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Department of Energy
Richland Field Office
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Richland, Washington 99352

OCT 30 1992

93-TPA-013

Mr. Paul T. Day
Hanford Project Manager
U.S. Environmental Protection Agency
Region 10
712 Swift Boulevard, Suite 5
Richland, Washington 99352

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

Dear Messrs. Day and Jansen:

DRAFT RESPONSES TO COMMENTS ON THE HANFORD SITE SOIL BACKGROUND DOCUMENT

Please find enclosed the responses to the written comments received on the Hanford Site Soil Background Report (DOE/RL-92-24). The Background Report was submitted on April 30, 1992, fulfilling the Hanford Federal Facility Agreement and Consent Order Milestone M-28-03. The comments responded to in the enclosure were received from the U.S. Environmental Protection Agency (EPA) and the State of Washington Department of Ecology (Ecology).

Response to these comments was not possible without an agreement between both EPA and Ecology regarding the clarification of issues and documents revision. The most efficient way to reach agreement in this instance was by joint meetings among representatives from the U.S. Department of Energy, Richland Field Office (RL), Westinghouse Hanford Company (WHC), EPA, and Ecology. Two of these meetings have been held (August 31, 1992, and September 16, 1992), and all comments were addressed and resolved, with a few exceptions noted in the attachment. Given schedule conflicts between the parties involved, RL and WHC have responded to the comments in the most timely manner possible.

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Adherence to a prearranged schedule for responses and comments from Ecology were received on July 9, 1992. Submittal of these responses to EPA without integrating Ecology's review and reflecting a consensus opinion from both agencies was not possible within 45 days of comment transmittal.

If you have questions, please contact me or Mr. K. M. Thompson of my staff on (509) 376-6421.

Sincerely,

Steven H. Wisness
Hanford Project Manager

EAP:KMT

Enclosure:
Draft Responses for the Hanford
Site Background Report

cc w/enclosure:
C. Cline, Ecology
P. S. Innis, EPA
F. A. Ruck III, WHC
B. A. Austin, WHC
cc w/o enclosure:
G. W. Jackson, WHC

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RESPONSE TO COMMENTS FROM THE ENVIRONMENTAL PROTECTION AGENCY (EPA) AND THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY (ECOLOGY) ON DOE/RL-92-24, "HANFORD SITE SOIL BACKGROUND"

The U.S. Department of Energy, Richland Field Office and the Westinghouse Hanford Company have prepared draft responses to the written comments on DOE/RL-92-24 submitted by EPA and Ecology.

General comments of both agencies are responded to first, followed by the specific comments.

Each comment number and the agency submitting the comment is identified. The general comments made by Ecology were numbered 1 through 9 and are so designated. The general comments made by EPA were not numbered, but have been designated 1 through 10 here. The specific comments are also numbered and presented in sequence according to section and paragraph.

In most instances, Ecology also provided recommendations as to how the comment might be resolved.

These recommendations are also included after each comment, to assist the reader in evaluating the responses provided.

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GENERAL COMMENTS

Comment (1-Ecology):
Deficiency:
The document does not contain a section detailing any deviation from the sampling plan that may have occurred during sampling activities. For example the Site-Wide Background Soil Sampling Plan (Revision 0) states in Section 6.2.4 page 7, that two samples were to be collected at each organic sampling point: and no deeper than the upper foot of surface soil, and the other from the point of an exposure roughly corresponding to a 3-foot depth. However, the Hanford Site Soil Background Document states that samples were collected from the top 6 inches of soil (Appendix b, Section 1.2, page 109, fifth paragraph).

Recommendation:
Add a section to the document detailing any deviations from the sampling plan that may have occurred during sampling activities.

Response:
Any deviations from the Sampling Plan will be documented in Appendix B.

Comment (1-EPA):
The terms "surface soil/sampling", "subsurface soil/sampling", and "vadose zone soil/sampling" are used interchangeably throughout the text. This can be confusing to the reader. A distinction should be made. The sampling sites are exposed and could be considered "surface" sites however the term is more often viewed as referring to the land surface level not exposed faces.

Response:
These terms will be reviewed and clarified throughout the document.

Comment (2-Ecology):
Deficiency:
In many places in the soil background document, reference is made to a statistical approach for determining a threshold concentration described in Washington Administrative Code (WAC) 173-340-708(11)(d). During their development of a statistical guidance document, Washington Department of Ecology (Ecology) has determined that the statistical approach used is not the best approach to use for identifying a threshold concentration. An approach, which more carefully balances the risk of identifying a contaminated area as clean and the risk of identifying a clean area as contaminated, should be available by the end of August, 1992. this approach uses a lower percentile that the one currently outlined in the WAC. .

Recommendation:
The statistical approach for determining a threshold concentration should be evaluated in light of Ecology's forthcoming guidance document (i.e., the Model Toxics Control Act (MTCA) Statistical Guidance document, particularly since the approach adopted at the Hanford site will be a model for other sites in

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the country.

Response:
The Guidance document referred to has been reviewed and discussed with EPA, USGS and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore agreement was reached that WHC will develop justifiable statistical procedures.

Comment (2-EPA):
The report does not explain whether surface soil samples are collected and analyzed for inorganic constituents. However, the terms "surface sampling strategy" and "compositional integrity of surface samples" appears in the report. Separate site background data for surface soils should be collected.

Response:
Use of the terms will be clarified. Samples collected from the various ecosystems on the Hanford Site were collected from the upper 6 inches of soil, and analyzed for organic and inorganic analytes. The evaluation of these data are to be included in the next revision.

Comment (3-Ecology):
Deficiency:
An evaluation of the new approach outlined under MTCA was performed to see what the effect would be on the computed threshold values. The following steps were followed to determine the threshold values based on the proposed new MTCA guidance:

Using a=0.05, compare the background data to a lognormal distribution using the Shapiro-Wilk "W" goodness-of-fit test (for n < 50), or D'Agostino's test (for n>=50) (D'Agostino, 1971, Conover 1980, and Gilbert 1987). If the hypothesis of a lognormal distribution is rejected, test the hypothesis of a normal distribution using the above-mentioned statistical tests. If the hypothesis of a normal distribution is also rejected, apply non-parametric methods for computing percentile values.

The appropriate percentile value to be used as threshold depends on the distribution of the data. For lognormal data, compute the 90th percentile; for normal data, compute the 80th percentile. If non-parametric methods must be used, compute the sample-based 90th percentile. The 80th percentile value for normal data and the sample-based estimate of the 90th percentile for non-normal data are strictly example values as would probably be applied as part of the MTCA statistical guidance manual. The precise values for calculating threshold concentrations for non-lognormal data would have to be determined following consultation with Ecology.

The 50th percentile should also be computed and used to calculate the ratio of the distribution-appropriate percentile value to the 50th percentile value

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(e.g., for lognormal data, the ratio is the 90th percentile value to the 50th percentile). This ratio is used to determine the level of skewness in the data set; if the ratio is greater than 4, then 4 times the 50th percentile value will be used as the threshold, rather than the distribution-appropriate percentile.

Several contingencies exist regarding the selection of the 90th percentile as the threshold value for lognormal data. The first contingency assumes that the compliance monitoring data are also lognormally distributed. In addition, the method of Land (1971, 1975) would be used to estimate the upper confidence limit on the mean of the compliance monitoring data when comparing these data to the background threshold level.

Three analytes were selected for this analysis under the proposed new guidance. Results of these analyses are presented in Figures 1-3 (shown at the end of these comments) and are summarized below.

Results for aluminum data:
All aluminum data listed as systematic samples in the tables of Appendix C were used in this analysis. Figure 1 shows histograms for the untransformed and log transformed (natural log) aluminum data. D'Agostino's test revealed that these data are not significantly different from a lognormal distribution (a=0.05); the ratio of 90th percentile to 50th percentile is 1.6. Hence, the 90th percentile value should be used as the background threshold value. The revised threshold value is 12,200 mg/kg, which is more conservative than the threshold value of 15,100 mg/kg based on the Weibull distribution. Guidance for calculating the values intended under the existing rule (i.e., the lower 95 percent confidence limit of the 95th percentile [lower 95/95] for a normal or lognormal distribution) was not identified in available literature. Therefore, for comparison of the values computed using the new guidance to those computed using the existing rule, non-parametric methods were used to compute the lower 95/95 value. This calculation resulted in 14,800 mg/kg as a threshold value.

Results for calcium data:
All calcium data listed as systematic samples in the tables of Appendix C were used. The data points identified as "outliers" in the text were not excluded because quality assurance and quality control (QA/QC) criterium (sic) did not indicate any error in the data (see later comments on outliers). In addition, values below 5600 mg/kg were not excluded because no justification for their exclusion could be determined.

Figure 2 presents the histograms of the untransformed and log transformed calcium data. The untransformed data appear to be right skewed, whereas the log transformed data appear to be normally distributed. However, hypothesis testing (D'Agostinos' test, at a=0.05) revealed that these data violate the hypotheses of an underlying normal or lognormal distribution. Because of the apparent lognormal distribution based on the histograms, a test of lognormality was also performed excluding the three highest data points to evaluate their influence on the results of the hypothesis test. The hypothesis of a lognormal distribution excluding these data points could not be rejected

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at a=0.05. However, because evidence identifying these data as outliers was insufficient, they were not excluded from final analyses. Consequently, a non-parametric method should be used to calculate the threshold value for calcium.

The ratio to 90th percentile to 50th percentile is 1.9; therefore, the non-parametric threshold value was calculated using the 90th percentile of the calcium data set. The threshold value obtained was 18,000 mg/kg, which is more conservative than the threshold value of 22,000 mg/kg based on the Weibull distribution. The lower 95 percent confidence limit of the 95th percentile (lower 95/95) based on non-parametric methods yields a value of 18 600 mg/kg.

Results for copper data:
Figure 3 shows histograms for untransformed and log transformed copper data. This analysis includes all systematic samples shown in the tables of Appendix C. D'Agostino's test rejected the hypothesis of a lognormal and a normal distribution at a=0.05. For this reason, sample-based 90th percentile values were used as the appropriate means for computing background threshold values. The ratio of 90th percentile to 50th percentiles is 1.6. Therefore, the sample-based 90th percentile was used as the background threshold value. The revised threshold value is 22.8 mg/kg, which is more conservative than the value of 32.8 mg/kg based on the Weibull distribution. The lower 95/95 estimate based on non-parametric methods yields a value of 22.8 mg/kg.

Recommendation:
The statistical approach outlined under Ecology's proposed new guidance consistently results in more conservative estimates for the background threshold values than those calculated using the upper 95/95 estimate based on the Weibull distribution. The lower 95/95 estimate is relatively close to the values computed using the new guidance. However, the new guidance provides more information regarding the distributional assumptions involved in the calculation of background values and the comparison of background to site monitoring data. Therefore, it is recommended that the new guidance be used to compute threshold values for this site and to evaluate elevations above background.

Response:
The Guidance document referred to has been reviewed and discussed with EPA, USGS and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore, agreement was reached that WHC will develop justifiable statistical procedures.

Comment (3-EPA):
Vadose zone soil samples are collected from exposed vertical surfaces of excavation pits, manmade pits, exposed hillsides, river overbank deposits, trenches, and burial grounds. Since these exposed surfaces may have been subjected to contamination from external influences such as precipitation, runoff, fallout, dust, and erosion, it remains questionable whether the data obtained from these samples provide accurate background information. The

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report should document the "appropriate procedures" and "quality control" used for representative samples from these locations.

Response:
Please referr to the Model Toxics Control Act definition of "natural" background. A considerable effort has been expended to determine natural background free of anthropogenic effects. The procedures used to assure that the samples were collected free from external influences will be discussed in the next revision.

Comment (4-Ecology):
Deficiency:
The approach that was used for determining the threshold concentration for background was apparently interpreted as the upper 95 percent confidence limit of the 95th percentile. The regulations [WAC 173-340-708(11)(d)] are unclear whether the upper or lower confidence limit on the 95th percentile should be used as the threshold value (95/95 rule); however, Ecology interprets the background level referenced in the rule to be the lower 95 percent confidence limit. This selection of the 95th percentile value was based on the assumption of normally distributed data. It is unknown how the lower or upper 95 percent confidence limit about the 95th percentile of the Weibull distribution will perform in setting the threshold values, such that there is sufficient confidence that contaminated sites will exceed the threshold.

Recommendation:
If the assumption of normality or lognormality is rejected based on a significant result (alpha=0.05) of an approved statistical test, then non-parametric procedures should be used. There are provisions in the regulations stating that alternative procedures (such as the Weibull distribution) may be used with the consent of Ecology. If alternative procedures were in fact approved by Ecology for the Hanford site, it should be clearly stated in the introduction to the statistical analyses. If such alternative procedures are proposed to Ecology, the performance of the proposed values in predicting "clean" and contaminated sites should be considered. The performance of the comparison between these threshold values and data sets sampled from the same population should be evaluated based on the potential errors (i.e., Type I and II; when are "clean" sites determined to be contaminated, and when are contaminated sites determined to be "clean").
Response:
The Guidance document referred to has been reviewed and discussed with EPA, USGS and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore agreement was reached that WHC will develop justifiable statistical procedures.
Comment (4-EPA):
Field duplicate samples are not collected and analyzed to evaluate the homogeneity of the medium sampled in a particular location or the precision in sampling.

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Response:
Field duplicate samples have been collected in accordance with EII's which does not allow splitting of samples. Field duplicates typically had a spacing of 3-6 inches between centers of volume collected. Because these are solid samples, exact duplication of values between paired samples is not a reasonable expectation. Examining the variance between samples in light of the variogram analysis results is appropriate as is comparing the distributions of values from each lab. Results of the variogram analysis indicate that the randomness in the medium is, in general, stationary and anisotropic (e.g., the variance in measurement results depends on vertical vs. horizontal direction that it is calculated in, but not on the distance), consistent with the overall deposition model. The variance of the sediments in the vertical direction is on the same order as the variance between field duplicate samples. In other words, pairs drawn randomly from the same vertical profile would yield the same statistical results as would be obtained by examining the field duplicate samples. This indicates that the paired nature of the data is not critical to maintain in performing the analysis of the field duplicate data.

Modification of the soil column through development of caliche has given calcium an apparent mild degree of nonstationarity. This is being further investigated.

Comment (5-Ecology):
Deficiency:
Without more information than is provided in the document, it is difficult to replicate calculations using the Weibull distribution.

Recommendation:
If the approach described in the document (using the upper 95/95 rule based on an underlying Weibull distribution) is approved by Ecology, complete information on how these values were computed should be included. Since the critical values for determining the percentile values and confidence limits for the theoretical Weibull distribution are not standard statistical material, a discussion and example of how these were derived and applied should be included.

Response:
Methods for working with Weibull distributions are well established in the literature. This information will be referenced or included as appropriate.

Comment (5-EPA):
Systematic random samples are collected from limited depths. The report should clarify how the samples collected from these depths represent the entire depth of the Hanford formation at these respective locations. The depth of the vadose zone varies from 30 feet to 200 feet at various waste management units.

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Response:
The sampling locations did cover the stratigraphic section of the Hanford formation, see Figure 4.1. It is true that the entire Hanford formation was not sampled at each sampling location. An additional figure or figures will be added to the report to better illustrate the stratigraphic and facies relationships.

Comment (6-Ecology):
Deficiency:
When comparing a set of data to background concentrations, additional considerations beyond just the threshold concentration are used (WAC 173-340-740(7)(e) and (f)). These considerations limit the number of samples that may exceed the threshold value, as well as set a limit on the maximum concentration of any one sample. The purpose of the additional criteria is to compare the overall distribution of the sample data set to the distribution of the background data set, not just to a single number derived from the background data set. Using the methods in WAC 173-340-740(7)(e) and (f) or the proposed guidance document, individual values from the sampling data are never compared independently to the background criteria or threshold value, as is stated in the soil background document. Either an upper confidence interval around the mean of the data set (for chronic or carcinogenic effects) or an upper tolerance limit around the 90th percentile of the data set (for acute or short-term effects) is compared to a background threshold.

Recommendation:
Revise the description of how data will be compared to background thresholds as described in the preceding paragraph.

Response:
The Guidance document referred to has been reviewed and discussed with EPA, USGS and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore, agreement was reached that WHC will develop justifiable statistical procedures.

Comment (6-EPA):
The usefulness of judgment samples is not clearly explained. It would be appropriate to determine separate background levels for strategically distinct units or subunits (end members) or a single average for Hanford formation with appropriate inclusion of end member samples.

Response:
The excluded samples are not exclusively endmembers. The judgment samples were collected for completeness, etc. (PARCC parameters), and included any part of an exposed section that appeared to be significantly different or important from the systematic random samples (e.g, darker or lighter, a missed lens, etc.). In the course of the evaluation, all the judgment samples expected to belong to the compositional population (other than exotic deposits, such as volcanic ashes) were in fact found to be included within the

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range of compositions defined by the systematic random samples, corroborating the conceptual model.

Comment (7-Ecology)
The conceptual model for soils can be confirmed or refined by performing and presenting adequate data analysis to demonstrate that there are no significant spatial trends across the site. At a minimum, values for the key constituents found in the soil should be plotted on a map and contoured to demonstrate that no obvious spatial trends exist across the site.

Response:
Analysis of data for spatial trends will be done if results of the variogram analyses indicate its necessity.

Comment (7-EPA):
Certain sampling activity objectives stated in Section 2.1 of Appendix A are not addressed. These include (1) the factors that affect the chemical composition of the Hanford site soils, (2) how these factors influence the compositions obtained by regulatory protocols, and (3) the type of compositional variability that exists.

Response:
These topics will be addressed in the next revision.

Comment (8-Ecology)
Deficiency:
Concentration units are missing from many figures.

Recommendation:
Units should be added to the axes of all figures.

Response:
Units will be added to next revision.

Comment (8-EPA):
Analytical results for soil sample leachates are reported in milligrams per liter (mg/L). However, the usefulness of such results for background conditions is limited. Background soil data should be reported on a dry-weight basis in milligrams per kilogram (mg/kg) or micrograms per kilogram (μg/kg) for comparison with site soil contamination.

Response:
Units will be added to next revision.

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Comment (9-Ecology)
Deficiency:
Definition of Terms Page ix, sixth paragraph; See general comment 2.

Recommendation:
See general comment 2.

Response:
see response to general comment 2.

Comment (9-EPA):
The soil report contains excessive statistical analyses which do not aid the reader's understanding of the site background soils. There is also some confusion between "background" and "threshold" values and concentration units are omitted.

Response:
More complete descriptions will be provided as to the purpose of each analysis.

Comment (10-EPA):
The preliminary results seem to support the conceptual model however, the deviation of sodium from the expected result will need further explanation.

Response:
The conceptual model is being modified to account for the behavior of sodium. Complete discussion will be included in next revision.

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SPECIFIC COMMENTS

EXECUTIVE SUMMARY

Comment (EPA Typo)Executive Summary, p.iii, line 17
Change "organic" to" inorganic".

Response:
The word change will be made.

Comment (1-EPA) Executive Summary, p. iii:
Line 34 uses the term "dangerous waste". The usage is inappropriate since this may be misconstrued to reference the Dangerous Waste regulations (WAC 173-303).
Response:
The sentence will be clarified to indicate reference to dangerous and/or hazardous wastes.

Comment (2-EPA) Executive Summary, p. iii, second paragraph
The text states, "the compositions of the entire vadose zone appear to be dominated by . . . two ubiquitous constituents in the soils . . . thus these two end members . . . strongly influenced by . . . minor end members." The two ubiquitous constituents and the two end members should be identified.

This paragraph is confusing and should be rewritten to clarify its meaning.

Response:
This paragraph will be rewritten to clarify its meaning.

SECTION 1 INTRODUCTION

Comment (3-EPA) Section 1.0, p. 1-1
In reviewing this report and the study plan for the background study (WHC-MR-0246), an explanation of why the study excludes a definition of the background levels of radionuclides was not found. Radionuclides were apparently excluded from the study because an adequate data base and a statistical analysis of the data already exists for the Hanford Site. If this is true, it should be so noted in the introduction and appropriate references should be provided. If this is not true, please explain how the background levels of radionuclides will be established.

Response:
A paragraph will be added to explain why radionuclide background is a separate study. The title of the revised soil background report will be reevaluated.

Comment (10-Ecology) Section 1.0, Page 1-1, first paragraph;
Deficiency:
The agencies have not stated that remediation of natural background concentrations would serve no practical purpose. In fact, it has been recognized that natural background concentrations of some constituents (e.g., arsenic, radon) are harmful. If it were possible to remediate such concentrations, it would be beneficial. However, the point that should be made is that it is often impractical or impossible to remediate below area background concentrations because of the potential for recontamination , particularly in the case of groundwater, and the difficulties associated with removing natural constituents of the environment.

Recommendation:

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Revise text accordingly.

Response:
The text will be revised to remove the statement referring to remediation of natural background serving no practical purpose, but including a statement that it is often impractical to remediate below area background because of the difficulties associated with removing natural constituents from the environment.

Comment (4-EPA) Section 1.0, p. 1-1
The definition of natural background in the Definition of Terms is not consistent with the definition of natural background noted in paragraph 2 of Section 1.0. The definition of natural background in the Definition of Terms includes low concentrations of anthropogenic organic compounds such as PCB's, while the definition in Section 1 does not. These definitions should be consistent.

Response:
Consistency will be established in the next revision.

Comment (5-EPA) Section 1.0, p. 1-2, second paragraph
Section 1.0 discusses the waste management unit (WMU) background, a single Hanford site background, and the area background. The paragraph should clearly explain why a single Hanford site background concept is used in this study, or a reference should be cited to clarify this decision.

Response:
Clarification will be added, and WHC-MR-0246 will be referenced.

Comment (6-EPA) Section 1.0, p. 1-2, lines 11-13
This sentence implies that natural background for soils will be established with data from analyses of the unconfined aquifer. The last sentence should include a reference for groundwater background or be reworded to specify only the soil media.

Response:
Reference to groundwater will be deleted from the text in the next revision.

Comment (11-Ecology) Section 1.1, p.1-2, first paragraph
Deficiency:
There are no radionuclides, organic chemicals, or trace elements on the list of six "representative" elements (all of the elements chosen are abundant in natural rocks). These types of contaminants might be expected to have different types of distributions than abundant elements, and the statistical methods selected might or might not work as well for them. Therefore, the testing of the method would not be complete unless contaminants with potentially different distributions were included. The elements appear to be

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chosen with the natural geologic compositions in mind, rather than by considering the contaminants for which cleanup standards will be required.

Recommendation:
A complete discussion of how these six elements were chosen and why they are considered to be representative of the contaminants that might be encountered at the site should be provided. For completeness, the proposed statistical methods should also be applied to representative radionuclides, organic chemicals, and trace elements.

Response:
The next revision will extend the statistical analysis to the remainder of the analytes that were measured during the sampling effort. Radionuclide background is not part of this study.

Comment (7-EPA) Section 1.1, p. 1-2
As noted in the last paragraph, the sodium values do not appear to represent a single statistical population. After the obvious outliers were deleted, the sodium values shown in Figure 40 on page F-40 appear to represent two distinct populations. This appears to violate the conceptual model of a single site-wide background population. The statement is made that "this is consistent with the variability in the natural repositories of sodium in the soils (e.g., minerals) and its geochemical behavior." This is an ambiguous statement and is unsupported by further discussion (see comment on Appendix D, Section 2.7, p. 2-7). A better explanation of the divergence of the sodium data from the conceptual model is warranted.

Response:
The conceptual model is being modified to account for the behavior of sodium. This topic will be included in the revised and expanded conceptual model in the next revision.

Comment (8-EPA) Section 1.3, p. 1-4
A brief description of the background conceptual model should be provided or a reference should be cited so that the reader can obtain this information.

In the second paragraph, the text states that the entire vadose zone of the Hanford site can be represented by two end member compositions. The two end member composition should be specified or a reference should be cited for this information.

Response:
An updated conceptual model will be described and references will be added in the next revision.

Comment (9-EPA) Section 1.3, p. 1-4, lines 46-47
It is noted here and elsewhere in the report that the composition of the soil is defined by differing proportions of two end member sediment types and that

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the composition of any sediment sample should fall somewhere between the composition of the two end members. This part of the conceptual model could be tested by obtaining information from the literature or by analyzing representative samples of the end members and comparing the results to confirm that the majority of soil samples tested fall within the range of the end-member compositions.

Response:
The next revision will include a more complete description of the conceptual model tests.

SECTION 2 MEDIA DESCRIPTION

Comment (10-EPA) Section 2.2, p. 2-1
This section should describe validation procedures used to qualify the analytical data. The description of the qualifiers used in Appendix C should also be provided here.

Response:
Validation procedures will be referenced and qualification described in the next revision.

Comment (11-EPA) Section 2.1, p. 2-1, lines 11 and 12
The sentence notes that the Hanford site is located in the Pasco Basin which is a structural element of the Columbia Plateau and references Figure 2-1. Figure 2-1 shows neither the Pasco Basin nor the Columbia Plateau. Either change Figure 2.1 or replace it with a figure that displays the referenced information.

Response:
The reference to Figure 2-1 will be placed after "Hanford Site".

Comment (12-EPA) Section 2.1, p. 2-1, line 18
The Ellensburg Formation also includes epiclastic sediments.

Response:
The sentence will be changed to read "volcaniclastic and epiclastic sediments".

Comment (13-EPA) Section 2.1, p. 2-1, line 25 and 26
The sentence is grammatically incorrect. It may be appropriately written as "The Ringold Formation, which directly overlies the basalt, consists of moderately consolidated fluvial-lacustrine sediment and is the principle member for the unconfined aquifers at the Hanford Site".

Response:
The grammar will be corrected in the next revision.

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Comment (14-EPA) Section 2.1, p. 2-3, lines 18-20
This sentence implies that plant and animal activity are the sole cause of soil horizons.

Response:
A more complete description of the development of soil horizons, naturally-occurring leaching, and weathering processes will be included in the next revision.

Comment (15-EPA) Section 2.1, p. 2-3, lines 37-38 and 44-45
It is noted that subordinate members of the vadose zone are included in the data evaluation process. The EPA believes these subordinate members should be represented by the judgment samples discussed in Appendix A, yet no evaluation of the judgment samples nor discussion of these subordinate members is found in either Chapter 5 or Appendix D.

Compare the results of judgment samples to the general population and discuss the results.

Response:
Discussion of judgment sample and data from the Ringold Formation will be included in the next revision.

Comment (16-EPA) Section 2.1, p. 2-3, lines 47-51
The site-wide soil background exclusively focussed on sampling the Hanford formation sediments. Underlying the 200-West area, the Ringold Formation comprises a large portion of the unsaturated zone, and this portion of the Ringold Formation meets the definition of soil used in this report. How will soil samples taken from the Ringold Formation be compared to background?

Chapter 1 or 2 should address whether the Ringold Formation will be compared to the site-wide background developed for the Hanford formation or to a particular end member or subordinate member of the Hanford formation, or if a separate 200-West Ringold Formation background will be developed.

Response:
This paragraph will be changed to indicate that in some parts of the Hanford Site the Ringold Formation does occur within the vadose zone, intercalated above the water table and beneath the Hanford formation. Wherever the Ringold Formation does occur within the vadose zone and in proximity to a waste disposal site, it could also be impacted by the release of wastes.

The initial comparison of a suspect soil sample will be against the Hanford formation background standard. If any constituents in the suspect sample have concentrations that are above the background threshold, the suspect sample would then be screened to determine if it may be an outlier within the natural geologic framework.

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Background data on the Ringold Formation indicates that most but not all naturally-occurring constituents fall within the range of the Hanford formation concentrations.

Comment (17-EPA) Section 2.1, p. 2-3, lines 47-49
It is unclear as to what is meant by the phrase "these soils support plant growth (DOE 1988) that is largely restricted to the upper few inches of the vadose zone." If this statement refers to rooting depth, it should be noted that "big sage" is common plant type on the Hanford reservation and commonly has a rooting depth of about 3 meters. Please explain or clarify this sentence.

Response:
This sentence will be clarified in the next revision.

Comment (18-EPA) Section 2.3, p. 2-3, line 17
This section states that maximum claimed detection limits are included in Appendix C, but this information is not included in the appendix. This omission should be corrected.

Response:
The table in Appendix C included the maximum quoted (claimed) detection limits for the six analytes for which data is reported. Inclusion of the remaining analyte data will be accompanied by detection limit data for those analytes.

Comment (19-EPA) Section 2.3, p. 2-3, line 21
This section states that the matrix effects for soil samples will be estimated during the statistical analysis. The text should provide details of this statistical estimation.

Response:
The estimation procedure is not statistically based. It depends upon the judgment of the analyst in dealing with apparent noise in the distribution of data. The regression fit for some analytes can be improved by left censoring the data at a value higher than the claimed detection limit. Consistently, these analytes are those for which experience indicates that matrix effects are most dominant. Also consistently, the effects are limited to the 10-12 smallest data points. Truncating the data distribution (left censoring) at this point provides an improved estimate of the 95/95 confidence interval. In as much as the lower tail is noncritical information, left censoring of the data is an acceptable analysis option. This discussion will be included in the next revision.

SECTION 3 DATA SOURCES

9 2 1 2 7 5 7 0 7 8 4

Comment (12-Ecology) Section 3.1, p. 3-1
Deficiency:
Procedures for screening each sampling site to ensure no pollutants were present are absent from the document.

Recommendation:
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), procedures for screening sampling sites for the presence of pollutants should be presented. These procedures may have included the use of monitoring equipment and visual observations.

Response:
A more complete discussion of the procedures used for screening sampling sites to ensure no pollutants were present will be included in the next revision.

Comment (13-Ecology) Section 3.1, p. 3-1
Deficiency:
No information on procedures is provided for chain-of-custody, geotechnical sample library control, and geologic logging.

Recommendation:
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), procedures for these three items should be discussed in the document.

Response:
Reference to EII's governing these procedures will be included in the next revision.

9 2 1 2 7 5 7 0 7 3 5

Comment (14-Ecology) Section 3.1.2, P 3-2
Deficiency:
The total number of organic samples collected is not mentioned in this section.

Recommendation:
State total number of organic samples collected during the sampling event. The total number of inorganic samples were mentioned in Section 3.1.1.

Response:
A new table with the number of samples of each type (random and judgment), identification of the type of analytes determined, etc., will be included in the next revision.

Comment (EPA-20)Section 3.1.2, p. 3-2
This section does not reflect the EPA policy that detected organic chemicals automatically represent contamination. The sole exceptions to this policy,

humic compounds and similar materials, are not detected in routine assays from the Hanford site.

Response:
It was expected that the levels of organic chemicals in the soil at Hanford would be low, but the assumption that such levels would be zero (or below detection) could not be justified (see pages 333 to 347 in The Soil Chemistry of Hazardous Materials by J. Dragun, Hazardous Materials Research Institute, Silver Springs, Maryland, 1988). Many of the dominant plant forms on the Hanford site are known to generate organics that are listed as dangerous wastes (i.e., halogenated hydrocarbons and ketones). WHC decided the prudent course would be to make no assumptions about the presence or absence of organics. The sampling program for organics was designed to determine if additional sampling was required, and to possibly provide provisional background for organic analytes.

Comment (15-Ecology) Section 3.2, p 3-3, sixth paragraph
Deficiency:
This paragraph talks about the 14 surface sample sites discussed previously. According to Section 1.0 of Appendix B, there were 14 inorganic sampling sites and 9 organic sampling sites.

Recommendation:
The paragraph should read either "14 inorganic sample sites", or "23 sampling sites". However, due to the content of the section "14 inorganic sample sites" may be more appropriate.

Response:
This paragraph will be revised to indicate 14 inorganic surface samples.

Comment (21-EPA) Section 3.2, p. 3-3 and 3-4
It is noted that soil samples were collected from Savage Island and near the Yakima Barricade yet no information on these sites is presented in Appendix A or Appendix B.

Describe the number and depth of samples collected in these bore holes and note which formation these samples represent, Hanford, Ringold, or alluvium.

Response:
Soil sampling description of the bore holes at Savage Island and the Yakima Barricade will be included in the next revision.

Comment (22-EPA) Section 3.2, p. 3-4, lines 41-42
Rational for the exclusion of carbonate analysis should be given.

Response:
Alkalinity analyses were performed and will be included in the next revision.

9 2 1 2 7 5 7 0 7 8 6

Comment (16-Ecology) Section 3.2, p 3-4, second paragraph
Deficiency:
This paragraph talks about the location of the Yakima Barricade Sampling site. However, the paragraph does not reference the sampling location map (Figure 3-1).
Recommendation:
Include a reference to Figure 3-1 after the first sentence in this paragraph.

Response:
A reference to Figure 3-1 will be included after the first sentence in this paragraph.

Comment (17-Ecology) Figure 3-1, p. F3-1
Deficiency:
This figure shows that many of the metals samples were located on or near roads or in cities. These samples would not be representative of the vast majority of the Hanford site because of the increased concentrations of metals found near roads related to gasoline and automobiles (e.g., lead).

Recommendation:
Discussion of how this potential bias was addressed should be included.

Response:
None of the samples collected were in cities, but some were near roads. Please provide references regarding the extent of contamination seen in soils for various types of roads, particularly in terms of the lateral and vertical extent. For the types of samples collected, the proximity to roads, the type of road, and other similar concerns were not considered to be key issues, particularly because all exposure surfaces were cleaned off by removing the soil for about a foot inward prior to collection of the sample. Moreover, the data results corroborate the lack of any influence for such concerns. Section 4.8 will be expanded in the next revision to address this topic.

Comment (23-EPA) Table 3-1, p.T3-1, line 19
This table lists method 200.7 CLP-M for analysis of titanium and zirconium; this method is not approved for analysis of these two compounds. The correct methods should have been used for these analyses. Method 300 for inorganic, nonmetallic analyses and method 7481 for molybdenum analysis should be included in the footnote for this table.

Response:
Method 6010 was used for zirconium and titanium. The text and table 3-1 will be corrected in the next revision.

SECTION 4 DATA EVALUATION

9 2 1 2 7 5 7 0 7 8 7

Comment (18-Ecology) Section 4.0, P. 4-1, first paragraph
Deficiency:
See general comment 2.

Recommendation:
See general comment 2

Response:
See response to general comment 2

Comment (24-EPA) Section 4.0, p. 4-1, line 19
This section states, "The CLP (leachate) analysis of these samples is the basis for determining background threshold levels." The CLP (leachate) procedures are not routine CLP analytical services and are not referenced in Table 3-1.

This method should be identified in the table.

The rationale for analyzing the sample leachate for determining background threshold levels is not provided and should be defined.

Response:
Additional text will be provided to clarify the term "leachate."

Comment (25-EPA) Section 4.1, p. 4-1, first paragraph
This section states that since bias is involved in the collection of judgment sample data, these data cannot be used in the statistical calculations of threshold contamination. The procedure and potential bias should be identified to determine any possible use of these data. It is not clear how biased data establishes the completeness of this sampling program. This section also states that the judgment data are used for identification of "subordinate end members." Subordinate end members should be defined.

Response:
Judgment samples are required for completeness (see DQO guidance). Part of the concern here may again be in terminology (i.e., subordinate end members). This term is misused in the text and will be defined and corrected.

Completeness is assured by specifically allowing the field geologist to sample identifiable or suspect lithologies not included in the random sample. This assures that a subordinate, unique member present in the sampling site is not overlooked or missed by the random sampling procedure.

Comment (26-EPA) Section 4.1, p. 4-1, second paragraph
This paragraph discusses quality assurance and quality control (QA/QC) sample

9 2 1 2 7 1 7 0 7 8 8

data sets. There is no discussion on the collection and analysis of field duplicate samples to measure either the homogeneity of the medium sampled in a particular location or the precision in sampling. Similarly, there is no discussion on the sample collection and analysis for field blanks to determine if certain field sampling or cleaning procedures might result in cross contamination of site samples.

Response:
The variogram analysis provides an adequate analysis of the homogeneity. Without a solid control material of accurately known composition, such issues as sampling errors and cleaning procedures cannot be tested. Sampling procedures prohibit repeat use of sampling tools in the field.

Comment (19-Ecology) Section 4.1, p 4-1, second paragraph
Deficiency:
Interlaboratory field split samples measure interlaboratory accuracy only if each sample was spiked with a measured amount of a known analyte prior to analysis. No such spiking procedure was mentioned in the report. If these field split samples were not spiked, then they are a measure of laboratory precision and bias of that precision between laboratories. These field split samples are not a measurement of laboratory accuracy or the bias in accuracy between laboratories.
Recommendation:
If field split samples were spiked before interlaboratory analysis, then this should be stated. If not, then omit statements about accuracy related to field split samples throughout the document.

Response:
Text will be changed to indicate that these splits were a measure of precision, not accuracy.

Comment (27-EPA) Section 4.2, p. 4-2, line 28
This section states that "constituents that do not exceed threshold levels by statistically significant amounts can be dropped from further consideration...". The acceptable statistical limit above threshold levels should be stated.

Response:
It has been agreed that WHC will develop justifiable statistical procedures. A description of these procedures will be included in the revised document.

Comment (20-Ecology) Section 4.3.2, p. 4-3
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), the data quality objectives should be clearly described.

Response:
This paragraph will be modified to provide a clearer description of the data quality objectives.

9 2 1 2 7 3 7 0 7 8 9

Comment (21-Ecology) Section 4.3.2, p.4-3, fifth paragraph
Deficiency:
The last sentence of this paragraph refers to the scatter plots presented in Figure 4-2 of the soil background document. These plots do not appear to be used and do not seem to have much relevance to the discussion in this section since the stratigraphies associated with the various sites are not noted on the scatter plots or in Figure 4-1.

Recommendation:
Revise the figures and/or text to provide better continuity.

Response:
This figure will be revised and additional text will be provided to enhance continuity.

Comment (28-EPA) Section 4.3.2, p. 4-4, lines 7 and 8
It is stated that "the ensemble of sampling locations covers the Hanford site both horizontally and vertically through the stratigraphic section" shown in Figure 4-1. As noted in comments to Section 2.1, it appears that the Ringold Formation was not sampled. It is therefore recommend that line 7 be changed from "Hanford Site" to"Hanford formation."

Response:
Text will be revised to reflect sampling from Hanford and Ringold formation.

Comment (22-Ecology) Section 4.3.3, p.4-4
Deficiency:
As stated in this section, a determination on whether the data are independent cannot be made since correlation analyses have not yet been performed.

Recommendation:
Because whether the data is independent is an important factor in determining whether the data set is appropriate for use in identifying background concentrations, correlation analyses should have been presented in this draft of the document along with the variograms (Appendix D, Figures 8-13).

Response:
Variograms, correlation analyses, and factor analyses will be included in next revision.

Comment (23-Ecology) Section 4.4, p. F4-4
Deficiency:
The use of the term "outliers" in this and other sections is problematic from a statistical standpoint. Information on why outliers are identified is missing from this section.

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Recommendation:
A clear definition of what is meant by the term "outlier" should be provided. Because these values identified as outliers have reasonable geologic explanations, they are not outliers in the sense normally used (i.e., a value that is likely incorrect, caused by an error at some point in the data collection or analysis process). However, they may be outside the range of values expected for the predominant lithologies at the site. A statistical test for identifying outliers, such as Rosner's test (Rosner 1983), could be used, rather than determining outliers by inspection.

This section should also discuss what has been done with these values for the statistical analyses. Have they been excluded from the evaluation? Careful inspection of the potential outliers may reveal that they are non-representative of the Hanford site. However, in general, data points should not be excluded from analyses unless they are determined to be in error.

Response:
A clearer definition of the term "outlier" will be provided in the next revision, which will also address the use of outlier data.

Comment (29-EPA) Section 4.5, p. 4-5, and Table 4-2, p. T4-2
"Thresholds" should be defined. The referenced Table 4-2 (which is not numbered) is difficult to decipher and should be reformatted. In addition, there is no explanation in the text for use of the Weibull distribution. Readily available reference books note that this distribution is most used by engineers and toxicologists for analysis of life data (survival times). It is useful to vary shapes by varying its two parameters (called α and ß in one reference and K and ρ in the other) from the exponential distribution to the extreme value distribution. Since Table 4-2 refers only to ^{n} and ß, it is unclear which shape variant is used. The text should clarify which shape variant is used.

Response:
The use of the Weibull distribution was explained in WHC-MR-0246 as referenced in section 4.5 line 10. Further repetition appeared to the authors to be unnecessary. The reviewer is referred to WHC-MR-0246 as well as Nelson, 1982 (John Wiley and Sons, New York), also referenced in WHC-MR-0246. As far as the changing parameter notation, this is a common problem when consulting between different references and the readers are expected to make their own translations based on comparison of the equation forms. A brief description of the Weibull distribution will be abstracted from WHC-MR-0246 and included as an additional appendix.

Comment (24-Ecology) Section 4.5, p. 4-5
Deficiency:
See general comment 2. This section mentions matrix interference effects but

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does not describe how these were taken into account in the development of threshold values, if at all. How does the bimodal distribution of sodium affect the statistical method used to determine the threshold concentration?

Recommendation:
Threshold concentrations should be recalculated using the newer method being developed by Ecology. This whole section needs to be expanded so that the reader can clearly follow and reproduce the calculations of threshold concentrations for each element.

Response:
Use of the term matrix interference effect will be reviewed and modified, as it actually refers to compositional dependencies of the proportions of endmember components in the matrix. Sodium will also be included in the next revision.

The newer method referred to has been reviewed and discussed with the EPA, the USGS, and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore agreement was reached that WHC will develop justifiable statistical procedures.

Comment (25-Ecology) Section 4.6, and 4.7, p. 4-5
Deficiency:
The discussions of judgment samples and model validation have been deferred until all data have been analyzed.

Recommendation:
A preliminary analysis should have been provided based on the data presented.

Response:
A discussion of judgment samples and model validation will be provided in the next revision.

Comment (26-Ecology) Sections 4.8, p. 4-6, second paragraph
Deficiency:
This section discusses the problem of having lead samples located near roadways and in cities, but does not provide a clear conclusion or statistical comparison between samples located near roads and samples located away from roads.

Recommendation:
Include quantitative discussion of the effect of sample location on lead concentrations.

Response:
Quantitative discussion of the effect of sample location on lead concentrations will be included in the next revision.

9 2 1 2 7 5 7 0 7 9 2

Comment (27-Ecology) Sections 4.8, p. 4-6, second paragraph
Deficiency:
Verification that background sampling sites have not been contaminated due to activities at the Hanford site is incomplete. The plots presented in Figure 4-2 illustrate sitewide concentrations, but no information is given on how these concentrations compare to other regional background concentrations. In addition, the titles for these scattergrams are meaningless in the context of this document and should be changed or excluded.

Recommendation:
Provide additional support for the verification that the selected background sites are free from contamination due to Hanford activities. This support should include descriptions of historical site activities, locations of such activities, chemicals used, and potential transport of chemicals in the environment. A table of relevant background values from literature for the analytes presented in Table 4-2 should be included. A listing of analytes related to Hanford activities and their relative contribution to contamination should also be included.

Response:
Selection criteria for background sites include: the proximity to waste operations, lack of historical records of operations, field screening, the use of and comparison to off-site samples and samples from the ALE reservation, screening of samples for absence of any anthropogenically introduced constituents (e.g., halogenated hydrocarbons, pesticides), etc.

Historical information on the operations at the Hanford Site and contaminants can be found in other documents and are not relevant to this document on natural background (in light of the screening activities etc.).

Comment (30-EPA) Section 4.11, p. 4-7
The text in Chapter 3 implies that no organic analyses, other than field determinations, were run on samples from the inorganic sites yet it is indicated that no detectable organics were found at these sites. A clarification should be made in Chapter 3.

Response:
Additional text will be added to clarify the high sensitivity and utility of the field screening. Limited laboratory organic analyses were performed on samples from one or more of the sites.

Comment (28-Ecology) Section 4.11, p. 4-7
Deficiency:
For organic contaminants whose natural concentrations fall below detection limits or are zero, the detection limit is typically used as a surrogate for the background concentration. No discussion of this topic is included.

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Recommendation:
This section should provide the detection limits that will be used in lieu of background thresholds. This section should also verify that the detection limits are lower than potential risk-based standards.

Response:
Sampling of organics was performed for screening, scoping, and for possibly establishing provisional background thresholds.

For those samples with concentrations less than detection, the detection limit becomes the threshold. It is not within the scope of this document to address the relationship of this threshold to risk-based standards. This section is to be further developed in the revised draft.

Comment (29-Ecology)Figures 4-2, 4-3 and 4-4, Pages F4-2.1 through F4-4
Deficiency:
These figures do not contain concentration units.

Recommendation:
Include the units with these figures.

Response:
Units will be added.

Comment (31-EPA) Table T4-1, p. T4-1
This table identifies sample numbers B014K4 and B014K5 as outliers. These two samples are field duplicates with high levels of alkalinity. The quality control criteria for identification of these samples as outliers should be stated. It should also be clarified whether the outliers listed in this table were used in identification of any other analytes.

Response:
Outlier identification for soil data does not depend solely on laboratory QA/QC criteria. Geologic and geochemical outliers also exist. These are determined on the basis of interelement correlations, stoichiometry, petrographic examination, and lithology. For these samples, correlation with alkalinity indicates a high probability that they are dominated by calcium carbonate, an expected subordinate soil type in the Hanford formation. It would be incorrect to include the calcium carbonate samples in the distribution describing the Hanford Formation. Because calcium carbonate is a subordinate soil type, comprehensive sampling and statistical analysis is not practical. The calcium carbonate data should be excluded from the Hanford formation distribution since caliche formation is different than the process by which most of the Hanford formation was created (cataclysmic flood and mixing), and may be controlled by a different statistical distribution. The best that can be done is to recognize that subordinate soil types exist, characterize them geologically and geochemically, and use the characterization knowledge to screen them out of the statistical calculations and treat them on

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a case by case basis.

Comment (32-EPA) Section 4, Figure 4-1, p. F4-1
The stratigraphic units sampled by the Savage Island and Yakima Barricade bore holes, and by site 14 are not shown on Figure 4-1.

Response:
A new table with the number of samples of each type (random and judgment), identification of the type of analytes determined, etc., will be included in the next revision.

Comment (33-EPA) Section 4, Figure 4-2, pp. F4-2.1 through 2.13
Fifteen sampling sites are plotted on the scattergrams. We assume that these represent sites #1-14. Does Site 15 represent the Yakima Barricade or Savage Island bore hole? Identify site 15 and explain why the data from the other site is missing.

Also, no units are given for these figures.

Response:
The Yakima Barricade borehole is Site 15. A new figure with the number of samples of each type (random and judgment), identification of the type of analytes determined, etc., will be included in the next revision.

Savage Island data had not been validated at the time of publication. These data have subsequently been identified as Ringold Formation and will not be included in threshold calculations.

Comment (34-EPA) Section 4, Figure 4-3, pp. F4-3.1 and F4-3.2
No units are given for the figures

Response:
Units will be added.

Comment (35-EPA) Section 4, Figure 4-4, p. F4-4
No units are given for the figures.

Response:
Units will be added.

Comment (30-Ecology) Table 4-1, p. T4-1
Deficiency:
Sample B014K5 in Table 4-1 is listed as a field duplicate of Sample B014K4. However, in the Hanford Site Soil Background table presented in Appendix C, Sample B014K4 is listed as a regular sample rather than a split sample.

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Recommendation:
Clarify the status of Sample B014K5.

Response:
Both of these are regular samples. The statement will be clarified in the next revision.

SECTION 5, SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Comment (31-Ecology) Section 5.0, p. 5-1
We are unable to comment on this section until all analyses have been completed and this section finished.

Response:
Section 5.0 will be completed and included in the next revision.

Comment (36-EPA) Section 5.0, p. 5-1, first paragraph
The text concludes that the Site-Wide approach is technically preferable to the unit-based approach for establishment of soil background. This conclusion should be explained.

Response:
Text supporting the justification for the site-wide approach (from WHC-MR-0246) will be included in the next revision.

Comment (37-EPA) Section 5.2, p. 5-1
This section addresses site-wide background threshold values for six representative inorganic analytes for vadose zone soils. However, there is no discussion of threshold values for these six representative inorganic analytes for surface soil samples.

Also, the text in this section states, "These soil compositions represent the range of lateral and vertical variability of soil types in the Hanford formation and younger soils." No supporting data related to this variability are discussed, but should be.

Response:
There appears to be some misunderstanding of terminology, particularly the meaning of surface soil samples. This will be clarified in the draft revision (i.e., distinction between samples representing vertical sampling of the vadose zone versus samples from boreholes.

Representativeness in terms of lateral and vertical variability are based on professional judgment of the geological relationships, which are generally self-evident because of the superb exposures provide by the borrow pits, excavations, etc. This is the best control on the stratigraphic variability

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of the Hanford formation that exist.

Comment (EPA typo) Section 5.3, p.5-2
The last word in this paragraph should be "values" and not "valves".

Response:
Spelling will be corrected in the next revision.

SECTION 6, REFERENCES

Comment (32-Ecology) Section 6.0, p. 6-1, DOE 1988 reference
Deficiency:
The volume and page numbers have not been included with this reference. It is very difficult to check the citation without this information.

Recommendation:
Please include the volume and page numbers for this reference.

Response:
Volume and page number will be corrected in the next revision.

APPENDIX A, SOIL SAMPLING OBJECTIVES AND SITE DESCRIPTION

Comment (38-EPA) Appendix A, Section 2.1, page 2-1
In the second paragraph, the text does not state the objective of the Hanford site-wide soil background sampling and analysis effort for the surface soils. This omission should be corrected.

Response:
The text will be revised and will refer to the DQO section in the main body of the text.

Comment (EPA typo) Appendix A, Section 2.1, pg. 2-2, line 7:
Delete the word "the" at the end of this line.

Response:
The word will be deleted.

Comment (39-EPA) Appendix A, Section 2.2, p. 2.2, lines 23-24
The Pleistocene floods that deposited the Hanford formation are noted to have occurred between 16,000 and 12,000 years ago. In Section 2.1, the floods are noted to have occurred between about 1 million and 6,000 years before present.

9 2 1 2 7 5 7 0 7 9 7

The estimate in Section 2.1 may be closer to the truth.

Response:
The statement will be qualified in the next revision as the last major Pleistocene flood, and correct and consistent ages will be used.

Comment (EPA typo) Appendix A, p. 2.3, line 2:
Change "quart" to "quartz".

Response:
Word will be corrected in the next revision.

Comment (33-Ecology) Appendix A, Section 2.3, p.2-3, first bullet
Deficiency:
Sampling sites should not have been located near other local sources of contamination, including roads.

Recommendation:
Reevaluate use of samples near roads for analysis of lead and other metals.

Response:
Please see response to Ecology comment 17.

Comment (40-EPA) Appendix A, Section 2.3, p. 2-4
The text in lines 27, 28, and 42 regarding the surface sampling strategy should be clarified.

Response:
Clarification will be made in next revision.

Comment (41-EPA) Appendix A, Section 2.4, p. 2-5
The discussion of the composition integrity of surface samples focuses only on the representativeness of the whole rock sample. In the arid environment of the Hanford site the rocks and minerals probably have not been subjected to extensive mineral weathering in the period of time that most of the surface samples have been exposed and the samples should accurately represent the primary mineralogy of the formation. However, the CLP extraction methods used for the analyses of inorganic composition of the soil do not measure the primary mineralogic composition of the soil sample, but rather measure the more chemically mobile fraction of the soil, such as ions dissolved in interstitial soil water, exchangeable ions, and precipitates on the soil surface. This relatively mobile fraction of the soil may indeed have been altered by years or 10's of years of exposure to the soil surface and leaching by precipitation.

As noted in a comment to WHC-MR-0246, the chemical composition of the soil

9 2 1 2 7 5 7 0 7 9 8

that is extractable can vary significantly depending on the depth of the soil, with soil within 1-2 meters of the surface being leached of soluble ions and soil below that depth being enriched with deposited ions. Soils below the root zone at a depth of 10-20 ft may be less affected by the near-surface leaching and deposition of soluble minerals.

The process of leaching of near-surface soils and redeposition at greater depth is not included in the conceptual model nor in the discussion of the representativeness of near-surface sampling.

The section title is "Compositional Integrity of Surface Soils", but the discussion cover subsurface soils. This discrepancy should be resolved.

Response:
It is not clear whether the reviewer is knowledgeable of the CLP dissolution method used in this study, and the extent to which this aggressive leach process dissolves soil materials. Any discussion of natural leaching process should also consider the nature of the Hanford soils, which are mostly alluvial sediments with no genetically related soil horizons.

Text revision will include a brief section documenting the extent of surface/near surface deposition of NaCl from meteoric water, and discussion concerning the general lack of soil and soil forming processes.

Comment (42-EPA) Appendix A, Section 2.5, p. 2-5, line 28
The four tentatively recognized subdivisions for the stratigraphy of the Hanford formation should be specified.

Response:
The reviewer is referred to the stratigraphic section in the text, Figure 4-1.

Comment (34-Ecology) Appendix A, Section 3.0, p. 3-1
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), the EII for geologic logging (EII 9.1) is adequate except the soils should be classified by the Unified Soil Classification System (ASTM D2488-84) and the most recent Munsell color chart should be utilized (Munsell Color, 1990 Edition, Revised).

Response:
The Hanford formation and most of the overlying loess are not soils in the classical sense (i.e., they are not formed *in-situ* by weathering processes). Implementation of this comment would require a modification to this EII, which is out of the scope of this document. The ASTM procedure is not relevant to this study.

APPENDIX B, SAMPLING NARRATIVE

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Comment (35-Ecology) Appendix B, Section 1.0, p. 1-1
Deficiency:
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), surface preparation techniques at each sampling site should be clearly described.

Recommendation:
Describe surface preparation techniques at each sampling site.

Response:
The appropriate EII will be referenced.

Comment (36-Ecology) Appendix B, Section 1.0, p. 1-1
Deficiency:
As stated in the comments to the Site-Wide Background Soil Sampling Plan (Revision 0), procedures for shipping, based on EII 5.11, should be provided.

Recommendation:
Include procedures implemented for shipping samples to the analytical laboratory for analysis.

Response:
The appropriate EII will be referenced.

Comment (37-Ecology) Appendix B, Section 1.1, p. 1-1
Deficiency:
The Site-Wide Background Soil Sampling Plan (Revision 0), states:

"Field quality control sampling will be as follows for systematic and judgment sampling: One set of split samples per general site for systematic sampling. One set of split samples per general site for judgment sampling."

However, it seems that only one set of split samples were collected per sampling location which included both the systematic samples and the judgment samples.

Recommendation:
Include a discussion of this change to the sampling plan and the rational for the change in a Deviations to Sampling Plan section.

Response:
Any deviations from the Sampling Plan will be documented in Appendix B.

Comment (38-Ecology) Appendix B, Section 1.1, p. 1-1
It is unclear the exact number of samples collected from each inorganic sampling location.

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Recommendation:
Clearly state the number of samples collected from each inorganic sampling location.

Response:
A new table with the number of samples of each type (random and judgment), identification of the type of analytes determined, etc., will be included in the next revision.

Comment (43-EPA) Appendix B, Section 1.1.1, p. 1-2
The height of the exposed vertical section of the hill should be provided as should the rationale for the assumption that three sample locations represented the full height of exposure. In the previous section (Section 1.1), sampling intervals are spaced at approximately 3-foot vertical intervals from a random starting point. This discrepancy should be addressed.

Response:
A new table with the number of samples of each type (random and judgment), identification of the type of analytes determined, etc., will be included in the next revision.

Comment (44-EPA) Appendix B, Section 1.1.2, p. 1-2
The depth of exposed hillside, the elevations (depths) at which the systematic samples are collected from the four locations, and the stratigraphic details should be provided to allow evaluation of the representative sample collection. The rationale for the collection of multiple samples from the uppermost location, about 1 foot below the top of the exposure, should be stated.

Response:
Please see response to EPA comment 43.

Comment (39-Ecology) Appendix B, Section 1.1.3, p. 1-3, 1st paragraph
The last sentence of this paragraph discussing the weather is out of place.

Recommendation:
Move the weather information to the introduction paragraph of Section 1.0 of this Appendix B.

Response:
The weather should remain because it is unique to each site at the time of sampling.

Comment (45-EPA) Appendix B, Section 1.1.3, p. 1-3
Two separate sampling events are conducted at Site 3 from 12-foot-high and 25-foot-high exposures. The significant difference between these two exposures is not explained elsewhere. The sampling depths for systematic and

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judgment samples are not specified for these two sampling events.

Response:
Explanation will be provided.

Comment (40-Ecology) Appendix B, Section 1.1.4, p. 1-4
Deficiency:
It is not mentioned in this section whether any judgment samples were collected at inorganic site #4.

Recommendation:
State whether judgment samples were collected at inorganic site #4.

Response:
Information will be provided in next revision.

Comment (46-EPA) Appendix B, Section 1.1.5, p. 1-4
The total depth of the pit exposure should be stated. The rationale for the collection of judgment samples at this site should be provided when all samples collected are fine grained.
Response:
Excluded samples are not exclusively endmembers. The judgment samples were collected for completeness, etc. (PARCC parameters), and included any part of an exposed section that appeared to be significantly different or important in some way from the samples that were collected as systematic random samples(e.g., darker or lighter, a missed lens, etc.). In the course of the evaluation, all the judgment samples expected to belong to the compositional population (other than volcanic ashes, etc.) were, in fact, found to be included within the range of compositions defined by the systematic random samples, corroborating the conceptual model.

Comment (47-EPA) Appendix B, Section 1.1.6, p. 1-5
No information on the collection of multiple samples or judgment samples is provided at Site 6, but should be. The total depth of the pit and the elevations at which the systematic samples are collected should be provided. This comment is applicable wherever appropriate in subsequent sections.

Response:
The excluded samples are not exclusively endmembers. The judgment samples were collected for completeness, etc. (PARCC parameters), and included any part of an exposed section that appeared to be significantly different or important from the systematic random samples (e.g, darker or lighter, a missed lens, etc.). In the course of the evaluation, all the judgment samples expected to belong to the compositional population (other than exotic deposits, such as volcanic ashes) were in fact found to be included within the range of compositions defined by the systematic random samples, corroborating the conceptual model.

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Comment (41-Ecology)Appendix B, Section 1.1.6, Page 1-5;
Deficiency:
It is not mentioned in this section whether any judgment samples were collected at inorganic site #6.

Recommendation:
State whether judgment samples were collected at inorganic site #6.

Response:
Please see response to EPA comment 47.

Comment (42-Ecology) Appendix B, Section 1.1.6, Page 1-5;
Deficiency:
It is not mentioned in this section where, if any, multiple samples were collected from inorganic site #6.

Recommendation:
State where the multiple samples were collected from inorganic.

Response:
Please see response to EPA comment 47.

Comment (43-Ecology) Appendix B, Section 1.1.8, Page 1-6 first paragraph;
Deficiency:
The first sentence of this paragraph states that "several judgment samples" were collected at site #8. It is unknown how many "several" is.

Recommendation:
Clearly state how many judgment samples were collected from site #8.

Response:
This information will be included in the revised document.

Comment (44-Ecology) Appendix B, Section 1.1.12, Page 1-7;
Deficiency:
It is not discussed how many inorganic samples were collected at site #12, nor is it mentioned at what elevations the samples were collected from the 22 foot slope.

Recommendation:
Clearly state how many samples were collected from site #12 and from what elevations.

Response:
Please see response to EPA comment 47.

Comment (45-Ecology) Appendix B, Section 1.1.14, Page 1-8, second paragraph;

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Deficiency:
The Site-Wide Background Soil Sampling Plan (Revision 0), Section 6.2.1, states that systematic samples will be selected by systematic allocation along a single line perpendicular to the major strata at a site. However, in this paragraph it states that due to the sheer size and steep pitch of the exposure, samples were collected in a vertical line down the slope only to a certain point, then shifted laterally and continued downslope to the floor of the pit. Therefore, the samples were collected along two lines perpendicular to the major strata at the site.

Recommendation:
Include a discussion of this change to the sampling plan and the rational for the change in a Deviations to Sampling Plan section.

Response:
Any deviations from the Sampling Plan will be documented in Appendix B.

Comment (46-Ecology) Appendix B, Section 1.1.14, Page 1-8;
Deficiency:
It is not discussed how many inorganic samples were collected at site #14, nor is it mentioned at what elevations the samples were collected from the exposure.

Recommendation:
Clearly state how many samples were collected from site #14 and from what elevations.

Response:
Please see response to EPA comment 47.

Comment (47-Ecology) Appendix B, Section 1.2, Page 1-9;
Deficiency:
The Site-Wide Background Soil Sampling Plan (Revision 0) outlined, in Section 11.2, pages 12 and 13, the field quality control procedures for volatile organic, semivolatile organic, pesticide, PCB, and TOC sampling. However, it is not mentioned in the Hanford Site Soil Background document if these procedures were followed.

Recommendation:
Include a discussion of the quality control samples collected at each organic sampling location.

Response:
Discussion of QA/QC will be included in the next revision.

Comment (48-EPA) Appendix B, Section 2.0, p. 2-1
Headspace analysis is suggested to validate background conditions for volatile organic compounds (VOCs). The primary limitation of this technique is that

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unless the soil type, headspace volume, temperature, sample handling techniques, and storage time are held constant, relative concentration levels between soil samples are not comparable. Analytical sensitivity, selectivity, and other considerations are required to determine the degree of analytical sophistication needed for a specific measurement. The reported headspace measurements are for total organic values, but will not provide data for detailed speciation. The intended use of headspace measurements is not clearly explained to allow evaluation of this technique for validating background conditions. Background soil samples should not be analyzed for VOCs since no VOCs are present.

Response:
As stated above, the assumption that no VOC's are present could not be justified, therefore samples were measured for VOC's (see pages 333 to 347 in The Soil Chemistry of Hazardous Materials by J. Dragun, Hazardous Materials Research Institute, Silver Springs, Maryland, 1988).

Comment (48-Ecology) Appendix B, Section 2.0, p. 2-1
Deficiency:
The raw data from Table 2 is summarized in this paragraph, however, no units are included with the data.

Recommendation:
Include the units to the data in the summary paragraph.

Response:
Units will be included.

APPENDIX C, RAW DATA SOIL BACKGROUND

Comment (49-EPA) Appendix C, General Comments
Extensive data is given for bore hole site 699-48-96, yet no reference is given for this site in Chapter 3 nor in Appendix A and B.

The data summary needs further explanation, including:
Why these soil data are reported in units of mg/L.
Why most "used" lead results are given as 5.85mg/L. The plotted data, such as Figure 34 in Appendix D, are quite different.
Why some sodium results (such as sample B014G1) are listed as rejected (qualified "R") but still given a numerical value in the "used" column.

Response:
Borehole 699-48-96 is the Yakima Barricade sampling site.
The soil data units were in error. They are in units of mg/Kg.
Applying a T-shift to the data causes it to plot in a different location.

There is a logic error in the spreadsheet that will be corrected in the next revision.

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Comment (50-EPA) Appendix C, Raw Data Soil Background Table
This table presents the maximum quoted detection limit, contract-required detection limit, achieved detection limit, and the used detection limit value. The text should define the maximum quoted detection limit and the achieved detection limit. The used detection limit value for aluminum, calcium, copper, iron, lead, and sodium are higher than the contract-required detection limit for these analytes. The text should describe how this raised detection limit will affect the data usability. The text also lists the contract-required detection limit for calcium at 5,000 mg/L. The contract-required detection limit is 5 mg/L. This error should be corrected.

Soil sample data should be reported on a dry-weight basis. Also, soil chemical data should be reported consistently for each type of analysis as either mg/k µg/kg as specified in the Site-Wide Background Soil Sampling Plan (WHC 1991).

In this report, soil chemical data are reported in mg/L using leachate of soil samples, which deviates from the site-wide background soil sampling plan that does not include any leachate analysis. This discrepancy should be addressed.

Response:
An explanation of this table will be provided and the units will be corrected in the next revision.

Comment (49-Ecology) Appendix C, All tables;
Deficiency:
The units presented in these tables are listed as mg/L. However, in Section 3, Page 3-4, paragraph 1, item 1, the analytical methods used are listed as EPA methods 3050/6010, 7060, 7421, 7740, 7841, 7870, and 7471. Concentrations determined using these methods should be reported in mg/kg, not as mg/L.

Recommendation:
Correct units.

Response:
Units will be corrected.

APPENDIX D, BACKGROUND DATA ANALYSIS

Comment (51-EPA) Appendix D,
The statistical results are not clearly justified, and this appendix seems to be based on a new methodology. the use of a new methodology should be justified, especially when accepted methods, such as the outlier analyses cited in Section 1.2, are available. Part of that justification includes referencing sources, which are almost totally absent here. Another crucial omission is the definition of terms, such as "factor analysis," and variogram," and the parameter of the Weibull distribution cited in the comment

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on Section 4.5, page 4-5, and Table 4-2, page T4-2.

Response:
No new methodology is used. All techniques described are available in the statistics literature. More complete references will be included in the next revision.

Comment (52-EPA) Appendix D, Section 1.0, p. 1-1 to 1-3
Several of the statistical analytical techniques described in this section, including variogram analysis and subordinate end member analysis, are not included in the data analyses presented in Section 2.0.

Response:
Analysis was not complete. These analyses will be included in next revision.

Comment (50-Ecology) Appendix D, Section 1.1.6, Page 1-2, fifth paragraph;
Deficiency:
The document states that field split soil samples cannot be considered identical. If field splits samples were simple subsamples taken in the field, then the samples may not be considered identical due to the heterogeneous nature of soils. However, the purpose of analyzing field splits is to test interlaboratory variability of the analysis technique for identical samples. Laboratories can prepare identical field splits of soil samples by grinding a dried sample. This eliminates potential for the nugget effect and ensures that splits are identical. It is not clear how the field splits were sampled (neither in this section, nor in Appendix B, Sampling Narrative).

Evaluation of the field split samples was done by comparison of the distributions. This comparison is inaccurate since the purpose of the evaluation is to identify variations between paired values.

Recommendation:
Provide a description of how split samples were collected, and revise the assessment of the uses of split samples based on independence. Rather than using cumulative distribution plots, relative percent differences and scatter plots showing the different lab results on the two axes would be more appropriate evaluations of interlaboratory variation.

Response:
Use of the term "split sample" will be reviewed and corrected. Actual splitting of the sample was not performed, because this would destroy the integrity of the sample. Samples taken were simple subsamples. The purpose of duplicates was to evaluate differences in laboratory performances. Variance of duplicates is only one of several tools that can be used in this respect.

Comment (51-Ecology) Appendix D, Section 1.1.7, Page 1-3, first paragraph;
Deficiency:

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The soil background document states that the underlying distributions for these data are based on the Weibull and lognormal functions. This paragraph goes on to state that "the option to use a lognormal distribution is retained for completeness of analysis." However, the lognormal distribution does not appear to be considered in any of the subsequent analyses.

Recommendation:
Revise discussion or analyses for consistency.

Response:
Log normal distribution was considered, but not reported. Additional discussion will be included in the next report.

Comment (52-Ecology) Appendix D, Section 1.1.7, Page 1-3, second paragraph;
Deficiency:
Data points should not be rejected simply because they lie outside the confidence intervals of the Weibull distribution because Westinghouse (1991) clearly shows that the Weibull distribution fails to accurately represent the data at the upper end of the concentration range (Appendix B, Section B2.2, Page B-10, 5th paragraph, and Figure B-3).

Recommendation:
These are the most important data points for determining the threshold; therefore, very careful consideration (and a detailed explanation) should be provided before these data points are rejected.

Response:
The confidence bands around the CDF are the basis for developing outlier tests. For a set of N data points, the one sided confidence limits around the N+1 largest data point establish the criteria for considering if a data point added to the distribution should be considered as part of the distribution or tagged as a suspect data point (outlier). The use of the confidence limits by visual inspection is a more efficient procedure than going through the calculations. In those cases where plotting inaccuracies made location of a data point questionable, then computational methods were used.

The reviewer has misinterpreted the intent behind the presentation of Figure B-3. Figure B-3 indicates that a Weibull distribution has a smaller (lighter) right tail than does the lognormal distribution. If data are drawn from a lognormal distribution and analyzed with the Weibull distribution then the predictions of parameters related to the upper tail are biased low. This is a conservative error when determining thresholds. If data are drawn from a Weibull distribution and analyzed with a lognormal distribution then the parameter estimates in the upper tail are biased high. This would be a nonconservative error when considering thresholds. Additionally, the calculation of tolerance intervals in the upper tail of the Weibull distribution result in tighter (more conservative) tolerance intervals than does the lognormal distribution. All of these factors favor the choice of Weibull distribution over the lognormal for the description of background data. As an example, the upper confidence limit computed for alkalinity with

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a lognormal fit is approximately twice that computed using the Weibull distribution. (alkalinity measured by saturated paste methods).

Comment (53-Ecology) Appendix D, Section 1.1.8, Page 1-3;
See general comment 2. This section and its conclusions should reflect Ecology's proposed guidance.

Response:
The Guidance document referred to has been reviewed and discussed with EPA, USGS and Ecology staff. These discussions indicated that the guidance does not cover the full range of analysis activities required for the Hanford Site Wide Soil Background project. Therefore agreement was reached that WHC will develop justifiable statistical procedures.

Comment (53-EPA) Appendix D, Section 2.1, p. 2-1, lines 16-18
The inorganic analyses of surface samples taken for the characterization of organics background are noted here, but are not included in the statistical analyses. How will these analyses be handled? Will they be included in the general systematic-random population or as judgment samples? In light of the comments on Appendix A, Section 2.4, it is suggested that these samples be handled as judgment samples for comparison with the general systematic-random population.

Response:
The inorganic data were not complete at the time this draft was issued. The complete data set will be included in the next revision along with the statistical analyses.

Comment (54-EPA) Appendix D, Section 2.2, p. 2-1
The column headings of the referenced Table 1 should be clearly defined. In addition, the report should consider whether the high data rejection rates, especially for antimony, would bias the results.

Response:
A complete description of Table 1 will be included in the next revision. All antimony values are below detection limit and the effect on the results are expected to be minor.

Comment (54-Ecology) Appendix D, Section 2.2, Page 2-1, fourth paragraph;
Deficiency:
Acceptance rates should not be computed in such a manner as to exceed 100 percent. This calculation is misleading and biases the acceptance rates high.

Recommendation:
The acceptance rate should reflect the percentage of the samples accepted out of those that were received, not the percentage accepted out of those that

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were requested. The latter percentage is the ratio of total samples that were accepted (which includes those samples not requested) over the total number of samples that were requested. This ratio results in a percentage greater than 100.

Response:
Information on data acceptance rates calculated both ways have value and will be included in the next revision.

Comment (55-EPA) Appendix D, Section 2.3, p. 2-3
Table 3 shows all the requested detection limits to be several orders of magnitude higher than the contract- required detection limits. Also, many achieved detection limits exceed both claimed and requested detection limits. More information on the causes and effects of these phenomena is needed.

Response:
Contractor required detection limits are based on water analyses. Acid digestion of soil samples yield a high detection limit. At the time of sampling no reliable data existed on achievable detection limits for soil analyses.

Comment (56-EPA) Appendix D, Section 2.4, p. 2-3
This section needs clarification. Besides the usual questions on statistical treatment, there are questions on the relevance of X-ray fluorescence (XRF) and leachate (liquid-phase) assays to the inductively coupled plasma (ICP) and furnace assays actually used for these background soil samples. The differences inherent in the assay methods must be separated from other variables. For instance, the sensitivity (detection limit) of XRF is a function of the excitation source, so, in some systems, chromium has a very high detection limit. Other factors govern detection limits in ICP, so lead has a relatively high detection limit. These factors must be considered.

Response:
The relationship between laboratory XRF and ICP analyses will be clarified in the next revision. A detailed discussion of the XRF data will be covered in a separate report which will be referenced.

Comment (55-Ecology) Appendix D, Section 2.6, Page 2-5;
Deficiency:
Laboratory bias should not be evaluated for field splits by comparing the cumulative distributions of the results from the two laboratories. The paired nature of the data set is lost in this type of analysis. The method for resolving the lab bias by adding a constant factor to each of the lower sample results may be conservative but is not justifiable. On what basis was it determined that the lower laboratory results are the incorrect values?

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Recommendation:
Field splits are intended for use in evaluating interlaboratory variability for the analytical method. If this analysis determines that the interlaboratory variability is not significant, then it would be appropriate to average the field split results. If the interlaboratory variability is significant, the quality of the data is affected. An attempt to "fix" the variation with a constant factor is a faulty approach. If the difference between the two laboratories is significant enough to affect the threshold calculations, the accuracy of the data sets should be resolved, perhaps by a confirmatory analysis at a third laboratory.

Response:
We agree that correcting for laboratory bias in estimating thresholds should not be done and this practice has already been discontinued. However, evaluation of laboratory bias must be incorporated into the data analysis at some point.

Comment (57-EPA) Appendix D, Section 2.6, p. 2-5
The given cumulative distribution function plots are not useful; they are difficult to read and make it impossible to connect the two assays of a single sample. A regression of Maxwell S-Cubed results against Datachem results, preferably on a log-log plot, would help determine if there is an interlaboratory effect.

Response:
See response to general comment 4 for the relevance of maintaining the paired relationship of the duplicate data. Since the data is being represented as a Weibull distribution (i.e., not normal or lognormal), statistical testing for equality of means and variances are not applicable. This leaves either tests based on nonparametric assumptions or tests constructed for the purpose based on the weibull distribution. The nonparametric-based tests (sign test and Mann-Whitney U test) typically have lower power than parametric based tests. Tests constructed for the Weibull distribution will be described and demonstrated in the next revision to the report. The authors acknowledge that the split pair testing in this manner represent "new statistics".

Comment (56-Ecology) Appendix D, Section 2.7, Page 2-5, seventh paragraph;
Deficiency:
A truncation value for calcium is set at 5,600 ppm "on the basis of the initial distribution plot." This value does not appear to be justified by any quantitative analysis.

Recommendation:
If this truncation value is related to the method or instrument detection limits, it should be stated so. Values below 5,600 ppm are not will-behaved with respect to the fit of the Weibull distribution, but they should not be dismissed as the result of matrix interference effects based solely on a visual analysis. (56-Ecology).

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Response:
See WHC-MR-0246. The censored data is used to establish the percentile rankings of the noncensored data. The regression fit of the distribution uses only the percentile rankings of the uncensored data. Left censoring was used to improve the accuracy of the estimation of the thresholds.

Comment (58-EPA) Appendix D, Section 2.7, p. 2-5
The meaning of "truncation" as applied to the calcium data, is not clear. The text should explain how censored data (such as the low end of the data in Figure 22B) are handled. There is extensive literature and several proposed methods on handling such left-censored environmental data.

Response:
See WHC-MR-0246. The censored data is used to establish the percentile rankings of the noncensored data. The regression fit of the distribution uses only the percentile rankings of the uncensored data. Left censoring was used to improve the accuracy of the estimation of the thresholds.

Comment (EPA typo) Appendix D, Section 2.7, p. 2-7, line 18:
Change "will be" to "were".

Response:
Word change will be made.

Comment (57-Ecology) Appendix D, Section 2.7, Page 2-6, first paragraph;
Deficiency:
See previous comments regarding the definition of outliers. Figure 22B shows that the "outliers" lie on a smooth curve with the rest of the data and do not appear to be exceptional in any sense, except that they exceed the limits of the Weibull distribution. If these values were indicative of the "nugget effect," they would be expected to be more dissociated from the rest of the data. It is recognized that these data may indeed represent discrete deposits of calcium carbonate. However, there is insufficient evidence given to conclude that such discrete deposits qualify as outliers for background calculations. There are no provisions in MTCA for excluding "outliers" that cannot be demonstrated to be in error.
Recommendation:
Provide further evidence that discrete deposits of calcium carbonate are truly nonrepresentative of the background soil concentration. If they cannot be shown to be nonrepresentative, do not exclude them from the analyses. (57-Ecology).

Response:
Data considered to be non-representative will be discussed and justified in the revised text.

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Comment (58-Ecology) Appendix D, Section 2.7, Page 2-6, sixth paragraph;
Deficiency:
An acceptable truncation value should be determined based on quantitative methods. It appears that a subjective approach was used to find the concentration below which the data do not follow the fitted distribution. The plot should not be used to estimate the limit of detection. In addition, the method of modifying the data for the laboratory bias is inappropriate, as discussed above.

Recommendation:
Use a quantitative method of determining an appropriate truncation value.

Response:
See WHC-MR-0246. The censored data is used to establish the percentile rankings of the noncensored data. The regression fit of the distribution uses only the percentile rankings of the uncensored data. Left censoring was used to improve the accuracy of the estimation of the thresholds.

Modifying data for laboratory bias has been discontinued by the method described in this report.

Comment (59-EPA) Appendix D, Section 2.7, p. 2-7, lines 23-26
Sodium is noted to occur in a number of different repositories and it is concluded that multiple distributions are a reasonable result. If the conceptual model is correct, these repositories should be relatively well distributed throughout the soil column and sodium analysis should fit a single statistical distribution. The occurrence of multiple distributions for sodium appears to violate the conceptual model. It appears that either the conceptual model is incorrect or that some other overriding factor controls the distribution of sodium. The discussion presented in Section 2.7 does not adequately explain the deviation of the sodium distribution from the conceptual model and should be expanded.

Response:
The conceptual model is being modified to account for the behavior of sodium. A complete discussion will be included in the next revision.

Comment (59-Ecology) Appendix D, Section 2.7, Page 2-7, second paragraph;
Deficiency:
There appear to be numerous problems with the sodium data set (e.g., outliers, low-end scatter, and bias).

Recommendation:
These data should be re-evaluated as to their usefulness in setting threshold concentrations.

Response:
The conceptual model is being modified to account for the behavior of sodium. A complete discussion will be included in the next revision.

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Comment (60-Ecology) Appendix D, Figures 6 and 7, Pages F-6 and F-7;
Deficiency:
These figures that show concentrations as a function of grain size are presented but are not referenced or discussed in the text. There appears to be a correlation between higher concentrations and larger sieve sizes for the elements selected.

Recommendation:
The document should state how this information will be used in determining background threshold values.

Response:
A complete description of the grain size study will be covered in a separate report. Additional text referring to the grain size study report will be added in the next revision this report.

Comment (61-Ecology) Appendix D, Figures 14-19B Pages F-14 to F-19B;
Deficiency:
It is not clear which regression lines and confidence intervals apply to each data set.

Recommendation:
Revise the figures to be more clear, possibly using different types of lines for each laboratory.

Response:
Unfortunately, the computer graphics does not allow changing line types to improve the legibility of the graphics.

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