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MPC&D 06-115

November 21, 2006

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

Attention: John Hickman

In your letter dated October 24, 2006, you requested additional information required to complete the NRC's review and approval of the Rancho Seco License Termination Plan (LTP). Attached is our response to your request. Members of your staff with questions requiring additional information or clarification may contact Bob Jones at (916) 732-4843.

Sincerely,

Steve Redeker
Manager, Plant Closure & Decommissioning

Attachment

Cc w/ attachment: B.S. Mallett, NRC, Region V

NMSS01

Response to RAIs Dated October 24, 2006

General Issues

1. Chapter 2, Section 2.1.4.3, page 2-4

   The first sentence states that a formal site reconnaissance was not performed. However, in the next sentence it states that appropriate site reconnaissance has been performed. Explain the difference between a formal site reconnaissance and the appropriate site reconnaissance.

Response

A "formal site reconnaissance" would be performing the full scope of the "Site Reconnaissance or Site Visit" as described by MARSSIM section 3.5. As explained below, such a full scope reconnaissance was not warranted and a reduced scope or "appropriate" reconnaissance was performed. The term "appropriate site reconnaissance" will be deleted as described below.

Chapter 2, Section 2.1.4 of the License Termination Plan (LTP) is a summary description of the methodology used to perform the Historical Site Assessment (HSA). Section 2.1.4.3 refers to the "Site Reconnaissance or Site Visit" described in MARSSIM (NUREG-1575) Section 3.5, which also states: "This section is most applicable to sites with less available information and may not be necessary at other sites having greater amounts of data, such as Nuclear Regulatory Commission (NRC) licensed facilities."

The last sentence of LTP Section 2.1.4.3 will be clarified to read:

> "Investigations were performed to verify locations and current conditions of questionable items or issues (radioactive liquid spills or spread of contamination) discovered during review of historical records or the conduct of personal interviews."

2. Chapter 2, Section 2.1.4.4, page 2-4

   The term "observation" is used but not defined. Clarify want is meant by observation. What was observed? What constitutes an observation?

Response

An "observation" is a comment made by an individual who was interviewed that contained information about the interviewees' knowledge of systems, facilities or areas where there may have been a radiological impact that was not already identified on a list provided to the interviewee.

Chapter 2, Section 2.1.4.4 summarizes the use of personnel interviews, including the use of questionnaires, of current, former and retired plant personnel to confirm documented incidents and identify undocumented incidents during performance of the HSA.

LTP Section 2.1.4.4 will be clarified through addition of the parenthetical expression

> "(knowledge of any systems, facilities, or areas of potential radiological impact not already identified on the Rancho Seco Historic Site Assessment Questionnaire)"

after the first use of the term "observation".

3. Chapter 2, Section 2.1.5.7.2, Discharge Canal Soil, page 2-13

   Were other radionuclides, such as hard-to-detect radionuclides, analyzed for? Were attempts made to detect hard-to-detect radionuclides in this area? And if so, what were the results? Is the discharge Canal Soil area still contaminated as stated on page 2-11?

Response

Even though characterization data is available for all areas (samples and/or surveys), not all samples taken have been analyzed for hard-to-detect radionuclides (HTDs). In this case, Discharge Canal Soil samples were not analyzed for HTDs. This soil has not been remediated and is still has detectable activity.

The Discharge Canal Soil is within the Effluent Corridor, which is also referred to as the Effluent Water Course. The Effluent Corridor or Effluent Water Course area soils (Discharge Canal Sediment, Discharge Canal Soil, Depression Area Soil) are all impacted from the same source; i.e., radioactivity in liquid effluents. Samples from all of these areas were taken and analyzed onsite during the characterization process. However, as a general rule, only the samples exhibiting the highest activities were analyzed for HTDs because: 1) those are the samples with the most likelihood of a positive result for the HTDs, and 2) those are the samples that would provide the most reasonable basis for surrogate ratios of HTDs to nuclides detectable with onsite laboratory equipment. In this case, samples of the Depression Area Soil were taken and analyzed for HTDs since this is the most highly impacted soil representative of this region.

The results of the offsite analysis of HTDs in site soils is contained in DTBD-05-014, "Rancho Seco Nuclear Generating Station Surface Soil Nuclide Fraction and DCGL," [Reference 2-27] as referenced in Section 2.5.5 of this LTP. Table 2-26, taken from DTBD-05-014, shows the nuclide fraction basis for site soils for HTDs.

The paragraph under Table 2-25 on Page 2-55 will be amended as follows (amended text italicized here but will not be in the LTP):

> "...The soil nuclide fraction, including the hard-to-detect radionuclides, is provided in Table 2-26. *This nuclide fraction applies to all site soils.*"

4. Chapter 2, Section 2.1.5.7.2, Depression Area Soil, page 2-13

   The text indicates that you are sending the results to an offsite vendor laboratory for the analysis for hard-to-detect radionuclides. However, on the next page, page 2-14, Table 2-4, two radionuclides, Co-60 and Cs-137, which are gamma emitters and not hard-to-detect radionuclides are reported. Were hard-to-detect radionuclides analyzed for? And if so, what were the results?

Response

A composite sample taken from 4 samples in the Depression Area was sent for offsite analysis. The text states "a composite sample...representing the highest concentrations was sent to a vendor laboratory for hard-to-detect-nuclide analysis."

In order to work with a single data set when observing nuclide fractions within a sample, SMUD had required the vendor lab to analyze for the entire suite of nuclides of concern for each sample, not only the HTDs. As stated in the last sentence on Page 2-13, Table 2-4 reports all radionuclides that were detected in the sample by the offsite vendor laboratory at levels above the minimum detectable activity (MDA), both gamma emitters and HTDs. Co-60 is also reported even though below the MDA because of its significance overall for the site.

Revision of the LTP is not warranted in response to this request for additional information (RAI).

5. Chapter 2, Section 2.1.5.7.2, page 2-14, Remainder of the Non-Industrial Area

   What were the "selected areas" outside of the Industrial Area?

Response

The "selected areas" outside of the Industrial Area are shown in Figure 1 below.

Figure 1

Within the "selected areas" survey blocks were identified for conduct of the radiological surveys. Figure 2 below shows the survey blocks indicated with the blue rectangles. Each survey block is nominally 48 meters by 100 meters. In general, an *in situ* measurement was taken at the southwest corner of each survey block, and one soil sample was taken for every two survey blocks, the sample location being within a meter of the *in situ* measurement for that block.

Figure 2

Revision of the LTP is not warranted in response to this RAI.

6. Chapter 2, Section 2.1.10, page 2-24

The License Termination Plan (LTP) states, "There were periods of liquid effluent releases during operation of the plant where it was determined that calculated dose to a maximally exposed individual via the liquid effluent pathway exceeded the design objective level of 10 CFR 50, Appendix I. However, it was also determined that these liquid effluent releases did not exceed the concentration limits of 10 CFR 20 or the fuel cycle limit of 40 CFR 190. The dose from which has already been accounted for in accordance with the regulation governing radioactive effluent from power plants and no remediation is required."

The assumptions used to determine the dose from the liquid effluent pathway differ from the assumptions used to determine the dose from residual radioactivity remaining in soils or structures. Provide a characterization and evaluation of the potentially affected area(s), and demonstrate compliance with 10 CFR 20 Subpart E.

Response

The paragraph quoted in RAI No. 6 was included to assure complete disclosure regarding offsite liquid releases and is not a basis for License Termination. Refer to the response to RAI No. 7 regarding demonstration of compliance with 10 CFR 20, Subpart E.

The onsite impacts from these historical releases were characterized and discussed in Section 2.5.5 of the LTP. Demonstration of compliance with 10 CFR 20, Subpart E of onsite impacted areas, identified by the HSA and characterization surveys, will be performed by Final Status Survey (FSS) design and performance and by data quality analysis (DQA) of FSS results as described in Chapter 5 of the LTP.

Revision of the LTP is not warranted in response to this RAI.

7. Chapter 2, Section 2.1.5.7.2, pages. 2-11 and 2-12

NUREG/CR 4286, which is referenced on page 2-12 in the LTP, states that background levels were reached 19 km from the plant. This was in Laguna Creek. The report also stated that elevated levels of contamination were detected in fish at least 8 km from the plant. Please demonstrate that these areas are in compliance with 10 CFR 20, Subpart E.

Response

The areas referenced are outside the licensed boundary of the plant and as outlined below they are not subject to compliance with 10 CFR 20, Subpart E.

10 CFR 20, Subpart E states that it applies "...to the decommissioning of facilities licensed under Parts 30, 40, 50, 60, 61, 63, 70, and 72 of this chapter, and release of part of a facility or site for unrestricted use in accordance with § 50.83 of this

chapter..."[1], Subpart E clearly applies to the 2,480 acre Rancho Seco site described in the licensing basis documents. Since the areas referenced in this RAI are in the environs outside of the licensed Rancho Seco site and were impacted from 10 CFR Part 20.2001(a)(3) authorized radioactive liquid releases, demonstration of compliance with 10 CFR 20, Subpart E in these environs is not required.

Reporting and recordkeeping requirements for decommissioning planning are specified in 10 CFR 50.75. Specifically, 10 CFR 50.75(g)(4)(iii) requires records to be kept of: "*The release and final disposition of any property recorded in paragraph (g)(4)(i) of this section, the historical site assessment performed for the release, radiation surveys performed to support release of the property, submittals to the NRC made in accordance with § 50.83, and the methods employed to ensure that the property met the radiological criteria of 10 CFR Part 20, Subpart E, at the time the property was released.*" The property is specified in paragraph (g)(4)(i) as: "*The licensed site area, as originally licensed, which must include a site map and any acquisition or use of property outside the originally licensed site area for the purpose of receiving, possessing, or using licensed materials.*"

A similar issue was raised during the LTP Public Meeting held to discuss the Big Rock Point Restoration Project License Termination Plan. A transcript of this meeting is available electronically through the NRC's Agencywide Documents Access and Management System (ADAMS) using accession number ML032340143. On page 36 of the transcript a member of the public asked a question as to what constituted the boundaries of the site requiring cleanup of contamination resulting from liquid radioactive waste discharges into Lake Michigan. The NRC representative's response to the question was that the water line is the end of the Big Rock Point property and that Big Rock Point is not responsible for any contaminates in the Lake Michigan sediment because the contaminates were the result of legal discharges into Lake Michigan and that the sediments are not on Big Rock Point property.

The authorized radioactive liquid releases that resulted in the NRC contracting with the Oak Ridge National Laboratory (ORNL) to conduct the study reported in NUREG/CR-4286 were historical events that occurred prior to the late summer of 1984. The consequences of the authorized radioactive liquid releases were the subject of studies conducted by Rancho Seco personnel, ORNL and Lawrence Livermore National Laboratory (LLNL) contracted by SMUD. This was one of eight studies of the liquid effluent pathway conducted since 1984 as part of the Environmental Exposure Controls Action Plan, which was described in the NRC Inspection Report 50-312/90-02, dated February 1, 1990. By letter AGM/NUC 92-241 from James R. Shetler (SMUD) to J. B. Martin (NRC), SMUD notified the NRC of completion of the Environmental Exposure Controls Action Plan.

The conclusion of the Action Plan was a calculation of doses that an assumed offsite individual would receive from three pathways; 1) drinking the creek water, 2) eating the fish, and 3) standing on the sediment. The results of the calculation showed that even

[1] 10 CFR § 20.1401

the maximum exposed individual would receive less than 2 mrem per year from any of the pathways.

Revision of the LTP is not warranted in response to this RAI.

8. Chapter 2, Section 2.4.7, page 2-45

This section states, "Several areas of the site were specifically targeted for detailed sampling and surveys." Describe what areas were specifically targeted for detailed sampling and surveys and provide results.

Response

Areas specifically targeted were the Regenerant Holdup Tank (RHUT) and area, the Tank Farm, the Spent Fuel Cooler Pad, the soils adjacent the Plant Effluent Water Course, the Fuel building West exterior wall, Spent Fuel Pool and Upender Pit walls and floor, soil beneath the Spent Fuel Pool, activated concrete in the Bioshield, suspect Co-60 dominant areas within the Auxiliary and Reactor buildings and the Barrel Farm. The results are included in Chapter 2 and Tables 5-4A through 5-4E of Chapter 5 of the LTP.

Revision of the LTP is not warranted in response to this RAI.

9. Chapter 2, Section 2.4.7.1, page 2-46, Paragraph after last bullet on page

This section states, "The nuclide suite includes those nuclides and the suite is found in Chapter 6 of this LTP." This sentence is unclear. Please clarify.

Response

The paragraph will be clarified to read:

> "With the exception of Bioshield concrete and rebar, samples submitted to the vendor laboratory were analyzed for the entire suite of 26 radionuclides. The radionuclide suite is presented in Table 6-1 of Chapter 6. The Bioshield Concrete and rebar acquired from the mid-core region (-2'6" Elevation) were analyzed for radionuclides expected to be found in activated media. These radionuclides include: H-3, C-14, Fe-55, Co-60, Ni-63, Cs-134, Eu-152, Eu-154 and Eu-155. Of the radionuclides listed in Chapter 6, Table 6-1 the following were not included in the analysis of activated concrete and rebar: Sr-90, Tc-99 Pm-147, Np-237, Pu-238 through Pu-242, Am-241 and Cm-244. The latter radionuclides are not concrete and rebar activation products but could be found on

external surfaces of activated concrete and are addressed using the radionuclide mix for structures and surfaces provided in Section 2.5.1."

10. Chapter 2, Table 2-15, page 2-47

Please provide more detailed information regarding the concentration(s). More specifically, what radionuclides(s) do these concentrations represent?

Response

Table 2-15 was intended to provide a general range of soil concentrations observed over the site area. The concentrations represent onsite gamma spectroscopy analysis results of which the principle nuclides are Cs-137 and Co-60. Some of the locations in Table 2-15 are the same locations provided in Table 2-25 and will be changed as follows:

Table 2-15
Specific Soil Contamination Investigation Locations

Location	Concentration (pCi/g)	Vendor Lab Analysis
Spent Fuel Cooler Pad	5-1100	Yes
Tank Farm	18-120	Yes
Spent Fuel Pool Diesel Generator Room Gap	50-1200	Yes
Plant Effluent Water Course	<1.0-23	Yes
RHUT Tank Area	20-100	No
Old Bechtel Bldg pad	<0.5	No
Locations outside the power block	<1.0	No

The paragraph immediately above Table 2-15 will be modified to read:

"The concentrations provided in Table 2-15 present gross concentrations in pCi/g observed using onsite gamma spectroscopy. The onsite soil gamma-emitting nuclide mixture consists primarily of Cs-137, Cs-134 and Co-60 of which the averaged Cs-137 concentration is greater than 90 percent of the mixture. The results of the detailed soil sampling and analysis were reported in DTBD-05-014 and formed the basis for the soil nuclide fractions. The sample locations in Table 2-15 where vendor laboratory analysis was performed were reported in DTBD-05-014 and are also presented in Section 2.5.5, Table 2-25 of this chapter."

11. Chapter 2, Section 2.5.1, page 2-48

This paragraph is awkward. For example, it refers to a mean but provides a range. It discusses hard-to-detect analyses, but indicates Co-60 and Cs-137 which are gamma emitters and are easy to detect radionuclides. The paragraph raises the issue about hard-to-detect radionuclides, but provides no information or data about the presence of these radionuclides.

Response

The mean values for each structure will be clarified along with a narrative on the hard to detect nuclides associated with structure surfaces. The information, which will replace the entire first paragraph for Section 2.5.1, (above Table 2-16) is as follows:

The mean direct beta contamination values as measured by gas flow proportional detectors for the Reactor, Auxiliary, Fuel and Turbine Buildings are provided below.

Reactor Building
- -27' Elevation 1.50E+06 dpm/100 cm^2
- Grade Level 2.00E+05 dpm/100 cm^2
- +40' Elevation 5.10E+04 dpm/100 cm^2
- +60' Elevation 2.00E+04 dpm/100 cm^2

Auxiliary Building
- -47' Elevation 3.20E+05 dpm/100 cm^2
- -29' Elevation 5.40E+05 dpm/100 cm^2
- -20' Elevation 2.50E+05 dpm/100 cm^2
- Grade Level 3.70E+05 dpm/100 cm^2
- +20' Elevation 8.50E+04 dpm/100 cm^2
- +40' Elevation 3.30E+03 dpm/100 cm^2

Fuel Building
- Spent Fuel Pool Floor 1.70E+07 dpm/100 cm^2
- +40' Elevation 5.90E+03 dpm/100 cm^2

Turbine Building
- -7' Elevation 3.10E+03 dpm/100 cm^2
- Grade Level 2.30E+03 dpm/100 cm^2
- Mezzanine 1.60E+03 dpm/100 cm^2
- +40' Elevation 2.8E0+03 dpm/100 cm^2

The mean, maximum and standard deviation of surface activity for each of the structures are provided in Tables 5-4A through 5-4E in Chapter 5 of this LTP.

Additionally, Seventy-five volumetric samples representing contaminated structure surfaces were examined and used to identify the radionuclide constituents and to determine the gross beta DCGL for structures. Eight of these samples were submitted for radionuclide analysis by a vendor laboratory. The samples were analyzed for the radionuclide suite presented in Chapter 6, Table 6-1. The eight samples represent the highest activity samples available from each principal building (Turbine, Fuel, Auxiliary and Reactor Buildings) and subsequently the greatest chance of establishing the ratios of the hard to detect radionuclides including the TRU's that are usually present at very low levels in comparison to the site's principal and easily detected nuclides, Co-60 and Cs-137. DTBD-05-015, "Rancho Seco Nuclear Generating Station Structure Nuclide Fraction and DCGLs," [Reference 2-26] describes the process for examination of the samples submitted for vendor analysis and the determination of the nuclide fraction for site structures. The following hard to detect radionuclides were reported as positive results by the vendor laboratory: H-3, C-14, Fe-55, Ni-59, Ni-63, Sr-90, Tc-99, Pu-238, Pu-239, Pu-240, Pu-241 and Am-241. Of these radionuclides, H-3, C-14, Fe-55, Ni-59, Ni-63 and Tc-99 were removed from the mixture based on their small dose contribution to the building occupant. Hard to detect analyses of concrete samples showed that the nuclide fraction was dominated by Cs-137 and Co-60 (90% or more of the individual sample nuclide fractions) with the remainder being the hard to detect radionuclides. The concrete nuclide fractions for the site structures other than "special areas" is shown in Table 2-16 below.

12. Chapter 2, Figure 2-14 to 2-21 (pages 2-73 thru 2-80)

    There is no legend associated with these figures. There was a legend found on page 2-111 but it is not clear whether this legend applies to these figures. Please provide a legend or legends that represent all the figures in this chapter of the LTP.

Response

The legend found on page 2-111 applies to all of the figures in Chapter 2.

Revision of the LTP is not warranted in response to this RAI.

13. Chapter 2, Table 2-17, page 2-49

    This table cites structures with contamination levels below the derived concentration guideline levels (DCGL). Please provide a table that shows all structures with levels that are above the DCGL.

Response

Table 5-4D in Chapter 5 of the LTP shows all the structures that, prior to remediation, had contamination above the DCGL as well as structures that had no contamination above the DCGL. Contamination levels for the major site buildings are given by elevation.

Revision of the LTP is not warranted in response to this RAI.

14. Chapter 2, Table 2-17, page 2-49

The maximum direct beta for exterior surfaces for the Bulk Waste Building was reported as 6.99E+4 dpm/100 cm^2. On page 2-48, first sentence, next to last paragraph, it states that the gross beta DCGL for surfaces and structures is 4.30 E+04 dpm/100 cm^2. The value reported in Table 2-17 exceeds the DCGL. This is not consistent with the title of the table. Please provide an explanation for this discrepancy and correct it, if necessary.

Response

The Bulk Waste Storage Building will be removed from Table 2-17 and the last sentence on page 2-48 will be revised to state:

> "Site structures determined to have levels of residual radioactivity below the DCGLs are provided in Table 2-17 below."

15. Chapter 2, Section 2.5.1.1, page 2-49

Please provide more detail on what constitutes a special area.

Response

The Term, "special areas" is defined in DTBD-05-015 as areas of the site that have significantly different nuclide ratios, which require separate DCGLs. The definition for special areas will be entered as the introductory sentence to Section 2.5.1 of Chapter 2 of the LTP as:

> "Special Areas are defined as areas of the site that have significantly different nuclide ratios, which require separate DCGLs."

16. Chapter 2, Section 2.5.1.1, page 2-50

This section states, "Sample locations 10-16, 18, 26, and 28 in Figure 2-14 depict the Special Area sample locations in Table 2-18." Table 2-18 on page 2-50 identifies 7 locations. According to the number of locations that are shown on Figure 2-14, and depending on how 10-16 is defined, the number of sample locations could be as few as 4 locations or as many as 10 locations. There does not appear to be any consistency between what is shown in Table 2-18 and what is shown in Figure 2-14. Please correct this discrepancy.

Response

The last sentence of Chapter 2, Section 2.5.1.1 and Table 2-18, will be clarified to read:

> "Sample locations 10, 14-16, 18, 26 and 28 depict the Special Area sample locations described in Table 2-18. The identified Special Areas consist of four survey areas; the East Decay Heat Cooler Room, Seal Return Cooler Room, Crud Tank Pump Room and the Miscellaneous Waste Filter Room."

The Location Descriptions in Table 2-18 will be modified to include the sample location number as follows:

Table 2-18
Special Area Locations

Sample Code	Location Description**	Co-60 Nuclide Fraction*	Cs-137 Nuclide Fraction*
SB8130690 SC03A	East Decay Heat Cooler Room (10)	0.806	0.195
SB8130640 SC02A	Seal Return Cooler Room (14)	0.881	0.119
SB8130660 SC02	Crud Tank Pump Room (15)	0.868	0.132
SB8130670 SC01	Crud Tank Pump Room (16)	0.866	0.134
SB8130670 SC02	Crud Tank Pump Room (18)	0.775	0.226
SB8130350 SC02	Miscellaneous Waste Filter Room (26)	0.788	0.212
SB8130350 SC04	Miscellaneous Waste Filter Room (28)	0.794	0.206

*Co-60 and Cs-137 nuclide fractions have been normalized, see DTBD-05-015

**The numbers in parenthesis are the sample locations found in Figure 2-14.

17. Chapter 2, Table 2-19

Does the concentration in Table 2-19 for the Reactor Bioshield Core and Reactor Bioshield Core Rebar represent the average value of the six core samples or the highest value of the six core samples? It is not clear as to what the concentration for each sample represents.

Response

The radionuclide results in Table 2-19 present the maximum radionuclide concentrations for the Bioshield. These sample results represent one concrete core sample and metal from rebar removed from near the "face" of the same core. The core and rebar were obtained from the reactor vessel mid-core (-2' 6" elevation) which is the region of highest activation.

The third bullet item of Chapter 2, Section 2.5.1.2 identifies the -2' 6" Elevation as a mid-core (centerline of the reactor core) level of the reactor vessel. Paragraph 5 of this Section identifies the -2' 6" Elevation core and metal rebar sample as submitted to the vendor laboratory but mis-identifies the sample location as the 2' 6" Elevation. There are missing minus signs in Paragraph 4 and in Table 2-19. The minus (-) elevation symbols will be appropriately added to the text of paragraphs 4 and 5 as well as Table 2-19.

18. Chapter 2, Section 2.6, page 2-58

"As previously stated, characterization data will be collected as necessary throughout the project. Results of future characterization sample analyses will be evaluated to determine the impact, if any, on the radionuclide identifies, nuclide fractions and the classification of structures, soils, and other site media."

Please provide a reference for "previously stated"

Response

The reference for "previously stated" is Section 1.5.2 of Chapter 1 of the LTP. This section of Chapter 1 discussed the status of characterization activities at the time of LTP submittal and merely pointed out that site characterization is an ongoing part of decommissioning.

Section 2.6 of the LTP will be revised to add this reference.

19. Chapter 2, Section 2.7, page 2-59, last sentence

"Furthermore, the current characterization data provide no indication that worker or public health will be adversely affected by the decommissioning."

The report does not make any comparison of health studies of workers or the public with the characterization data. Also, what is meant by adverse? What endpoint was being measured? It is suggested that this statement be removed or revised.

Response

The statement will be removed from Section 2.7 of the LTP.

20. Chapter 3, Section 3.2.2 (last sentence) page 3-4

    This section states, "No significant activity was found below the concrete floor." Please define quantitatively what is meant by "no significant activity." What would be considered significant?

Response

In this case, the use of "no significant activity" meant "less than a small fraction of the DCGL". The analytical results performed by ORISE can be found in Section 2.5.5 of Chapter 2, which describes the collection of soil samples from beneath the Spent Fuel Pool. The results of the soil analysis performed by ORISE are compared to the site soil DCGLs proposed at the time of sampling are included in Table 2-28.

Revision of the LTP is not warranted in response to this RAI.

21. Chapter 3, Section 3.2.4.3, page 3-5

    This section states, "Exterior dose rates were 0.2 mrem/hr or less except for a hot spot at the pressurizer bottom where the surge line exits the vessel. To ensure 49 CFR 173.441 radiation limits were met, a carbon steel shielding cover was placed over the surge line and welded to the exterior of the vessel reducing the contact dose rate to less than 200 mrem/hr." What was the dose rate from the hot spot? Why did you elect to shield rather than decontaminate or remediate?

Response

The pressurizer was being shipped as radwaste following commodity removal. Shielding hot spots to comply with package dose rate limits is a common industry practice that resulted in the workers receiving less dose than they would have received with decontamination of the hot spot. The hot spot prior to shielding was 500 mrem/hr.

Revision of the LTP is not warranted in response to this RAI.

22. Chapter 3, Section 3.3.5 (last bullet) page 3-10

    This section states, "Upon completion of the Final Status Survey (FSS), the area is placed under periodic routine survey by Radiation Protection to ensure no re-contamination occurs. If re-contamination is identified, an investigation will be initiated that would result in corrective actions up to and including re-performance of the FSS for that area." What would constitute recontamination?

Response

Recontamination would constitute the identification of residual radioactivity in excess of that identified during the FSS.

Section 3.3.5 will be revised for clarification and to better summarize the more detailed information on access control measures provided in Section 5.2.4 of the LTP by deleting the bulletized list and adding reference to Section 5.2.4. The last sentence of the remaining paragraph will be revised to read:

> "Upon commencement of the FSS for survey areas where there is a potential for re-contamination, isolation and control measures will be implemented as described in Section 5.2.4.4 of this LTP."

The last bullet of Section 5.2.4.4 will be revised to state:

> "Periodic surveillance/inspection to monitor and verify adequacy of isolation and control measures."

Also, the last paragraph of Section 5.2.4.4 will be revised to state:

> "Periodic surveillances/inspections will not be required for open land areas that are not normally occupied and are unlikely to be impacted by decommissioning activities. If the periodic surveillance/inspection indicates that the adequacy of isolation and control measures has been compromised with the potential for recontamination of the area, post-FSS radiation survey locations will be judgmentally selected for survey, based on technical or site-specific knowledge and current conditions present in or near the survey area. The selected locations will be surveyed using the same instruments and techniques used for the FSS and the results will be compared with those obtained during the FSS to determine whether the area had been re-contaminated. These surveys are primarily designed to detect the potential migration of contaminants from decommissioning activities taking place in adjacent areas."

23. Chapter 4, Section 4.4.3.1, page 4-6

This section states, "The characterization data for concrete surfaces at the Rancho Seco facility indicates that a major fraction of the contamination occurs in the top 10 millimeters of the concrete." However, on page 2-46, third bullet, it states, "The results of the sampling provided strong evidence that contamination penetrated deeply into some cracks associated with the concrete." It further states, "The results of the characterization contributed significantly to the decision to remove the concrete from the Containment structure down to the plate liner." Please provide clarification and expand the discussion in this area and support the statements with additional data.

Response

Section 4.4.3.1, page 4-6 will revise the statement, "The characterization data for concrete surfaces at the Rancho Seco facility indicates that a major fraction of the contamination occurs in the top 10 millimeters of the concrete" to read:

> "Industry experience has shown that a major fraction of concrete contamination occurs in the top 10 millimeters of the concrete."

This should reduce confusion with characterization results reported in Section 2.4.7.1 of the LTP.

Additional data is not required for the discussion in this area. Chapter 4, Section 4.4.3 provides the bases for the determination of costs of various methods of decontamination for the purpose of performing cost/benefit analyses to determine if remediation below the NRC 25 mrem/y dose limit is ALARA.

Section 4.4.3.1 specifically provides the bases for the determination of costs to remediate (scabble) concrete surfaces, not the remediation of contamination that has penetrated the surface into cracks. The bounding cost estimates for scabbled depths of 0.125 and 0.25 inches are based on NUREG/CR-5884, Volume 2, Appendix C estimates as discussed in Chapter 4, Appendix 4-A, Sections A.4.a and A.4.b.

The purpose of the information provided in Chapter 4 is to describe the methods used to reduce residual contamination to levels that comply with the NRC's annual dose limit of 25 mrem plus ALARA and to determine if the cost of remediation below the annual dose limit is ALARA. Therefore, information contained in Section 4.4.3.1 is not applicable to evaluation of the results of characterization surveys provided in Chapter 2 or future FSS surveys to determine if remediation is required to comply with the annual dose limit.

24. Chapter 4, Section 4.4.4.1, page 4-7

    This section states, "For the evaluation, the truck container is assumed to carry 13.5 m^3 of concrete per shipment based on the NUREG 1757, Volume 2 guidance contained in Table 4.1." The parameter value referenced in Table 4-1 for Waste Shipment Volume (V_{ship}) is 13.6 m^3 per shipment. Also, the reference used in this table is not consistent with the reference stated on page 4-7. Although the difference in values is only 0.1 m^3, this could have a significant impact on the volume if there are a lot of shipments made during the decommissioning. Please correct this discrepancy.

Response

Section 4.4.4.1, page 4-7 incorrectly identifies a truck container volume of 13.5 m^3 of concrete per shipment and should reference NUREG–1496, Volume 2 instead of NUREG-1757, Volume 2. The parameter value referenced in Table 4-1 for Waste Shipment Volume (V_{ship}) of 13.6 m^3 per shipment and the source reference for this parameter value are correct as stated. Also, the truck container volume referenced in Appendix 4-A is the correct value of 13.6 m^3 and the calculations performed to generate the data contained in Table 4-2 used the correct value.

LTP Section 4.4.4.1 will be revised to show the correct truck container volume of 13.6 m^3 and the correct source reference of NUREG–1496, Volume 2. Also, the references listed in Section 4.8 will be re-ordered to show the earlier use of NUREG-1496, Volume 2 as a reference.

25. Chapter 4, Section 4.4.4.6, page 4-9

This section discusses the excavation of 52,972 cubic feet of soil. However, Section 3, "Identification of Remaining Decommissioning Activities" does not discuss or mention soil excavation. Please correct this discrepancy.

Response

There are no remaining soil excavations planned. The 52,972 cubic feet noted related to an ALARA cost/benefit analysis and did not represent an actual planned excavation activity as described below.

Chapter 4, Section 4.4.4.6 provides the bases for the determination of unit cost of soil excavation for the purpose of performing cost/benefit analyses to determine if remediation below the NRC 25 mrem/y dose limit is ALARA. The selection of a volume of 52,972 cubic feet of soil for this determination corresponds to the resulting volume if the top 15 cm of soil is removed from a 10,000 m^2 area (1,500 m^3 or 52,972 cubic feet). The 10,000 m^2 area is the soil surface area that was used in Chapter 6 of the LTP to perform dose modeling for the purpose of calculating derived concentration guideline values (DCGLs) for soil to demonstrate compliance with the NRC 25 mrem/y dose limit. Therefore, the information contained in Section 4.4.4.6 and the additional assumptions identified in Appendix 4-A, Section A.7 provide a unit cost for soil excavation based on the dose modeling assumptions contained in Chapter 6.

The purpose of the information provided in Chapter 4 is to describe the methods used to reduce residual contamination to levels that comply with the NRC's annual dose limit of 25 mrem plus ALARA and to determine if the cost of remediation below the annual dose limit is ALARA. Therefore, information contained in Section 4.4.4.6 is not applicable to evaluation of the results of characterization surveys or future FSS surveys to determine if remediation is required to comply with the annual dose limit. Section 4.7 concludes that there is no ALARA justification for remediation beyond that required to demonstrate compliance with the annual dose limit of 25 mrem and to determine if the cost of remediation below the annual dose limit is ALARA.

Therefore, there is no discrepancy between Section 4.4.4.6 and Chapter 3. Soil excavation was not discussed in Chapter 3 because, at the time of the preparation of Chapter 3, no soil areas had been identified that required additional remediation to demonstrate compliance with the annual dose limit of 25 mrem.

Revision of the LTP is not warranted in response to this RAI.

26. Chapter 5, Section 5.3.6.3.2, page 5-29

Why is the default pipe length 3 meters? Please provide a technical basis for this statement.

Response

Use of 3 meters as the default pipe length for embedded pipe was based on engineering judgment. A review of the cubicle areas in the Auxiliary Building showed typical dimensions of 10 to 20 feet. Assuming the pipe traversed an entire cubicle floor or ran from a floor drain located in the center of the cubicle to the wall resulted in a model pipe length of 10 feet. This length was also consistent with a vertical pipe running from the floor up a cubicle wall (a distance of approximately 10 feet).

The DCGL of 100,000 dpm/100 cm^2 was established based on levels used as a DCGL by other decommissioning facilities. DTBD-05-009, "Embedded Piping Scenario and DCGL Determination Basis," [Reference 2-28] demonstrates that the annual dose rate to the building occupant would not exceed 0.5 mrem/y from embedded pipe contaminated at the DCGL level. Specifically, for the two highest dose rate scenarios, the annual dose contribution is 0.19 mrem/y and 0.12 mrem/y for Auxiliary Building and Reactor Building pipe respectively. The technical basis document prepared for the Trojan decommissioning showed that the dose rate from pipe greater than 16 feet in length did not change at all. Microshield analyses conducted for the Rancho Seco pipe model showed that, for pipe lengths from 10 feet to 18 feet, the dose rate varied by less than 4%. Increasing the annual dose rates by 4% would have resulted in an annual dose rate of 0.198 mrem/y and 0.125 mrem/y for the Auxiliary and Reactor Building piping respectively. Both of these dose rates were well below the 0.5 mrem/y limit imposed on embedded piping and therefore the 10 foot (3 meter) default value was considered conservative and acceptable.

Revision of the LTP is not warranted in response to this RAI.

27. Chapter 5, Section 5.4.3.4.3, page 5-43

This section states, "For scan surveys, gross beta measurements appear to be a practical method, under certain conditions, *in situ* gamma spectroscopy may be a reasonable method for replacing beta scan surveys." Under what conditions would *in situ* spectroscopy be acceptable? Please describe these conditions.

Response

In situ gamma spectroscopy would be applicable for performing scan surveys provided the area being surveyed has a well known nuclide profile with HTDs being a small fraction of the total activity, clearly established surrogate DCGLs based on the gamma emitters, residual activity present in a known geometry (i.e., material composition, contamination depth, and detector field of view), and investigation criteria established such that the $DCGL_{EMC}$ would not be exceeded. In addition, count times must be long enough to detect the investigation criteria with a 95% confidence level. Examples of such situations would be the Reactor Building liner, remediated concrete structure surfaces, surface soil survey areas, and areas containing activated concrete.

Revision of the LTP is not warranted in response to this RAI.

28. Chapter 5, Section 5.8.2.4.1, page 5-57

This section mentions quality control for exposure rate measurements. However, Table 5-11 (pages 5-36 and 5-37) and Table 5-12 (page 5-38) do not show any exposure rate instruments. Please provide an explanation for this discrepancy.

Response

The term "exposure rate measurements" referred to in Section 5.8.2.4.1 was intended to describe any gamma direct measurements performed.

The text in Section 5.8.2.4.1 will be revised to reflect this. The appropriate gamma instrumentation is cited in Table 5-12.

DCGL Issues

Structural Surface DCGLs

29.[2] Page 6-24 of LTP of Section 6.6.3.2 "Derivation of Single Nuclide DCGL Values"

An incorrect DTBD document is referenced when describing the development of the results of structural DCGLs and DCF values listed in Table 6-9.

The reference should be changed to DTBD-04-004 "DCGLs for RSNGS Structural Surfaces," [Reference 6-20].

Response

The LTP will be revised to list DTBD-04-004, "DCGLs for RSNGS Structural Surfaces," which is the correct title of Reference 6-20.

Bulk Material DCGLs

30. Page 6-27 of the LTP, Table 6-10

The DCGL value for Pu-239 is listed as 1.23E+02 pCi/g, but in the DTBD-05-005 "DCGLs for RSNGS Activated and Volumetrically Contamination Bulk Materials," Table 6-1, the DCGL value for Pu-239 is listed as 2.96E+02 pCi/g. The DCGL detailed analysis provided for NRC review supports the DCGL value of 2.96E+02 pCi/g listed in the DTBD-05-005.

Provide justification and/or clarification for the different DCGL values for Pu-239 and revise the DCGL value, as appropriate.

Response

The Pu-239 DCGL value of 2.96E+02 pCi/g listed in the DTBD-05-005 is the correct value. Table 6-10 in the LTP will be revised to list 2.96E+02 pCi/g as the DCGL value for Pu-239.

DCGLs from Alternate Resident Farmer Scenario

31. Page 6-44 of the LTP, Table 6-19

The total dose listed in the table for 50 years following license termination is 11.6E+01 mrem/y. Adding the listed values for the detected nuclide dose

[2] The numbering of the "DCGL Issues" RAIs has been revised to continue the numbering sequence used for the "General Issues" RAIs.

(1.07E+01 mrem/y) and the discounted nuclide potential dose (9.50E-01 mrem/y) at 50 years, the total should be 1.165E+01 mrem/y.

Provide clarification of results and revise the total dose listed in Table 6-19, as appropriate.

Response

Table 6-19 contains a misplaced decimal point in the total dose listed for 50 years following license termination. Table 6-19 in the LTP will be revised to list the total dose listed for 50 years following license termination as 1.15E+01 mrem/y in response to RAI No. 33 below.

32. DTBD-05-001, "Comparison of Dose Impacts from Alternative Scenarios," section 6.3.3

The "drinking water intake" parameter is listed as sensitive for the resident farmer scenario for discounted radionuclides. In the LTP, page 6-42, section 6.8.2.3.2, instead of the "drinking water intake" being identified as a sensitive parameter, the "depth of soil mixing layer" parameter is identified as sensitive. The sensitivity analysis provided for NRC review demonstrates that the "depth of soil mixing layer" parameter is sensitive and the "drinking water intake" parameter is insensitive. The assigned value for the "depth of soil mixing layer" parameter based on the sensitivity analysis is used as the input into the mathematical model to calculate dose.

Provide clarification on identifying the "drinking water intake" parameter as sensitive in the supporting documentation (DTBD-05-001).

Response

The DTBD-05-001 sensitivity analysis for discounted radionuclides was performed using two RESRAD calculations, one for transuranic discounted radionuclides and another for non-transuranic discounted radionuclides. Excerpts from the RESRAD output reports showing the sensitivity analysis results are provided in Attachment 8.12 of DTBD-05-001. The results included in Attachment 8.12 indicate that the parameter ranked number 6 for the transuranic discounted radionuclides is depth of soil mixing layer. The text in Section 6.3.3 of DTBD-05-001 incorrectly lists the parameter ranked number 6 for the transuranic discounted radionuclides as drinking water intake.

The results from Attachment 8.12 are summarized in Attachment 8.10, which also lists the assigned conservative deterministic parameter value used for dose calculations. Attachment 8.10 indicates that drinking water intake is not a sensitive parameter and that it was treated probabilistically in the dose calculation. Attachment 8.10 also indicates that depth of soil mixing layer is a sensitive parameter and that it was treated deterministically in the dose calculation using a conservative parameter value. The

RESRAD parameter input reports contained in Attachment 8.13 confirm that this was the case.

Revision of the LTP is not warranted in response to this RAI; however, DTBD-05-001 will be revised to correctly list the parameter ranked number 6 for the transuranic discounted radionuclides as depth of soil mixing layer.

33. LTP, section 6.8.2.3.2 and Appendix 6-Z and DTBD-05-001, section 6.3.3

Under the resident farmer scenario for discounted radionuclides, the "contaminated zone erosion rate" parameter is identified as sensitive in the LTP, section 6.8.2.3.2 as well as in the DTBD-05-001, section 6.3.3. The assigned value of 7.59E-4 m/y was used in the site-specific mathematical model for the contaminated zone erosion rate but for only the transuranics (electronic file DiscNuc RF Dose1. RAD). However, for the non-transuranics, the default value of 1.0E-03 m/y was used as input into the model (electronic file DiscNuc RF Dose2. RAD). Appendix 6-Z of the LTP lists the assigned values for sensitive parameters to be used in the site-specific mathematical model. The "contaminated zone erosion rate" assigned parameter value of 7.59E-4 m/y is listed in Appendix 6-Z.

Provide justification for using the default value for the contaminated zone erosion rate parameter for the non-transuranics when the parameter is clearly identified as sensitive in the sensitivity analysis. As appropriate, provide the revised DCF and DCGL values for this scenario.

Response

Use of the default value for the contaminated zone erosion rate parameter for the non-transuranics cannot be justified. RESRAD calculations were recalculated by treating the parameter "contaminated zone erosion rate" probabilistically for transuranic radionuclides and deterministically for non-transuranic radionuclides as discussed below. The evaluation of the resident farmer alternative scenario presented in Section 6.8.2 of the LTP is conservative compared to the recalculations.

The potential dose calculations in DTBD-05-001 should have used the statistical parameter distribution for transuranics and the assigned value of 7.59E-4 m/y for non-transuranics as discussed below. Even though the default value for the "contaminated zone erosion rate" parameter is shown as used for the non-transuranics deterministic calculation, it was not used in the probabilistic calculation because the statistical parameter distribution had been provided for the "contaminated zone erosion rate."

DTBD-05-001, Section 6.3.3, identifies that the parameter "contaminated zone erosion rate" is sensitive for non-transuranic radionuclides but not for transuranic radionuclides. This level of detail was not provided in Section 6.8.2.3.2 of the LTP. Instead the sensitive parameters listed in Section 6.8.2.3.2 are the parameters that are sensitive for either transuranic radionuclides or non-transuranic radionuclides or for both. The sensitive parameter values listed in Attachment 8.10 of DTBD-05-001 and Appendix 6-Z of the LTP are also the parameters that are sensitive for either transuranic radionuclides or non-transuranic radionuclides or for both.

When potential dose from discounted radionuclides was calculated in DTBD-05-001, the parameter "contaminated zone erosion rate" was incorrectly treated deterministically for transuranic radionuclides (electronic file DiscNuc RF Dose1.RAD) using the conservative deterministic parameter value listed in Attachment 8.10 of DTBD-05-001 and incorrectly treated probabilistically for non-transuranic radionuclides (electronic file DiscNuc RF Dose2.RAD) using the statistical distribution listed in Attachment 8.10 of DTBD-05-001 as shown in the RESRAD summary reports provided in Attachment 8.13 of DTBD-05-001. The parameter "contaminated zone erosion rate" should have been treated probabilistically for transuranic radionuclides and deterministically for non-transuranic radionuclides.

DiscNuc RF Dose1.RAD and DiscNuc RF Dose2.RAD were recalculated by treating the parameter "contaminated zone erosion rate" probabilistically for transuranic radionuclides and deterministically for non-transuranic radionuclides using the assigned value of 7.59E-4 m/y. The resulting potential dose from discounted radionuclides was lower than that reported in LTP Table 6.19 for up to 100 years following license termination. The resulting potential dose from discounted radionuclides from 100 to 1,000 years following license termination was slightly higher than that reported in LTP Table 6-19 but the total dose for this period was still well below 25 mrem/y.

Section 6.8.2 of the LTP and DTBD-05-001 will be revised to provide the DCF and DCGL values resulting from these recalculations.

Containment Building DCGLs

34. DTBD-05-007 "Containment Building DCGLs"

The DTBD-05-007 "Containment Building DCGLs," is not referenced in the LTP. Suggest adding this reference since it provides the derivation of the DCGLs for the containment building.

Response

The LTP will be revised to list DTBD-05-007, "Containment Building DCGLs," as a reference for Section 6.6.5.

35. Page 6-32 of the LTP, Table 6-12 and Table 6-2 of the DTBD-05-007

Page 6-32 of the LTP, Table 6-12 lists the DCF and DCGLs for the renovation/demolition scenario for the containment building. Table 6-2 of the DTBD-05-007 also lists the DCF and DCGLs values for the containment building. The DCF and DCGL values in these two tables should be the same for all radionuclides listed for consistency and clarification purposes. Some of the DCGL values appear to be slightly different due to numerical rounding in the presentation of results. The DCGL values are different for the following radionuclides: Na-22, Co-60, Sr-90, Tc-99, Sb-125, Cs-134, Cs-137, Eu-152, Eu-154, Eu-155, Np-237.

Provide justification for the differences in the DCGL values in the two tables. Provide the revised DCF and DCGLs for the containment building as appropriate.

Response

The DCF and DCGL values in Table 6-2 of DTBD-05-007 are the correct values. Table 6-12 of the LTP will be revised to match Table 6-2 of DTBD-05-007.

Hydrology Issues

36.[3] Page 2-25, Section 2.2.1.1 Initial Site Investigation

For soil boring DH-23, please provide a boring log including geologic formation, their depths and the total depth of the soil boring DH-23.

Response

The boring log including geologic formation, their depths and the total depth of the soil boring DH-23 was first provided to the NRC as part of the information contained in Appendix 2C, Geology and Seismology, to the Rancho Seco Nuclear Generating Station Unit No. 1 Preliminary Safety Analysis Report. This information was carried through various licensing document changes and now exists as Appendix 2C to the Updated Safety Analysis Report.

The "Rancho Seco Nuclear Generating Station, Unit No. 1, Updated Final Safety Analysis Report" will be added as a reference for LTP Section 2.2.1.1. The boring log for DH-23 is provided as Attachment 1 to this RAI response.

37. Page 2-25, Section 2.2.1.2 Geotechnical Investigation for Proposed Evaporation Ponds

Please provide geologic cross-section(s) showing the subsurface geologic features and the groundwater level(s) indicating the hydraulic gradient(s).

Response

"Geotechnical Investigation for Proposed Evaporation Ponds," ERPT-C0104, Rev.1, 1989 will be provided to the NRC. The report contains geologic cross-section(s) showing the subsurface geologic features and the groundwater level(s) indicating the hydraulic gradient(s). The geologic cross-section(s) (Figures 4, 5, and 6) from ERPT-C0104, Rev.1 are provided as Attachment 2 to this RAI response.

Revision of the LTP is not warranted in response to this RAI.

38. Page 2-26, Section 2.2.1.3 2005 Update Investigation

Please provide drilling logs and construction details for the selected soil borings and monitoring wells.

[3] The numbering of the "Hydrology Issues" RAIs has been revised to continue the numbering sequence used for the "DCGL Issues" RAIs

Is it correct to assume that the chosen depth intervals of the screens for each well were separated by at least 35 feet? The word 'feet' is missing after the number 35 and it may be corrected.

Response

Reference 2-19 of the LTP, URS Corporation, "Hydrogeological Characterization of the Rancho Seco Nuclear Generating Station," March 2006 (Hydrogeological Characterization Report), contains the drilling logs and construction details for the new monitoring well borings (MW1A-1C, MW1D, MW2A-2C, MW3A-3C, and MW4A-4C). The Hydrogeological Characterization Report was provided to the NRC by letter dated March 15, 2006. Drilling logs and construction details for OW-2 and OW-3 are contained in the Geotechnical Investigation for Proposed Evaporation Ponds report addressed in the response to RAI No. 37 above. Drilling logs and construction details for SW-1 and SW-2 are not available.

Depth intervals of the screens for each new monitoring well are provided in Table 2-6 of the LTP. The depth intervals of the screens for the new monitoring well nests exceed 35 feet.

The word 'feet' will be placed after the number 35 when the LTP is revised.

39. Page 2-27, Section 2.2.2.1 Geology

In addition to describing the stratigraphy of the site, please provide geologic cross-sections and fence diagrams to better illustrate the subsurface geology and the geohydrologic parameters of the site.

Also, please provide geologic cross-section(s) indicating the subsurface geology for borings MW2, MW3, MW4, OW2 and OW3 (Page 2-28).

Response

Figure 2-4 of the Hydrogeological Characterization Report is a cross section illustrating the extent of hydrogeologic information with a three-dimensional perspective. Figure 2-4 does not depict the geologic cross section in the vicinity of MW3; however, the boring log for MW3 is provided in Appendix A of the Hydrogeological Characterization Report.

The Hydrogeological Characterization Report will be revised to include a new figure (Figure 2-5) to provide a fence diagram connecting the new monitoring wells, MW1 – MW4. This new figure is included in Attachment 2 to this RAI response.

Fence diagrams for OW2 and OW3 are provided in Figure 5 of the Geotechnical (included in Attachment 2 to this RAI response) Investigation for Proposed Evaporation Ponds report addressed in the response to RAI No. 37 above.

Revision of the LTP is not warranted in response to this RAI.

40. Page 2-28, Section 2.2.2.2 Hydrology

Please provide a map showing creeks, streams, rivers and other surface water drainage features along with flood elevations, flood and low flow values, and nearby flood gaging stations (also Section 8.5.4.1, Page 8-12).

Please provide 100-year flood plain map to support that the site would not be flooded during a 100-year storm event.

Response

Creeks, streams, rivers and other surface water drainage features along with flood elevations are shown on Figures 2-2 and 2-3 in the Hydrogeological Characterization Report. 100-year flood plain maps for the immediate areas surrounding the Rancho Seco site are shown on Figure 2-3. General 100-year flood area information for Sacramento County may be viewed at http://www.msa.saccounty.net/waterresources/floodready/FloodMap.pdf.

There are no gaging stations or any stream flow values within 9 miles of the Rancho Seco site. The closest gaging station to the Rancho Seco site is on Laguna Creek near Highway 99. The intersection of Laguna Creek and Highway 99 is shown on Figure 2-2 of the Hydrogeological Characterization Report. Runoff from the site drains into an un-named "No-Name" Creek, which in turn flows into Clay Creek. Clay Creek flows into Hadselville Creek. Hadselville Creek then flows into Laguna Creek south.

Revision of the LTP is not warranted in response to this RAI.

41. Page 2-28, Section 2.2.3 Hydrogeology

Please provide a figure suitable geologic cross-section(s) showing the eleven (11) borings which penetrated the groundwater for the purpose of illustrating the aquifer formation. Please indicate groundwater elevations, flow directions, hydraulic gradients and other geohydrologic parameters.

Response

Geological information is not available for all eleven (11) borings which penetrated the groundwater. Figure 2-4, Geologic Cross Sections Rancho Seco NGS Site, will be revised (included in Attachment 3 to this RAI response) in the revised Hydrogeological Characterization Report to provide additional clarification. A new Figure 2-5 will also be added to provide a fence diagram connecting the new monitoring wells, MW1 – MW4. Groundwater elevations and contours are provided in Figure 2-7; Potentiometric

Surface Map for Groundwater Beneath RSNGS, December 2005; and the groundwater flow direction is also provided on the new Figure 2-5 in the revised Hydrogeological Characterization Report. Hydraulic gradients and other geohydrologic parameters are also discussed in Section 2.4, Hydrogeology, in the revised Hydrogeological Characterization Report.

Revision of the LTP is not warranted in response to this RAI.

42. Page 2-29, Section 2.2.4.1, Groundwater Movement

Please show the calculations including the parameters used for the hydraulic gradient value of 0.0028 feet per foot.

Likewise, please show the calculations including the parameters used for the vertical upward gradient of 0.0028 feet per foot (Page 2-30).

Please show the calculations including the parameters used for the estimated hydraulic conductivity values obtained from the laboratory hydraulic conductivity tests and *in situ* packer permeability tests (Page 2-30).

Response

The Hydrogeological Characterization Report will be revised to include the calculations requested by this RAI. The revised Hydrogeological Characterization Report will be submitted to the NRC upon completion.

The revised Hydrogeological Characterization Report will contain the following discussion:

> Groundwater levels in the four new well nests suggest that there is one aquifer between the water table and 300 feet bgs, that the horizontal gradient is southwesterly, and the vertical hydraulic gradient is upward. A potentiometric surface map, constructed with data collected in the monitoring wells on December 6, 2005, is shown in Figure 2-7. Data collected in two subsequent events support the flow direction and gradient. The contours support the hypothesis of southwesterly gradient beneath RSNGS. The range of hydraulic gradients calculated from potentiometric data for the wells is 0.002 to 0.0033 feet per foot in all depth intervals. Only one potentiometric surface map was prepared because the data suggest that the horizontal gradients are similar in all depth intervals from 170 to 300 feet bgs (Table 2-1). Horizontal gradients were determined with water level depth information obtained in December 2005. Depth information for all wells was converted to elevation by subtracting the depth from survey elevations of the tops of casing of monitoring wells. Water level elevations from MW1B, MW2B, MW3B, and MW4B were combined with data from OW2 and OW3, wells constructed in

1985, to develop a potentiometric surface map. The well screens in OW2 and OW3 are most similar to those in MW1B, MW2B, MW3B, and MW4B. The potentiometric surface map developed with the water level elevations was used to determine the direction and magnitude of the maximum gradient among the six well locations. It was determined that the water level elevation decreased 4.5 over a distance of 1610 feet between potentiometric contours; therefore,4.5 was divided by 1,610, yielding a gradient of 0.0028 foot per foot southwesterly for the B depth interval. Horizontal gradients were roughly estimated from water elevation differences between MW1C and MW3C and between MW1C and MW4C without contours. Those gradients were within the same range as the "B" depth gradients, suggesting horizontal gradients are similar in all depth ranges beneath RSNGS.

Vertical gradients were determined only for the well nests constructed in 2005. Gradients were calculated with water level elevations obtained in December 2005, March 2006, and June 2006 for the following screen interval pairs: MW1B and MW1C, MW2A and MW2B, MW2B and MW2C, MW3A and MW3B, and MW3B and MW3C. The distance between the center of screens in the well nests were determined from the well construction logs. Then for each pair (for example, MW2A and MW2B) of water level elevations at a well nest, the absolute difference between the higher water elevation and the lower screen elevation was divided by the distance between the center of the screens. The result of the calculation is the magnitude of the vertical gradient. If the water elevation for the lower screen had a value less than the elevation for the upper screen, the gradient was designated "downward" and provided with a minus sign. If the elevation for the lower screen was greater than that for the upper screen, the gradient was designated "upward". The vertical gradient calculations for RSNGS well nests varied from 0.0057 foot per foot downward to 0.0056 foot per foot upward across all screen interval pairs. Six gradients were downward and four upward between "A" and "B" depth interval well screens. Four gradients were downward and four upward between "B" and "C" depth interval wells screens. None of the well screen pairs had consistently upward or downward gradients over the seven-month period that measurements were collected. There is no evident upward or downward influence on gradients caused by the change in season between the first and last measurements. The vertical gradient data calculated for RSNGS well nests indicate that neither an upward or downward gradient prevails in the aquifer.

The *in situ* packer permeability tests referenced on Page 2-30 of the LTP were performed as part of the Geotechnical Investigation for Proposed Evaporation Ponds and discussed in the report provided in response to RAI No. 37. Table 4, Field Permeability Test Results, in the report summarizes the *in situ* packer permeability tests is included as Attachment 4 to this RAI response.

Revision of the LTP is not warranted in response to this RAI.

43. Page 8-13, Section 8.5.4.2 Hydrogeology

The last paragraph states that "... the permeability of the site soils result in infiltration rates (from several hundred to several thousand years) that effectively preclude any radiological impact on the aquifer or the closest well to the site by the facility". Please provide calculations or data from publications to support this statement.

Response

"Geotechnical Investigation for Proposed Evaporation Ponds," ERPT-C0104, Rev.1, 1989, Section 8.3, Analysis of Hypothetical Liner Failure, contains an analysis, including calculations, that supports this statement. As stated in the response to RAI No. 37 above, this report will be provided to the NRC. Section 8.3, Analysis of Hypothetical Liner Failure, from ERPT-C0104, Rev.1 is included as Attachment 5 to this RAI response.

Revision of the LTP is not warranted in response to this RAI.

Attachment 1

Boring Log for DH-23

BECHTEL CORPORATION

SHEET 1 OF 16

GEOLOGIC LOG OF DRILL HOLE

HOLE NO. DH 23

PROJECT RANCHO SECO NUCLEAR STATION ANGLE FROM HORIZ 90° BEARING

LOCATION N247,750 E 2,253,130 BEGUN 6-28-67 COMPLETED 7-28-67

OVERBURDEN 3.0' DEPTH DRILLED INTO ROCK 599.0' TOTAL DEPTH OF HOLE 602'

ELEV. WATER TABLE +34.5' NO. CORE BOXES 21 NO. SAMPLES TAKEN 23

CORE RECOVERY (%) 78 FEET 188.2 MODEL & MAKE OF DRILL JOY 22

GROUND ELEV. +177.4' HOLE LOGGED BY MACKAY, FOX, ELSTON DRILLER BOYLES BROTHERS

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG / SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
Fresh water used for circulation 0-10 ft Set 8 in. I.D. casing to 4.8 ft Set 6 in. I.D. casing to 5.0 ft (Retrieved)	0		8 1/4 IN. ROCK BIT			175	0		0-3.0' GRAVEL: (GM-GW) Dark red brown, sandy, silty, clayey, cobbles to 8" 3.0'-19.2' SAND AND SILT: (SM-SP) Red brown to brown, very fine to fine-grained sands, with abundant variegated gravel
Set 4 in. I.D. casing to 5.1 ft	0		NC DIA. CORE BIT			170	5		
Commence using drilling mud at 10 ft (Quick-Gel + fresh water) Easier drilling @ 13 ft	0		NC DIA. CORE BIT			165	10		Gravel decreases below 13 ft
Where no core recovery, lithologic descriptions derived from ditch samples Lowered 4 in. I.D. casing to 18.5 ft (Retrieved)	0		NC DIA. CORE BIT			160	15		19.2'-19.7' GRAVEL: (GM-GW)
	14		NXWL DIA CORE BIT			155	20		19.7'-30.0' SILTSTONE: (ML) Red brown, scattered sand and gravel, firm, friable
	0	REFUSAL	2" I.D. SPLIT SPOON	140	30				
	20		NXWL DIA. C. BIT				25		Below 28', material is (ML) Red brown, clayey, scattered sand grains, firm, slightly to moderately friable, locally indurated
	0		NXWL DIA. C.B			150			
	50		NXWL TUNG. CARB. C. BIT						
Mud viscosity = 70 sec/1000 cc	57		NXWL TUNG. CARB. CORE BIT			145	30		30.0'-33.7' SANDSTONE: (SM-SP) Red brown, silty, abundant pea gravel, soft-firm 33.7'-40.0' SILTSTONE: (ML) Red brown, scattered sand grains
Inner barrel not properly latched	0		NXWL TUNG. C. BIT				35		

Hole Size NC, NX, 6-1/4

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 2 OF 16

HOLE NO DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	CLASSIFICATION AND PHYSICAL CONDITION
							35		
	0		NXWL TUNG. CARB. C. BIT			140			
	67		NXWL TUNG. CARB. CORE BIT			135	40		40.0'-52.0' SANDSTONE (SM-SP) Red brown, very fine to medium, variegated grains, predominantly quartz, silty, firm, friable
Hole drift angle 1° from vertical @ 50'						130	45		
Pull 4" & 6" I.D. casing, reem hole with 6-1/4" rock bit to 52 Ft.	0		NXWL TUNG. CARB. C. BIT				50		
Gradational contact	100		5 1/2" OD TUNG. CARB. C. BIT			125			52.0'-54.0' CLAYEY SILTSTONE: (ML) Red brown, scattered fine to coarse sand grains, soft-firm, massive, locally plastic, trace anhydrous opal root replacements
	100		5 1/2" OD TUNG. CARB. C. BIT			120	55		54.0'-81.7' SILTSTONE (ML) Red brown, locally gray, scattered coarse sand and pea gravel, firm, massive, local vertical irregular fractures, scattered uneven horizontal silicic bands 1/32" to 1/16" thick, grades to slightly clayey silt at 75.3'
	100		5 1/2" OD TUNG. CARB. C. BIT			115	60		
	100		5 1/2" OD T.C. C. BIT				65		
	100		5 1/2" OD TUNG. CARB. C. BIT			110			
	100		5 1/2" OD TUNG. CARB. C. BIT			105	70		
	77		5 1/2" OD T.C.C.B				75		

Hole Size NX, 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES
	100		5½" OD T.C.C.B		
	0		5½" OD TUNG. CARB CORE BIT		
Lithology based on drill characteristics and cuttings 77'-87'	0		5½" OD T.C.C.B.		
	0		5½" OD DIA CORE BIT		
	56		2" I.D. SPLIT SPOON		
	100		5½" OD DIA. C.B.		
Gradational contact	100		5½" OD DIA. CORE BIT		
Drift angle 2-1/4° from vertical @100'	100		5½" OD DIA. CORE BIT		
	100		5½" OD DIA CORE BIT		
Flat lying contact-	100		5½" OD DIA. CORE BIT		
Flat lying fracture; Bedding dips 6° from horizontal core axis	100		5½" OD DIA CORE BIT		

ELEVATION: 100, 95, 90, 85, 80, 75, 70, 65

DEPTH: 75, 80, 85, 90, 95, 100, 105, 110, 115

LOG / SAMPLE: 10, 11, 12

CLASSIFICATION AND PHYSICAL CONDITION

81.7'-89.8' SILTY, SANDY, CLAYEY GRAVEL: (GM) gray, some brown, gravel to 1-1/2", sub-angular to round

89.8'-94.5' SILTY SANDSTONE: (SM) Red brown to brown, fine to medium-grained, massive, firm, uneven silicic bands (to 1/2") and replacement fillings, local vugs to 1/8"

94.5'-98.2' SANDY SILTSTONE: (ML) Brown, scattered medium-grained sand, local vugs, silicic root replacements, friable, very firm, 1/2" silicic band at 98.2'

98.2'-100.3' SILTY SANDSTONE: (SM) Brown, very fine-grained scattered silicic streaks and pockets, local vugs

100.3'-109.8' SANDSTONE: (SP) Gray, very fine-grained, poorly graded, clean, scattered vugs, manganese-stained massive, unconsolidated to firm, trace anhydrous opal, 1' black, fine-grained, quartzitic sandstone at 104.4'; flat-lying fractures 1/4" to 3/4" apart below 105.4', micaceous

109.8'-110.6' CLAYEY SILTSTONE: (ML) Gray, massive, firm, 1 flat lying fracture

110.6'-119.4' SANDSTONE: (SP) Gray to dark gray, very fine to fine-grained, uncemented to local moderate induration some bed planes, micaceous

Hole Size 5 1/2", 6 1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 4 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH
	94		5 1/2" OD DIA. CORE BIT			60	120
Base of Laguna Fm. ——?——?——? Top of Mehrten Fm.	100		5 1/2" OD DIA. CORE BIT			55	125
Bedding dips 17° from horizontal core axis	90		5 1/2" OD DIA. CORE BIT			50	130
Contact dips 22° from horizontal core axis	100		5 1/2" OD DIA. CORE BIT			45	135
	100		5 1/2" OD DIA. CORE BIT			40	140
Gradational contact; Irregular contact; Water Table @ 143'	100		5 1/2" OD DIA. CORE BIT			35	145
Drift angle 3-1/4° from vertical @150'	100		5 1/2" OD DIA. CORE BIT			30	150
	100		5 1/2" OD DIA. CORE BIT			25	155

LOG

SAMPLE

CLASSIFICATION AND PHYSICAL CONDITION

119.4'-125.8' SILTSTONE: (ML-SM) Brown, massive, firm; below 120.5', scattered coarse sand gravelly, unconsolidated to slightly firm, trace clay Grades to: (SM) Tan, trace fine grained sand, light weight, unconsolidated to moderately firm

125.8'-127.5' SAND AND GRAVEL: (GP-SP) Tan, gray, light gray fine to v. coarse sand white to light gray gravel and siliceous nodules to 1/2"

127.5'-131.6' SANDSTONE: (SP) Tan to gray, very fine to fine-grained, poorly graded, well bedded uncemented to moderately indurated grades very coarse grains at 131.6

131.6'-140.7' SILTSTONE: (ML) Brown, massive, firm, vugs, manganese-stained in part, scattered sand grains

140.7'-141.3' SANDSTONE: (SP) Brownish black, fine-grained subround, friable to firm, poorly graded, abundant quartz, trace mica, bedded

141.3'-142.0' SANDY SILTSTONE: (ML) Brown, firm, trace mica, abundant manganese staining

142.0'-145.0' CLAYEY SILTSTONE: (ML) Red brown, unconsolidated to moderately firm, massive, slightly plastic, becoming sandy at 145'

145.0'-161.3' SILTSTONE: (ML) Brown to red brown, locally sandy and clayey, firm, massive

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 5 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH
	100		5-1/2" OD DIA. CORE BIT			20	155
	100		5-1/2" OD DIA. C.B.				160
	100		5-1/2" OD DIA. CORE BIT			15	165
Bedding dips 15° from horizontal core axis	100		5-1/2" OD DIA. CORE BIT			10	170
	100		5-1/2" OD DIA. CORE BIT			5	175
Sea Level	100		5-1/2" OD DIA. CORE BIT			0	180
	100		5-1/2" OD DIA. CORE BIT			-5	185
	100		5-1/2" OD DIA. CORE BIT			-10	190
Joint dips 30° from horizontal core axis	100		5-1/2" OD DIA. CORE BIT			-15	195

LOG — SAMPLE: 13, 14, 15, 16

CLASSIFICATION AND PHYSICAL CONDITION

161.3'-165.1' SANDSTONE: (SP) Blackish brown, very fine to fine-grained, poorly graded, clean, massive, abundant quartz, trace anhydrous opal root replacements, friable, slight to moderately cemented

165.1'-166.0' SILTSTONE: (ML) Red brown, massive, firm

166.0'-168.3' SANDSTONE: (SP-GP) Dark gray, v. fine to fine-grained at top with scattered medium to v.coarse, pea gravel; grades to pea gravel at base.

168.3'-175.8' SILTSTONE: (ML) Red brown, (Top foot is interlaced with white silicic streaks and banks) Firm, locally friable, manganese stained, scattered vugs

175.8'-181.0' CLAYSTONE: (CL) Dark red brown, silty, unconsolidated to slightly firm, massive, grades to clayey silt at 181.0'

181.0'-190.8' SILTSTONE: (ML) Red brown, grading to gray brown at 182.5', grading to gray through light gray with local iron staining at 188.5' clayey, poorly to moderately indurated, massive, manganese streaks

190.8'196.3' SANDSTONE WITH SILTSTONE INTERBEDS: (SP-SM-ML) Dark brown to black sandstone, light gray siltstone; grades to medium grains at 196.3', poor to indistinct bed planes, manganese-stained friable-moderately indurated

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 6 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG / SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							195		
Drift angle 4-1/4° from vertical @200'	60		5 1/2" OD DIA. CORE BIT			-20		17, 18	196.3'-231.0' SANDY SILTSTONE: (ML) Light brown, slightly clayey, trace bed planes at top, trace iron oxide stains, trace manganese
Hole reamed to 6-1/4" from 4.8 ft to 201.0 ft							200		
From 201 ft to 250 ft lithology determined from drill returns, drill characteristics and geophysical logs			6 1/4" OD ROCK BIT TO 250'			-25	205		Gray to black, fine to scattered medium sand grains from 205.0' to 218.0'
205 to 218 drilled easy						-30	210		
						-35	215		
218' to 224' - no discernible cuttings returned to surface, slow drilling						-40	220		
224' to 232' drilled easy						-45	225		
						-50	230		
232 to 240 considerable rig vibration, bounce, and chatter						-55	235		231.0'-243.0' SANDY CONGLOMERATE (GP) Gray to black, abundant coarse sand grains

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

SHEET 7 OF 16

PROJECT RANCHO SECO

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	SAMPLE DATA: PENETRATION TOOL	SAMPLE DATA: HAMMER WT/LBS	SAMPLE DATA: HAMMER FALL-INCHES	ELEVATION	DEPTH	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							235		
						-60			
240' to 250' drilled relatively easy							240		
						-65			
									243.0'-257.7' SANDSTONE (SP) Gray, very fine to fine-grained, locally silty, massive, hard
							245		
						-70			
Drift angle 3-1/2° from vertical @250'							250	19, 20	
	100		5-1/2" OD DIA. CORE BIT			-75			
							255	21, 22, 23	
Bedding dips 5° from horizontal core axis	72		5-1/2" OD DIA. CORE BIT			-80			257.7'-310.0' SILTSTONE: (ML-SM-SP) Light gray, massive, firm, locally sandy and interbedded with light gray, very fine to fine-grained, scattered medium, poorly graded, moderately hard sandstone
From 260 ft. to 310 ft. lithology determined from drill returns, drill characteristics and geophysical logs			6-1/4" OD ROCK BIT TO 310'			-85	260		
							265		
						-90			
							270		
						-95			
							275		

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 8 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS.	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							275			
						-100				
							280			
						-105				
							285			
						-110				
							290			
						-115				
							295			
						-120				
Drift angle 2-1/4° from vertical @300'							300			
						-125				
							305			
						-130				
Bedding dips 3° from horizontal core axis	100		5 1/2" OD DIA. CORE BIT				310			310.0'-345.5' SANDSTONE (SP) Light gray, very fine to fine grained, scattered medium, poorly graded, moderately hard
						-135			1	
							315		2	

Hole Size 5 1/2", 6 1/4"

Hole No. DH 23

Site RANCHO SECO

SHEET 9 OF 16

PROJECT RANCHO SECO

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG / SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
From 315 ft. to 365 ft., lithology determined by drill returns, drill characteristics and geophysical logs			6¼" OD ROCK BIT TO 365'			-140	315		
						-145	320		
						-150	325		
						-155	330		
						-160	335		
						-165	340		
Drift angle 1-1/2° from vertical @350'							345		345.5'-350.0' CONGLOMERATE (GP)
Base of Mehrten Form ——?—— ——? Top of Valley Springs						-170	350		350.0'-354.0' CLAYSTONE? (CL)
						-175	355		

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 10 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	SAMPLE DATA: PENETRATION TOOL	SAMPLE DATA: HAMMER WT/LBS	SAMPLE DATA: HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
						-180	355			354.0'-365.0' SILTSTONE? (ML)
						-185	360			
	100		5 1/2" OD DIA. CORE BIT			-190	365		3	365.0'-367.6' CLAYSTONE: (CL) Light brown to light gray, highly fractured vertically and horizontally, firm
From 370 Ft. to 405 Ft., lithology determined by drill returns, drill characteristics, and geophysical logs			6 1/4" OD ROCK BIT TO 405'			-195	370			367.6'-394.0' SILTSTONE: (ML) Light green, firm to moderately hard, inclusions of angular fragments of similar material, slightly harder
						-200	375			
						-205	380			
						-210	385			
						-215	390			
							395			

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 11 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	SAMPLE DATA: PENETRATION TOOL	SAMPLE DATA: HAMMER WT./LBS	SAMPLE DATA: HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
						220	395			394.0'-406.5' CLAYSTONE: (CH) Blue green, highly plastic, fatty, high dry strength
Drift angle 1-3/4° from vertical @400'						225	400			
	100		5-1/2" OD DIA. CORE BIT			230	405			406.5'-428.0' SILTSTONE: (ML) Blue green, firm to hard, interlaced with silicic veinlets to 1" thick
From 410 ft to 460 ft lithology determined by drill returns, drill characteristics and geophysical logs			6-1/4" OD ROCK BIT TO 460'			235	410			(ML-SM) Locally sandy below 410 Ft: very fine to fine grained, predominantly quartz
						240	415			
						245	420			
						250	425			
						255	430			428.0'-439.0' CLAYSTONE? (CL-CH)
							435			

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 12 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG / SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							435		
						-260			
							440		439.0'-513.0' CLAYSTONE AND SILTSTONE (CL-ML)
						-265			
							445		
						-270			
Drift angle 1-1/2° from vertical @450'							450		
						-275			
							455		
						-280			
							460		
	100		5-1/2" OD DIA. CORE BIT			-285		4, 5	Green, interbedded, firm to hard, with rounded inclusions of like material (ML-CL)
From 465 ft to 515 ft lithology determined from drill returns, drill characteristics and geophysical logs			6-1/4" OD ROCK BIT TO				465		
						-290			
							470		
						-295			
							475		

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 13 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG / SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							475		
						-300			
							480		
						-305			
							485		
						-310			
							490		
						-315			Claystone and siltstone as above (ML-CL)
							495		
						-320			
Drift angle 3/4° from vertical @500'							500		
						-325			
							505		
						-330			
							510		
						-335			513.0'-524.0' SANDY SILTSTONE: (ML) White to light gray, scattered 1/2" pebbles, clayey, hard when dry, trace anauxite?
							515		

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 14 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
	100		5-1/2" OD DIA. CORE BIT			-340	515		6, 7	
From 520.2 ft. to 565.3 ft., lithology determined from drill returns, drill characteristics and geophysical logs			6-1/4" OD ROCK BIT TO 565.3'			-345	520			
						-350	525			524.0'-565.0' SILTSTONE AND CLAYSTONE (ML-CL) Locally sandy
						-355	530			
						-360	535			
						-365	540			
						-370	545			
Drift angle 3/4° from vertical @550'						-375	550			
							555			

Hole Size 5-1/2", 6-1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

SHEET 15 OF 16

HOLE NO. DH 23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
							555			
						-380				
							560			
						-385				
							565			
	100		5 1/2" OD DIA. CORE BIT			-390			8, 9	565.0'-569.5' SANDSTONE (SP) Light olive green, very fine-grained, poorly graded, very firm to moderately hard, massive
From 570.3 ft. to 597 ft., lithology determined from drill returns, drill characteristics and geophysical logs			6 1/4" OD ROCK BIT TO 597'				570			569.5'-593.0' SILTSTONE AND CLAYSTONE (ML-CL)
						-395				
							575			
						-400				
							580			
						-405				
							585			
						-410				
							590			
						-415				593.0'-602.0' CLAYSTONE (CL) Olive green, scattered sand grains, firm
							595			

Hole Size 5 1/2", 6 1/4"

Hole No. DH 23

Site RANCHO SECO

PROJECT RANCHO SECO

HOLE NO. DH-23

NOTES ON WATER TABLE LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	% CORE RECOVERY	SAMPLE DATA: BLOW COUNT	PENETRATION TOOL	HAMMER WT/LBS	HAMMER FALL-INCHES	ELEVATION	DEPTH	LOG	SAMPLE	CLASSIFICATION AND PHYSICAL CONDITION
Drift angle 1/2° from vertical @600'	100		8 1/2"OD DIA. CORE BIT			420	595 600			
										Bottom of hole 602 ft

NOTE 1. GEOPHYSICAL LOGS:
- Induction - Electric Log
- SNP Neutron Log
- Sonic Log (With Hole Caliper)
- Formation Density Log
- Directional Survey

NOTE 2. PUMP TEST:
- Water Table: 143 ft
- Set 4 inch ID casing at 318 ft
- Produced 48 gpm (av.) during 24 hr test with 10 ft (av.) Drawdown

NOTE 3. PIEZOMETER INSTALLATION:
Installed 180 ft of 1-1/8 in. ID P.V.C. pipe with .95 ft stickup above cover plate. The bottom 13 ft was perforated. Static water level, upon completion of piezometer installation, was 145.39 ft below the cover plate.

Attachment 2

Geologic Cross-Section(s)

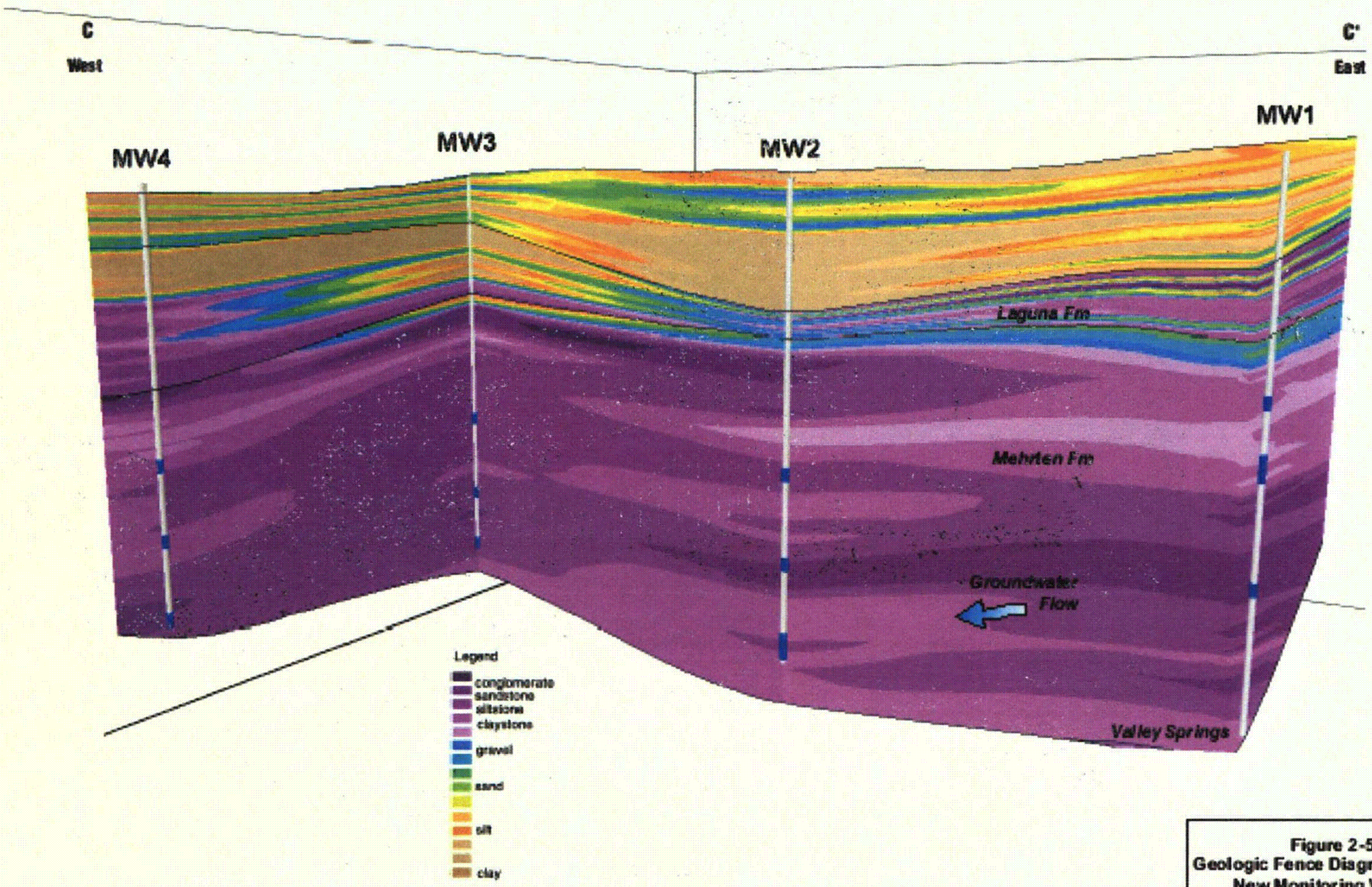

Figure 2-5.
Geologic Fence Diagram Through New Monitoring Wells at Rancho Seco NGS Site

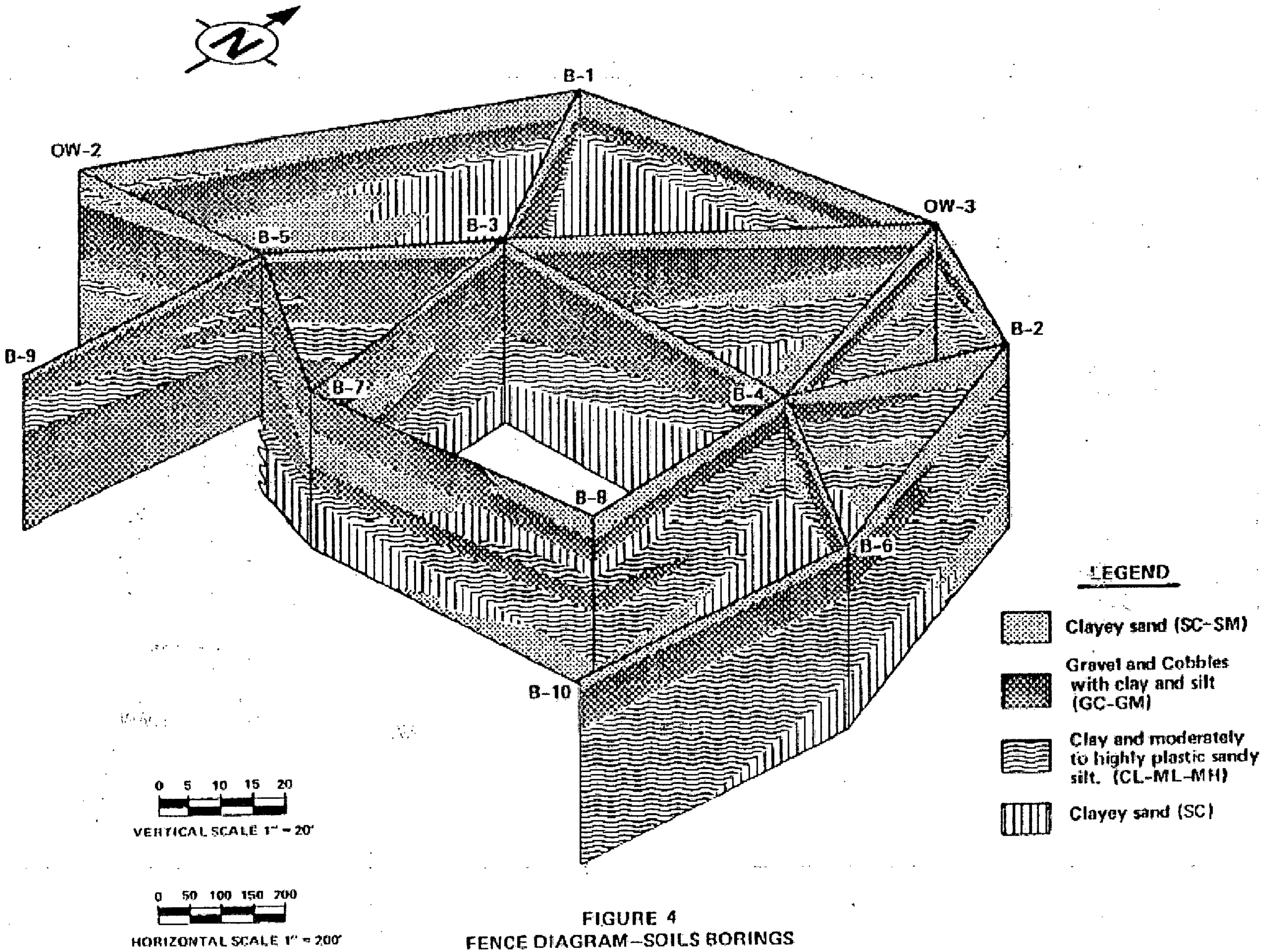

FIGURE 4
FENCE DIAGRAM—SOILS BORINGS

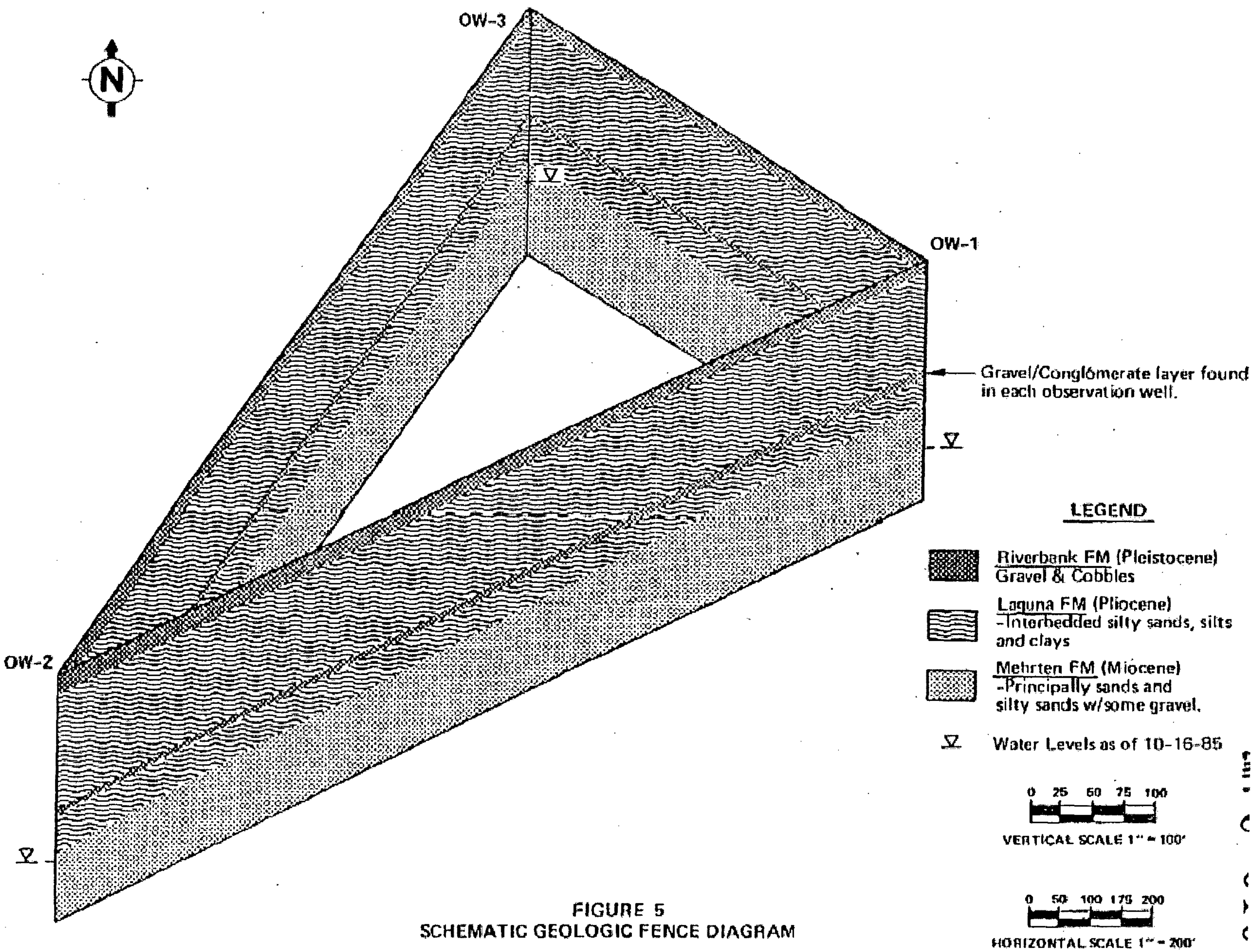

FIGURE 5
SCHEMATIC GEOLOGIC FENCE DIAGRAM

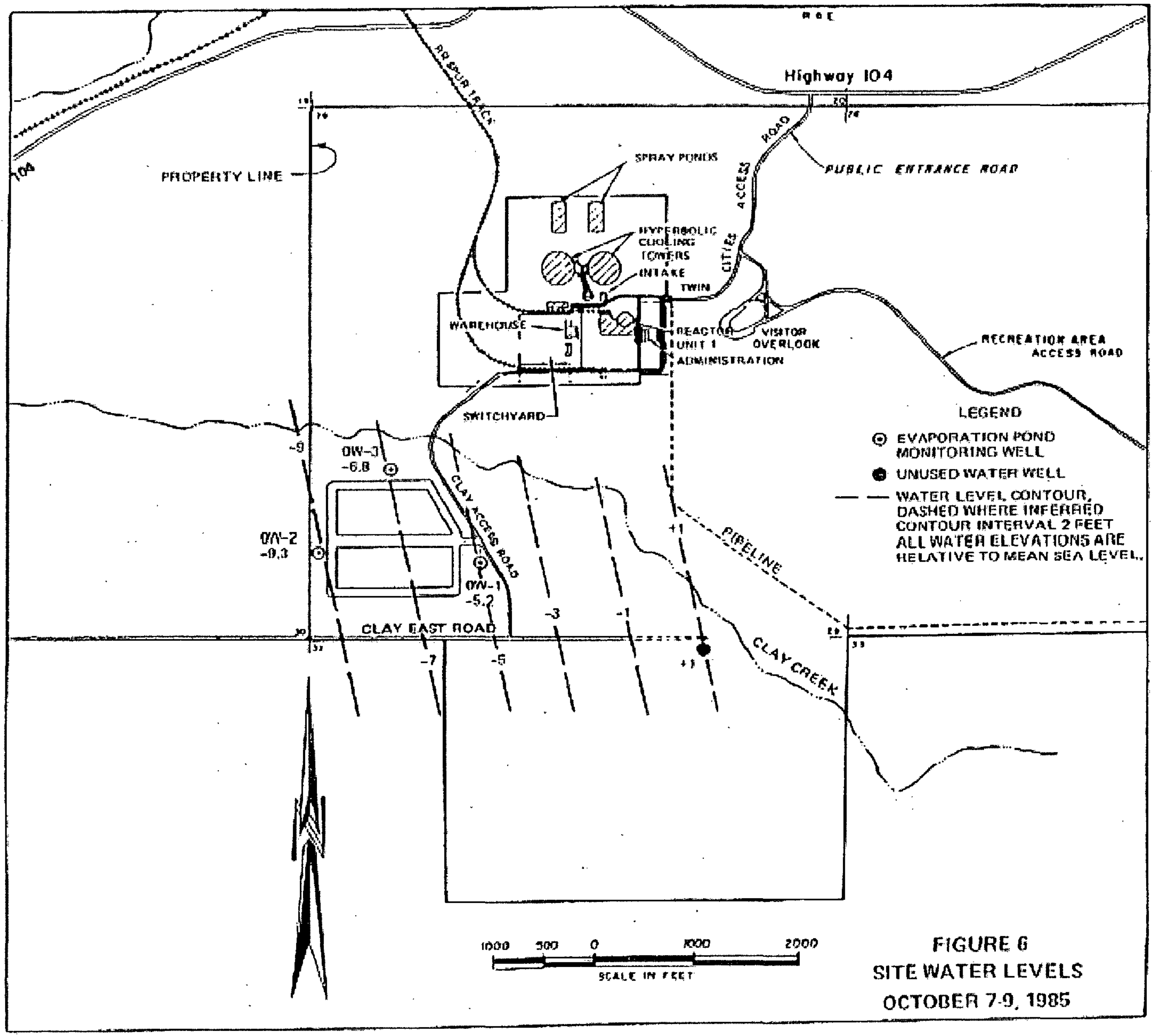

FIGURE 6
SITE WATER LEVELS
OCTOBER 7-9, 1985

Attachment 3

Figure 2-4, Geologic Cross Sections Rancho Seco NGS Site, from the Revised Hydrogeological Characterization Report

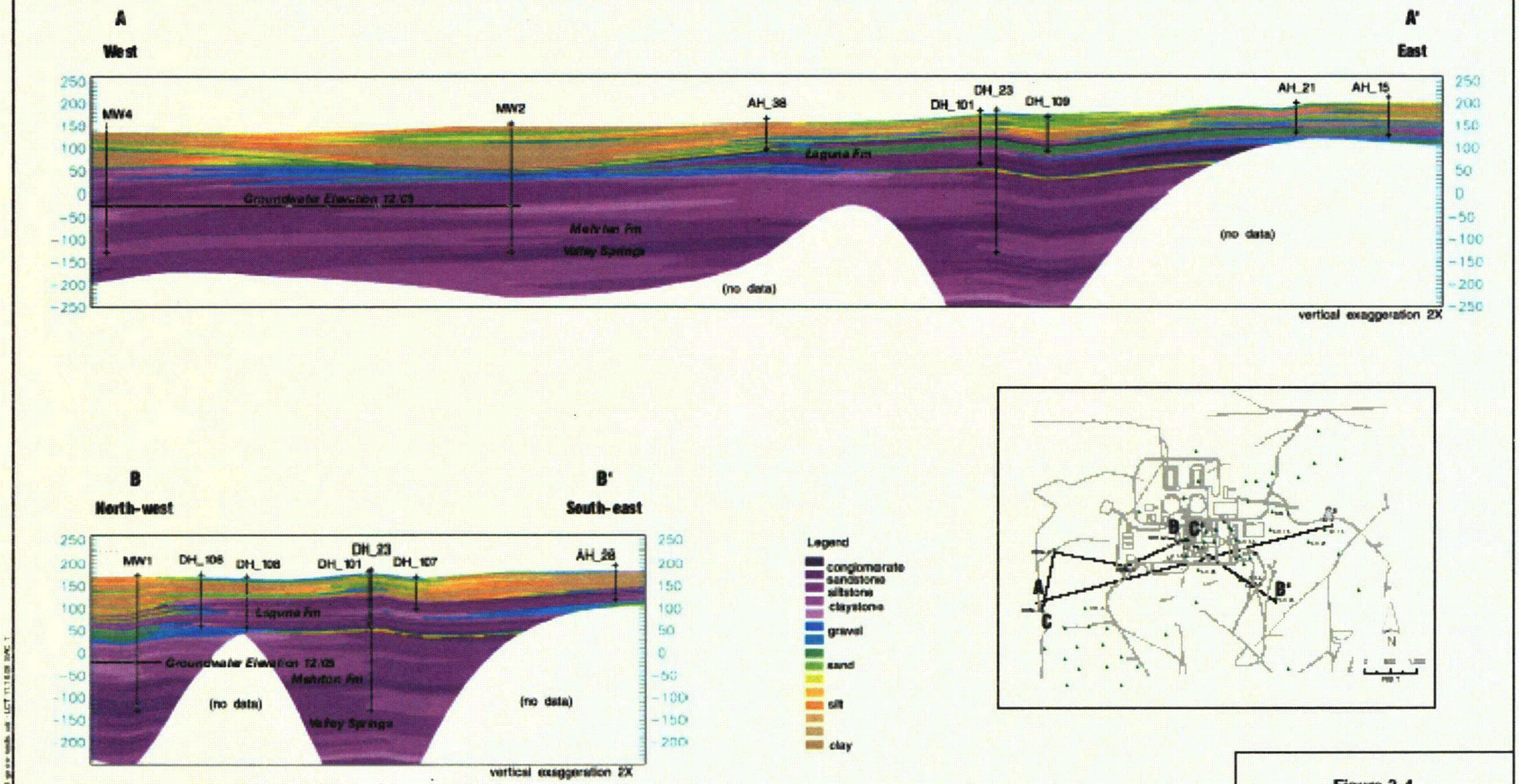

Figure 2-4.
Geologic Cross Sections
Rancho Seco NGS Site

Attachment 4

Field Permeability Test Results from ERPT-C0104, Rev.1

Table 4 Field Permeability Test Results

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-1	53.1-61.0	7.9	-	Couldn't seat packers	
	90.0-99.1	9.1	97.7	Packer-Constant Head	2.3×10^{-6}
	126.8-135.9	9.1	152.4	Packer-Constant Head	No Take
	126.8-135.9	9.1	168.6	Packer-Constant Head	No Take
	126.8-135.9	9.1	191.6	Packer-Constant Head	No Take
	146.8-155.9	9.1	153.2	Packer-Constant Head	2.3×10^{-6}
	166.5-200	33.5	160.6		4.7×10^{-6}
	166.5-200	33.5	175.5		4.0×10^{-5}
	166.5-200	33.5	189.3		5.5×10^{-5}
	166.5-200	33.5	175.5		5.5×10^{-5}
	167.7-187.8	20.1	-	Bailer-Recovery	5×10^{-6}*
OW-2	23.7-191.4	167.7	110.2	Packer-Constant Head	6.9×10^{-7}
	67-79.5	10.5	96.7	Packer-Constant Head	No Take
	69-79.5	10.5	112.8	Packer-Constant Head	No Take
	100-110.5	10.5	128.7	Packer-Constant Head	No Take
	100-110.5	10.5	144.8	Packer-Constant Head	No Take
	100-110.5	10.5	181.6	Packer-Constant Head	No Take
	114-119.7	5.7	178.0	Packer-Constant Head	No Take
	114-119.7	5.7	224.0	Packer-Constant Head	No Take
	114-119.7	5.7	258.5	Packer-Constant Head	No Take
	114.5-156.3	41.8	183.9	Packer-Constant Head	3.1×10^{-6}
	114.5-156.3	41.8	206.9	Packer-Constant Head	3.1×10^{-7}
	114.5-156.3	41.8	241.4	Packer-Constant Head	3.1×10^{-6}

Table 4 Field Permeability Test Results (continued)

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-2	122.0-127.7	5.7	142.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	165.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	188.0	Packer-Constant Head	No Take
	122.0-127.7	5.7	234.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	152.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	175.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	198.0	Packer-Constant Head	No Take
	136.0-141.7	5.7	232.0	Packer-Constant Head	No Take
	146.0-151.7	5.7	164.0	Packer-Constant Head	No Take
	146.0-151.7	5.7	187.8	Packer-Constant Head	No Take
	146.0-151.7	5.7	210.8	Packer-Constant Head	No Take
	146.0-151.7	5.7	245.3	Packer-Constant Head	No Take
	148.5-159.0	10.5	200.9	Packer-Constant Head	No Take
	148.5-159.0	10.5	235.4	Packer-Constant Head	No Take
	148.5-159.0	10.5	267.6	Packer-Constant Head	No Take
	149.5-160.0	10.5	197.6	Packer-Constant Head	1.1×10^{-4}
	149.5-160.0	10.5	232.1	Packer-Constant Head	2.7×10^{-5}
	151.0-156.7	5.7	176.0	Packer-Constant Head	No Take
	151.0-156.7	5.7	185.2	Packer-Constant Head	No Take
	151.0-156.7	5.7	196.7	Packer-Constant Head	No Take
	151.0-156.7	5.7	219.7	Packer-Constant Head	No Take
	151.5-162.0	10.5	230.1	Couldn't Seat Packers	
	153.0-174.0	21	--	Specific Capacity	2×10^{-3}**

Table 4 Field Permeability Test Results (continued)

Borehole No.	Interval Tested in Feet	Test Interval Length (Ft)	Test Pressure In Feet of Water	Test Method	Permeability cm/sec
OW-2	169.5-180.0	10.5	221.6	Packer-Constant Head	1.6×10^{-5}
	169.5-180.0	10.5	279.1	Packer-Constant Head	1.5×10^{-5}
	184.5-195.0	10.5	274.1	Packer-Constant	1.5×10^{-5}
OW-3	21.8-31.0	9.2	30.2	Packer-Constant Head	2.7×10^{-6}
	47.5-164.0	116.5	115.0	Packer-Constant Head	1.5×10^{-6}
	111.5-164.0	52.5	117.0	Packer-Constant Head	1.2×10^{-6}
	112.5-164.0	51.5	126.9	Packer-Constant Head	No Take
	112.5-164.0	51.5	138.4	Packer-Constant Head	No Take
	112.5-164.0	51.5	152.2	Packer-Constant Head	No Take
	168.0-192.9	24.9	--	Specific Capacity	8×10^{-4}**
P-1	9.25-9.50	9.25	--	Permeameter	1.6×10^{-5}
P-2	0.47-9.50	9.03	--	Permeameter	1.8×10^{-5}
P-3	0.36-9.50	9.14	--	Permeameter	6.0×10^{-6}
P-3	0.25-9.50	9.25	--	Permeameter	1.8×10^{-4}

*Test was conducted prior to completion of well development.
**Permeabilities are for sand zones only.

Attachment 5

Analysis of Hypothetical Liner Failure from ERPT-C0104, Rev.1

is the effective or interconnected porosity. Using an average hydraulic conductivity for the sands of 1×10^{-3} cm/sec, an estimated effective porosity of 30% and the observed hydraulic gradient of 0.003, the approximate seepage velocity is 0.028 ft/day or about 10 ft/yr.

8.3 Analysis of Hypothetical Liner Failure

An analysis was performed to evaluate the effects of a hypothetical pond liner failure on the quality of ground water downgradient of the site. The nearest downgradient well is 6/8-30Q1, on the north side of Clay East Road, about 2200 feet west of the west edge of the evaporation ponds. It was assumed that the liner is breached at the end of the pond life, when Cs-137 is expected to be at a concentration of 8.5×10^{-2} µCi/ml as a result of evaporation.

The analysis considered migration of Cs-137 to well 6/8-30Q1 in two stages. The first stage is vertical seepage of pond fluid to the underlying water table. The second stage is horizontal migration in the Mehrten aquifer from the pond site to the well.

Stage 1

For seepage through the unsaturated zone to the water table, the method of Bouwer for vertical movement of a wetting front (1978, p. 254) was used. The appropriate equation is:

$$t = \frac{f}{K_u}\left[L_f - (H_w - h_{cr})\ \ln\left(\frac{H_w + L_f - h_{cr}}{H_w - h_{cr}}\right)\right]$$

where:

t = time since start of infiltration

K_u = hydraulic conductivity of wetted zone (unsaturated conductivity)

L_f = depth of wetted front

H_w = depth of water above soil

h_{cr} = critical pressure head of soil for wetting

f = fillable porosity (difference between volumetric water content of soil before and after wetting).

Conservative input values were selected for calculating the time it would take for a wetting front to reach the water table. For K_u (unsaturated conductivity), a value of half the saturated hydraulic conductivity was used (Bouwer, 1978, p. 253). For the material above the water table, a saturated conductivity of 3×10^{-6} cm/sec is believed to be representative, based on packer test results (See Table 4). This gives a value for K_u of 1.5×10^{-6} cm/sec, or 1.55 ft/yr.

L_f is the depth to the wetting front from the bottom of the pond excavation. This depth is variable during seepage from the pond, but would be a minimum of about 144 feet when the front reaches the water table. The height of water above the soil (H_w) was assumed to be seven feet, which is the maximum operating depth of five feet, plus two feet for the clay liner thickness. The average critical pressure head was estimated to be about -100 cm (-3.3 ft), based on typical values for fine-grained soils reported in Bouwer (1978, p. 243).

The fillable porosity is a difficult parameter to estimate, as it would vary considerably from one type of soil to another, and is dependent on the in-place volumetric water content. On the basis of limited soils tests, a conservative value of ten percent (0.10) was used for the fillable porosity (f).

Using the input data described above, time for a wetting front to reach the ground water is approximately 8 years. However, because of Cs-137 adsorption onto the soils particles as the wetting front moves downward, the time of arrival of radionuclides at the water table will be much longer. Applying a retardation factor of 0.005 (see description of Stage 2 seepage) to the average velocity of the wetting front 144 ft/8 yrs gives an average estimated Cs-137 velocity of 0.09 ft/yr. At this rate it would take 1600 years for Cs-137 to reach the water table. During this period of time, the concentration would be reduced by radioactive decay to less than 10^{-17} µCi/ml.

Stage 2

The method of analysis for migration of Cs-137 in ground water from the pond to the nearest downgradient well is based on the following relationships (Grove, p. 28):

$$U_{ion} = U_{water} R_f$$

$$R_f = \frac{1}{1 + \rho \frac{K_d}{n}}$$

$$\text{and } C = C_0 e^{-\lambda t}$$ where:

U_{ion}	=	velocity of Cs-137
U_{water}	=	ground-water seepage velocity
R_f	=	retardation factor
ρ	=	bulk density
n	=	porosity
K_d		distribution coefficient
C	=	concentration at time t
C_o	=	initial concentration
t	=	travel time
λ	=	radioactive decay constant

The ground water seepage velocity, U_{water}, is determined by the Darcy relationship:

$$U_{water} = \frac{KI}{n_e}$$, where:

K	=	hydraulic conductivity
I	=	hydraulic gradient = .003 ft/ft from Figure 6
n_e	=	effective porosity, assumed to be .30

A hydraulic conductivity of 2×10^{-3} cm/sec (2069 ft/yr) -- the highest value from field tests (see Table 4) -- was used for calculation of U_{water} = 21 ft/yr.

To determine R_f, a value of 4 g/cc was used for ρ/n, and 50 ml/g was used for the distribution coefficient, K_d. These values are believed to be conservative based on data reported in the literature. Using the described input data, R_f = 0.005, and U_{ion} = 21 ft/day x .005 = 0.11 ft/yr. At this rate of movement, it will take 20,000 years for Cs-137 to travel to well 6/8-30Q1. After this period of time, the calculated concentration of Cs-137, reduced by radioactive decay, is less than 10^{-99} µCi/ml, nondetectable level. It is well below the MPC (maximum permissible concentration) value of 2×10^{-5} uCi/ml under 10 CFR 20, Appendix B, Table II.

9.0 Ground Water Monitoring Program

To ensure that there is no leakage of effluent from the ponds and to comply with Regional Water Quality Control Board (RWQCB) regulations, the following ground water monitoring program is proposed. Four ground water monitoring wells located at the perimeter of the pond will be monitored on a quarterly basis for the parameters listed in Table 7. In addition, lysimeters or other vadose zone monitoring devices adjacent to the ponds will be sampled quarterly to determine the chemical composition of the soil pore water and ensure that no leachate is escaping into the unsaturated zone. The vadose zone monitoring, however, is not required by the RWQCB for this project. Water samples of the ponds will also be collected monthly and analyzed for the parameters listed in Table 7.