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T.M. VENEZIANO

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July 1, 1992

Mr. Steven H. Wisness
Tri-Party Agreement Manager
Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352

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Dear Mr. Wisness:

Re: Review of Hanford Site Soil Background Report

The Washington State Department of Ecology (Ecology) and its contractors have completed the review of the Hanford Site Soil Background, DOE/RL-92-24, report. Enclosed are our comments on the technical and regulatory content of this report.

The review incorporated the objectives presented in the Site-Wide Background Soil Sampling Plan, WHC-SD-EN-AP-052, dated June 1991. Parts of the soil background report are not consistent with that which was presented in the soil sampling plan. These inconsistencies will need to be resolved or rationalized. This issue is addressed in the specific comments from our review.

Ecology's primary concern with this report is that emphasis has been placed on evaluating six "representative" elements, none of which include radionuclides, organic chemicals or trace elements. These types of contaminants may have different statistical distributions than the more abundant inorganic constituents that have been addressed. The testing of this method will not be complete until contaminants with potentially different distributions have been included. The elements appear to have been chosen with natural geologic compositions in mind, rather than by considering the contaminants for which cleanup standards will be required. Milestone M-28-03 will be considered complete when the background thresholds for the contaminants of concern have been incorporated into the soil background document.

Ecology is presently drafting a statistical guidance document to supplement the regulations in the WAC 173-340 Model Toxics Control Act (MTCA). This document

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should be available by the end of August 1992. We have evaluated the significance of the proposed changes to the statistics and remediation threshold values for three of the six inorganic constituents addressed in the soil background report. Comment three describes our findings and possible revisions that may be required at some future date. Even though both USDOE

(WHC) and Ecology have evaluated the statistical distributions based on the systematic samples that have been collected, it may be more accurate (if not better statistics) to compare site characterization and remediation samples to a background that includes both systematic and judgmental samples. This will need to be discussed during the resolution of comments.

If you have any questions or concerns regarding these comments, please contact me at (206) 438-7556.

Sincerely,

Chuck Cline
Hydrogeologist
Nuclear & Mixed Waste Management

CC:jw
Enclosure

cc: L.G. Goldstein, Ecology
P.S. Innis, EPA-Richland
D.R. Jensen, Ecology
D.C. Nylander, Ecology
K.M. Thompson, DOE
T.B. Veneziano, WHC

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1. General Comment;

Deficiency: The document does not contain a section detailing any deviations 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: One 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 1-9, fifth paragraph).

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

See also comments on:

- Appendix B, Section 1.1, Page 1-1; and
- Appendix B, Section 1.1.14, Page 1-8, second paragraph.

2. General Comment;

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 od August, 1992. This approach uses a lower percentile than 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 the country.

3. General Comment;

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 $\alpha=0.05$, 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 $n\geq 50$) (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 (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.

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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 ($\alpha=0.05$); 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 datapoints identified as "outliers" in the text were not excluded because quality assurance and quality control (QA/QC) criterium 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 $\alpha=0.05$) 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 datapoints to evaluate their influence on the results of the hypothesis test. The hypothesis of a lognormal distribution excluding these datapoints could not be rejected at $\alpha=0.05$. 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.

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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 $\alpha=0.05$. 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.

4. General Comment;

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").

5. General Comment;

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.

6. General Comment;

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.

7. General Comment;

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.

8. General Comment;

Deficiency: Concentration units are missing from many figures.

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

9. Definition of Terms, Page ix, sixth paragraph;

Deficiency: See general comment 2.

Recommendation: See general comment 2.

10. 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: Revise text accordingly.

11. Section 1.1, Page 1-2, fifth 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 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.

12. Section 3.1, Page 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.

13. Section 3.1, Page 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.

14. Section 3.1.2, Page 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.

15. Section 3.2, Page 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.

16. Section 3.2, Page 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.

17. Figure 3-1, Page 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.

18. Section 4.0, Page 4-1, first paragraph;

Deficiency: See general comment 2.

Recommendation: See general comment 2.

19. Section 4.1, Page 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.

20. Section 4.3.2, Page 4-3;

Comment: As stated in the comments to the *Site-Wide Background Soil Sampling Plan (Revision 0)*, the data quality objectives should be clearly described.

21. Section 4.3.2, Page 4-3, fifth paragraph;

Deficiency: The last sentence of this paragraph refers to the scatterplots 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 scatterplots or in Figure 4-1.

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

22. Section 4.3.3, Page 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).

23. Section 4.4, Page 4-4;

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.

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.

24. Section 4.5, Page 4-5;

Deficiency: See general comment 2. This section mentions matrix interference effects but 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.

25. Sections 4.6 and 4.7, Page 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.

26. Section 4.8, Page 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.

27. Section 4.8, Page 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.

28. Section 4.11, Page 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.

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.

29. 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.

30. Table 4-1, Page T4-1;

Deficiency: Sample BO14K5 in Table 4-1 is listed as a field duplicate of Sample BO14K4. However, in the *Hanford Site Soil Background* table presented in Appendix C, Sample BO14K is listed as a regular sample rather than a split sample.

Recommendation: Clarify the status of Sample BO14K5.

31. Section 5.0, Page 5-1;

Comment: We are unable to comment on this section until all analyses have been completed and this section finished.

32. Section 6.0, Page 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.

33. Appendix A, Section 2.3, Page 2-3, first bullet;

Deficiency: Sampling sites should not have been located near other local sources of contamination, including roads.

Recommendation: Re-evaluate use of samples near roads for analysis of lead and other metals.

34. Appendix A, Section 3.0, Page 3-1;

Comment: 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).

35. Appendix B, Section 1.0, Page 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.

36. Appendix B, Section 1.0, Page 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.

37. Appendix B, Section 1.1, Page 1-1;

Deficiency: The *Site-Wide Background Soil Sampling Plan (Revision 0)*, states:

"Field quality control sampling will be as follows for systematic and judgement sampling:

- One set of split samples per general site for systematic sampling
- One set of split samples per general site for judgement sampling."

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

38. Appendix B, Section 1.1, Page 1-1;

Comment: It is unclear the exact number of samples collected from each inorganic sampling location.

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

39. Appendix B, Section 1.1.3, Page 1-3, first paragraph;

Comment: 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.

40. Appendix B, Section 1.1.4, Page 1-4;

Deficiency: It is not mentioned in this section whether any judgement samples were collected at inorganic site #4.

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

41. Appendix B, Section 1.1.6, Page 1-5;

Deficiency: It is not mentioned in this section whether any judgement samples were collected at inorganic site #6.

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

42. 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 site #6.

43. Appendix B, Section 1.1.8, Page 1-6, first paragraph;

Deficiency: The first sentence of this paragraph states that "several judgement samples" were collected at site #8. It is unknown how many "several" is.

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

44. 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.

45. Appendix B, Section 1.1.14, Page 1-8, second paragraph;

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.

46. 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.

47. 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.

48. Appendix B, Section 2.3, Page 2-3, first paragraph;

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.

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49. 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.

50. 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 scatterplots showing the different lab results on the two axes would be more appropriate evaluations of interlaboratory variation.

51. Appendix D, Section 1.1.7, Page 1-3, first paragraph;

Deficiency: 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.

52. 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.

53. Appendix D, Section 1.1.8, Page 1-3;

Comment: See general comment 2. This section and its conclusions should reflect Ecology's proposed guidance.

54. 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 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.

55. 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?

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.

56. 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 well-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.

57. 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.

58. 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.

59. 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.

60. 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.

61. 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.

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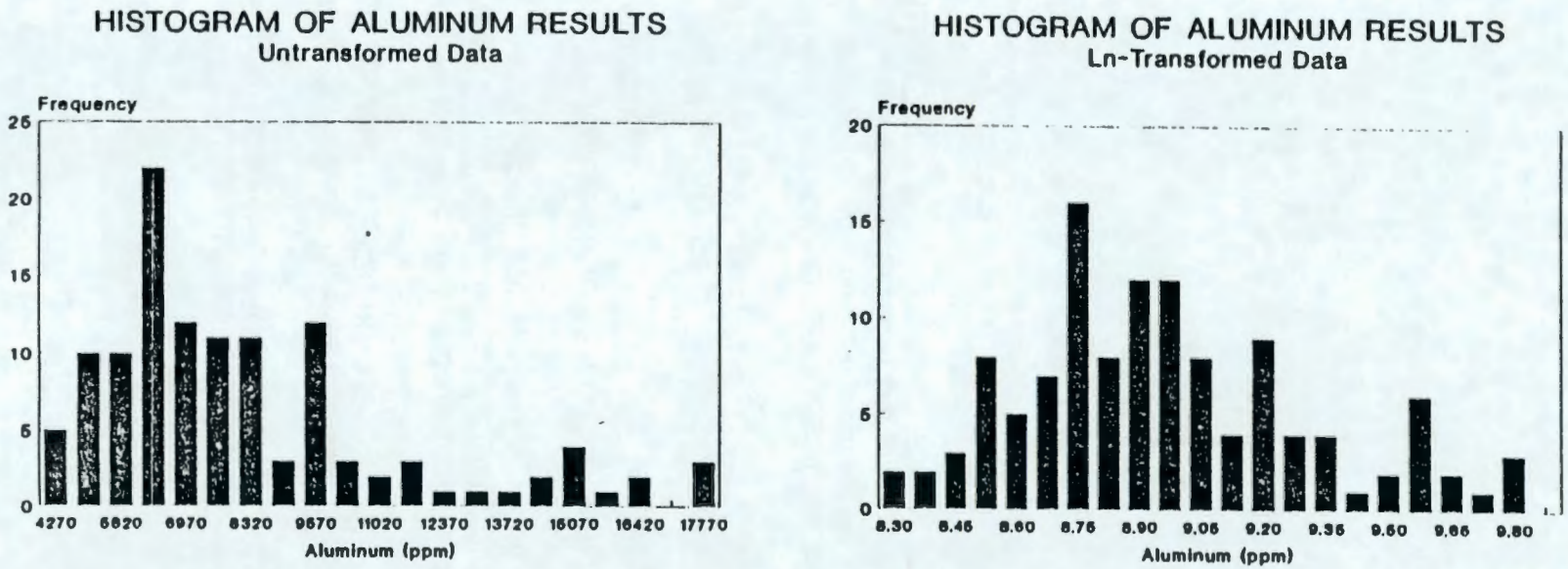

Figure 1. Histograms of untransformed and natural log transformed aluminum data (N=119).

9 3 1 2 7 5 9 0 0 7 8

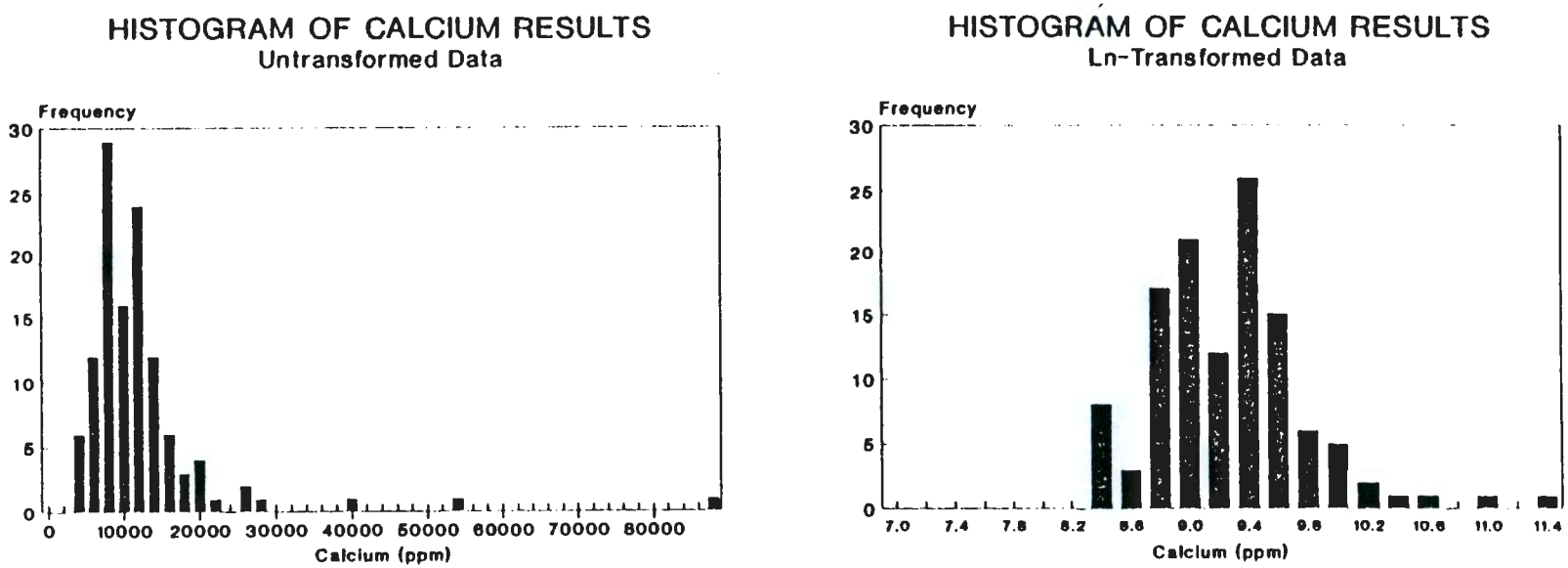

Figure 2. Histograms of untransformed and natural log transformed calcium data (N=119).

9 3 1 2 7 . 9 1 0 7 9

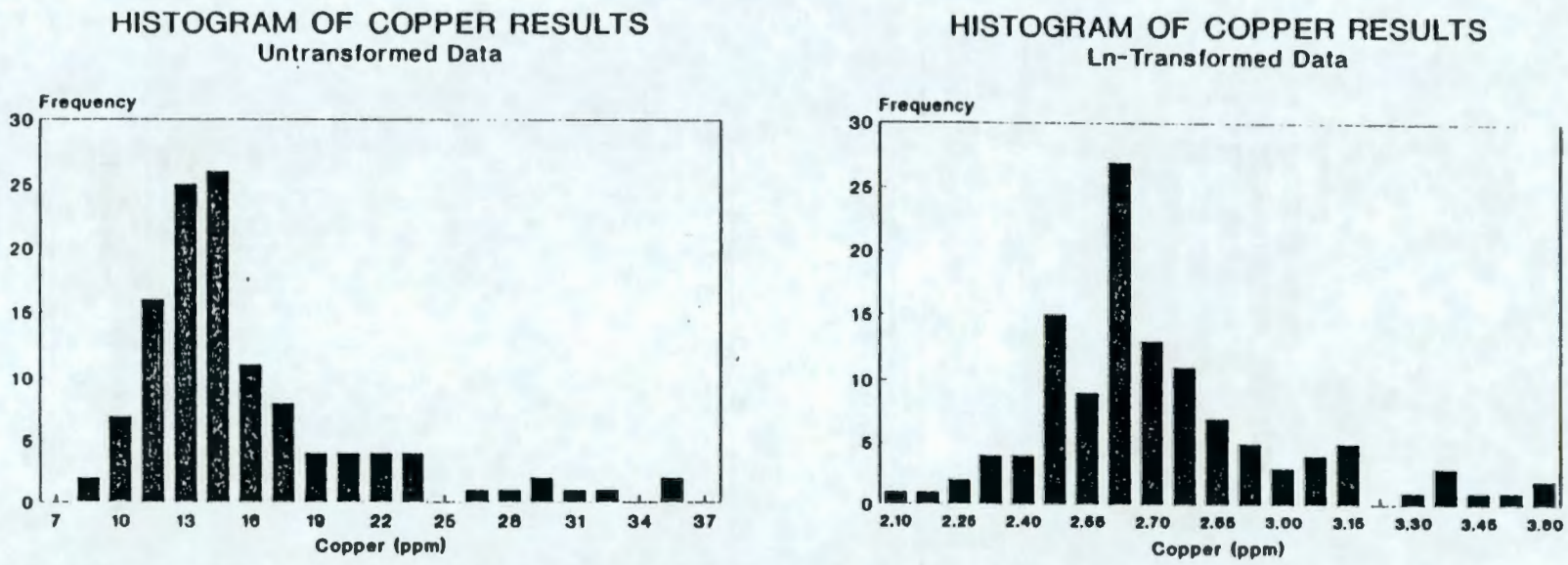

Figure 3. Histograms of untransformed and natural log transformed copper data (N=119).

9 3 1 2 7 5 9 0 0 8 0

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