationship between the uppermost aquifer system and the basalt system is characterized as "modest basalt rock water interaction." However, elsewhere in the report the presence of contamination having arrived in the deeper basalt has been acknowledged and recognition given to the interconnection.<br><br>**Recommendation:** Evaluate more thoroughly this relationship and discuss in the report. | Reject. The "modest basalt rock water interaction" is geochemical. Hydrogeologic effects may be more significant but that is not the issue here. |
| 79. | Section 4.1.1.6 Pages 4-6, Line 28<br><br>Is this $^{106}Ru$ instead of $^{106}Rb$? Clarify. | Accept. "$^{106}Rb$" will be replaced with "$^{106}Ru$". |
| 80. | Section 4.1.1.6 Pages 4-6<br><br>Only the 1st study has much to do with vertical extent of contamination in unconfined aquifer to determine the distribution. The other two studies were mostly on the assessment of intercommunication. The text should clearly identify these. | Accept. The second sentence in Section 4.1.1.6 will be deleted. Jensen (1987) and Graham et al. (1984) did not study the vertical extent of contamination. |
| 81. | Section 4.1.1.7.1 Pages 4-8, Line 1<br><br>**Deficiency:** The Washington Groundwater Quality Standards (WAC 173-200 Table 1) place the maximum concentration level at 0.05 µg/l.<br><br>**Recommendation:** State Washington Groundwater Quality Standard for arsenic in text. | Accept. The Washington Groundwater Quality Standard for arsenic will be included in the text. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 82. | Section 4.1.1.7.1 Third and fourth Paragraphs on Page 4-9<br><br>**Deficiency:** There are apparently no maps showing the plume configuration for arsenic in the semi-confined portion of the plume. The report states that it is located beneath Plume C. The next paragraph states that another potential contaminated area is located under Plume B. Why is there not a figure showing these plumes?<br><br>**Recommendation:** Insert a figure showing the plumes in the semi-confined portion of the upper aquifer. | Reject. Lack of data from the lower portion of the uppermost aquifer and the confined aquifers would cause any attempt to generate plume maps for these aquifers to be very speculative and potentially misleading. |
| 83. | Section 4.1.1.7.2 Paragraph 3 on Page 4-11<br><br>**Deficiency:** There is no figure showing the plume configuration for chromium in the confined Rattlesnake Ridge Aquifer even though it was shown in at least 4 wells.<br><br>**Recommendation:** Insert a figure showing the configuration of the chromium plume in the confined aquifer. | Reject. Lack of data from the confined aquifers would cause any attempt to generate plume maps to be very speculative and potentially misleading. |
| 84. | Section 4.1.1.7.4 Page 4-14, Paragraph beginning Line 8<br><br>Elevated nitrate concentrations are mentioned in 3 wells that are open to multiple aquifers. These open intervals could serve as a contaminant migration pathway between aquifers, and as such, the screened intervals in these wells should be shortened. Are these wells scheduled for remediation? We found no mention in Section 9.0. | Accept. A discussion of wells screened across multiple aquifers will be added to Section 9. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 85. | Section 4.1.1.7.5, Line 32, page 4-15<br><br>**Comment:** The report states that "six wells were identified as being screened across more than one aquifer." Were these wells used to determine plume concentrations for the aquifers involved?<br><br>**Recommendation:** Do not use the chemical and water level data collected from these wells (and any others that have been determined to be crossing aquicludes) to define plume configurations and concentrations. | Accept. Wells with screens across multiple aquifers will be identified in the text. These wells will be checked to verify that they were not included in the plume delineation for the unconfined portion of the uppermost aquifer. In addition, text will be modified to state five wells, rather than six. |
| 86. | Section 4.1.1.7.6 Pages 4-15, Line 39<br><br>In the past, the gross Beta activity in the 200 East groundwater plumes has been derived from $^{106}$Ru not $^{99}$Tc. | Accept. Text will be changed to include $^{106}$Ru as a contributor of beta activity in the 200 East Area, although a comparison of Figures 4-7 (Gross Beta plume) and 4-12 (Technetium-99 plume) demonstrates that $^{99}$Tc is the major contributor where it is present in high levels. |
| 87. | Section 4.1.1.7.6 Page 4-15 Lines 36-38<br><br>**Deficiency:** The list of beta decay radionuclides given from which groundwater "gross beta levels can commonly be attributed" is incomplete.<br><br>**Recommendation:** If there is a reason why the list is incomplete, please state so. Otherwise, complete the list including, for example, tritium, the largest source of beta decay radioactivity in the groundwater. | Accept. The list will be checked, but is not intended to be a complete listing of beta emitters. In particular, tritium though a beta emitter usually does not show up in gross beta because of standard analytical procedures which do not detect it. |
| 88. | Section 4.1.1.7.6 Pages 4-16, Line 9<br><br>The drinking water standards for $^{90}$Sr is 8pci/L. How is this to be resolved? The background should be 3'5 pci/L. There has been no rod background established at the Hanford Site. | Accept. The reported high background beta level could mask $^{90}$Sr concentrations so this radionuclide may have to be analyzed more frequently than simply on the basis of the gross beta screening value. This is already common practice in groundwater sampling at the Hanford Site. No change to text. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 89. | Section 4.1.1.7.7 Page 4-18 Lines 39-40; Page 4-19 Lines 2-4<br><br>**Deficiency:** The $C_4$ tritium plume extends to the Columbia River. Why were only the portions of the plume on Figure 4-8 used in calculating the activity in the plume?<br><br>**Recommendation:** Either explain why the estimate is cropped to Figure 4-8 or use the actual plume as shown in Figure 4-9. | Accept. An explanation as to why the estimate was not extended to the Columbia River will be added to the text. |
| 90. | Section 4.1.1.7.9 Page 4-21, lines 13-15 and Figure 4.11<br><br>**Deficiency:** Plume A is described as being defined with three wells, and yet table A-1 shows STP wells in this area with concentrations greater than 8 pCi/L of Strontium-90. None of the six wells in the area of 216-A-25, 6-53-48B, 6-53-47B, 6-53-47A, 6-53-48A, 6-54-48, and 6-54-49 are listed in any of the four groundwater monitoring programs listed in Tables 2-9, 2-10, 2-24, and 2-25. | Accept. Text will state that the plume is defined by six wells. Wells will be included Operational Groundwater Monitoring Network in Section 2. |
| 91. | Section 4.1.1.7.9 Page 4-21, Lines 17-19 and Figure 4-11<br><br>**Deficiency:** Plume B is described as being defined by one well, and yet Figure 4-11 shows three wells with concentrations greater than 8 pCi/L of Strontium-90. Figure 4-11 appears to be missing Well 2-E28-7, located adjacent to wells 2-28-23 through 25. It is shown in Table A-1 as having a concentration of 75.585 pCi/L of Strontium-90.<br><br>**Recommendation:** Clarify the number of wells in Plume B and include the referenced well on Figure 4-11. | Accept. The figure will be corrected. Although the data point was omitted from the figure, the data from this well was used in generating the Sr-90 plume map. Text will be modified to state that the plume is defined by four wells. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 92. | Section 4.1.1.7.11 Page 4-24 Lines 8-12 and Figure 4-13<br><br>**Deficiency:** If the areal estimate of dissolved $^{129}I$ is based on values ≥ 1 pCi/L, how are the values to the southeast, which go beyond the edge of Figure 4-13, taken into account? It is known that the $^{129}I$ plume in the unconfined aquifer extends to the Columbia River similar to the tritium plume in Figure 4-9. These data need to be presented.<br><br>**Recommendation:** Show an $^{129}I$ plume figure for the Hanford site similar to the tritium plume Figure 4-9. Either explain why the estimate is cropped in Figure 4-13 or use the actual $^{129}I$ plume from the Hanford site. | Accept. See response to Comment 89. A plume map for $^{129}I$ was not available in Evans et al. (1990). |
| 93. | Section 4.1.2.1.3 Page 4-27 Lines 35-36<br><br>**Deficiency:** The bullet stating that "multivalent ions are more strongly sorbed than univalent ions." is not completely accurate. Large univalent ions with low hydration energies such as cesium can adsorb more strongly than some smaller divalent ions with higher hydration energies such as magnesium.<br><br>**Recommendation:** Rewrite to state that "multivalent ions are more strongly sorbed than univalent ions with similar ionic radii." | Accept. "...with similar ionic radii" will be added to the end of the bullet. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 94. | Section 4.1.2.2 Page 4-29, Line 18-21<br><br>**Deficiency:** Given that Hoover (DOE/RL 1992f) has presented a background of 10 µg/L, to state that the concentration of arsenic detected in groundwater from the 200 Area may reflect background is not valid. The maximum concentration for arsenic in the 200 East area is 56 µg/L in Well 299-E25-17 (Tables A-1 and A-2).<br><br>**Recommendation:** Document to a greater degree why the concentration of arsenic may reflect background concentrations, or eliminate sentence. | Accept. "Some of the ..." will be added to the beginning of the statement to clarify that some of the arsenic detections may be background. |
| 95. | Section 4.1.2.2.1 Last paragraph on Page 4-29<br><br>**Comment:** If probable source of chromium plumes A and B are the 216-B-35 through -42 Cribs, then it is reasonable to assume that the plumes may be connected.<br><br>**Recommendation:** Determine if this is the case or justify why the two plumes should be separated. | Accept. Text will be modified to state that these two plumes probably are part of the same plume. |
| 96. | Section 4.1.2.2.2 Page 4-31, Lines 30 and 31<br><br>**Deficiency:** There is no explanation why organic compounds present in the groundwater are not described even though several organic compounds are present above MCL.<br><br>**Recommendation:** Document why organic compounds are not included. | Accept. An explanation as to why plume maps were not created for organic compounds with MCL detections will be added to the text. |
| 97. | Section 4.1.2.2.2 Sentence starting on Line 15, Page 4-32<br><br>**Deficiency:** If trichloroethylene is not a chemical that is included in the inventory, why mention it at all?<br><br>**Recommendation:** Delete the reference to TCE. | Accept. Reference to TCE will be deleted. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 98. | Figure 4F-16<br><br>**Deficiency:** There is no flow line moving from the 216-B-3 pond area to the north. Since there is a known groundwater mound under the ponds, flow lines from all sides would be expected.<br><br>**Recommendation:** Add flow line from the ponds toward the north. | Accept. A flow line to the north will be added to Figures 4-16 and 4-17. |
| 99. | Section 4.1.2.3 Page 4-32, Lines 33-34<br><br>**Deficiency:** Describe how significance was determined to screen, "radionuclides with the most significant concentrations."<br><br>**Recommendation:** Document methodology of screening process. | Accept. Sentence will be changed from "...describes the plumes..." to "...describes the radionuclides with mappable plumes." |
| 100. | Section 4.1.2.3.13 Page 4-38<br><br>**Deficiency:** Given that plumes of uranium are present, and an IRM is proposed, why is there no figure showing plume configuration in Section 4?<br><br>**Recommendation:** Provide figure showing uranium plume. | Reject. $^{234}U$ and $^{238}U$ are detected above their 4% DCGs in only one well, Well 299-E28-21. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 101. | Section 4.1.3.1.3, Page 4-43, Line 23-25 and Figure 4-18<br><br>Deficiency: We question the conceptual model described in the text and shown in the figure concerning the future direction of groundwater flow through Gable Gap. The conceptual model states that when all artificial recharge in the 200-Areas stops, groundwater flow conditions in the area will include some flow northward through Gable Gap. We assume that when artificial recharge in the 200 Areas is discontinued, the groundwater flow system will revert back to "pre-Hanford conditions." Other Hanford documents indicate a southerly flow of groundwater through Gable Gap, prior to 1943, and we find no data in this report to support the conclusion that groundwater would flow otherwise after the cessation of artificial recharge in the 200 Areas.<br><br>**Recommendation:** Provide data to support the conceptual model or change the figure and text to reflect no groundwater flow northward through Gable Gap. | Reject. Groundwater flow will not revert back to pre-Hanford conditions because of irrigation in the upper Cold Creek valley. This has caused an overall rise in water levels across the 200 Areas Plateau so that it would be unlikely for groundwater to move south through the gap as long as irrigation continues. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 102. | Section 4.1.3.2, p. 4-44, lines 18-20<br><br>Deficiency: Anticipated releases from the unsaturated zone are not adequately addressed. The report notes that "slow draining of soil underlying waste management units that were recently closed may contribute some small amount of additional contaminants to the groundwater." In comments to the B Plant AAMS report, the EPA noted that using the data from Bierschienk (1959), it is estimated that "there is potentially as much as 10 million gallons of drainable waste still in the soil" of the B Plant alone. in our opinion, 10 million gallons is not "some small amount" and we conclude that gravity drainage from the soil as a potential source of groundwater contamination should not be arbitrarily dismissed, as was done here. The contamination potential 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. Little or none of this data are presented or evaluated in this report.<br><br>**Recommendation:** Either present the data needed to support this statement or modify the statement to reflect the existing uncertainty with respect to this subject as noted in SECTION 8.2.3 on pages 8-22 and 8-23. | Accept. Statement will be modified to reflect the existing uncertainty of continued drainage in the soil underlying waste management units. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 103. | Section 4.1.3.2, Page 4-44, Line 39<br><br>Deficiency: With reference to current and future liquid discharges to the ground from waste management units, it is noted that the "Liquid Effluent Study Final Project Report (WHC, 1990b) states that in most cases a negligible impact to the groundwater is expected from future discharges." In the review of the Liquid Effluent Study in 1991, the USEPA found the Study to be flawed and inadequate to judge the impact of future liquid discharges at the Hanford site. Specifically, the EPA found "The impacts of effluent discharges on the migration of residual contamination in the soil column underlying the receiving sites are not thoroughly evaluated. ...the residual contaminants in the soil column may constitute the most significant source of mobile contaminants available from transport to groundwater. yet, the potential for the leaching of these contaminants, and in particular Uranium, to groundwater was overlooked in the analyses of future impact." In light of this critical flaw in the Liquid Effluent Study Report, we cannot support using the conclusions of this report to develop the conceptual model for the 200 East groundwater flow system.<br><br>**Recommendation:** We recommend deleting references to the Liquid Effluent Study's conclusions on the effects of future discharges on the groundwater flow system. It serves no beneficial purpose to perpetuate unsubstantiated and potentially incorrect conclusions. | Reject. It would not be appropriate to delete reference to the Liquid Effluent Study's conclusions. A primary objective of the AAMS process is to summarize existing information. Instead, paragraph 2 of Section 4.1.3.2 will be modified to read: "Gross gamma-ray geophysical logging has not provided evidence that downward migration of radionuclides is ongoing in the vadose zone (spectral gamma-ray logging may provide more definitive data in the future). However, slow draining of the soil under waste management units may contribute additional contaminants to the groundwater."<br><br>Please note that the "negligible impact" is not an assumption of the conceptual model. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 104. | Section 4.1.3.3.7 Page 4-46 Lines 21-33<br><br>**Deficiency:** Discussion in this section regards the tritium plume and the long-term prospect that transport will continue into the Columbia River at diminished concentrations. This reinforces the impression that is given throughout the remainder of the document that no attempt will be made to remediate the tritium problem. As the tritium plume is very significant and is flowing into the Columbia River at levels many times the Maximum Contaminant Levels for drinking water, the potential for remediation of the tritium plume needs to be addressed.<br><br>**Recommendation:** Examine remedial alternatives for the tritium plume. | Accept. Remedial alternatives for the tritium plume will be discussed in greater detail. |
| 105. | Section 4.1.4 Page 4-47 Lines 29-34<br><br>**Deficiency:** This discussion is limited to nitrate and tritium and should include $^{129}I$ which is also very mobile and has a large plume similar to nitrate and tritium.<br><br>**Recommendation:** Include $^{129}I$ in the discussion with nitrate and tritium. | Accept. $^{129}I$ and $^{99}Tc$ will be added to the discussion. |
| 106. | Section 4.2.2.1.5 Page 4-54 Lines 17-18<br><br>**Deficiency:** This sentence indicates that compounds suspected as being problematic, specifically tributylphosphate, dibutylphosphate, EDTA, and HEDTA, were not analyzed for. It is not clear why they were not and what their potential significance is.<br><br>**Recommendation:** Clarify this issue. | Accept. "Non-detections" for EDTA, HEDTA and DBP will be checked. EDTA, HEDTA, DBP, and TBP are included as part of the groundwater transport investigation discussed in Section 8.0 for future RI work plan activities. This investigation addresses data gaps associated with the role of chelating agents such as EDTA and other chemical complexation agents in contaminant transport. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 107. | Section 4.2.3 Page 4-60, Lines 4-12<br><br>These bullets describe the general routes by which exposure to groundwater contaminants can occur. Exposure via inhalation of volatiles from contaminated potable water and surface water, as well as direct contact with and ingestion of sediments, should be discussed. These exposure route are included in the Hanford Site Baseline Risk Assessment Methodology (HSBRAM) Figure 2-4, page 23 (DOE-RL 1992). | Accept. A statement will be added that states that exposures to potable water, surface water, or sediments, any of which that have been contaminated by groundwater migration, are possible paths of exposure. |
| 108. | Section 4.2.4 Page 4-61, Lines 8-11<br><br>**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.<br><br>**Recommendation:** The criteria for selection should be expanded to include environmental receptors. | Reject. Assessment of ecological impacts will require a more detailed analysis (e.g., impacted species) and as well is a concern for the longer term rather than present conditions because of travel time to the Columbia for the many constituents which have not already reached there. As a result, ecological risk must be left to the quantitative risk assessment phase rather than this screening study regarding short-term remediation decisions. |
| 109. | Section 4.2.4.3 Pages 4-62 through 4-65<br><br>**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. | Accept. Redox potential state is discussed in regard to groundwater and mobility. Mobility in soil will be added to the discussion. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 110. | Section 4.2.4.3 Page 4-64, lines 23-26 and Table 4-8<br><br>**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.<br><br>**Recommendation:** Explain why the particular values for Cs and Co $K_d$s 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 $K_d$s, then this should be clearly stated. | Accept. Tables and text will be checked against original sources and inconsistencies will be corrected. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 111. | Section 4.2.4.5.1, Page 4-67, Lines 22 and 23<br><br>The text discusses the additive risk from chemical and radionuclide carcinogens. The text states that these should be computed separately. HSBRAM (DOE-RL 1992) (page 43), however, states that "to allow for cumulative risks, chemical and radiological incremental lifetime cancer risks must be summed." This methodology should be included in the text. | Accept. Text will be modified to reflect that the risk assessment approach in the 200 East Groundwater AAMSR considered cumulative risks for chemical and radiological constituents, as described in the Hanford Site Baseline Risk Assessment Methodology (DOE 1991d). This approach is consistent with the groundwater contaminant screening and relative ranking evaluation presented in Section 5.0. |
| 112. | Section 4.2.4, Page 4-61, Lines 12 through 20 and Section 4.2.4.5.2, Page 4-67, Lines 34 through 40<br><br>These two sections list compounds with known chronic toxicity but no toxicity factors. Dibutyl phosphate is listed in Section 4.2.4 but not Section 4.2.4.5.2. This discrepancy should be corrected. Also, selenium is included in the list, though it does have a reference dose listed in the Integrated Risk Information System (EPA 1992). | Accept. Dibutyl phosphate will be added to list of constituents in Section 4.2.4.5.2. Selenium will be removed from the lists of constituents in Sections 4.2.4 and 4.2.4.5.2. Selenium will be added to the list of metals on Table 4-6, and IRIS toxicity data will be added to Table 4-12. |
| 113. | Section 4.0, Figures 4-1 To 4-15<br><br>Deficiency: Plume shapes and sizes appear to be identified on the basis of the lowest value contour equaling the MCL. This is useful information, but it tends to minimize the size of the contaminant plume.<br><br>Recommendation: We recommend that contours be drawn for concentrations below the MCL so that the reader is able to ascertain the full extent of the contaminant plume. We suggest that the lowest contour be selected as 2x natural background or some other reasonable level and that the contour representing the MCL be drawn as a bold line and identified in the legend as such. | Reject. Plume maps were generated to depict plume areas exceeding MCL regulatory Thresholds. For the purposes of the AAMSR, these regulatory criteria, rather than contours reflecting the detection limit, are appropriate. Detection limit contours will be provided in the Groundwater Field Characterization Report. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 114. | Figure 4-19, page 4F-19<br><br>This figure illustrates the 200 East groundwater aggregate area conceptual model. The arrows from affected media to exposure routes should be changed to reflect the conceptual model outlined in HSBRAM (DOE-RL 1992). According to HSBRAM, the only direct radiation exposure route is through surface soils. Also, arrows leading from sediment to the ingestion and direct contact exposure routes and from off-site groundwater to the inhalation, ingestion, and direct-contact exposure routes should be included. | Accept. Suggested changes will be made to Figure 4-19. |
| 115. | Table 4.1 Page 4T-1a<br><br>**Deficiency:** The relationship of the columns in this table is confusing. A specific example would be the relationship under the first line, carbon tetrachloride, where an average of reported values of 4.48 is described with a maximum of detections of 0.8. This relationship is not clear and continues through many of the parameters in this table.<br><br>**Recommendation:** Clarify this relationship and correct any deficiencies in the table. | Reject. The discrepancy is due to the inclusion of the detection limit (as a "reported value") for each non-detection, in the average of reported values. This was intended to be a conservative method of estimating contaminant concentrations. It does not significantly affect the constituents with significantly high concentrations, where all the values are detections. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 116. | Table 4-2, Page 4T-2a (ff)<br><br>Deficiency: This table shows many occurrences of contaminants in the confined aquifer. Contamination in the confined aquifer is only discussed in a cursory manner in the text.<br><br>Recommendation: Contamination in the confined aquifers should be more fully discussed in the text so that the reader understands the extent of the problem not only in the unconfined but confined aquifers. Also, most of the wells for which data are described here are not included in the monitoring programs listed in Tables 2-24 and 2-25. Please note the source of these data. | Reject. See response to Comment 73. |
| 117. | Table 4-3<br><br>The background concentrations for the Hanford groundwater are yet to be finalized/determined. Therefore, the table may not represent the actual information.<br><br>**Recommendation:** Remove the table from the text. | Reject. The AAMSR reports on the state of data as it is available at the time. With continued study this state of the data is never going to be fully finalized. The preliminary nature of these results is indicated in the text and in the footnotes to the table. |
| 118. | Section 5.1 Page 5-2, lines 25-36<br><br>**Deficiency:** This paragraph stresses that this screening process is different from an evaluation of potential risks without explaining the difference.<br><br>**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. | Accept. The difference between this screening and a quantitative RA will be explained. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 119. | Section 5.2.1 Page 5-3, lines 26-27<br><br>**Deficiency:** There is not sufficient detail on exposure pathways to determine if the screening process is adequate.<br><br>**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. | Accept. Additional text and tabular information will be provided to detail the MEPAS calculations. |
| 120. | Section 5.3 Page 5-7 Lines 2-10<br><br>**Deficiency:** This comment really pertains to the whole discussion of screening of results and relative risk assessment. In the referenced paragraph, a statement is made beginning on line 6 that the relative significant rankings are based on human health risk considerations and not evaluated based on potential risk associated with the Hanford site or potential exposure to contaminated groundwater. This comment is inconsistent with the objective of this document as stated elsewhere, which is specifically to address risk and potential risks associated with human health and the environment, and furthermore will result in final remediation inconsistent with ARARs if uncorrected.<br><br>**Recommendation:** Expand the discussion of relative risk to encompass the complete objectives of remediation and specifically include relative risks to the environment and modify the relative risk assessment and screening results accordingly. | Reject. As stated on lines 4 and 5 of page 5-1 of this AAMSR, the intent of these evaluations is to provide input to the recommendation process discussed in Section 9.0 of the AAMSR. This intent is consistent with the overall AAMSR objectives listed in Section 1.3. The MEPAS screening was conducted to provide just one of several inputs judged to be appropriate in prioritizing groundwater actions. "Higher" priority sites may be considered as candidates for interim remedial measures. A screening level analysis is considered to be an appropriate tool for developing this timely input in the early stages of the groundwater remediation planning process. In any event, the MEPAS screening results will not be used to select final remedial actions which instead will be based on a quantitative risk assessment. Such a quantitative assessment will be performed using extensive site specific data and complex analytical tools that are not consistent with the objectives of this AAMSR. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 121. | Section 6.0 Pages 6-1 through 6-22<br><br>**Deficiency:** ARARs and action-specific CARS that may be applicable to the site and should be referenced include the following:<br><br>Washington Standards for Protection Against Radiation (WAC 402-24 and 426-221)<br><br>Washington Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (WAC 402-80-050)<br><br>Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (173-490)<br><br>**Recommendation:** Include the above regulations in the text. | Comment accepted in part. Washington Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (WAC 402-80-050) should be included in the action-specific ARARs. However, it has been renumbered and should be referenced as follows: WAC 246-247-040. This requirement applies to dose limits of radionuclides to the air the public can be exposed to.<br><br>Washington Standards for Protection Against Radiation (WAC 402-24 and 426-221) will be included. While not applicable, they are considered relevant and appropriate.<br><br>Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (173-490) does not apply to the Hanford Site. It applies to ozone non-attainment areas. |
| 122. | Section 6.2.2 Page 6-6, Line 24<br><br>**Comment:** Reference is made to Section 6.22.2. There is no section with that number. | Accept. Reference to 6.2.2.2 will be deleted from the text. No other reference is required. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 123. | Section 6.6 Page 6-21, Lines 22-23<br><br>**Deficiency:** Point of compliance is not the boundaries of the Hanford site; see MTCA 173-340-720(6).<br><br>(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 groundwaters from the point of compliance to the outer boundary of the hazardous substance plume.<br><br>(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.<br><br>**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. | Accept. The Hanford Site boundary, or even a point beyond the Hanford Site boundary, is an appropriate point of compliance for many of the ARARs identified in Sections 6.2 through Section 6.4. As an example, the current text cites Clean Air Act regulations. In particular, federal NESHAPS establish the "maximally exposed individual" as the point of compliance for radionuclide emissions. This point is often beyond the Hanford Site boundary. Chapter 402-24 WAC, a potentially relevant and appropriate requirement, establishes maximum radionuclide effluent concentrations for "unrestricted" and "restricted" areas. The point of compliance where "unrestricted" limits may apply has generally been considered to be the Hanford Site boundary. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | | While the MTCA section noted by the agency governs the establishment of the point of compliance under MTCA, and does state that the point of compliance will generally be established in a manner consistent with the agency's comments, the section goes on to state that "...Where hazardous substances remain on-site as part of the cleanup action, the department may approve a conditional point of compliance which shall be as close as practicable to the source of a hazardous substance, *not to exceed the property boundary*. Where a conditional point of compliance is proposed, the person responsible for undertaking the cleanup action shall demonstrate that all *practicable* methods of treatment are to be used in the site cleanup." (emphasis added).<br><br>It is likely that hazardous substances will remain at some of the source units which contribute to the 200 East and 200 West Groundwater Aggregate Areas. It is likely that hazardous substances will remain at some of the source units which contribute to the 200 East and 200 West Groundwater Aggregate Areas. Additionally, methods of limited practicability of treatment for tritium contaminated groundwater exist; containment of the contaminated groundwater and natural radioactive decay are likely to be the most practicable treatment methods. Based upon these considerations, conditional points of compliance may be appropriate for some groundwater remediation actions within the 200 East and 200 West Groundwater Aggregate Areas. Therefore, the property boundary (e.g., the Hanford Site boundary) is an appropriate potential point of compliance for groundwater remedial actions, the MTCA language quoted by the agency notwithstanding. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | | Text will be revised and expanded on page 6-21, lines 31-35 to summarize MTCA regulations (Chapter 173-340-720(6)) regarding establishment of ARAR conditional and non-conditional (saturated zone) points of compliance. |
| 124. | <u>Section 6.6 Page 6-21, lines 24-26</u><br><br>**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.<br><br>**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. | Accept. See Response to comment 123 above. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 125. | Section 6.7<br><br>**Deficiency:** Use the actual language stated in CERCLA Section 121 (d)(4)(A through F) rather than an interpretation.<br><br>(A) the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed;<br><br>(B) compliance with such requirement at that facility will result in greater risk to human health and the environment than alternative options;<br><br>(C) compliance with such requirements is technically impracticable from an engineering perspective;<br><br>(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;<br><br>(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<br><br>(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 | Accept. The text will be replaced with the actual CERCLA language, with minor modifications made to improve readability in this context. Existing language related to Section 104-funded actions will be retained: it is recognized that the Section 104-funding waiver criteria will not apply to the Hanford Site; therefore, a paraphrase versus the longer actual language is appropriate. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | 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. | |
| 126. | Section 7.2.1 Page 7-5<br><br>**Deficiency:** This section discusses no action and institution controls but provides very little discussion with relation to groundwater usage and specifically irrigation issues. The potential exists to significantly modify groundwater flow patterns through the area through a combination of modified irrigation practices, irrigation source development, and institutional controls associated with them.<br><br>**Recommendation:** This issue needs to be much more thoroughly evaluated in conjunction with the potential for hydraulic containment and other relevant remedial alternatives. | **Irrigation Issue:** Accept. Modification of irrigation practices, and source development, and related activities will be mentioned as a potential institutional control measures. The implementability of these controls is suspect however, and a detailed evaluation of associated issues is not appropriate at the screening level presented in the AAMSR.<br><br>**Ongoing Waste Disposal:** Reject. The focus of Section 7.0 is to present a summary of Remedial Action Technologies for the 200 East Groundwater AA. Discussion of specific institutional control measures supporting ongoing waste disposal activities in the 200 Areas is only tangentially related to this discussion, and provides little background material. Institutional measures necessary to support the selected remedial technologies will need to be considered on a case by case basis. This topic will be addressed as part of future FS activities for the 200 East Groundwater AA. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 127. | Section 7.2.2 Top of Page 7-7, Section 7.4.1 Page 7-16, Lines 4-6, Table 7-5, Section 7.5, Lines 14-16<br><br>**Comment:** There is known selective membrane technology that might be applied to remove tritium from groundwater. One system involving upstream electrolytic decomposition of water into hydrogen and oxygen, followed by the selective separation of hydrogen from other gases, is now in the laboratory demonstration phase of development. The three forms of hydrogen are then separated into their respective streams, hydrogen, deuterium, and tritium.<br><br>**Recommendation:** This selective membrane technology should be researched and evaluated for its possible application to remove tritium from Hanford groundwaters. | Accept. Text will be changed to reflect that for compounds like tritium, no large-scale treatment has been performed (rather than saying no treatment is possible), and that natural attenuation may be the feasible option.<br><br>Tables will be expanded to include the technology of electrolytic decomposition followed by physical separation of resulting gases. The technology will be retained as an innovative technology, but rejected as a currently applicable technology for tritium plumes at the Hanford Site because of unproven effectiveness and expected high cost at this scale. The implementability of this remedial technology will be further researched during future FS activities for the 200 East Groundwater AA. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 128. | Section 7.2.3 Page 7-8..9 Lines 3-10<br><br>**Deficiency:** In this environmental setting, we believe that great potential exists to achieve significant remediation results through the hydraulic containment approach versus other containment technologies. Impermeable barriers, such as grout or soil freezing, will be extremely difficult to implement, expensive, and highly unreliable. Dynamic systems have significant potential flexibility, particularly with potential for modification of the groundwater flow regime through modified irrigation practices and reduced overall flow through the system and ultimate discharge of the Columbia River.<br><br>**Recommendation:** Much more comprehensive evaluation of this approach or combination of approaches needs to be addressed. This comment holds true throughout the rest of the document and discussion should be modified accordingly. | Accept. Page 7-15, line 34 Alternative 1 will be changed to "Containment" and add "or dynamic systems using clean water injection"<br><br>Page 7-17 change name of Alternative 1 to "Containment"--The text of Alternative 1 will be expanded to include a discussion of how hydraulic control could be used to form a containment barrier. The discussion will also highlight limitations to include mounding associated with injection (without removal of contaminated groundwater). Limitations such as potential dilution and expansion of the current plumes will also be included.<br><br>Page 7-25, line 8 the word "physical" will be eliminated in the Alternative 1 title.<br><br>Table 7T-4, the containment column of table will be modified to include grout walls, freeze walls, and hydraulic control.<br><br>Page 9-34, line 34 bullet will be revised to list "containment" rather than "barriers," and will include hydraulic methods. |
| 129. | Section 7.2.5, Page 7-10, lines 32 through 40<br><br>This section provided advantages and limitations of treatment at point-of-use and point-of-discharge locations. Another disadvantage of point-of-use treatment should be included in the text: this response action requires frequent testing and maintenance since treatment system malfunction would create a direct contaminant pathway to receptors. | Accept. The potential disadvantage described will be included in the text discussion. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 130. | Section 7.4.3, Page 7-17, Lines 32 through 37<br><br>The locations of extraction wells for a groundwater extraction system should be based on contaminant plume capture. The wells may be located in the center of the contaminant plume, as noted in the text, as well as near the down gradient extent of the plume. Well spacing should be determined based on the well capture zone calculated using pump test data. Existing wells may be used if their locations are appropriate, if they are appropriately screened for plume capture, and if they can support the desired flow rates. Also, if additional monitoring wells are required for an LFI or remedial investigation, then larger diameter wells (4 to 6 inches) that can also be used as extraction wells during remedial action should be considered where appropriate. | Accept. Text will be modified to state that pump test data will be used to calculate well capture zones as a determinant of well spacing. Although it would be desirable to have dual use wells, dual use wells may not be feasible at Hanford. The optimum designs for monitoring wells (e.g., low purge volumes) and for extraction wells (e.g., high production volumes) are typically not compatible. |
| 131. | Section 7.4.3, Page 7-18, Lines 22 and 23<br><br>The text should be clarified to indicate that alternative 2 will treat all contaminants except tritium. | Reject. Per comment 127, tritium remediation via selective membrane technology will be retained as an innovative remediation technology. This technology is included under the extract and treat scenario described for Alternative 2, and on Tables 7-2 and 7-3. |
| 132. | Section 7.5, First paragraph page 7-23<br><br>**Comment:** When discussing the in-situ precipitation of various metals within a plume, it should be noted that there is a definite possibility of the precipitate filling the interstitial spaces within an aquifer and locally changing the permeability. This could have an effect on flow paths, water levels, and the cleanup rates for other chemicals in multi-constituent plumes. | Accept. The suggested text discussion will be added to Section 7.5. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 133. | Figure 7.1 Page 7F-1<br><br>**Deficiency:** This figure presents graphically the development of candidate remedial alternatives for the 200 East Area. However, in our view, there are some linkages that should be made which have not been made. Specifically, the containment option should be linked to institutional controls, which should also be linked to Alternative 1, Engineered Barriers, as potential remedial options. Further, hydraulic barriers should be linked back to engineered barriers in the fourth column. These comments are particularly true as they relate to the tritium and potential application of hydraulic controls.<br><br>**Recommendation:** Made the appropriate changes to the figure. | Reject. The intent of Figure 7-1 is to identify example technologies and candidate remedial alternatives associated various RAO response actions. The figure does not purport to show all conceivable linkages, and does not preclude utilization of multiple approaches to achieve the RAOs listed. This concept is discussed in Section 7.2.6, and describes that individual response actions may be combined to optimize advantages of each technology. As further discussed in Section 7.2.1 "institutional controls will likely be an integral component of all interim remedial alternatives and will be combined with active groundwater treatment steps." |
| 134. | Figures 7-4 and 7-5<br><br>**Deficiency:** Although they are simply schematic drawings, there should be a groundwater mounding around the injection wells in these two figures.<br><br>**Recommendation:** Modify the two figures as suggested. | Accept. Figures 7-4 and 7-5. The inversion cones depicted in the location of the injection wells will be replaced with a mound in each figure. |
| 135. | Table 7-3, Page 7T-3e<br><br>The description of freeze separation technology is incomplete. A clear definition such as concentration of contaminants by selectively freezing contaminated water into pure ice crystals; removing and melting pure ice crystals to produce clean water should be provided. | Accept. The suggested clarification for freeze separation technology will be made to Table 7-3. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 136. | Section 8.1.2, p. 8-3, line 19<br><br>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. | Accept. A list of topical reports is provided in Section 1.0. Drafting of the 200 AAMS groundwater sampling field activity report is in progress, and therefore is not available for incorporation into the 200 East Groundwater AAMSR. The topical report will be completed and released by the end of the calendar year. |
| 137. | Section 8.1.2, p. 8-5, lines 36-40<br><br>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, considerably more data may need to be collected before hydrologic parameters are known reasonably. | Accept. While the data are not perfect, they are known to a sufficient degree to allow most analyses (e.g., computer modeling) to be initiated. A data gap (Section 8.2.3) is included that additional aquifer property data are required. Calibration of the computer model will assist determination of these parameters. |
| 138. | Section 8.1.2 Page 8-6, lines 18-22<br><br>**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.<br><br>**Recommendation:** Address all future land uses so appropriate amounts and types of data will be collected. | Reject. Upon finalization of the source AAMSRs (i.e., U Plant AAMSR) it was mutually decided to limit addressing land use issues. Section 7.1 will be revised accordingly. |
| 139. | Section 8.1.3 Page 8-7, lines 7-10<br><br>**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. | Accept. Many plumes do have gradual contaminant gradients at their leading edge. Some models add to this phenomenon with numerical dispersion. The example cited is, however, a worst case which would strain the checking of analytical consistency. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 140. | Section 8.2.3<br><br>**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 34). 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.). The most significant data gaps or information needs relate to the vertical extent of plumes and the hydrogeology of the lower portion of the unconfined aquifer and the confined aquifers. | Accept. The first data gap is mentioned in Section 8.3.3.2 but will be included (more clearly) in Section 8.2.3.<br><br>Second point: See response to Comment 75.<br><br>Third point: Ranking of data gaps tries to compress too much into a linear scheme. The relative importance of these issues may vary among the different operable units and occasionally among different contaminants. The suggested prioritization is better left to the Work Plan development process. |
| 141. | Section 8.2.3 Page 8-21 Lines 7-17 and Table 8-4<br><br>**Deficiency:** The background concentrations of inorganic constituents is correctly identified as a data gap. As previously suggested, using ICP/MS method 200.8 will dramatically lower detection limits for most inorganics. The PQLs in Table 8-4 and the detection limits in Table 4-3 can be lowered as given below: | Accept. Use of other methodologies such as EPA method 200.8 appears to be appropriate to promote in future work plan development. Table 8-4 will be changed to reflect this. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | ICP/MS (ppb)Table 8-4 or 4-3 (ppb)<br><br>Aluminum:0.2200<br>Arsenic:0.5 10<br>Barium:0.02 20<br>Beryllium:0.02 5<br>Bismuth:0.02 5<br>Boron:0.1100<br>Chromium:0.2 10<br>Copper:0.05 10<br>Lead:0.02 5<br>Nickel:0.2 30<br>Phosphorus:101000<br>Selenium:1 5<br>Silver:0.02 10<br>Vanadium:0.1 40<br>Zinc:0.2 20<br><br>**Recommendation:** Include ICP/MS method 200.8 as part of the data quality objectives for the Hanford site characterization. | |
| 142. | Section 8.2.3 Fourth bullet on Page 8-21<br><br>**Deficiency:** Concerning one-well-plumes, the report states that other wells immediately down gradient should be checked, but does not mention that up gradient wells should also be investigated.<br><br>**Recommendation:** Include a recommendation to investigate up gradient wells. | Accept. A statement will be added that upgradient wells should be checked. Since they may also be upgradient of the source of the contamination, and therefore not show the plume, they may be less important and will not be made as high a priority. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 143. | Section 8.2.2.1, p. 8-15, Section beginning on Line 14<br><br>This is supposed to be a description of all the types of data necessary to understand the vadose zone, the unconfined and confined aquifers of the ground water system, and contaminant transport from the 200-East Area to the accessible environment. As stated in lines 17-18, models are important tools in understanding groundwater flow and contaminant transport. We agree, and the text goes on to say 'data requirements for such models ...include... flow domain characteristics..' are listed in ' Table 8-1.'<br><br>However, Table 8-1 only specifically addresses collecting data on the vadose zone and the unconfined aquifer (3.5 on p. 8T-1a) and never mentions the confined aquifers: There is a real possibility that the confined aquifer underlying the 200-East Area may be contaminated (Table 4-2). This issue should be addressed here as a data requirement as well as in 8.2.3 as a data gap (Data Gaps, p. 8-19) where the confined aquifers are mentioned as needing study. | Accept. Table 8-1 will be augmented to include saturated (and confined) flow modeling needs. Text modifications to Section 8.2.3 will be made as recommended. |
| 144. | Section 8.2.3, Page 8-21, fifth paragraph<br><br>This paragraph lists analytes that were detected only once in one well. This paragraph also suggests that these wells should be resampled and reanalyzed to confirm the earlier single detections. However, neither these analytes nor their corresponding detection limits are listed in Table 8-4 and should be included. | Reject. These analytes can be added during the work plan development where they need to be checked. As it is, their existence is questionable and do not need to be included in the table which is based on contaminants of concern. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 145. | Section 8.2.3, Pages 8-19 to 8-26<br><br>Deficiency: Several of the data gaps described in this section (Estimate of Recharge Rates, Hydraulic Interconnections with Continued Aquifers, DNAPL's, and Complexing) are somewhat ambiguous. Many of the data gaps in this section are well described, however, in the data gaps noted above, the process in question or problem is only generally described, and the specific data required to address the problem is not. For instance, in the Estimate of Recharge, it is noted that available data from previous studies indicate a wide range of estimates of recharge through natural or disturbed Hanford site soils and that recharge estimates are important, but does not describe specifically what data are required to address this problem.<br><br>Recommendation: We suggest including more specific information in the sections describing the data gaps noted above. For instance, at the end of the Recharge Rate section, we suggest including a statement such as "Accurate measurements or estimates of recharge through soils and vegetative cover conditions representative of those found at 200 Area waste sites will be required for predicting contaminant transport through the unsaturated soils. Existing recharge data will need to be reviewed and data representative of the 200 Areas soil and vegetative cover conditions selected. Some additional recharge measurements may need to be made for those areas in the 200 Areas with soil and vegetative conditions not fully represented by the existing data set." | Reject. We do not agree that the suggested wording clarifies the nature of what investigation is required for natural recharge rate. Similarly, investigations of the other issues mentioned are also better left to the development of work plans rather than being over-specified here. |



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| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 146. | Section 8.2.3, Page 8-22, Section beginning on Line 32<br><br>Here you use the term 'pump test' interchangeably with 'aquifer test' to describe the test necessary to determine aquifer properties. To be consistent and to use the more correct term, use 'aquifer test' throughout the text. | Accept. The term "pump test" was intended to differentiate from slug tests of aquifer properties. The term "pumping test" will be substituted. |
| 147. | Section 8.2.3, p. 8-24, Section beginning on line 20<br><br>DNAPLs are mentioned here. In liquid phase these contaminants can move against the upward vertical gradient (and flow) in the ground water system in response to geologic structures and gravity. DNAPLs in vapor phase can migrate through the unsaturated zone in the direction upgradient of ground water flow. Transport in both phases is an important part of the contaminant transport conceptual model for the 200-East area and this should be described to the reader. | Accept. DNAPLs and volatile organics are discussed in more detail in conjunction with the conceptual model (Section 4.1), and are more likely to occur in the 200 West Area. A mention of the density gradient effect will be added. It is not appropriate to discuss vapor transport under this heading as the compounds are not in liquid form. |
| 148. | Table 8-4, Pages 8T-4a to 8T-4e<br><br>In addition to practical quantitation limits (PQL) for the listed analyses, this table should list the required detection limits. | Reject. Required detection limits are an issue for laboratory contract programs rather than for DQO discussions. |
| 149. | Section 9.0, Page 9-2, Line 13<br><br>The text indicates an ERA is recommended for the strontium-90 ($^{90}Sr$) plume in the vicinity of the 216-B-5 reverse well. The $^{90}Sr$ plume should be further identified as plume B shown on Figure 4-11 since three $^{90}Sr$ plumes exist. | Accept. Identification of Plume B will be added. |
| 150. | Section 9.0, Page 9-2, Lines 39 and 40<br><br>The contaminant plume recommended for IRMs should be identified as Technetium-99 ($^{99}Tc$) Plume B shown on Figure 4-12 and nitrate plume B shown on Figure 4-4 since multiple plumes exist for these contaminants. | Accept. Identification of subplumes will be added. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 151. | Section 9.0, Page 9-3, Lines 17 through 27<br><br>Contaminants present in several plumes, such as nitrate, $^{90}Sr$, and $^{99}Tc$ have not been completely addressed in the 200 East groundwater AAMS. Some of the plumes of these contaminants have been recommended for ERAs, LFIs or IRMs. The remainder of these plumes, however, have been neglected. Specific plumes should be incorporated into the AAMS text and Table 9-1 as an LFI, an IRM or a remedial investigation path as follows: nitrate plumes A, C, D, and E; $^{90}Sr$ plumes A and C; and $^{99}Tc$ plumes A and C. | Reject. Only the "highest" priority recommendation (i.e., ERA over IRM over LFI) is presented for each constituent, in order to avoid the complications inherent in listing all "subplumes", which may change with new plume maps. It is understood (as mentioned on page 9-14, lines 37-41) that "lower" priority remedial actions may be needed for subplumes of many of these constituents, either during the higher priority remedial action or at its completion. |
| 152. | Page 9-3, Lines 32-33<br><br>Why have the wells not been resampled? | Reject. Statement reflects state of data as reported in data base. Recommendations are based on the current state of the data. Plans for groundwater operable units will be developed on the basis of both the recommendations in the AAMSR as well as changes in the state of the data by the time of work plan development. |
| 153. | Section 9.1.1 Page 9-6<br><br>**Deficiency:** In the discussion of decision-making criteria in this section, it is not clear why tritium has been excluded through application of these criteria for further action. We believe that based on information presented in this document and the logic paths presented tritium should be addressed.<br><br>**Recommendation:** Address the tritium plume in a remediation mode or discuss clearly why it has been excluded. | Accept. While treatment and containment technologies are available for tritium, we do not agree that they are sufficiently feasible for implementation in an ERA or IRM. A statement to this effect will be added. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 154. | Section 9.1.1 Second paragraph on Page 9-7<br><br>**Deficiency:** The second line in the paragraph states " The criteria used to determine 'unacceptable' are based on the maximum concentration detected (averaged for all samples collected in a well during 1989 through 1992)." It does not seem reasonable to have a maximum concentration based on averaged data.<br><br>**Recommendation:** Base the risk criteria on the highest numeric data that can be validated for each well. | Reject. For purposes of screening, it is better to base ERA/IRM decisions on more than a single analytical result. |
| 155. | Section 9.2.1.1. Pages 9-10, Lines 40-41<br><br>We believe the DWS came before DCG. | Accept. The drinking water standard (MCL) of 8 Pci/l will be called out separately and the reference to the DCG will be deleted. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 156. | Section 9.2.2<br><br>**Comment:** This section of the AAMS Report discusses the five contaminants proposed for direct application of Interim Remedial Measures (IRMs). As discussed, IRMs are based on risk reduction. The response object of an IRM can be a reduction in RRI or effective implementation of containment.<br><br>It is our opinion that tritium must be considered for an IRM because it presents a high risk level and exceeds the Maximum Contaminant Level (MCL) by more than 200 times. According to section 9.2.4.2 (page 9-17), tritium has the fifth highest current carcinogenic RRI and the fourth highest future RRI level.<br><br>Section 9.2.4.2 states that no ERA is proposed for tritium because "there is presently no commercially viable treatment system to remove tritiated water from the groundwater." Containment using hydraulic barrier and control systems is viable using proven, routine, and cost-effective technology. Moreover, because of the relatively short half-life of tritium, containment will actually achieve a specific reduction in contaminant levels and RRI.<br><br>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 contaminant plumes. 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 and $^{99}Tc$ does not increase the tritium RRI. | Reject. Containment is a viable technology. However, implementation of this technology on the scale required for tritium is not considered to be consistent with an IRM. This technology will likely be implemented to some extent in association with IRMs (e.g., pumping / treatment / reinjection) and therefore may accommodate tritium containment. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | **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 in the proposed single multi-contaminant IRM for the overlapping plumes of these contaminants. Entries for tritium in Tables 9-1 and 9-2 will require modification. | |
| 157. | Section 9.2.3 Pages 9-12.14<br><br>**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. As stated on page 9-14, lines 37-38, some contaminant plumes for which an ERA or IRM is recommended also have portions where an LFI is recommended.<br><br>We believe an LFI may be required to evaluate DNAPL behavior and portions of the carbon tetrachloride plume.<br><br>**Recommendation:** Include the DNAPL portion(s) of the carbon tetrachloride plumes with the proposed contaminants for LFIs listed in section 9.2.3. | Accept. LFI studies will address DNAPL aspects of the carbon tetrachloride plumes in the 200 West Groundwater Aggregate Area where DNAPLs are more likely to be present than in the 200 East Groundwater Aggregate Area. The list of contaminants to be addressed as part of the LFIs specifically leaves out the higher ranked constituents, which will be addressed by an ERA or IRM, but will also have aspects for study under the LFI program. See also response to Comment 151. |
| 158. | Section 9.2.3 Pages 9-15, 4th bullet<br><br>Clarify the statement "sanctioned by EPA". | Accept. Reference to IRIS and HEAST will be added. |
| 159. | Section 9.2.3, Pages 9-15, Line 39<br><br>'Aquifer test' is preferred over 'pump test.' | Accept. Suggested terminology will be used. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 160. | Section 9.2.4.2 First paragraph in the section, Page 9-17<br><br>**Comment:** Same comment as for Section 7.2.2 for the viability of removing tritium from groundwater<br><br>**Recommendation:** Delete the sentence beginning on line 7 of page 9-17. | Accept. See response to Comment 127. Text will be revised to indicate that tritium treatment technology is available but unproven on a large scale basis. |
| 161. | Section 9.3.1, Page 9-19, Lines 12 through 15<br><br>The 200 East groundwater has been divided into two operable units, GW-OU-3 and GW-OU-4, based on current groundwater flow patterns and plume distributions. The text states that this division will change in response to recharge conditions but should be consistent over the period of time during which the studies will be performed. However, the operable unit definition should specify the duration of the remedial action phase, especially since long-term pump and treatment may be involved. Because of the relatively flat potentiometric surface under the 200 East Area, the effects of pumping on localized lithologies will be significant in controlling groundwater flow in this area. Figures 4-16, 4-17, 4-18 estimate the present, near-future, and future groundwater flow paths for the 200 Areas, respectively, and indicate changes caused by the closure of 216-B-3 pond and state approved liquid disposal structure (SALDS). The approximate near-future and future schedules should be estimated to show whether separate groundwater operable units in 200 East Area are appropriate. | Accept. Figures 4-16, -17, and -18 are only schematic, and certainly not based on modeling, and so cannot be used to estimate appropriateness of designated operable units or schedules. No change to text. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 162. | Section 9.3.3.2.5 Pages 9-28, 2nd Page, Lines 23-25<br><br>Why GW-OU-4? Why not GW-OU-3? The movement of the groundwater is to the southeast.<br><br>**Recommendation:** Clarify the above. | Accept. Groundwater flow in arsenic plumes A and B appear to be different and should be addressed separately by each operable unit. Text will be modified. In addition, Figure 9-2 will be modified to allow the operable unit boundary to be less controlled by source operable unit boundaries. |
| 163. | Section 9.5.1, Page 9-36, Lines 22 through 25<br><br>Several references are made to information being gathered for Projects C-018H and C-049H that may be applicable to the 200 Area groundwater operable units. A brief summary of these projects and a project status report should be provided. | Reject. Reference here is to technology development only. |
| 164. | Section 9.3.2 Pages 9-20, Lines 4-12<br><br>Just how similar are $^{90}Sr$, $^{137}Cs$, and $^{239,240}Pu$ in chemical and physical properties? | Accept. Reference to "similarities" will be removed. Multiple technologies may be required for treatment of this groundwater. |
| 165. | Section 9.6, page 9-37, Lines 33 through 35<br><br>Additional monitoring wells should be strategically located based on data needs and not arbitrarily selected as proposed for an initial investigation. | Accept. Reference to number of wells will be deleted. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 166. | Section 9.4.1 Page 9-34<br><br>**Comment:** This section of the AAMS Report proposed a Focused Feasibility Study (FFS) on barrier technology for groundwater remediation. We strongly 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.<br><br>Section 7.4.1 discusses preliminary remedial action alternatives, including containment of groundwater. Lines 3-4, page 7-15 indicate that information on the entire range of remedial alternatives is provided. While Table 7-3 (page 7T-3b) does list hydraulic containment as effective and implementable, only grouting and ground-freezing are considered among the remedial alternatives.<br><br>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 East 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.<br><br>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 | Accept. See response to Comment 128. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | flow patterns. These changes could be engineered for control of contaminant migration, even though clean groundwater is being extracted and reinjected.<br><br>Hydraulic containment using clean water extraction and reinjection is also unconstrained by the very complex treatment requirements associated with extraction of contaminated groundwater. Containment can be implemented to control plumes of essentially untreatable contaminants such as tritium. In comparison with pump-and-treat systems, extraction of even very large volumes of clean groundwater for hydraulic containment should be relatively inexpensive.<br><br>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.<br><br>A form of hydraulic containment could be implemented by institutional controls on artificial recharge induced by irrigated agriculture and modified irrigation systems perhaps utilizing seepage from hydraulic containment systems upgradient and to the west of the 200 Areas.<br><br>**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 section 7.4.1 and add a hydraulic containment alternative to section 7.6. | |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 167. | Section 9.6, p. 9-37, line 33<br><br>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, regional investigations require geologic, water quality, and water level control with a density of something like 1 (or more) data point per $m^2$. This is mainly defined by the complexity of the geology, geochemistry, and flow system; the Hanford site and the 200 Areas are as complex as they come. Further development of an operable unit work plan will be required before assigning a specific number of wells to this task. | Accept. Phrase referring to number of wells will be removed. Selection of the wells will likely be made in operable unit work plans. |
| 168. | Section 9.6 Pages 9-37..38<br><br>**Comment:** This section of the AAMS Report proposed three investigations to be conducted on an Aggregate-Area scale. We believe three additional technical issues require characterization on an Aggregate-Area or broader scale:<br><br>I. Accounting for the volume of contaminants discharged on the Hanford site should be improved. More accurate accounting of contaminant discharges versus plumes would supplement decision-making criteria discussed in section 9.1.<br><br>II. The relationship between geology and groundwater hydraulic parameters needs to be better characterized. This data gap was identified in section 8.2.3 (page 8-22, lines 32-37). | I.: Reject. We do not believe additional data for discharges will resolve the discrepancy issue. The data gap is not a major factor in the decision making process.<br><br>II.: Accept. A Groundwater Transport Characterization recommendation will be added. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | III. Characterization of the degree of interconnection between the shallow sedimentary and deep basalt aquifers was identified as a data gap in AAMS Report section 8.2.3 (page 8-23, lines 35-41). Additional investigation of this issue should utilize the extensive information compiled in 1986-87 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. In conjunction with the concern over $^{129}I$, more than 600 USDOE and contractor documents were compiled and made available to WDOE. Converse Consultants and URS Consultants reviewed these documents and submitted a report of findings to WDOE in January, 1988.<br><br>**Recommendation:** Include recommendations for studies I, II, and III discussed above in section 9.6. | III.: Accept. This will be a part of the Groundwater Transport Characterization. Documents cited will be reviewed as part of Work Plan development. |
| 169. | Figure 9.1 Page 9F-1<br><br>**Deficiency:** In follow-up to the previous comment, the logic path identified in this figure appears to reinforce the need to address tritium.<br><br>**Recommendation:** Discuss further and modify report or clarify logic appropriately. | Reject. See responses to Comments 153 and 156. |
| 170. | Table 9.1 Page 9T-1<br><br>**Deficiency:** Tritium has been omitted from any further action under this table.<br><br>**Recommendation:** Remedy by including or explaining logic. | Reject. See response to Comment 169. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 171. | Table A-9 Page AT-9n<br><br>Footnote 'i' appears in the table but not at the end where an explanation is needed. | Accept. The "i" footnote reference (typo) will be corrected to an "f" footnote reference. |
| | **Supporting Document:**<br><br>**Hydrogeologic Model for the 200 East Groundwater Aggregate Area.** | |
| 172. | Figure 2-15, p. F2-15<br><br>Contour interval is incorrectly stated to be 5 meters, it is probably 12.5 meters.<br><br>Some areas are shown on this map as having a non-zero thickness. However, none of those units are present on previous maps showing the thickness of the individual units making up the Hanford formation. If the sum is non-zero, one of the components that make the sum must be non-zero. Correct the thickness map(s) to reflect this error. | ACCEPT FIRST PART OF COMMENT. An Engineering Change Notice (ECN) is being prepared to correct the map contour interval error.<br><br>REJECT SECOND PART OF COMMENT. Discrepancies between the isopach maps of the Hanford formation (total) and individual Hanford formation sequences are due to the inability to differentiate the upper and lower gravel sequences in various localities of the 200 East aggregate area. Where the sandy sequence is missing, it is not possible to differentiate the two gravel sequences due to their similar texture and clast lithologies. If it is not possible to differentiate the upper and lower gravel sequences, the term "Undifferentiated Hanford" is used. As a result, the isopach map of the Hanford formation will show apparent thickness in localities dominated by undifferentiated Hanford (no intervening sandy sequence), whereas isopachs of the individual gravel sequences only show those areas were they (individual sequences) can be distinguished. |
| 173. | Section 3.1.1, p. 3-1, First paragraph<br><br>It is well known that the Van Genuchten relation does not hold up near saturation. This shortcoming should be so noted here, and a recommendation made to directly measure hydraulic conductivity in situ or by column methods if unsaturated hydraulic conductivity values in the near saturation range are needed. | REJECT. Recommendations for determining unsaturated hydraulic conductivity (unsat-K) are beyond the scope of this document. The document does state that there are differences between measured and theoretically derived unsat-K values, and that efforts are ongoing to develop methods to directly measure unsat-K. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 174. | Section 3.2.1.2, p. 3-9, 4th line<br><br>Typo. error, exit should be exist. | ACCEPT. An Engineering Change Notice (ECN) is being prepared to correct the typographical errors. |
| 175. | Section 3.2.4.2 Page 3-20, Line 6<br><br>The vertical gradient 'is substantial (Figure 3-41)' probably should refer to 3-40 where head contours are shown. | ACCEPT. An ECN is being prepared to correct the typographical errors. |
| 176. | Section 3.2.4.2 Page 3-20, Section on 'Well 699-54-57'<br><br>We disagree with the stated reasoning for your conceptual model concerning wells 699-54-57 and 699-55-57. On page 3-18 and in Table 3-4 (P.3-16) it is stated that upward flow is occurring in the area near these wells. However, on page 3-20 aquifer communication is used to explain the contamination of the water in well 699-54-57 (the deeper well of the pair). If only upward flow is documented by water-level data it is inconsistent to then state that contamination is moving downward to the deeper aquifer. An alternative conceptual model could be formed using the information on figure 3-12. That figure shows water levels in a piezometer nest near 699-54-57 and 699-55-57, that indicate a downward gradient. If downward flow is occurring, this may explain the contamination in the deeper (semi-confined?) aquifer. The wells shown in figure 3-12, 699-53-55 (A-C), are in the uppermost aquifer but right over the erosional window in the Elephant Mountains Basalt. If contaminants were moving downward through the window and then laterally toward Gable Gap, they could be detected in well 699-54-57. | REJECT. The well cluster referred to by the reviewer (699-53-55A/B/C) only monitors the upper 1/2 of the uppermost aquifer system in this area, and thus does not permit adequate determination of the vertical hydraulic gradient between the Rattlesnake Ridge aquifer (remnants at the base of the erosional window) and the uppermost aquifer system. From the hydrographs for well cluster 699-53-55A/B/C, it does appear that there is a downward gradient in the erosional window area. We believe that this apparent downward gradient is a product of the geometry of the aquifer and the vertical positioning of the well cluster monitoring wells. Saturated thickness of the aquifer changes from less than five feet south of the erosional window to over 150 feet within the erosional window. This extreme lateral thickening occurs over a distance of less than 2000 feet. The downward gradients observed in the upper 1/2 of the aquifer at the 699-53-55A/B/C is probably related to this abrupt thickening of the aquifer.<br><br>Note that current head data from surrounding well clusters monitoring the Rattlesnake Ridge aquifer and uppermost aquifer system indicate that the vertical hydraulic gradient between the two aquifers ranges from indeterminant to upward. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| | | Historical water quality data indicate that the Rattlesnake Ridge aquifer was impacted in the feneral vicinity of well 699-54-57; current data indicate that contaminant levels have fallen off to near-background conditions. The historical impact was probably due to contaminated groundwater from the uppermost aquifer system discharging into the Rattlesnake Ridge aquifer via the erosional window. At the time of these impacts, water levels in the uppermost aquifer system were much higher than current conditions due to large volumes of waste water disposed in the 200 East Area and in the nearby Gable Mountain Pond. These increased water levels probably produced a significant downward vertical gradient between the two aquifers in the vicinity of the erosional window, which in turn provided the driving force for introduction of contaminated groundwater from the uppermost aquifer system in to the Rattlesnake Ridge aquifer. These conditions no longer exist, so it is doubtful that the erosional window is currently functioning as portal for the discharge of contaminated groundwater from the uppermost aquifer system into the Rattlesnake Ridge aquifer. |
| 177. | Figure 3-8<br><br>Is this a saturated thickness? If so, during what time were the water level taken? | ACCEPT. The map represents saturated thickness. Data used to generate the map are the same data used to generate the water table map in figure 3-9 (December 1991). An ECN is being prepared to clarify the map data. |

| 14. Item | 15. Comment(s) (Provide technical justification for the comment and proposed action to correct or resolve the comment.) | 16. Disposition (Provide brief justification if NOT accepted.) |
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| 178. | Figure 3-41<br><br>Mapping the 'locations of past and present aquifer communication' would seem to limit any investigation of communication to those areas identified on the figure. we would argue that ground water has and will flow between all the aquifers solely dependent on the existing gradient and hydraulic conductivity of the materials present. Since we consider that these factors are a continuum and they vary laterally and vertically, but nowhere are they exactly zero, communication has occurred virtually everywhere under the site and will probably continue to do so. | ACCEPT. No change required. The authors agree with the reviewer's statements regarding the nature of aquifer communication. For your clarification, the intent of figure 4-41 was to provide a summarization of known locations of water quality impacts to the Rattlesnake Ridge aquifer as a result of aquifer communication. Rather than limiting the study of aquifer communication, the figure provides a starting point for further investigation. |
| 179. | Appendix C:<br><br>An Aquifer designation for each well would help the reader to relate this QW information to the hydrogeology of the area. | ACCEPT. No change required. All water quality data in appendix C were collected from wells screened in the Rattlesnake Ridge aquifer. This is indicated in the text for Chapter 3. |

ATTACHMENT 1

| Well | OGWM Table 2-9 | RCRA Table 2-10 | CERCLA Table 2-24 | PNL Table 2-25 |
|---|---|---|---|---|
| 299-E17-12 | 313-334 | | | 317-338 |
| 299-E28-26 | | 278-325 | | 279-299 |
| 299-E32-3 | | Hlg | | Unit E |
| 299-E27-9 | | 219-239 | | 220-239 |
| 299-E27-10 | | DNF | | 212-240 |
| 299-E18-1 | | 208-379 | | 308-329 |
| 299-E18-2 | | Unit E | | Hlg |
| 299-E18-4 | | Unit E | | Hlg |
| 299-E25-32P | | 259-279 | | 260-280 |
| 299-E25-32P | | Hlg | | Unit A |
| 299-E25-26 | | Hlg | | Unit E |
| 299-E25-34 | | 282-272 | | 252-272 |
| 299-E25-34 | | Hlg | | Unit E |
| 299-E25-35 | | Hlg | | Unit E |
| 299-E17-15 | | Hlg | | Unit E |
| 299-E17-20 | | Hlg | | Unit E |
| 299-E25-11 | | Undifferentiated | Unit E | |
| 299-E25-18 | | Undifferentiated | Unit E | |
| 299-E25-19 | | Undifferentiated | | Unit E |
| 299-E25-20 | | Undifferentiated | | Unit E |
| 299-E25-21 | | Hlg | | Unit E |
| 299-E25-31 | | Hlg | | Unit E |
| 299-E25-36 | | Hlg | | Unit E |
| 299-E25-25 | | Hlg | | Unit E |
| 299-E25-33 | | Hlg | | Unit A |
| 299-E25-37 | | Hlg | | Unit E |
| 299-E25-38 | | Hlg | | Unit E |
| 299-E25-29P | | Hlg | | Unit E (bottom) |

| Well | OGWM Table 2-9 | RCRA Table 2-10 | CERCLA Table 2-24 | PNL Table 2-25 |
|---|---|---|---|---|
| 299-E33-12 | | | Hlg | Basalt |
| 299-E33-38 | | | DNF | 219-240 |

| Well | OGWM Table 2-9 | RCRA Table 2-10 | CERCLA Table 2-24 | PNL Table 2-25 |
|---|---|---|---|---|

ATTACHMENT 1 (cont)

DNF = Data Not Found
Unit E = Ringold Formation Unit E
Unit A = Ringold Formation Unit A
Hlg = Hanford Formation Lower Gravel

Note: Depth of screened intervals are shown in feet.

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