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November 23, 1992
Project No. 40104.25

Mr. Randy Ogg
EG&G Rocky Flats
P.O. Box 464, Building 080
Golden, Colorado 80403-0464

Re: Transmittal of Vadose Zone Tech Memo Responsiveness Summary

Dear Randy:

Enclosed are three copies of the responsiveness summary for the Draft Final Vadose Zone Technical Memorandum. The responsiveness summary addresses comments received from DOE EH-453 on the Draft Technical Memorandum. Please review the document at your earliest convenience, and advise us as to revisions or requested copies for distribution.

Please call if you have any questions.

Sincerely,

Applied Environmental Consulting, Inc.

Barbara J. Neary

Barbara J. Neary, P.E.
Project Manager

Judy Flook, CPG
Program Manager

Enclosure

cc: G. Cantrell
File

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EH-453 COMMENTS:

DOCUMENT REVIEW: TECHNICAL MEMORANDUM VADOSE ZONE CHARACTERIZATION; ROCKY FLATS PLANT SOLAR EVAPORATION PONDS OU4

MAJOR CONCERN

COMMENT 1. The process of data evaluation should have been conducted prior to the development of this technical memorandum. There exist large historical data base concerning the subsurface of the Rocky Flats Plant. This data includes aquifer tests, top-of-rock contour maps, alluvium/colluvium isopach maps, groundwater elevation maps, surficial geological maps, etc. There is also a large base of information concerning groundwater contamination at Rocky Flats in general, and the Solar Evaporation Ponds in particular. This technical memorandum outlines a substantial amount of work, much of which can probably be divined from the existing data base.

RESPONSE There is a substantial amount of data concerning subsurface conditions at the RFP in general and at OU4 in particular. These data have been assembled and reviewed, and are currently being evaluated in detail. However, much of this data pertains to conditions in the saturated zone rather than in the unsaturated zone. For instance, there is a lack of information on the following parameters needed to characterize the vadose zone at the RFP in general and at OU4 in particular. The parameters for which there are not data or for which additional data are needed include:

- infiltration rates;
- soil tension-water content curves documenting the hysteresis effect;
- unsaturated hydraulic conductivities;
- chemical content of vadose zone moisture; and
- the leaching rate of contaminants.

Without these data from the unsaturated zone, an adequate evaluation of the water balance as well as the rate of contaminant movement cannot be completed, and the goals of the Inter-Agency Agreement cannot be met. The Technical Memorandum more explicitly identifies the data needs and the method of obtaining the needed data.

COMMENT 2. There is a significant amount of physical and chemical data that has been collected at OU4 and adjacent areas (e.g., OU4 Work Plan, Groundwater Monitoring and Protection Program Plan, The Geological Characterization Report). This prior data has established the contaminants of concern (COC) at OU4. It is, therefore, unclear why chemical analysis of soil borings will be analyzed each time for comprehensive contaminant scans, e.g., each sample will be analyzed for _____ Target Compound List (TCL) Semi-Volatile Organic Compounds (SVOC), and _____ the list of COC derived from earlier investigations, and design a discussion _____ percentage (e.g., 10%, 20%) of analysis will include comprehensive scans for TAL and TCL contaminants.

RESPONSE Although the use of a reduced list of Contaminants of Concern might be technically justified, the Inter-Agency Agreement and the approved work plan require that the extensive list of contaminants identified in the Technical Memorandum be used for investigation purposes. All past attempts to limit contaminant parameter lists with regulatory agency approval at the RFP have been unsuccessful.

COMMENT 3. The study states that is objectives are to characterize "active vadose zone migration pathways" and to develop a data base of physical and chemical data to support a baseline risk assessment. The data needed to accomplish these goals is not clearly defined (i.e., the Data Quality Objectives are not defined). For example, it is fine to say that data are needed to develop "a three dimensional representation of the subsurface environment," however, it is equally important to define how this three dimensional data will be used. The report should specify whether these data will be used for some type of numerical or analytical fate and transport model, or if the data will simply be used in a Baseline Risk Assessment, assuming a specific conservative land use scenario at the present site conditions. It is totally unclear what the use of this "three dimension representation" of the vadose zone will be. Again, as an example, if a simple analytical mathematical model is the anticipated data use for the three dimensional representation, then the differential equation(s), the initial conditions, the boundary conditions and the solutions(s) should be presented. Next, the memorandum should clearly specify how data collected in this report will supply the needed initial and boundary value conditions.

RESPONSE The three-dimensional geologic representation will document the physical and chemical characteristics of the subsurface environment, including both the vadose and saturated zones. This representation will be used to identify, in three dimensions, the hydraulic conduits which allow fluid migration in the subsurface, as well as the existing contaminant loadings and potential for continued future migration. A

three-dimensional representation is desirable because of the large amount of topographic relief in the OU4 area, and the high degree of geologic variability observed at the RFP site. Hydraulic and chemical characteristics will be used to develop the cascade-type vadose zone water balance and estimate infiltration, recharge, and contaminant flux. Available vadose zone numerical transport models will also be reviewed to assess their suitability in aiding calculation of the water balance and simulating the conditions observed in the OU4 area. Preliminary reviews, however, reveal that vadose zone transport models are unable to provide acceptable predictive capabilities. Long-term monitoring, designed on the basis of the three-dimensional geologic representation, may prove to be the preferred option in assessing long-term contaminant migration.

COMMENT 4. This technical memorandum on the OU4 Vadose Zone Characterization does not properly support the proposed technical investigation with Data Quality Objectives (DQOs). DQOs were not integrated into the proposal to support the investigative procedures detailed in the memorandum.

RESPONSE Data Quality Objectives are presented in Section 2.3 of the Technical Memorandum.

GENERAL COMMENTS

COMMENT 1. The soil-gas survey appears to be one of the last tasks to be started in this effort. This should be one of the first tasks, as it will provide useful information that can be used to relocate borings and wells.

RESPONSE The soil gas survey is not designed as a screening tool to be used siting soil borings. Instead, the program is intended to establish the presence or absence of volatile organic compounds within the earthen ponds and upgradient areas, and to determine the relative abundance of major gases in the vicinity of the 207B ponds. Borings will not be relocated based on this data, although Phase II installation of monitoring wells may be based on the soil gas survey results.

COMMENT 2. The reliance on the availability of the geographic information system (GIS) should be examined. The current capability of the GIS module to the Rocky Flats Environmental Data System (RFEDS) is limited and cannot support an effort of this type.

RESPONSE The contractor will provide the GIS system to be used in data interpretation, which will be compatible with, but independent of, RFEDS.

SPECIFIC COMMENTS

COMMENT 1. Section 1.0, p. 1-1, third paragraph: The development of methodologies for closure and post-closure monitoring does not appear to be a specific goal of this investigation. To discuss closure and post-closure at this time may be premature, as clean closure may still be an option for this site.

RESPONSE The development of methodologies for closure and post-closure monitoring is a specific goal of this investigation program as stated in the approved RFI/RI Work Plan. An entire range of remedial options should be considered, and many conceivable options will include monitoring as a component. The development of appropriate methodologies for closure and post-closure monitoring requires adequate knowledge of the vadose zone site characteristics to predict how the system will change in response to perturbations. From this point of view, all Phase I site characterization activities can be related to development of methodologies for closure and post-closure monitoring.

COMMENT 2. Section 1.0, p. 1-3, fourth paragraph: The statement that the solar ponds clean-out is taking place as part of an interim measure/interim remedial action (IM/IRA) is technically incorrect. The IM/IRA at operable unit (OU) 4 only covers removal of the water from the ponds and the storage and treatment of that water and water from the interceptor trench system (ITS). The removal and solidification of the sludge is not covered by the IM/IRA but by the closure plan.

RESPONSE See Randy T. Ogg.

COMMENT 3. Section 1.3, p. 1-5: Please provide a figure that shows the location of these investigations.

RESPONSE A figure identifying the locations of the related investigations and the discussion of related investigations has been expanded.

COMMENT 4. Section 2.1, p. 2-1, first paragraph: Please clarify how the data from OU4 is "limited." The short comings of the borehole data collected during construction of the numerous monitoring well and boreholes already emplace at OU4 (e.g., The Ground Protection and Monitoring Program Plan, 1991) should be discussed.

RESPONSE There is a great deal of historical data from the OU4 area regarding subsurface condition, as demonstrated by Figure A-1 of the Technical

Memorandum. These data have been gathered and reviewed by the project team and are currently being evaluated in detail. A summary of the historical investigations is presented in Appendix A. Most of the available data are related to subsurface geologic materials and saturated zone flow. However, the data are fairly limited in the sense that the previous subsurface work did not investigate physical and hydraulic parameters needed to characterize and predict vadose zone flow.

COMMENT 5. Section 2.1, p. 2-1, second paragraph: The decision path shown on Figure 2-1 lacks a decision point for no further action. For example, if soil sampling and analysis of vadose borings are free of contaminants or if contaminated concentrations do not exceed health-based action levels, then there is no point in proceeding with video logging. Please include decision points for no further action.

RESPONSE Program schedule constraints and site standard operating procedures require that downhole measurements be completed during or shortly after completion of the borehole. The borings cannot be left open while awaiting laboratory data, nor will health based action levels be available in a timely fashion. In addition, the available data indicate that useful information regarding contaminant occurrence and migration can be obtained from all the outlined measurements. As a result, completion of all activities in the outlined scope of work is planned.

COMMENT 6. Section 2.1, p. 2-1, third paragraph: Some of this synthesis has already taken place. The OU4 work plan provides some of this information and should be used as a basis for this plan.

RESPONSE As suggested, the RFI/RI work plan has been considered, and other available data sources have also been reviewed during the preparation of this Technical Memorandum. The text of the Technical Memorandum has been modified based on the current status of these ongoing activities, and identifies the many sources of information on subsurface conditions at OU4 or that may be pertinent to OU4.

COMMENT 7. Section 2.1, p. 2-2, first paragraph: Please explain why "it is currently envisioned that such a program will be required."

RESPONSE The text of the Draft Technical Memorandum was unclear regarding the need for a vadose zone program. The text of the Technical Memorandum has been changed to reflect the facts that a vadose zone characterization program is required in the approved RFI/RI work

plan, and that the available data, though extensive, are inadequate to fully characterize the vadose zone.

COMMENT 8. Section 2.1, p. 2-2, second paragraph: Please specify which borings are being proposed in this memorandum which are in addition to those discussed in the OU4 work plan. This wording of this memorandum is very confusing regarding what is additional work and what is already proposed.

RESPONSE The text of the Draft Technical Memorandum was confusing regarding what borings were specifically required in the RFI/RI Work Plan and which were additional borings. This issue has been clarified in the final Technical Memorandum. Information gathered from the RFI/RI Work Plan will be used in the vadose zone investigation; however, additional holes will be drilled for the installation of monitoring equipment. Currently, 16 boreholes from the RFI/RI have been selected for use in vadose zone characterization. These borings will be used for collection of physical samples, borehole permeability, moisture profile neutron logging, and pore water sampling. An additional 16 shallow boreholes will be drilled for installation of instrumentation specific to the double ring infiltrometer tests, and 25 shallow hand auger borings are planned for Guelph permeameter measurements. The locations of the boreholes are subject to minor revisions if the results of ongoing detailed data review suggest better locations.

COMMENT 9. Section 2.1, p. 2-2, third paragraph: The statement "... monitoring techniques will be continuously evaluated ...." should be explained. What monitoring technique is being monitored? It is not clear why the ____ will "recommend monitoring methodologies" after the OU4 vadose zone characterization is completed. If the recommendations will be "based on the findings of the OU4 vadose zone characterization," then explain for what application/study the methodologies will be recommended.

RESPONSE Monitoring techniques to be implemented during or after future closure activities need to be evaluated for applicability based on site-specific conditions identified during implementation of the program. The advantages of one particular technique over another may become apparent if certain favorable conditions are made apparent during drilling, or later during operation of the equipment. This section was expanded in the Technical Memorandum to be more clearly stated.

COMMENT 10. Section 2.2, p. 2-5, second paragraph: The list of pathways should be provided. There does not seem to be that many that would apply to this situation.

RESPONSE As suggested by this comment, a preliminary list of potential vadose zone migration pathways has been presented in the final Technical Memorandum.

COMMENT 11. Section 2.2.3, p. 2-5, third paragraph: The historical information indicates that the unconsolidated materials is not "relatively homogeneous". In fact it is highly variable ranging from clay dominated strata to gravel and cobble dominated strata. This section should be rewritten to more accurately describe the unconsolidated material present at Rocky Flats Plan.

RESPONSE The intent of the draft Technical Memorandum had never been to imply that the unconsolidated materials were expected to be relatively homogeneous. The available data indicate that the unconsolidated materials are quite heterogeneous. The Technical Memorandum has been modified so that the language is less confusing regarding the expected conditions in the unconsolidated materials.

COMMENT 12. Section 2.2.4, p. 2-6, first paragraph: Specifically state what elements 11 through 14 include and reference Figure 2-1 for clarity.

RESPONSE A more explicit reference to the figure was made as was additional detail to the text so that the elements alluded to were more specifically identified.

COMMENT 13. Section 2.2.4, p. 2-6, second paragraph: Explain for what reasons "It is presently envisioned that the existing data set will not be adequate...." There is currently an abundance of data that has or should have been collected from the site.

RESPONSE The statement that there is an abundance of data at OU4 is certainly true. However, very little of the data is pertinent to characterization of the vadose zone physical and chemical characteristics. At the current time the available data are not sufficient to accurately estimate storage of moisture in the vadose zone nor to estimate the amount of recharge to groundwater from percolation or leakage through the vadose zone. Similarly, although preferential pathways of migration have been identified in the vadose zone near the solar ponds, the data are insufficient to quantitatively evaluate the difference between those

pathways of migration and the more general movement of moisture through the vadose zone.

COMMENT 14. Section 2.2.4, p. 2-6, third paragraph: Attempting to validate a geologic model statistically does not appear to be an effort that should be undertaken. A geologic model by definition contains a variety of different data types, some of which can be defined statistically, others that cannot. An arbitrary rating system would not provide any level of confidence in the model either. The best test of a model is to predict what should be present, and then test it by investigation. If the model correctly predicts what the investigation finds the level of confidence in the model can be considered high, if incorrect the model must be changed.

RESPONSE We concur with this comment. The passage in the Draft Technical Memorandum regarding the use of geologic models was confusing. The passage has been re-written to more fully reflect this comment and the expected uses of a three-dimensional geologic representation.

COMMENT 15. Section 2.2.5, p. 2-6, fourth paragraph: Figure 2-3 does not indicate the sandstone beds are seasonally unsaturated. All this figure shows is that water level changes over time, but the figure does not indicate unsaturated conditions. Please clarify either in the text or on the figure.

RESPONSE We concur with this comment. The well hydrograph figure has been deleted from the Technical Memorandum, and the text has been modified. As previously stated in responses to above comments, there may be no sandstone beds at OU4 directly underlying alluvial materials.

COMMENT 16. Section 2.2.5, p. 2-7, first paragraph: Please detail the evidence that exists suggesting the alluvial aquifer is perched. Recently, the Draft Final Phase II RFI/RI Aquifer Test Report 903 Pad,, Mound, and East Trenches Areas OU2 (DOE, August 1992) documented a significant hydraulic connection between the saturated alluvium and the underlying Arapahoe sandstones. Explain how the assumption of a perched aquifer at OU4 can be reconciled with the data from OU2.

RESPONSE The potential for perched water tables presented in the approved RFI/RI Work Plan for OU4 cannot be proved or disproved with the current data. Apparently dry conditions have been described within the OU4 area at a depth greater than the alluvial water table. Such conditions may be indicative of perched water. Perched water tables

were found at OU1, and the saturated alluvium and Arapahoe sandstones are hydraulically connected at OU2. At both OU1 and OU2 the Arapahoe sandstones directly underlie the alluvial materials. However, the available data at OU4 do not support the existence of Arapahoe sandstones immediately underlying the saturated alluvial materials. As a result, the alluvial water tables may be perched on less permeable claystones of the Arapahoe Formation. The generally known characteristics of the Arapahoe Formation include the presence of discontinuous sandstones and sandy claystones of limited areal extent. Therefore, it is not surprising to find Arapahoe sandstones present in one area and not present a few thousand feet away. Further investigations are needed at OU4 to further define the relationship among alluvium, sandstone, claystone, and conditions of perched water tables. The text of the Technical Memorandum has been modified to more completely address these issues.

COMMENT 17. Section 2.2.5, p. 2-7, sixth paragraph: Please clarify if the 16 borings referred to here are different from the borings proposed in the OU4 work plan.

RESPONSE The requested clarification has been made in the Technical Memorandum. Information gathered from the RFI/RI work will be used in the vadose zone investigation; however, additional borings will be drilled for installation of vadose zone monitoring equipment. Currently 16 boreholes from the RFI/RI have been selected for use in vadose zone characterization, however, an additional 16 shallow boreholes will be drilled for installation of instrumentation specific to the double-ring infiltrometer tests and 25 shallow hand auger borings are planned for the Guelph permeameter measurements.

COMMENT 18. Section 2.2.6, p. 2-9, second paragraph: Please discuss the COC and design the analyses plan accordingly (i.e., analyze for the COCs and limit the full scans to a small percentage of samples).

RESPONSE Although the use of a reduced list of Contaminants of Concern might be technically justified, the Inter-Agency Agreement requires that the extensive list of contaminants identified in the Technical Memorandum be used for investigation purposes. All past attempts to limit contaminant parameter lists with regulatory agency approval at the RFP have been unsuccessful.

COMMENT 19. Section 2.2.7, p. 2-10: Please clarify why all of these techniques are being applied for this investigation. It would seem that the continuous core would provide most of the information and the geophysical

techniques would only be supplemental data. Explain how each of these techniques will supply the data needs of the transport and fate model (or whatever the "three dimensional representation" will be used for) and the baseline risk assessment.

RESPONSE The downhole geophysical testing of deep bedrock borings has been deleted from this program. However, additional explanation has been added to the Technical Memorandum to further explain the need for various types of data and to explain the need for various types of monitoring equipment.

COMMENT 20. Section 2.2.8, pp. 2-10 to 2-14: It is unclear why in situ permeability test are needed. The Draft Final Phase II RFI/RI Aquifer Test Report 903 Pad,, Mound and East Trenches Area OU2 (DOE, August 1992) provide storativity, transmissivity, and hydraulic conductivity measurements based on constant rate pumping tests for the Rocky Flats Alluvium and the underlying Arapahoe Formation. The saturated hydraulic conductivities can be related to unsaturated conductivities by theoretical or empirical means (e.g., _____ and Parloer, 1990, Ground Water). It seems highly unlikely that the hydraulic properties of the Arapahoe Formation and Rocky Flats Alluvium differ significantly between OU2 and OU4. Recommend diminishing the scope of the investigation detailed in this section.

RESPONSE As suggested in this comment, the scope of the borehole permeability tests have been diminished. In addition to tests conducted at OU2, there have been additional tests at OU1 and as a part of the site-wide geologic characterization activities in similar geologic strata as found at OU4. There have also been in-situ permeability tests conducted at limited numbers of OU4 wells. However, it is felt that some additional, confirmatory borehole permeability tests should be conducted at OU4 to verify that permeability values lie within the expected range. As previously mentioned in Comment 11, the alluvium is heterogeneous, ranging from clay to gravel. Site-specific measurements of vadose zone strata are considered critical to this program.

COMMENT 21. Section 2.2.10, p. 2-15, second paragraph: Please explain in detail what short comings in the data set collected by the investigation outlined above will signal that "...more data are required..."

RESPONSE Based on the current understanding of the site, the vadose zone characterization activities outlined should be sufficient to meet the requirements of the Interagency Agreement. However, the possibility exists that the data generated from our characterization activities will

not be sufficient to characterize the site due to unanticipated conditions. Additional data may be particularly important if the alluvial water tables are found to represent perched water conditions, and the vadose zone is determined to extend deep within the Arapahoe Formation. In the latter case it may be necessary to generate additional data during later investigation phases in order to characterize the site.

COMMENT 22. Section 3.0, p. 3-1: This section does not appear to have any purpose other than to document reasons for why this effort will not succeed. Almost all of the problems mentioned here are management related, or should have been determined prior to writing this memorandum.

RESPONSE We concur with this comment and have deleted the section of the Draft Technical Memorandum to which this comment pertained.

COMMENT 23. Section 4.0, p. 4-1: This section should provide an actual schedule showing the durations for the different tasks, and how the efforts proposed here will interact with the rest of the program at OU4. This effort should not be delayed until after the approval of this memorandum.

RESPONSE The schedule for vadose zone characterization activities is contingent upon conditional or unconditional approval of the Vadose Zone Technical Memorandum on the subject. The actual schedule of vadose zone investigation activities will be incorporated into the existing OU4 RFI/RI schedule when the Technical Memorandum is approved.

COMMENT 24. Table 2.1. _____ in the OU4 work plan. Please provide a break-out showing which _____ already proposed.

RESPONSE The table was clarified to identify which boreholes are dedicated to vadose zone investigation work and which boreholes were previously proposed under the RFI/RI Work Plan.

COMMENT 25. Figure 22-2: Please include the borings proposed as part of the OU4 work plan.

RESPONSE The figure and the text of the Technical Memorandum have been modified to clearly state which boreholes are to be drilled as part of

the RFI/RI Work Plan and which are to be dedicated to the vadose zone investigation.

COMMENT 26. Figure 2-3: To evaluate this figure more information is needed, such as screened interval, length of screen, and well location. This figure as it stands adds nothing to the discussion.

RESPONSE We concur with this comment. The figure did not directly relate to any discussion or issue in the Draft Technical Memorandum; we have deleted the figure.

COMMENT 27. Figure 2-4: This figure appears to be a conceptual model only. There is enough information present at OU4 to develop actual cross-sections based on real data and those should be provided. Also, please clarify what is meant by the "Regional Ground Water". This implication of this figure is that contamination from the Solar Ponds has effected a regional ground water aquifer, which is not the case. This portion of the figure should be re-labeled. Also, in the vicinity of the Solar Evaporation Ponds does the ground water intersect the surface streams as shown in this figure? Information from other OUs indicate that the streams in the area are losing streams. This fact indicates that the ground water in the Rocky Flats vicinity does not intersect the surface streams. Please re-draft this figure using available data.

RESPONSE This figure was included in the approved RFI/RI Work Plan for OU4 and in the Draft Technical Memorandum for discussion purposes only; it was not intended to accurately and fully represent subsurface conditions in the OU4 area. The figure is still useful for discussion purposes and was therefore retained in the Technical Memorandum, but additional discussion was presented in the text explaining the purpose of the figure.

Cross-sections of the OU4 area are in the Final Phase I RFI/RI Work Plan. Revision of these cross-sections is ongoing and will be continued through the program, in the three-dimensional geologic representation. In the process of preparing these cross-sections considerable evaluation of the data was conducted, and this increased site understanding is presented in the Technical Memorandum. The issue of "Regional Ground Water" was also clarified. It was further explained in the text of the Technical Memorandum that at this time we believe that the deeper, confined hydrostratigraphic unit (presented on the figure as "Regional Ground Water") is uncontaminated.